OCCASION

This publication has been made available to the public on the occasion of the 50th anniversary of the United Nations Industrial Development Organisation.

DISCLAIMER

FAIR USE POLICY

CONTACT

Please contact publications@unido.org for further information concerning UNIDO publications.

For more information about UNIDO, please visit us at www.unido.org

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
Vienna International Centre, P.O. Box 300, 1400 Vienna, Austria
Tel: (+43-1) 26026-0 · www.unido.org · unido@unido.org

RESTRICTED

FS 417

MARKET STUDY
FOR
SEA CHEMICALS PROJECT
IN
ICELAND

C/F
S/F CHEMICALS

PREPARED FOR
NATIONAL RESEARCH COUNCIL
REYKJAVIK, ICELAND

BY

p. 263
+ app

W. B. Thompson

WILLIAM B. THOMPSON
CHEMICAL CONSULTANT

Assigned by
UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
Vienna, Austria

REYKJAVIK, ICELAND
JULY 15, 1972

UNIDO REF:
OA-220-ICE(10)

"The writer of this report is solely responsible for the views expressed in it. Copies of the reports have been submitted to the Office of Technical Co-operation of the United Nations which will in due course communicate its own assessments and recommendations to the Government."

TABLE OF CONTENTS

SURVEY

FORECAST OF MARKETS & PRICES

A P P E N D I X

Number

MARKET SURVEY

Salt and Related Chemicals Plant

Iceland

PREFACE

1. This market investigation and study has been undertaken by the United Nations Industrial Development Organization on behalf of, and in complete collaboration with, the National Research Council of Iceland. The guidelines for the Survey were outlined in the UNIDO Job Description ICE -041-D(SIS) Rev. (See APPENDIX I).

2. The recovery of mineral values from seawater and geothermal brine, with the aid of natural steam from thermal fields which abound in the region of Reykjanes in the south-western area in the general vicinity of Reykjavík, has been under active investigation since 1966. By 1969 the technical development and research studies had reached the point where it was becoming evident that it would be technically and economically feasible to produce certain saleable salt-based chemicals from this valuable, and heretofor un-tapped, natural resource. Research and process design investigations are continuing under the leadership of Mr. Baldur Líndal, consulting chemical engineer, and Dr. Vilhjálmur Lúðvíksson, chemical engineer with the National Research Council, who is in charge of project coordination and related studies.

On the assumption that the various technical, economic, marketing and financial investigations continue to reflect positive end-results, it is planned that actual production of chemicals will commence in 1975.

3. A preliminary feasibility study of the projected "Sea Chemicals Industry" was carried out in 1969 by personnel of the National Research Council. The marketing part of this preliminary study gave strong indications that some of the salt-based products visualized for exploitation could be sold, at a profit, in the logical marketing areas such as Scandinavia, Northern Europe and the East coasts of Canada and the United States. Preliminary market studies for several selected products, including potassium chloride and bromine, have also been carried out in 1968 by independent consulting firms, and, here again, findings were positive.

INTRODUCTION

The Assignment

4. To carry out a comprehensive market survey for calcium chloride in Northern Europe and selected locations in Canada and the United States. It is also intended to conduct an analysis of the markets for soda ash, caustic soda and liquid chlorine, taking into particular consider- ation the special problems inherent to bulk storage, and

bulk ocean and inland transportation of chlorine. It is also intended to prepare an estimate of the possible share of potential markets which an Icelandic producer of the various salt-based chemicals can expect to enjoy in the years 1975 to 1980.

5. Other potential chemicals for which marketing information is required includes salt, potash, bromine and lithium. While this group of products is of relatively lesser significance to the requirements of the Assignment, the actual marketing investigations for the entire eight items are generally inter-related and, for all practical purposes, are capable of concurrent exploration insofar as market data and statistical information are concerned.

6. In addition to the eight specified chemicals, the projected Sea Chemicals Industry is also seriously considering the production of certain magnesium compounds, including magnesium metal. This phase of the Sea Chemicals Project is not, however, within the scope of this Survey.

The Objectives

7. It is intended that this independent Market Survey should provide reliable, and sufficient substantiated information and data pertaining to potential markets and marketing of the products to enable Icelandic authorities to arrive at

a decision respecting future planning for implementation of the projected installations.

The Investigation

8. Essentially, the work consisted of up-dating preliminary reports and information prepared in 1967 and 1968 and expanding on available data, import and export statistics, prices, markets, etc., pertaining to the various products and the several countries which are considered as logical market outlets.

9. The order of priority attached to the products under investigation is approximately as follows:

1.	Calcium chloride	5.	Salt
2.	Soda ash	6.	Potash
3.	Caustic soda	7.	Bromine
4.	Liquid chlorine	8.	Lithium

10. Officials in Iceland considered the accumulation of data on major consumers, marketing and consumption patterns in probable countries of export, and primarily Scandinavia, to be of first importance to the feasibility of the project. This applies most particularly to calcium chloride as successful marketing of a high percentage of total productive capacity is essential to efficient manufacturing operations and overall economic feasibility of the Project.

11. Substantial penetration of the markets in the four Scandinavian countries is critical to the success of the Project. Considerable importance is also attached to markets in the U.K. and in the Netherlands, Belgium and West Germany for some of the products. Other potential markets which appear to be "freight logical" for reasons of economical transportation are the eastern ports of Canada and the United States.

12. The projected "Sea Chemicals Industry" is definitely export-oriented and only relatively minor quantities of the products will be consumed in Iceland.. The most notable exception is specially treated Fishery Grade coarse salt which is expected to consume about 20% of the total planned production of high quality vacuum pan salt. The other significant exception is potassium chloride where the current domestic consumption amounting to approximately 4,600 metric tons per annum, is equivalent to about 20% of total planned production.

The Report

13. The survey to accumulate information, statistics, data, impressions and the preparation of this Report was carried out over a period of six months by Mr. William B. Thompson, chemical consultant from Montreal, Quebec, Canada, who was selected as a suitably qualified "chemical industry expert"

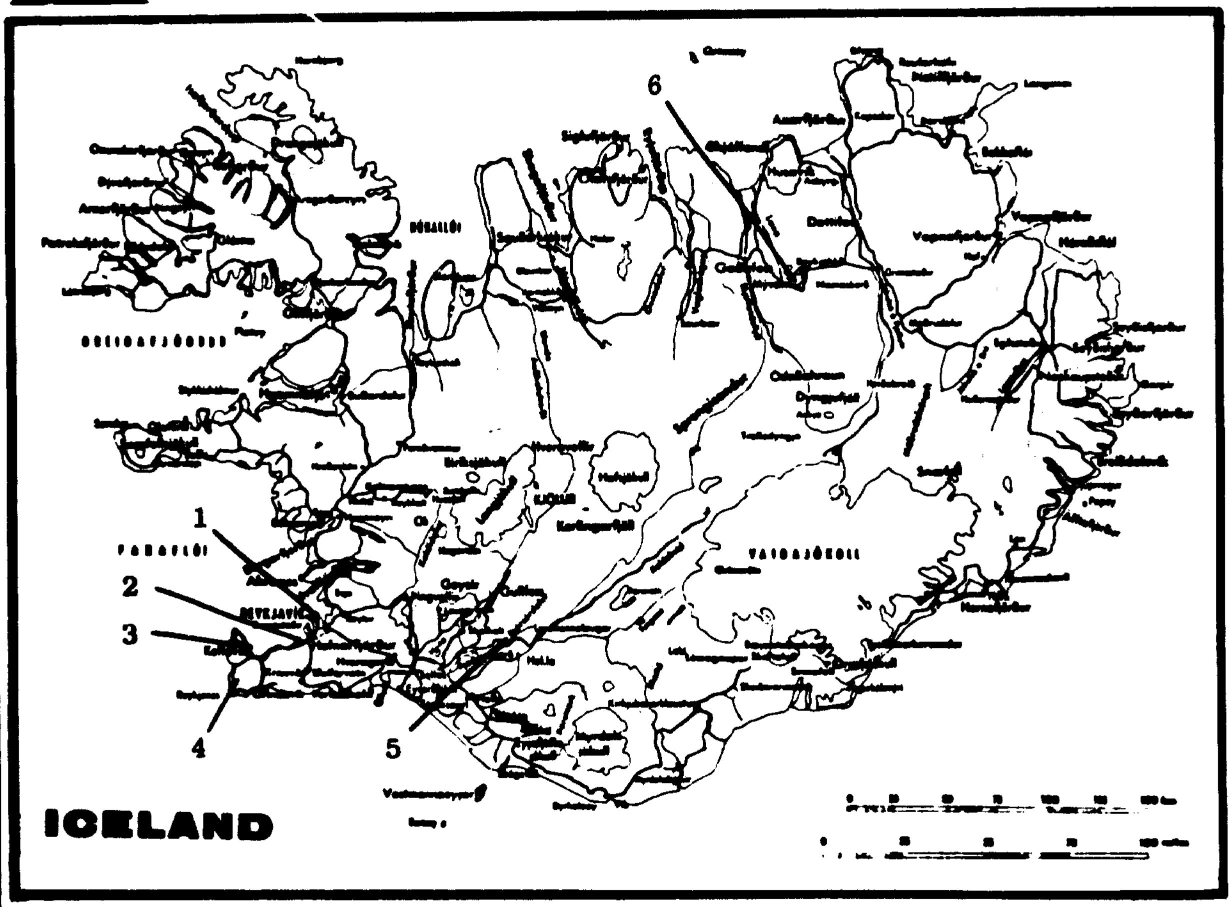
by UNIDO and the National Research Council of Iceland. Throughout the assignment, Mr. Thompson was ably assisted by Mr. Georg Gunnarsson, chemical engineer, who was assigned by the National Research Council as national counterpart for on-the-job training and personal development. Every effort was made during the assignment, as and when considered appropriate, to impart knowledge, experience and guidance to Mr. Gunnarsson and other Icelandic personnel working on the development of the "Sea Chemicals Plant".

14. Thoughout the Report, all quantities are expressed in metric tons (2205 pounds) unless otherwise stated. Values are expressed in U.S. dollars, currently approximately equivalent to Icelandic Kr.88.00 for US$ 1.00. The following foreign exchange equivalents were used throughout:

Country	Currency	Units per US dollar	US cents per unit
Belgium	Franc	50.	2.
Canada	Dollar	1.08108	92.5
Denmark	Krone	7.5	13.3333
Finland	Markka	4.19997	23.8097
France	Franc	5.55419	18.0044
Germany	Deutsche Mark	3.66	27.3224
Iceland	Króna	88.	1.13636
Netherlands	Guilder	3.62	27.6243
Norway	Krone	7.14286	14.
Sweden	Krona	5.17321	19.3304
U.K.	Pound Sterling	.416667	240.

Source: International Financial Statistics, Vol. XXIV, September 1971; IMF, pg. 6.

Iceland is situated in the North Atlantic Ocean, bounded by the Polar Sea in the north and by the warm waters of the Gulf Stream in the south. It is nearly midway on the shortest air route between New York and Moscow. The shortest distance to Scotland is 798 km (500 miles), to Norway 990 km (600 miles) but to Greenland only 278 km (190 miles). The surface area of Iceland is 103.106 km^2 (39.979 sq. miles), of which 11.800 km^2 (4.550 sq. miles) are covered by permanent ice. From north to south the greatest span is 300 km (190 miles) and from west to east 500 km (300 miles).



L E G E N D

1	REYKJAVIK	-	Capital, home of National Research Council and Icelandic Fertilizer Plant, Ltd.
2	STRAUMSVIK	-	The harbour for shipping projected chemicals and site of Icelandic Aluminium Company Ltd.
3	KEFLAVIK	-	International Airport
4	REYKJANES	-	General location of brine wells and projected salt-based Sea Chemicals Plant
5	BURFELL	-	Hydro-electric power plant (210.000 kW cap.)
6	MYVATN	-	Site of Icelandic Diatomite Company, Ltd.

15. SUMMARY & RECOMMENDATIONS

A. SUMMARY

15.1. OBJECTIVE

To assess the potential markets for the various salt-based chemicals to be produced from seawater and geothermal brine. The "freight logical" markets in Scandinavia, northern Europe and the northeast areas of the United States of America and the Maritime Provinces of Canada were investigated and studied. Potential markets in Iceland, Faeroe Islands and Greenland were also evaluated in the course of the six months Market Survey.

15.2. PRODUCTS INVESTIGATED

The proposed annual outputs of each of the projected chemicals, when the plants attain full production in the third year of operation, are as follows:

		Annual production metric tons
UNIT I	- Salt-fishery grade	50,000
	- vacuum pan	200,000
	- Calcium chloride, 77-80%	58,000
	- Potassium chloride, 60-62%	25,000
	- Bromine	700
	- Lithium compounds	500
UNIT II	- Soda ash, 58%	120,000
	- Chlorine, liquid	65,000

UNIT III	- Caustic soda, 50%	50,000
	- Chlorine, liquid	45,000

NOTE: Unit III is an electrolytic chlor-alkali plant planned for the future and is not included in the immediate programme for the Sea Chemicals Plant Project.

15.3. INVESTIGATION

A period of six weeks in March and early April was taken to conduct investigations of market potentials in the four Scandinavian countries and in West Germany, Netherlands, Belgium and Great Britain. After completing these visits and assimilating the data and information at home-base in Iceland, a trip of fifteen days duration in mid-May to New York, Montreal and Ottawa was undertaken to explore the market potentials for certain of the products on the northeast coast of the U.S.A. and in the Maritime Provinces of Canada. Calls were made on selected major consumers; importers; exporters; world trading organizations; government departments responsible for industry, commerce, planning and development; central statistical bureaux; etc. and on others who were considered knowledgeable and able to furnish desired information. This included statistical data; information and facts relating to major consumers; market trends and outlook for the various products; present sources of supply; prices; transportation;

impressions; and whatever pertinent additional information was obtainable.

15.4. GENERAL OBSERVATIONS

The Sea Chemicals Plant will, of necessity, be export-oriented as domestic consumption in Iceland will only consume about 50,000 metric tons of fishery grade coarse salt, 5,900 m.t. of potassium chloride and some 2,500 m.t. of soda ash. It quickly became obvious that the four Scandinavian countries, and including the Faeroe Islands and Greenland, because of historical ties and relatively close proximity, presented the most logical marketing prospects. In eastern North America, only calcium chloride and soda ash have special significance but they may prove of immense importance to the success of the Project.

15.5. Each of the Scandinavian countries is currently importing considerable quantities of the products being surveyed, generally to augment supplies from domestic producers which do not have sufficient capacity to meet the total requirements within their respective countries. Iceland's products must, therefore, compete with importations from other countries both as to quality, price and ability to guarantee continuity of supply and service. The potential markets for Iceland's chemicals, therefore, are directly related to the volume of the imports in each country rather than to their respective consumptions and the forecasts which follow are predicated on this assumption.

15.6. All the products are produced in the Western European countries in much larger quantities than are projected for Iceland and with one or two possible exceptions there are no opportunities for sustained sales to consumers. A number of the larger West German and Dutch firms dealing on world markets in chemicals are, however, definitely to be considered as being able to sell important quantities of Iceland's products. No meaningful assessment of potential markets which these traders may be able to serve is practical or possible at this time, but much valuable background information and data was obtained during interviews. In the U.S.A. and Canada, the only hope for participation for certain products in selected market areas is in being able to deliver goods from Iceland at cif prices which are more favourable than U.S. and Canadian materials which must bear heavy inland railway freight charges from producing works to some of the more distant consuming locations in the east.

15.7. SPECIFIC OBSERVATIONS

It is assumed that the various products can be produced in Iceland of a quality and in grades which will at least meet accepted international competitive standards. It is further assumed that the manufacturing costs will permit sales to be made at a profit in the logical countries of destination. The marketing function will have the responsibility of distributing the materials to markets which will reflect the maximum possible profits.

15.8. All the products surveyed, excepting bromine and lithium compounds, are referred to in international trading circles as "commodity chemicals". Essentially they are high-volume and low-profit chemicals and hence must be manufactured, packaged, transported and distributed in conformity to accepted specifications and standards. The rule of supply and demand, influenced by competitive pressures inherent to the manufacture and distribution of these salt-based chemicals, and further complicated by the nature of the inter-related processes of production of co-products and the peculiar problems associated with marketing them, all contribute to a highly complex and extremely sensitive industry of world-wide proportions. The Sea Chemicals Plant must be viewed, and in all respects operated, as an international chemical industry. Competition in world marketplaces will be realistic and ruthless and will be governed by the cold, hard facts of economics and geography. Entering into markets already being served by giant international chemical organizations such as Solvay; Imperial Chemical Industries; Akzo; Allied Chemical; Kalk; and a host of others is truly a venture which will require administrative, operating and marketing performance of the highest order.

15.9. All the projected chemicals are in universal demand and markets for them are expanding at predictable rates as populations increase and their requirements and demands lead to ever greater industrial development in order to supply their basic needs and wants. Iceland's problem then, is to devise ways and means of gaining a position as a supplier in selected marketing areas which will be reflected in an acceptable return on the capital invested in the Sea Chemicals Plant.

15.10. MARKET POTENTIAL

The markets available to the projected salt-based chemicals, when looked at in the broad view, are virtually limitless, even in the areas of Scandinavia, northern Europe and the northeastern ports of the U.S.A. and the Maritime Provinces of Canada which appear freight-logical to Iceland. To sell the products at prices which will produce satisfactory profits, however, will require well-conceived, intelligent, aggressive and common sense planning and execution. Iceland's chemicals must replace materials which are already being imported and which therefore enjoy acceptance and some measure of priority. As the demands for the products in all markets are generally growing at annual rates ranging from three to six percent, or more, some percentage of Iceland's products will, in effect, be absorbed to satisfy new (i.e. expanding) market demands. This may appear logical to marketers from Iceland, but the reverse reaction will be assumed by the competitive manufacturers and their distributors. How, then, to approach the problems and the future?

15.11. LOGICAL MARKETS

The investigations covered all the visualized markets and have provided the evidence to pin-point potential countries of destination for the various products. These should, in total, be capable of absorbing the projected volumes of production. Some problems of supply and demand during the early stages of start-up will, however, be inevitable, especially as entry into new competitive markets will have to be gradual. In the tabulations which follow covering the various products, by countries, only the products which have significant potential for consumption are shown. When the Project becomes operative, it is entirely probable that other markets than those now listed will be found. The purpose of this Survey is to identify markets which give every indication of being capable of consuming Iceland's products on a sustained basis and which show every indication of growth over the coming years. The very real potential markets visualized for most of the products through the international trading firms of West Germany and the Netherlands, for instance, are not listed hereunder. This Survey is better served by forecasting market potentials which are considered to be logical, substantial and durable and hence minimizing the element of risk to the owners.

15.12. The forecasts, by product, which follow are compiled from data and information gathered in the course of the Survey and substantiating details leading up to these summaries can be found in the body of this Final Report. The fob prices are weighted averages. The estimated share of markets for Iceland in the various countries is predicated on quantities which appear reasonable and possible of achievement. An all-out effort to gain significantly greater sales participation in the introductory years will lead to certain failure and to lower prices. The thinking behind the forecsts has been that the sales objectives will be best accomplished by adopting a policy of "sliding" into the markets without causing severe disruptions or giving competitors sufficient cause to cut prices. The whole procedure should be designed to be as painless as possible to all parties concerned. One good selling point for Iceland chemicals is their natural origin and the fact that the processes for recovery and production will not contribute to environmental pollution and the noxious effluent problems usually associated with the manufacture of salt-based chemicals. Because of this, consumers may regard deliveries from Iceland to be more reliable and permanent than for material shipped from "synthetic" plants. Large consumers of calcium chloride and soda ash in the United States are already demanding supplies from natural instead of synthetic sources.

15.13. **FORECAST OF CALCIUM CHLORIDE MARKETS**

Quantity in Metric Tons & fob Straumsvík Value US$/M.T.

(Figures in brackets under tonnages are % share of est.mkts.)

COUNTRY	FORECAST					
	1976		1978		1980	
	M.T.	fob	M.T.	fob	M.T.	fob
NORWAY (Bags)	5,000 (11%)	31.25	8,000 (18%)	32.25	12,000 (28%)	32.25
SWEDEN (Bags)	7,500 (10%)	31.70	11,000 (16%)	31.70	15,000 (23%)	32.70
FINLAND (Bags)	1,000 (10%)	36.25	1,500 (15%)	37.25	2,000 (20%)	38.25
DENMARK (Bags)	200 (2%)	38.10	500 (5%)	39.10	1,000 (8%)	39.10
SUB-TOTAL	13,700		21,000		30,000	
1) U.S.A.						
77-80%, bags	10,000	39.95	25,000	39.95	25,000	38.95
" bulk	15,000	29.60		29.60		28.80
3) 94-97%, bags	10,000	51.25	15,000	51.25	15,000	51.25
" bulk	5,000	38.70		38.70		38.70
CANADA						
77-80%, bags	12,000	42.75	13,500	42.75	14,000	42.75
" bulk	15,000	31.50	15,000	31.50	16,000	31.40
94-97%, bags	15,000	52.05	16,500	52.05	17,500	52.05
" bulk	7,000	38.10	7,000	38.10	7,500	38.10
2) TOTAL,						
77-80%	65,700		74,500		85,000	
94-97%	37,000		38,500		40,000	

NOTE: 1) Some shipments to the Scandinavian countries will undoubtedly be required in bulk quantities. While only bags have been shown, the actual net-at-works for either bags or bulk is similar.

2) The sub-totals shown in 1) do not meet the planned plant capacity of 58,000 m.t./yr. and hence it is essential to seek markets in the U.S.A. and Canada.

3) The tonnages shown for anhyd. 94-97% grade are basis 77-80% as is customary in the trade.

15.14. **FORECAST OF SODA ASH MARKETS**

Quantity in Metric Tons & fob Straumsvík Value in US$/M.T.

(Figures in brackets under tonnages are % share of est. mkts.)

COUNTRY	FORECAST					
	1976		1978		1980	
	M.T.	fob	M.T.	fob	M.T.	fob
ICELAND	2,300	-	2,400	-	2,500	-
(Bags)	(100%)		(100%)		(100%)	
NORWAY	5,000	38.25	10,000	39.25	18,000	40.25
(Bags & bulk)	(13%)		(24%)		(37%)	
SWEDEN	15,000	36.30	33,000	37.30	45,000	38.30
(Bags & bulk)	(10%)		(21%)		(26%)	
FINLAND	5,000	34.25	12,000	35.25	20,000	36.25
(Bags & bulk)	(5%)		(10%)		(13%)	
DENMARK	2,000	38.10	6,000	39.10	10,000	39.10
(Bags)	(2%)		(6%)		(8%)	
1) SUB-TOTAL	29,300		63,400		95,500	
2) U.S.A.						
- Bags	15,000	40.75	17,500	40.75	20,000	40.75
- Bulk	50,000	27.60	55,000	27.60	60,000	27.60
2) CANADA						
- Bags	15,000	59.90	17,500	59.90	20,000	59.90
- Bulk	30,000	35.20	35,000	35.20	40,000	35.20
3) TOTAL	139,300		188,400		235,500	

NOTE: 1) Some shipments to the Scandinavian countries will undoubtedly be required in bulk quantities. While only bags have been shown, the actual net-at-works for either bags or bulk is similar. Also, deliveries will be for both light and dense grades.

2) In the U.S.A. the prices for dense and light grades are the same. In Canada the figures show dense grade whereas light grade is cheaper by US$ 2.45/m.t. in bags and US$ 1.65/m.t. in bulk.

3) The sub-totals shown in 1) do not meet the planned plant capacity of 120,000 m.t./yr. and hence it is essential to seek markets in the U.S.A. and Canada.

15.15. CAUSTIC SODA MARKETS

The Survey included investigation of markets for caustic soda so that background and current information would be available when the appropriate time arrives for Iceland to seriously consider installation of manufacturing facilities. Production of caustic soda and its co-product chlorine by electrolytic means can only be justified when there is sizeable captive or nearby assured markets for a large proportion of the output of the plant. To construct such a chlor-alkali plant without a large domestic demand would be unwise and virtually unprecedented in the chlor-alkali industry. International trade in these products is relatively small (see APPENDICES VI & VII for records of imports in countries surveyed) and consists almost entirely of surplus productions which must be disposed of, hopefully, at a profit. No realistic forecast of sales, or markets, is practical or possible. Substantiating details of interviews in the various countries are given in the Survey section.

15.16. CHLORINE MARKETS

The same situation exists for chlorine as mentioned in the previous paragraph for caustic soda, except that the problems are infinitely more complex. While it is possible to ship caustic soda, liquid 50% grade, which is the usual article of trade, in barges or ocean-going vessels in bulk cargoes, the fact is that bulk chlorine shipments by ocean transport are practically and economically not feasible at the present time. In spite of the great urge to move chlorine by water, the facts clearly show that no one is doing it in Scandinavia, Europe or North America at the present time. Actually, there is one movement of minor proportions, amounting to 300 to 400 ton lots, from Liverpool to Ireland which has been going on now for about ten years. Another movement of greater consequence from Norway to Maydown, Northern Ireland, was discontinued in 1971 after several years of operation because of technical and economic problems. (This subject is dealt with in paragraphs 39.4.2. to 39.4.13.) Under prevailing conditions it is impossible to prepare a meaningful forecast of chlorine markets in the countries surveyed. If marine, harbour and other authorities, both on and off-shore, can be satisfied that vessels and handling at ports, at both ends of the voyage, will meet regulations for safety and environmental pollution, the "time lag" required to construct an acceptable bulk cargo vessel would be about four years. To re-fit an existing vessel of relatively small carrying capacity would require one and one-half to two years. In either case the capital cost would be high and the experts have some doubts that the high rates of freight (probably in the order of US$ 25.00 to US$ 35.00 per metric ton) could be justified by the business.

15.17. **FORECAST OF SALT MARKETS**

Quantity in Metric Tons & fob Straumsvík Value US$/M.T.

(Figures in brackets under tonnages are % share of est. mkts.)

COUNTRY	FORECAST					
	1976		1978		1980	
	M.T.	fob	M.T.	fob	M.T.	fob
1) ICELAND						
- Fishery	51,000	-	52,000	-	53,000	-
	(100%)		(100%)		(100%)	
FAEROE IS.						
- Fishery	6,000	7.50	15,000	8.00	20,000	8.50
	(32%)		(76%)		(100%)	
GREENLAND						
- Fishery	2,000	12.50	5,000	12.50	6,000	12.50
	(40%)		(90%)		(100%)	
NORWAY						
- Fishery	7,000	5.50	20,000	6.00	40,000	6.50
	(5%)		(13%)		(25%)	
- Vac.Pan	50,000	6.50	75,000	7.00	100,000	8.00
	(25%)		(36%)		(45%)	
SWEDEN						
- Vac.Pan	100,000	5.50	150,000	5.50	200,000	6.00
	(11%)		(16%)		(20%)	
FINLAND						
- Vac.Pan	50,000	3.00	100,000	3.00	100,000	3.00
SUB-TOTAL	(10%)		(18%)		(16%)	
- Fishery	66,000		92,000		119,000	
- Vac.Pan	200,000		325,000		400,000	
2) CANADA						
- Vac.Pan	90,000		90,000		90,000	
TOTAL-Fishery	66,000		92,000		119,000	
-Vac.Pan	290,000		415,000		490,000	

NOTES: 1) The pricing of domestic sales will be an internal matter.

2) This potential tonnage used by Aluminum Company of Canada Ltd., Arvida, Que. appears to be a logical prospect for Iceland and one of the very few believed to be available in Canada. Further investigations may, however, locate others, including fishery salt for Maritime and Gulf of St. Lawrence fisheries.

15.18. **FORECAST OF POTASSIUM CHLORIDE MARKETS**

Quantity in Metric Tons & fob Straumsvík Value US$/M.T.

(Figures in brackets under tonnages are % share of est. mkts.)

COUNTRY	FORECAST					
	1976		1978		1980	
	M.T.	fob	M.T.	fob	M.T.	fob
1) ICELAND	5,300 (100%)	-	5,600 (100%)	-	5,900 (100%)	-
NORWAY	20,000 (10%)	28.00	20,000 (8%)	29.50	20,000 (7%)	30.00
SWEDEN	20,000 (10%)	28.05	20,000 (10%)	29.05	20,000 (9%)	30.05
FINLAND	20,000 (8%)	22.00	20,000 (7.5%)	23.00	20,000 (7%)	25,00
DENMARK	20,000 (8%)	27.85	20,000 (7.5%)	28.85	20,000 (7%)	28.85
TOTAL	85,300		85,600		85,900	

Potential markets in Scandinavia, 1976 - 905,300 m.t.
1980 - 1,050,900 m.t.

NOTES: 1)- The pricing of domestic sales will be an internal matter.

- Any one of the foregoing potential markets can easily absorb Iceland's entire production of 25,000 m.t. and no marketing problems are anticipated.

15.19. **FORECST OF BROMINE MARKETS**

Quantity in Metric Tons & foL Straumsvík Value US$/M.T.

(Figures in brackets under tonnages are % share of est. mkts.)

COUNTRY	FORECAST					
	1976		1978		1980	
	M.T.	fob	M.T.	fob	M.T.	fob
DENMARK	50 (30%)	400.00	175 (80%)	400.00	200 (80%)	400.00
W.GERMANY	400 (20%)	315.00	500 (20%)	290.00	600 (20%)	290.00
BELGIUM	25 (70%)	370.00	40 (80%)	345.00	50 (70%)	320.00
OTHER SMALL POTENTIAL MKTS:						
- NORWAY	5	-	10	-	15	-
- SWEDEN	10	-	15	-	20	-
- FINLAND	5	-	10	-	15	-
- U.K.	25	-	35	-	50	-
- CANADA	10	-	15	-	25	-
TOTAL	530		800		975	

COMMENTS - The fob prices are for shipments in bulk containers.

- Many details involving packaging in lead-lined steel containers; loading and unloading vessels; handling, warehousing and distribution at destination; and return of empty containers to Iceland for refilling are a few of the major problems to be resolved. Planned plant production is 700 m.t. per year.

15.20. FORECAST OF LITHIUM COMPOUNDS MARKETS

Quantity in Metric Tons & fob Straumsvik Value US$/M.T.

(Figures in brackets under tonnages are % share of est. mkts.)

Lithium carbonate & Lithium Hydroxide

COUNTRY	FORECAST					
	1976		1978		1980	
	M.T.	fob	M.T.	fob	M.T.	fob
SWEDEN	50 (50%)	-	65 (50%)	-	80 (53%)	-
W.GERMANY	150 (?)	-	200 (?)	-	250 (?)	-
U.K.	200 (?)	-	225 (?)	-	250 (?)	-
OTHER SMALL POTENTIAL MKTS:						
- NORWAY	10	-	15	-	20	-
- FINLAND	10	-	15	-	20	-
- DENMARK	10	-	15	-	15	-
- NETHERLANDS	10	-	20	-	35	-
TOTAL	440		555		670	

COMMENTS - From information gathered during the investigation, admittedly more general than specific, new markets will develop gradually in most industrial economies and Iceland should be alert to the potential markets listed when materials become available. There should be no great difficulty in disposing of the planned production of 500 metric tons.

15.21. CLOSING REMARKS

Since the Survey commenced it is understood that the original objectives and timetable for the Project have been modified and that UNIT I will be given first priority. This presumes production of five of the original eight chemicals to serve the following forecast market potentials:

	Annual Production		Forecast Markets	
	1st year	3rd year	1st year	3rd year
Calcium chloride, 77-80% flake (58,000 m.t.)	37,700	58,000	101,200	115,500
Salt - fishery, (50,000 m.t.)	32,000	45,000	66,000	92,000
- vacuum pan (200,000 m.t.)	162,500	250,000	290,000	415,000
Potassium chloride, 60-62% K_2O (25,000 m.t.)	16,250	25,000	85,300	85,300
Bromine, (700 m.t.)	450	630	530	800
Lithium compounds, (500 m.t.)	325	450	440	555

NOTE: Full projected annual capacities are shown in brackets under each product.

15.22. Implementation of the programme to produce the UNIT I group of chemicals as the first phase of this potentially great natural resource industry appears to have considerable merit. It will soften the impact of the emergence of Iceland's chemicals in the competitive marketplaces and tend to create a lesser degree of concern or cause for precipitate emotional reactions by the traditional manufacturers and their distributors. By having fewer items to introduce at one time into existing highly competitive markets, Iceland's selling organization will be able to concentrate their efforts more effectively to meet forecast targets.

15.23. The plan to implement UNIT II at a later date will provide needed time to search out and, hopefully, develop a domestic consumption of chlorine and hence avoid having to face the almost insurmountable, costly and hazardous technical problems inherent to storage and bulk ocean transport.

15.24. While marketing the projected tonnages of soda ash should not be any more difficult than calcium chloride, the fact is that trying to sell the two products at one time, in many instances to the same distributors, will bring forth more than twice the number of complications. Once the marketing of calcium chloride is accomplished successfully the task of introducing soda ash at a later date will be greatly simplified.

15.25. During the marketing investigation it became evident that in each country for certain of the products there were one or two major firms whose enlistment as distributors for

Iceland is considered vital. While it is impractical, and indeed premature, to mention specific names it is confidently expected that Iceland's selling organization will be able to negotiate agreements with at least some of these prospects. The National Research Council is aware of these potentially valuable sales outlets.

B. RECOMMENDATIONS

15.26. During the writing of this Final Report it seemed appropriate from time to time to make certain recommendations applicable to marketing the various products. Only a few new notions, therefore, will be mentioned here.

15.27. The functions of distribution and marketing should be commenced soon after the Project enters the construction stage. Full and continuous liaison with construction and future operational managers is earnestly recommended. The benefits of such mutual understanding and confidence will prove to be of great value to all the operations which are essential for getting the products to the markets and ultimate consumers in the most efficient and economical manner. The extreme importance of selecting Icelanders with exceptional personalities and appearance combined with first-hand practical and technical experience to the top positions for Marketing and Transportation cannot be over-stressed.

15.28. It is recommended that the available information at the National Research Council pertaining to the products together with the findings of this Survey should be kept current and some system should be devised for keeping abreast of developments concerning the products; marketing; competition; pricing; new processes; new uses; etc.

15.29. It will be in the best interests of the Project to minimize publicity and every attempt should be made to avoid giving out information which will provide competitors with ammunition which will enable them to make life more difficult for the Sea Chemicals Plant. It is recommended that perhaps the emphasis should be placed on production of fishery salt for domestic use and mention the other products, if at all, in very general and vague terms. It will be advisable to refrain from quoting projected production figures, start-up dates, visualized markets, etc. Circulation of this Report or others pertaining to the Project should be only on a restricted and confidential basis so as not to risk jeopardizing future operational and marketing programmes.

15.30. The findings of the investigation in the United States and Canada indicated a definite probability that attractive marketing opportunities could be developed there for calcium chloride and soda ash. This business could represent an important segment of the production and hence of the capital investment in the Project. On a market survey assignment which is essentially an information-gathering mission, it is not often possible to elicit much definite information concerning future plans for products, production or marketing from manufacturers or distributors engaged in highly competitive businesses. When the Proposal for the Sea Chemical Plant receives Government approval it would be practical and highly desirable to arrange preliminary discussions with selected firms in North America before final designs are completed or construction is commenced. It should be possible at that stage to enter into meaningful discussions, in mutual confidence, and perhaps reach some kind of tentative trading agreement. It the results substantiate in greater depth the findings of this Survey, implementation of the Sea Chemicals Plant Project can proceed with confidence and with reasonable assurance that adequate markets will be available.

15.31. The year 1975 appears appropriate to launch Iceland's chemicals into the markets. The acute competitive and operating problems which the salt-based chemical industries will be facing about that time in Scandinavia, Europe and North America should prove advantageous to Iceland's aspirations for the Sea Chemicals Plant.

15.32. This Survey has demonstrated the importance of evaluating market potentials as an integral element in development studies seeking to establish new industrial manufacturing facilities in Iceland. It has shown that production from UNIT I of five new chemical products represents an ideal new resource industry insofar as marketing is concerned. It has also shown that while the production of caustic soda and chlorine is technically feasible the problems relating to transportation and marketing are not presently solveable. While all the physical ingredients such as remarkably cheap hydro-electric power; abundant reserves of salt and other basic mineral resources; pure water and un-polluted fresh air; skilled labour force and other desirable attributes are available in Iceland, it will be important for developers to avoid acceptance of optimistic hopes in place of tangible evidence of available markets. This notion expressed by Murray D. Bryce in his book INDUSTRIAL DEVELOPMENT is particularly appropriate. He goes on to say "whether a project can sell some or all of its products in a foreign market depends on the same factors which would affect it if it were located in a foreign country, plus transportation costs and the additional hazards arising from existing or possible future tariffs, exchange controls, and other import restrictions". Iceland's chances for success depend on measuring the extent of its special advantages.

C. ACKNOWLEDGEMENTS

Before concluding this Final Report I wish to express sincere thanks and appreciation to the many fine people who gave me assistance, advice and encouragement throughout the Assignment. To name them all would be well nigh impossible but several must be singled out for special recognition:

- Departmental Chiefs and Officials at UNIDO Headquarters, Vienna.
- Mr. Finn Munch-Petersen, Special Representative of UNDP, Copenhagen.
- Mr. Olle Rimer, UNIDO Representative, Reykjavík.
- Mr. Steingrímur Hermannsson, Director, National Research Council and Chairman, The Sea Chemicals Committee.
- Dr. Vilhjálmur Lúðvíksson, Project Engineer, National Research Council and Project Manager, Sea Chemicals Project.
- Mr. Baldur Líndal, Consulting Chemical Engineer, Sea Chemicals Project.
- The Staff at National Research Council for their cheerful and invaluable assistance at all times.

- Mr. Sveinn Björnsson, General Manager, Industrial Development Institute of Iceland.

- Mr. Árni Snaevarr, Secretary General, Ministry of Industry.

- Mr. Th. Ingólfsson, Ministry of Foreign Affairs.

- Mr. Dennis C. Goodman, Second Secretary, Embassy of the United States of America for providing useful reference and statistical data.

- The Embassies of Iceland in Norway, Sweden, Finland, Denmark, West Germany, Belgium, Netherlands and Great Britain for suggesting survey visits and providing essential statistical and other information.

- The Embassies and High Commission Offices of Canada and their respective Trade Commissioners in Scandinavia and Europe who arranged appointments and provided desired background data and information.

To all I say "thank you" for going out of your way to be helpful in making my Report just that much better. Last but not least to my counterpart, Georg Gunnarsson, I wish to pay special tribute for his constant assistance, advice and friendship throughout the Assignment.

W.B. Thompson

William B. Thompson

[redacted]

SURVEY

Strategy

16. Study, assimilation and up-dating of available Project reports, import and export statistics, prices, market information and other data pertaining to the various countries being considered as potential customers was the first pre-requisite of this assignment.

17. The next step was to plan for the various personal visits abroad and to list potential major consumers, importers, manufacturers and other known sources of information gleaned from National Research Council files, available publications dealing with trade and commerce published in the various countries and the writer's experience. The Commercial Counsellors in the appropriate Icelandic and Canadian Embassies and/or High Commission offices were requested in advance to render advice, guidance and assistance so that travel time could be utilized for maximum effectiveness and minimum loss of time and effort. Their uniqualified desire and willingness to assist proved to be an important factor contributing to the success of the field investigations in the foreign countries visited.

18. Travel abroad was planned to produce such first-hand information as statistical data; impressions, information and facts relating to major consumers; market trends and outlooks for the various products; sources (i.e. countries) of present supply; current fob and cif prices; transportation; methods of delivery and carrier costs; types of package (bulk and/or packages); trading patterns such as preferences, tariffs on imports, etc.; and whatever additional pertinent information was obtainable.

19. The home market in Iceland was investigated and studied before travelling abroad in order to set some kind of trial pattern for the future and the manner in which the information could perhaps best be recorded and eventually incorporated in this final Report.

Assignment Timetable

20. After arrival at duty station in Reykjavik on January 29, 1972 the month of February was devoted to familarization and planning. The month of March was essentially devoted to travel in Scandinavia, Netherlands, West Germany, Belgium and the U.K. The information gathered was studied and assimilated in preliminary fashion during April as the National Research Council was most anxious to get some specific market data and indications of probable market

outlets and prices. Certain of their feasibility studies were being delayed until this information, even in preliminary form, could be made available.

21. The early days of the month of May were devoted to planning for a brief series of visits which were carried out later in the month to selected industrial centres in Eastern Canada and the U.S.A. to assess potential markets for certain of the products. The month of June and up to July 15th was consumed in preparation of this final Report. The termination date of the Assignment contract is July 24, 1972.

Foreign Travel Itinerary

22. Details of the planned visits made in March to Scandinavia, Northern Europe and the U.K. are shown in the Travel Itinerary attached as APPENDIX II.

23. The Travel Itinerary covering the planned visits to selected major American and Canadian corporations is attached as APPENDIX III. Iceland, located as it is more or less mid-way in the Atlantic Ocean between the European and North American Continents, is well situated to ship selected chemicals to the west as well as to the east where perhaps the bulk of the projected products will find markets.

Satisfactory conclusion of this Market Survey, however, inevitably required first-hand investigation of the potential markets in the major northeastern areas of the United States and Canada. The findings confirmed this contention.

PRODUCTS

24. Scant space will be devoted to descriptions of each of the products beyond a few appropriate details, as follows:

- Calcium chloride, $CaCl_2$, 77-80% white or opaque flake grade, which is the usual article of commerce, packed in 50 kg plastic or water-proof multi-wall paper bags or light steel drums. Principle uses are for de-icing of roads in winter; dust control on summer roads; additive for treating concrete; brine refrigeration; tractor tire weighting and some other relatively minor industrial uses.

- Soda ash, Na_2CO_3, 58% (Na_2O) greyish to white powder, in light or dense grades, referring to apparent density. Light grade bulks twice that of dense grade material, but both have the same chemical composition and can generally be used interchangeably. Because of the greater density of dense grade material it is more economical to transport and store twice the amount in the same space as equivalent weights of light grade ash.

Shipments are usually made in water-proof multi-wall paper or plastic bags, weighing 50 kg each. Some shipments are made in bulk, in rail box-cars or in vessels, to large consumers such as glass or alumina manufacturers, where suitable combinations of loading, unloading and handling facilities are available. Principle uses are for glass manufacture; chemicals; alumina; pulp and paper; textiles; soap and detergents; water treatment and numerous miscellaneous uses.

- Caustic soda, NaOH, whitish, deliquescent flakes, pieces, lumps or solid grades. Anhydrous grade, 100% NaOH, is usually sold commercially in solid or flake grades, and is packed in steel drums or water-proof bags. Liquid grades containing 50% or 73% NaOH are usually produced where bulk shipments to consumers can be made more economically by means of special tankcars or specifically designed barges or vessels for water transportation. No instances of 73% liquid shipments were discovered in Scandinavia or Europe, although some movements of this grade are common in the USA. By far the largest tonnage of liquid caustic soda traded thoughout the world is 50% grade. Accounting for tonnages and prices is done on the bases of 100% NaOH content. Principle uses are for chemicals and metal processing; cellulosics (paper, rayon, etc.); petroleum; textiles, soaps and detergents; food and numerous smaller and miscellaneous uses.

- Chlorine, liquid, Cl_2, heavy, toxic greenish-yellow gas. It is handled in steel tankcars, steel pressure cylinders for smaller users and special barges or vessels for water transport in bulk quantities. Principle uses are for chlorinated hydrocarbons; pulp and paper bleaching; chemicals; water treatment and many miscellaneous small uses.

- Salt (Common salt), NaCl, occurs in nature in three major forms, (a) in crystalline form, commonly referred to as rock salt; (b) in brines which are more or less saturated solutions of rock salt in water; and (c) in the waters of the ocean. Various grades of salt for specific uses are produced by special processing, including high purity vaccum pan salt; coarse salt and fine salt for fisheries; treated salt for human and animal consumption; etc. Principle markets are the chemical industry and for de-icing of highways in winter. The fishing industry in Scandinavia and the U.K. is a large consumer of fishery grade course salt produced by solar evaporation in the sea salt plants of Italy, Spain and Tunisia. These Mediter-anean operations also supply a specially refined salt which is used for chemical conversion in chlor-alkali electrolytic plants and in Solvay type soda ash plants. Sea salt as well as vacuum-pan grade is used to a considerable extent in the food industry.

- **Potassium chloride, KCl**, in refined form exists as colourless cubic crystals, granules or powder. It is usually recovered from potash-bearing salt brines or from potash salts interbedded in subterranean rock salt deposits. Fertilizers consume about 95% of the supply and the balance is used in the manufacture of potash chemicals such as caustic potash and potassium carbonate. The term potash when used as a noun signifies potassium oxide (K_2O) equivalent and when used as an adjective it refers to potassium compounds or potassium bearing materials. Potash mineral deposits and their derivatives are graded according to their K_2O equivalent, with potassium accounting for approximately 83 percent of pure potassium oxide. The commercial potassium chloride, or muriate of potash as it is called in the trade, is usually sold containing 60 to 62% K_2O. Some commercial potassium chloride is produced with considerably lower K_2O content. The newly exploited potash deposits in Saskatchewan, Canada, are the largest known high grade (average 25% K_2O) reserves in the world. Other large producers are located in West Germany; U.S.S.R.; East Germany; Israel and U.S.A. Fertilizer mixing plants are prevalent in all developed countries and they import, where necessary, the essential Nitrogen-Phosphatic-Potassic (N-P-K) ingredients or fertilizer compounds for the formulations required to meet domestic or export requirements.

- **Bromine, Br_2**, a nonmetallic element of the halogen group which also comprises chlorine, iodine and fluorine. It is a dark, amber-red colour with an intensely irritating odor. It is usually recovered from natural brines and bitterns and from sea water. It is used almost exclusively in the manufacture of chemical compounds for industrial use.

- **Lithium, Li**, usually produced and handled as lithium carbonate or lithium hydroxide, is generally recovered from spodumene ore and more recently, from brines and bitterns, notably in a gigantic project now being developed at the Great Salt Lake, Utah, U.S.A. Principle uses of lithium compounds are for atomic energy and rocket fuel purposes; in the manufacture of fluxes and enamels; alkaline batteries; lubricants and greases; pharmaceuticals; and numerous other applications and compounds, uses for which are yet to be more fully exploited.

MARKETING CONSIDERATIONS

25. The eight products under investigation in general are all derived from salt, salt brines, sea water and inter-bedded subterranean deposits consisting essentially of rock salt. Salt, or common salt, referred to chemically as sodium chloride, (NaCl), is by far the greatest source of sodium and its compounds are necessary to the physical well-being

of mankind. Sodium compounds play some part, directly or indirectly, in the preparation or manufacture of practically every material people eat, drink, touch or see. Salt, caustic soda, chlorine and soda ash can be viewed as "building block" chemicals and their applications and consumptions will grow commensurately as population and industrial expansion increases at spectacular and predictable rates.

26. The same optimistic forecast holds true for potassium chloride as an essential plant nutrient in fertilizers. The outlook for bromine and lithium is similarly optimistic and impressive as they are also basic chemicals, but in somewhat more restricted volumes compared to the relatively higher tonnages of the other products.

27. All the products under consideration are viewed as commodities for international trade and hence must be manufactured, packaged, transported and distributed in conformity with accepted specifications and standards. This Survey and study assumes that the various products will meet or preferably exceed the currently accepted standards and that the marketing function associated with the Project will not be unduly handicapped by finished products of inferior quality in the highly competitive

marketplaces of Scandinavia, Northern Europe and North America. It seems reasonable to suggest that Iceland's projected Sea Chemicals Industry must be viewed, and in all respects operated, as an international chemical industry and in no way should it be considered in the narrow concept usually associated with a strictly national industry. Competition will be realistic and ruthless and the inescapable factors of economics and geography will be major considerations with prospective wholesalers and consumers. Assuming at least equal quality and delivery standards, the delivered cost of products at points of consumption will invariably be the ultimate determining factor in concluding sales contracts.

28. Generally speaking, therefore, a manufacturer of these essential basic chemicals associated with sodium is assured of participating in expanding markets with historically increasing growth patterns over the years, providing the products continue to be commercially attractive. Substantiation of this contention is provided by the United States Bureau of Mines which has published a forecast of demand for sodium (Na) in the year 2000, as follows on next page:

	Forcast range of demand for sodium (thousands of tons of sodium, Na)	
	Year 1968	**Year 2000**
United States:		
High		69.370
Low	(e) 16.609	49.150
(Median)		(59.260)
Rest of the world		
High		200.000
Low	(e) 38.000	168.000
(Median)		(184.000)

e: Estimate.

29. In the above forecast the high side estimate of 200 million tons corresponds to a growth rate of 5.5 percent per year for the rest of the world. In the period 1954-1969, the rate of growth was 4.8 percent per year. If this rate of growth is maintained to the year 2000, the sodium forecast low base of 168 million tons will be attained. If industrial growth in the less developed nations is broadened, as can be reasonably expected, the 200 million tons for the high side of the forecast range in the year 2000, the corresponding growth rate may well prove to be 5.5 percent per year. In the United States, the low side

of the forecast range indicates a 3.4 percent average annual compound growth rate for sodium, while the high side indicates a 4.6 percent annual growth rate.

30. One of the more encouraging aspects of marketing the projected "natural" chemicals at this point in time when the trend in the advanced economies in Europe and North America is emphatically towards more pollution-free manufacturing industries, is the fact that natural sources, geothermal wells and sea water, will provide the basic chemical elements, and the required energy in the form of heat, for transformation to saleable commodities. As, if, and when required, an abundance of relatively low-cost hydro-electric power is available from existing installations and others planned for future implementation as the needs arise. Iceland is therefore an ideal location for an electrolytic chlor-alkali installation provided markets for the co-products can be developed. The structure and products to become available from the projected complex are as follows:

Product	Annual production [1)] metric tons
UNIT ONE (Salt)-	
Salt, vacuum pan grade-	
fine grained	200,000
course grained, for fisheries	50,000
Calcium chloride, 77-80% flake	58,000
Potassium chloride, 6o-62 K_2O	25,000
Bromine, Br_2	700
Lithium compounds (still under consideration)	500
UNIT TWO (Magnesium)-	
Soda ash, 58%	120,000
Liquid chlorine, Cl_2	65,000
UNIT THREE (Chlor-alkali) - Planned for future implementation after Units One and Two are in operation. Quantities are only tentative for purposes of preliminary study.	
Caustic soda, 100% NaOH	50,000
Liquid chlorine, Cl_2	45,000

NOTE (1)

During the start-up period the capacity of the plant is expected to be less than shown in the above table followed by an increase to full capacity within a few years.

ICELAND MARKET

31. Iceland's requirements of the products under investigation are entirely served at present by imports, which consequently are indicative of annual consumptions. Only fishery grade coarse salt and potassium chloride from the projected Sea Chemicals plant will have any significant bearing on the visualized totals of the materials for export, in each case the domestic consumption representing about 20% of the planned production.

Imports and Consumption, 1961-1970

32. The tabulation on the following page shows the average annual imports over a ten-year period 1961-1971 and the fob and cif prices for the years 1969-1971. It is of interest to note that consumptions of the various products, with the exception of soda ash and chlorine, remained almost constant throughout the 10-year period, a reflection of the lack of significant industrial demand and development.

Prices

33. The prices shown for the various products, both fob and cif, remained fairly constant with the biggest variant

IMPORTS TO ICELAND

1961 TO 1971

PRODUCT	US$/M.T.	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971
Calcium chloride, Flake 77-80% (2839.01)		267	297	296	327	406	254	316	319	369	158	360
	fob	N/A	N/A							33.00	41.00	43.60
	cif									21.50	62.00	68.20
Soda ash, 58% (2842.10)		317	280	311	300	312	345	201	250	243	821	2,362
	fob									40.00	42.00	44.45
	cif									57.00	64.00	69.25
Caustic soda, 100% (2817.10)		251	286	437	432	405	361	207	299	283	336	[illegible]
	fob									72.00	88.00	137.30
	cif									96.00	134.00	166.00
Chlorine, Liquid (2801.10		N/A	N/A	67	47	46	32	31	26	51	113	72
	fob									216.00	188.00	205.50
	cif									252.00	232.00	252.00
Salt - Fishery (Sea) (2501.00)		48,251	37,766	34,093	62,227	50,832	42,934	42,034	62,827	46,086	41,653	51,004
	fob									5.10	5.30	5.35
	cif									15.20	16.30	17.05
- Human (2501.01)		175	210	243	294	300	314	322	274	324	340	301
	fob									88.00	116.00	114.00
	cif									98.50	124.00	147.50
- Animal (2501.02)		N/A	N/A	578	680	927	700	832	1,089	1,240	296	711
	fob									47.50	63.00	93.50
	cif									68.70	27.00	117.00
Potassium chloride, 60 - 62% (3104.21)		2,047	5,250	4,721	5,861	6,000	5,400	2,170	4,283	4,632	4,460	2,610
	fob									24.60	31.00	32.90
	cif									47.60	46.00	54.40
Bromine (2801.900)		NO IMPORTS										
Lithium (2805.1)		NO IMPORTS										

SOURCE: The Statistical Bureau of Iceland

NOTES:

- fob and cif prices are in US$ per m.t. (KR. 88.0 - US$ 1.00)
- Only prices for years 1969 to 1971 are used as others are not meaningful because of changed rates of exchange.
- Numbers in brackets for each product are the Brussels Nomenclature codes.
- Imports to Iceland in 1971 came principally from the following countries, in order of volume:

<u>Calcium chloride</u> - Belgium.

<u>Soda ash</u> - West Germany, Denmark, France.

<u>Caustic soda</u> - France, Denmark, W.Germany.

<u>Chlorine</u> - Denmark.

<u>Salt</u> - Spain, Tunisia, France.

<u>Potassium chloride</u> - E.Germany, W.Germany.

being in ocean freight rates as reflected in the cif prices. Ocean freights generally jumped up in 1970 over the 1969 rates. On the other hand, as a general rule, the products are all basic, high-tonnage commodities and prices are governed by the vagaries and competitive pressures of international trade and are therefore not usually subject to violent fluctuations. Actually, when Iceland becomes an exporter rather than an importer, domestic prices will tend to decrease to levels more consistent with current fob prices and be less subject to change. Secondary manufacturing industries in Iceland will henceforth be encouraged because of the lower prices of the domestic produced basic chemicals as opposed to the higher delivered costs of imported materials.

Forecast 1970 - 1975

34. Key personnel in the several large new industries recently established in Iceland were interviewed in order to determine their probable consumption of chemicals in the immediate future, with particular reference to liquid chlorine, soda ash and potassium chloride. Briefly, the situation is as follows on next page:

Icelandic Aluminium Company Ltd. - Present rate of consumption of liquid chlorine is about 20 m.t. per year. In 1973 or early 1974 upon completion of the expanded manufacturing facilities which are now being constructed, annual consumption will approximate 35 m.t. This trend of increased consumption began to be reflected in the import statistics commencing in 1969. There is no significant consumption of caustic soda or soda ash at this smelter as the raw mateial used is alumina imported from foreign reduction plants.

Icelandic Diatomite Company Ltd. - When this plant started operating in 1969, the imports of soda ash showed an increase of about 200 m.t. which represented new consumption by this natural resource industry. By 1970, the apparent increased consumption was in the order of 500 m.t. and was increased to about 1,500 m.t. in 1971. When the plant attains full production capacity in 1972, the annual consumption is expected to approximate 1,600 m.t.

Icelandic Fertilizers Plant, Ltd. - The consumption of potassium chloride fertilizer as reflected in the import statistics has shown a tendency to increase slightly. This plant is just bringing new facilities into production to manufacture fertilizers which contain varying percentages of the essential ingredients of nitrogen, phosphorous and potash, and in many cases, sulphur, which is gaining in demand as a useful element for plant growth. This new domestic production capability will largely eliminate imports of prepared mixed fertilizers which in 1970 were valued at US$ 887,000. In 1971, this importation amounted to 23,080 m.t. valued at cif US$ 1,420,000. A considerable percentage of potassium chloride is incorporated in most of these mixed fertilizers and, as a consequence, the requirements in Iceland for potassium chloride are expected to show some modest increase in the years ahead. The changing demands of the farmers and growers, however, also require mixed fertilizers with a considerable percentage of potassium sulphate, largely to impart sulphur to the soil for certain plants. The net result is that about one-quarter (900 m.t. in 1971) of the potassium used in fertilizers in Iceland was in the form of potassium sulphate, having replaced a portion of the potassium chloride previously used. It is expected that fertilizer consumption in Iceland will increase at a rate of about 3% per year and that the rate of increase in the consumption of each of the essential fertilizer ingredients will parallel each other.

Union of Icelandic Fish Producers - It is expected that the demand for fishery grade salt for cod fish will continue indefinitely at the present rate of about 40,000 m.t. per year. No significant increase in fishery grade salt requirements can be forecast.

Forecast 1975 - 1980

35. From the more or less foreseeable levels of consumption of the various chemicals in 1975 it becomes more difficult to forecast levels in 1980. Natural domestic growth due to normal population and industrial expansion and consumer demand can be expected to produce some modest general increase in requirements. Without the infusion of new industries, however, the history of consumption during the period 1961 to 1975 cannot be interpreted to suggest any appreciable increases beyond possibly a 2 to 3 percent per annum improvement because of population increase and the consequent greater demands for products and services. Establishment of any new industries which require sizeable use of any of the products will naturally have a noticable effect on the consumption and will make obsolete any forecast formulated at this time for the particular products which may be involved.

36. From the numerous interviews with representatives of the major industries and Government departments, apart from the projected Sea Chemicals Plant complex, no major new industries which will use important tonnages of the chemicals being investigated are visualized at this time. Based on all available information, the market forecast for Iceland for the period 1975 to 1980 is as follows on next page:

DOMESTIC MARKET FORECAST

Years 1975 - 1980

In Metric Tons

Product	Average Annual Consumption 10-Years 1961-1970	Act. fob Price 1971 (3)	Est. Av. Annual Consumption 5-Years 1971-1975	Est. fob Price 1975 (3)	Forecast By Years					
					1975	1976	1977	1978	1979	1980
Calcium chloride 77-80%	297.1	43.60	315	45.00	330	335	340	345	350	350
Soda ash, 58%	376.2	44.45	2,250	46.00	2,300	2,350	2,400	2,400	2,450	2,500
Caustic soda, Solid	3[illegible]9.9	137.50	375	120.00	380	385	390	395	400	400
Chlorine, Liquid	53.3	205.50	85	200.00	100	100	105	110	110	115
Salt - Fishery	49,203.7	5.35	51,000	5.50	51,000	51,500	52,000	52,500	53,000	53,000
- Human	290.5	114.00	375	110.00	400	410	425	435	440	450
- Animal	877.5	93.50	800	85.00	900	910	920	930	940	950
(1) Potassium chloride 60-62%	4,657.1	32.90	5,100	35.00	5,300	5,400	5,500	5,650	5,750	5,900
(2) Bromine	N/A	-	-	-	-	-	-	-	-	-
(2) Lithium compounds	N/A	-	-	-	-	-	-	-	-	-

Source: Statistics for tonnage and values, years 1961-1970, from the Statistical Bureau of Iceland. Other estimates are made by the writer, based on best available information, including interviews with major manufacturers and other reliable sources.

Notes:

1) Consumption of potassium sulphate is expected to approximate 25 % of projected consumption of potassium chloride in mixed fertilizers in the period 1971-1980.

2) There are no consumptions of bromine and lithium compounds reported in Iceland at present time.

3) The fob prices are based on US dollars (Kr. 88.00=US$ 1.00).

37. SCANDINAVIAN MARKETS

The patterns of production, imports, exports and consumption of the chemicals being surveyed in the countries of Norway, Sweden, Finland and Denmark bear a striking resemblance to one another. Because of their historical and traditional ties with Iceland, and their geographic proximity, these countries certainly represent the most attractive potential markets for many of the projected chemicals. Successful penetration of these growing markets is of vital importance to efficient and profitable operations of the projected Sea Chemicals Plant. In the Faeroe Islands and Greenland the only significant chemical requirement is salt for their fishing industries.

38. In order to present the findings of the Survey in an orderly and understandable manner, is is proposed to deal with each country, representing a major market area, separately, and then detail as precisely as possible the significant statistics, marketing information and related data pertaining to each of the products. Except where noted as an estimate (est.), the statistics quoted for imports and exports are invariably taken from official government sources. The production figures are based on reliable information furnished by knowledgeable people and verified by the writer from official and other sources.

38.1. The text of the section dealing with Norway in the first instance will be considerably more elaborate than that of the other countries to follow and much of the background text given in the various sub-headings will be applicable thereafter and hence avoid unnecessary repetition.

38.2. For the benefit of the projected Icelandic manufacturer, the official and actual cif prices of each of the products in the various countries are the all-important considerations and great care was taken to ensure that these were obtained, verified and recorded as accurately as possible. In some countries, and in some years, the desired statistics were not available (N/A) and were so marked. In some countries, statistics are not published which would reveal the operations of one or two manufacturers and sometimes to obscure the exact data one or more similar chemical products are "grouped" together in a so-called "basket item". The statistics for the various grades of salt proved most difficult to tabulate as no uniform procedure is followed, in spite of the Brussels Nomenclature Agreement, and each country publishes to suit its own individual purposes. Very inadequate statistics are published, if at all, for bromine and lithium compounds.

39. **NORWAY**

Products, Production, Export and Import

Year 1971 - In Metric Tons

PRODUCT	PRODUCTION	EXPORTS	IMPORTS	CIF VALUE US$/M.T.
Calcium chloride,77-80%	30,092	0.3	45,883	49.80
Soda ash,58%	26,137 (light grade)	0.5	35,218	48.50
Caustic soda, basis 100%				
-solid and flake	NIL	20.0	7,827	162.00
-liquid,50%	70,000	NIL	6,390	59.30
Chlorine,liquid	60,000	10,650	1	-
Salt - solar salt	NIL	NIL	133,816	11.40
- refined & vac.pan	NIL	NIL	182,322	15.10
- rock salt	NIL	NIL	54,309	9.80
Potassium chloride,60-62%	NIL	NIL	157,963	34.20
Bromine	NIL	NIL	NIL	-
Lithium compounds	NIL	NIL	NIL	-

39.1. CALCIUM CHLORIDE, FLAKE, 77-80%

39.1.1. Manufacture - The only manufacturer of calcium chloride in Norway is Norsk Hydro, the largest producer of basic chemicals, fertilizers, aluminium and magnesium, chlorinated solvents and plastics in Norway. Solar salt is imported from Italy and Spain for use in a Solvay process plant which produces soda ash and co-product calcium chloride which is generally considered a by-product. Production in 1971 was 30,092 m.t. In theory it is possible to recover in the Solvay process something in the order of 1.05 tons of calcium chloride per ton of soda ash produced. In practice, however, nowhere near this amount is produced and much of the raw calcium chloride liquors are discarded as waste into streams or oceans as may be most convenient.

39.1.2. Slow growth of the markets for calcium chloride and the relatively high cost of recovery make it unlikely that the volume of production will be increased voluntarily by manufacturers of soda ash. Disposal costs may, however, increase very considerably because of more stringent regulations being enforced against pollutants being dumped into rivers and streams. Unless a manufacturer can run his waste calcium chloride liquors into the sea, he may be confronted by one of two alternatives; (a) he may increase his recovery of commercial grade calcium chloride and tend to bring about an over-supply situation which will result in lower selling prices, or (b) he may be forced to install expensive pollution control equipment to render less noxious the offending liquors which must be processed in one way or another.

39.1.3. Several large "synthetic" soda ash manufacturers in the United States have already, or are about to, shut down a few of the older Solvay type soda ash operations and some inland European manufacturers may have to do likewise. One such plant producing 600,000 tons per year is reported to be scheduled for closing at the end of 1972, after having already spent more than US$ 10 million in recent years to control wastes but is still unable to meet Ohio's Pollution Control Board requirements. Solvay type plants in Europe are also experiencing effluent problems because of the considerable discharge of calcium chloride wastes into inland waterways. While some plants can discharge their effluents into tidal waters, legislations such as are being imposed along the Rhine River on chloride ion disposal will seriously affect soda ash plant operations in inland Europe. The situation in Europe is perhaps more serious because in the United States the Solvay "synthetic" process has over the years lost economic advantage over "natural" soda ash produced from huge subterranean reserves in Wyoming and natural alkaline carbonate lakes in California.

39.1.4. Exports - Foreign trade in calcium chloride is negligible compared with soda ash and only occurs in special circumstances. As a general rule, calcium chloride is produced and consumed locally and is not shipped internationally in great quantities except to countries where its use is essential or beyond the capability of domestic manufacturers to supply. Norway, Sweden and Finland each imports sizeable tonnages to supplement domestic productions in order to meet the requirements for dust-control on the roads in summer and, to a much lesser extent, the requirements for de-icing in winter. Norwegian exports of 300 kg. of calcium chloride in 1971 are indicative of the customary pattern of trade.

39.1.5. Imports - Norway's consumption of calcium chloride has consistently exceeded the tonnages produced domestically and the deficiency has been met by importations. Apparent consumption in 1967 and 1971 were as here follows:

	In metric tons	
	1967	1971
Domestic production	30,000	30,000
Imports	29,418	45,883
Apparent consumption	59,418	75,883

Imports originate principally from Belgium-Luxemburg; West Germany; Sweden and Poland, in descending order of magnitude.

39.1.6. Reference to APPENDIX IV will illustrate the trend of imports in recent years and the cif costs per metric ton in US dollars, These cif costs show considerable consistency in the various countries being surveyed. Inconsistencies are generally capable of explanation in each instance.

39.1.7. Uses - In the countries of Scandinavia and Northern Europe surveyed, the principal uses of calcium chloride, flake, 77-80% grade, are, in general order of importance, as follows:

- Dust control on gravel roads. (This use is by far the largest in Norway, Sweden and Finland)
- De-icing of roads and other icy surfaces in winter. The cities and towns use small quantities for de-icing purposes, sometimes mixed with salt.
- Brine refrigeration.
- Concrete treatment.
- Tractor tire weighting.
- De-icing on oil-drilling rigs on the North Sea.
- Miscellaneous industrial uses.

The foregoing pattern of utilization is, incidentally, prevalent in most developed economies in Europe and North America but vary, of course, with climatic conditions and preferences insofar as the degree of severity of winter weather requires the application of greater or lesser amounts of calcium chloride for de-icing purposes. Also as mentioned, salt is more universally preferred because of its lower cost.

39.1.8. In Norway, by far the preponderance of calcium chloride is used in summer on gravel roads for dust control. Relatively small quantities are used for brine refrigeration, for tractor-tire weighting and treating of concrete. The total of these specific and miscellaneous applications is nevertheless considerable, amounting to about 35,000 m.t. in 1971 compared with 39,300 m.t. used on government roads for dust control.

39.1.9. The future of calcium chloride consumption in Norway is definitely linked with the requirements for dust control which are essentially the responsibility of the Norwegian Department of Highways. The various cities and towns are, however, responsible for application of calcium chloride within their environs and use some calcium chloride to control dust but, of course, the vast majority of gravel roads are in the rural areas and come under government jurisdiction. As more and more hard-top and asphalt surfaces are applied, the mileage of gravel roads decreases. On the other hand, heavier traffic on the gravel roads increases the need to apply calcium chloride and whereas some years ago only one application was necessary during the summer months, it is now often necessary to make two or three applications. Therefore, in spite of more hard-top and asphalt roads, more calcium chloride is used now, per kilometre, due to heavier traffic on most roads. Little or none is used for de-icing purposes as salt is cheaper and is generally accepted, albeit with some reservations because of corrosion to vehicles and damage to vegetation.

39.1.10. The Government Roads Department has never used magnesium chloride as a substitute for calcium chloride. Some towns and cities have actually used it in small quantities when calcium chloride was in short supply but experience has shown that it is not as effective, or desireable, even at the same price. At the time, magnesium chloride could be purchased at a lower price than calcium chloride, for material imported from Poland.

39.1.11. The use of calcium chloride by the Government Roads Department since 1962 and as forecast to 1980 is as follows:

YEAR	QUANTITY	YEAR	QUANTITY
1962	33,754	1972	42,000
1963	35,444	1973	43,250
1964	41,587	1974	42,000
1965	38,726	1975	40,000
1966	46,428	1976	38,000
1967	46,589	1977	37,000
1968	48,800	1978	35,000
1969	50,500	1979	34,000
1970	50,700	1980	33,000
1971	39,300		

The forecast decline in application is expected to level off slowly at about the 1980 figure and perhaps remain more or less constant, with any tendency to fluctuate being on the down side.

39.1.12. Another feature of supplying calcium chloride to the roads departments in the Scandinavian countries is the fact that each one looks after building up its stocks at local distribution centres, at its own expense, for application to the roads at the appropriate time. This factor of seasonal storage is not usually a cost factor assumed by the importers or distributors.

39.1.13. Price - Reference to APPENDIX IV will show that prices are relatively stable in Norway, although governed by international selling prices in Europe from whence imports to Norway emanate. Increasing production costs in Europe, caused in part by the comsequences of the more exacting pollution control regulations and by increased costs of ocean transport in 1971, are reflected in the cif prices. The Norwegian manufacturer undoubtedly adjusts selling prices of domestic material, to some extent at least, to conform to the imported costs. The cif prices, therefore, are of major significance to this Survey.

39.1.14. Customs duties - There are no duties imposed at present on imports of calcium chloride to Norway. If Norway joins the European Economic Community, as seems likely, and in the absence of some agreement between Iceland and the E.E.C. members, imposition of a tax is probable. Such a tax would most likely have to be absorbed by the Icelandic manufacturer with the resultant loss of gross profit which is bound to cause some financial hardship to the Project.

39.1.15. Marketing - In each of the countries surveyed, the products under investigation are invariably distributed by wholesalers, dealers or agents, some with their own or rented warehousing facilities and each with some kind of sales force which maintains contact and services the trade and individual consumers. These marketing organizations act as distributors for locally manufactured materials and /or rely on imported materials. In some cases, manufacturers of certain high-tonnage basic chemicals may reserve for themselves the right to serve certain large buyers or classes of trade directly, in bulk quantities, but by and large, experience has proved that detailing of sales to consumers by specially trained sales organizations, and preferably with adequate warehousing and other supporting facilities, is the most efficient and effective means of distribution.

39.1.16. Norway is no exception to this established pattern. A number of highly reputable and respected marketing organizations were interviewed, each of which carried out its particular functions to best serve its interests and that of its clients. It was evident in Norway and, in fact, everywhere visited, that all the chemicals being considered are highly competitive and that market positions already established by the powerful giants in the industries, such as Solvay, Akzo and I.C.I., will be jealously and ruthlessly guarded against incursions by new manufacturers. The inevitable result of a new-comer attempting to invade established markets is a "price war" and consequent loss of profits to all concened.

39.1.17. While this subject will be dealt with later in this Report, it seems important to mention here just how critical and precarious the competitive pressures on these basic commodities really are. A sales programme to "invade" these markets with new productions from Iceland must be carefully and intelligently organized and carried out with skill and determination. Anything less will lead to hardship and loss of profit. Norway must, however, be looked upon as perhaps the best potential market outlet for calcium chloride as well as for other chemicals to be produced in Iceland.

39.1.18. The Product - The commercial calcium chloride produced and sold in Norway, and indeed in all of Scandinavia, Europe and the U.K., is "flake" material, 77-80% $CaCl_2$. It is usually packed in polyethylene bags or waterproof multi-wall paper bags, the former being preferred. In several instances dealers referred to light-weight metal containers but the roads department people invariably favoured plastic or waterproof paper bags as they are more easily handled and stored than the more awkward metal drums. This preference was expressed in the first instance by the Roads Department in Iceland and was confirmed in succeeding interviews abroad.

39.2. SODA ASH, 58%

39.2.1. Manufacture - The sole manufacturer of soda ash in Norway is Norsk Hydro, which, as mentioned for calcium chloride, operates a "synthetic" type Solvay process plant with an annual capacity of about 26,000 m.t. Soda ash and calcium chloride are co-products of the Solvay process and with the enforcement of more rigid pollution regulations it is conceivable that in many areas of Europe and North America some curtailment of "synthetic" soda ash production is probable. Soda ash production is generally maintained in reasonable supply as opposed to demand and the pollution problems associated with calcium chloride could have some serious repercussions on the consumers of soda ash in certain areas. The consquences may be reflected in higher delivered prices or in some cases by substituting soda ash produced from natural sources for the traditional "synthetic" Solvay process ash. In the glass, pulp and paper and alumina manufacturing industries it is possible to use either soda ash or caustic soda.

39.2.2. During the last fifteen years a rather spectacular transition in the use of "natural" soda ash has taken place in the United States since the very extensive natural reserves in Wyoming were developed. The manufacturing costs of synthetic soda ash are increasing over the years whereas the costs associated with the recovery of natural ash should not increase to a like extent because of fewer cost factors involving labour and expensive equipment and plant maintenance. Natural soda ash is usually of high quality and is capable of being sold at lower prices, assuming equal transportation costs to points of consumption. Natural soda ash is also being produced near Searles Lake in California, U.S.A. from natural carbonate deposits but in much lesser amounts than in Wyoming.

39.2.3. Within the limits of ability to economically supply demands, soda ash produced from natural sources will gradually replace material produced synthetically, and, except in special circumstances and in certain developing countries, it is not likely that many new synthetic type plants, or additions to existing plants, will be constructed. It is estimated that by 1975 in the United States, 50% of the soda ash produced will be from natural sources as more and more synthetic plants are being closed as being uneconomic to operate any longer. The obvious alternate source of supply is in the countries which have large reserves of natural sodium carbonate which can be exploited without the serious problems of environmental pollution.

39.2.4. Significant reserves of natural sodium carbonate deposits exist in various parts of the world other than in the U.S.A. Lake Magadi in Kenya has been a minor source of natural soda ash since the days of World War I and is currently producing at the rate of about 200,000 m.t. per year. This operation is owned by Imperial Chemical Industries Limited, the largest synthetic soda ash producer in the U.K. Natural sodium carbonate deposits and alkaline lake brines are also found in Mexico, Venezuela, Russia and at Lake Van in Turkey, but these have not yet been developed to any extent. Lake Natron in Northern Tanzania has virtually inexhaustible reserves of high grade natural sodium carbonate which will undoubtedly be developed in future years.

39.2.5. It is important to emphasize the emerging significance of natural soda ash. The projected production in Iceland will fall into this category and the recovery process and marketing function will not be plagued with the hazards and problems associated with environmental pollution. In other words, consumers of soda ash from Iceland will be assured of receiving very high quality material from a dependable source at price levels which should not be influenced by the uncertainties of pollution regulations originating from public outcry and political reaction.

39.2.6. Exports - As in the case of calcium chloride, exports in 1971 of 500 kg. are minimal and are only to supply some unusual or specific demand. As Norway consumes much more than it manufactures, it is obvious that exports are not considered as a lucrative or practical commodity for trade.

39.2.7. Imports - Consumption in Norway has consistently exceeded Norsk Hydro's ability to supply. Apparent consumption in 1971 compared with 1967 is typical of the situation which necessitates increasing imports almost every year:

	In metric tons	
	1967	1971
Domestic production	26,000	26,000
Imports	22,752	35,218
Apparent consumption	48,752	61,218

39.2.8. Imports originate principally from the following countries: France, Great Britain, West Germany and Poland. Reference to APPENDIX V will illustrate the trend of imports in recent years and the cif costs per metric ton in US dollars.

39.2.9. Uses - Consumption in Norway follows the traditional pattern of other countries. As Norsk Hydro produces only light grade soda ash, the glass manufacturers who are the largest single consumers, and prefer dense grade, are served essentially with imported material. Norsk Hydro material will be sold to manufacturers of chemicals, pulp and paper, soap and detergents, for water treatment and for a multitude of miscellaneous purposes. The manufacture of titanium dioxide by the chloride process represents another sizeable use for chlorine.

39.2.10. Price - Appendix V shows that prices are relatively stable in Norway, balanced by the prices charged for imported material versus the prices charged for domestic production. Much of the fluctuation in cif costs is due to variations in the freight costs of ocean shipping. As with other basic high-tonnage chemicals, the actual cost or selling price of soda ash has a great tendency to remain reasonably constant. Selling prices of both light and dense grades are usually the same.

39.2.11. Customs duties - No duties are imposed at present on imports of soda ash but, as in the case of calcium chloride, the effect of affiliation with the E.E.C. will be critical.

39.2.12. Marketing - The usual pattern of distribution for soda ash is similar to that described for calcium chloride. Norsk Hydro reserves to itself the right to supply directly the large accounts, several of which take deliveries in bulk quantities. The small accounts are serviced through wholesalers and dealers.

39.2.13. Penetration of this market by an Icelandic producer will be precarious as the large multi-national manufacturers such as Solvay, Akzo and ICI are firmly entrenched through reputable and long-established channels of distribution. Solvay, for instance, has a subsidiary company in Sweden to promote its intersts in Scandinavia although actual marketing and distribution of products is handled by designated dealers and wholesalers. Several substantial trading organizations interviewed, however, expressed a genuine willingness to seriously consider handling Iceland's chemicals as, if and when they become available for sale.

39.2.14. The product - As the domestic produced material is all light grade, it is obvious and logical that the optimum potential market for Icelandic material would be for dense grade soda ash, 58%, although light grade should also be available. As a commodity for international trade, soda ash is usually packaged in waterproof 50 kg. polyethylene plastic bags. Manufacturers in France and Poland also make shipments in multiwall paper bags. Large consumers such as the glass industry, have a decided preference for dense ash and where practical and economical, are desirous of receiving deliveries in bulk, either in railway box cars or in barges or vessels. It seems likely that an Icelandic producer should be prepared to make shipments in bulk cargo lots in order to be at no disadvantage in the marketplaces. Shipments of both light and dense grades, in bags, will of course be mandatory.

39.3. CAUSTIC SODA

39.3.1. Manufacture - Norway has two manufacturers of caustic soda and its co-product chlorine, namely:

	Annual capacity in metric tons	
	Caustic Soda 50% Bais 100% NaOH	Chlorine
Norsk Hydro	30,000	26,000
Borregaard, Aktieselskapet	40,000	34,000
Total production	70,000	60,000

39.3.2. Both these chlor-alkali plants dissociate imported vacuum pan salt in mercury type electrolytic cells and each company has some captive consumption of both co-products for use in the manufacture of the other products. Borregaard operates a large pulp mill at Sarpsborg which uses both caustic soda and chlorine. Norsk Hydro uses chlorine for chlorinating hydrocarbons, essentially poly-vinyl chloride resins. Any excesses of production over consumption by these two organizations are marketed in Norway by a jointly owned company known as A/S Klorsalg. All the caustic soda manufactured in Norway is 50% liquid grade and requirements of flake or solid "anhydrous" grades are served by imports. The problems associated with operating chlor-alkali plants and Solvay type soda ash plants are simular in many respects, especially with regard to the essentiality of maintaining production and marketing balances of the two co-products. These are problems of the highest order of importance for both practical and financial reasons. Supply and demand and inevitably pricing structures applicable to these products are invariably reflected in the marketplaces and eventually in the operations of the individual ultimate consumers.

39.3.3. Exports - Norway exported 20 m.t. of solid or flake caustic soda in 1971. Here again, this transaction was for a special purpose and involved re-exporting material which had been imported as no solid grades are manufactured here.

39.3.4. Imports - Deficiencies in domestically produced material are supplemented by imports of both liquid and solid grades. Apparent consumptions in 1967 and 1971 were approximately as follows:

	In metric tons - basis 100% NaOH			
	1967		1971	
	Liquid, 50%	Solid	Liquid, 50%	Solid
Domestic prod'n	70,000	Nil	70,000	Nil
Imports	3,100	6,902	6,390	7,827
Apparent consumption	73,100	6,902	76,390	7,827

39.3.5. Imports originate principally from the following countries:

Solid & flake	Liquid, 50%
Netherlands	France
Italy	Netherlands
Sweden	Switzerland

39.3.6. Several of the larger importers and dealers reported that the demand for caustic soda is growing steadily, especially for liquid grade, 50% NaOH. Reference to APPENDIX VI bears out this notion but while the demand may exist it is probable that supplies, particularly for relatively small consumers, are limited by the abilities of the two domestic manufacturers to supply. The larger consumers are more liable to be able to secure all or most of their demands from the manufacturers or be in a position to arrange for imports. The lower delivered cost of liquid grade in many instances is bound to increase its demand.

39.3.7. Uses - The largest single use for caustic soda in Norway is undoubtedly for the pulp and paper industry. Other major consumers include makers of soap and detergents; chemicals manufacture; petroleum refineries; textiles; food processors and a host of miscellaneous smaller users. This is the same pattern of consumption that exists in most countries. The glass industry is traditionally the largest consumer of soda ash, accounting for about 40%-45%

of total production on a worldwide basis. Glass manufacturers are beginning to substitute caustic soda for the traditional soda ash and this new demand will put further pressures on the manufacturers of caustic to increase production capacities. This can be successfully accomplished, however, only if new outlets for chlorine can be found. The aluminium reduction industry is normally a large consumer of soda ash and/or caustic soda but unfortunately,all the aluminium works in Norway perform only the smelting operation and import the already processed alumina to the smelters for the production of aluminium metal.

39.3.8. Price - Reference to APPENDIX VI will show that the prices of liquid caustic 50% are relatively stable, brought about by the counter-balancing pressures of domestic production and imports. In 1971 the prices were increased somewhat because of rising costs of vacuum pan salt in the Netherlands and increased cost of ocean transport. The average cif costs of liquid caustic in 1971 showed similar increases over 1970 in all the countries surveyed. Some of the increase, too, can be attributed to the tendency to increase selling prices when caustic soda is in worldwide short-supply as it is at present. There are indications that some reversal of this trend will become evident by 1973.

39.3.9. The situation with repect to flake and/or solid grade caustic soda is more exaggerated as the manufacturers, dealers, and transport groups have apparently taken advantage of the short-supply situation and have raised prices for the packaged products by over 50%. In Belgium and the Netherlands the increases were marginal, perhaps a reflection on the close control exerted by the Solvay and Akzo groups on transactions within these countries. Refernce to APPENDIX VI will clearly illustrate what is happening and can happen again repeatedly in future as competition and various pressures are brought to bear on these basic chemicals of international trade.

39.3.10. Customs duties - There are no duties imposed at present on imports of caustic soda to Norway, but as mentioned earlier, entrance into the E.E.C. could cause this favourable situation to change.

39.3.11. Marketing - Distribution of liquid caustic soda is almost entirely in the hands of the two chlor-alkali manufacturers which ship direct by barge, railway tankcars, or highway tankwagons to the major consumers. Some selected large wholesalers have installed their own storage tanks for liquid to enable them to ship in smaller lots to individual users. Liquid caustic soda is usually moved in special barges or ships in lots of 1,000 to 1,500 m.t., either within Norway or when imported from abroad. Highway tankwagons usually convey about 8 to 10 tons of 50% caustic, depending on load-limits and safety restrictions imposed by highway authorities.

39.3.12. Flake and solid grades of caustic soda, basis 100% NaOH, is imported by the dealers and wholesalers and distributed to the various industries and consumers through well-established channels along with other chemical products of similar nature. Selling prices are subject to fluctuations which are imposed by pressures originating in foreign countries and the supply/demand position on world markets. The importers in any country are therefore compelled to take considerable risks in purchasing and warehousing. The demand for caustic soda by so many and varied users ensures that a steady growth in sales is inevitable as the level of industrialization and economic growth expands over the years. The cif prices are a fair reflection of the average costs incurred by importers, to which they add their costs of handling, warehousing, selling expense and profit for services rendered. The reputable dealers interviewed all seemed satisfied that the basic products discussed would continue to enjoy a slow (3to5%) steady yearly growth. Some of these were agents for Solvay, Akzo and I.C.I. products and others handled competitive lines from other European and East Bloc countries. The highly competitive marketing problems were universally accepted and respected.

39.3.13. The Product - As with calcium chloride and soda ash, high purity caustic soda, whether 50% liquid or 100% solid grades, is essential for successful marketing. The flake grade is usually packed in polyethylene 50 kg. bags, or sacks, and in lightweight steel drums, weighing either 50 kg. or 200 kg. Material in both types of containers sell for the same price. Solid grade caustic is always sold in rigid metal containers weighing about 325 kg. net.

39.3.14. An Icelandic producer of caustic soda would have to produce both liquid and solid grades of caustic soda. This would be necessary in order to balance production and sales as demands for each vary from time to time. The ability of the selling organization to dispose of the full production on a year-round basis is an essential prerequisite to minimize plant operating problems and to maximize overall profitability. Caustic soda and co-product chlorine are not materials which can be stored for extended periods, for valid practical and economic reasons.

39.4. CHLORINE

39.4.1. Manufacture - In the previous section on caustic soda, some of the more important aspects of manufacture were outlined. Production in Norway by conventional electrolytic methods is as follows on next page:

	Annual capacity - m.t.
Norsk Hydro	26,000
Borregaard, Aktieselskapet	34,000
Total production	60,000

39.4.2. Of the two co-products, chlorine presents more major problems. Commercial chlorine is a compressed, liquified gas under pressure, about one and one-half times as heavy as water, packed in steel pressure containers. Liquid chlorine vaporizes under normal atmospheric temperature and pressure and the gas is about two and one-half times as heavy as air. It has a characteristic penetrating and irritating odor and is highly reactive chemically. It is a skin irritant and can cause severe damage to body tissues.

39.4.3. For all these and many more reasons, chlorine is a very difficult and, indeed, dangerous material to handle and store although when proper precautions are taken it can be considered relatively safe. It is not economical or practical to store large quantities of liquid chlorine, hence the absolute necessity of being assured of adequate and continuous markets. The electrolytic manufacturing process is continuous and should be operated at near full capacity for maximum economies in operation and profit. Production from these plants cannot be curtailed to any great extent without suffering damage to the equipment due to excessive corrosion and, of course, the concurrent loss in production of co-product caustic soda. While the planned production of chlorine in Iceland is to be from the magnesium production unit and not from an electrolytic operation, the problems of handling, storage, shipping and marketing the chlorine are the same. The specific matter of shipping chlorine in bulk cargoes will be referred to later on in more detail.

39.4.4. Exports - Up until late 1971, Norsk Hydro's chlor-alkali plant at Heroya had been shipping liquid chlorine to British Oxygen Company's plant at Maydown, Northern Ireland by means of the specially constructed chlorine tanker, the PORSGRUNN. The chlorine was used in BOC's Wulff process at Maydown to chlorinate ethylene and the resulting ethylene dichloride (EDC) was shipped back to Heroya for use as feed-stock in Norsk Hydro's 50,000 ton per year vinyl chloride plant. The extent of this movement by water of liquid chlorine is revealed by the following statistics which are the only records available:

Year	Imports to U.K.		Exports from Norway	
	Quantity	cif/mt	Quantity	fob/mt
1970	16,420	US$ 64.50	16,420	US$ 39.90
1971	10,650	US$ 71.00	10,650	US$ 43.20

These figures indicate an ocean freight rate between Norway and Northern Ireland as shown on next page. It is assumed, too, that this rate takes into consideration that the same vessel returns loaded to Norway with a cargo of EDC and therefore may represent a low figure and perhaps should be used with caution for estimating purposes.

Year	Quantity shipped	Apparent freight rate
1970	16,420	US$ 24.60 / m.t.
1971	10,650	US$ 27.80 / m.t.

39.4.5. The foregoing statistics more or less confirm a reliable opinion expressed during an interview that ocean freight rates for bulk cargoes of chlorine would likely be in the order of US$ 30.00 per metric ton, depending on distances and other variable factors prevailing at both ends of the movement. Most authorities interviewed were naturally reluctant to express opinions and certainly did not wish to be quoted.

39.4.6. Shipments of chlorine to Maydown terminated during 1971, as evidenced by the decrease in tonnage from the level in 1970. Published and other information give the clear impression that the imposition of new and more rigid regulations would entail a virtual rebuilding of the tanker PORSGRUNN. The capital cost of carrying out the required rehabilitation, which also would include modification of shore installations at Heroya and Maydown, would not be justified by the value of the transactions. Other determining factors, all adverse, include less than planned productive capacity levels at BOC's Wulff plant, and the introduction of new and more stringent regulations to control the disposal of chlorinated hydrocarbon residues resulting from the EDC cracking operation at Heroya. The Swedish authorities have also imposed new controls on the uses of chlorinated hydrocarbons to combat the possibilities of environmental pollution and poisoning of the waters adjacent to Norway and the Baltic area where considerable contamination has already taken place. Contamination of the waters between Sweden and Denmark in the Malmo - Copenhagen area is also a serious problem.

39.4.7. The net result is that bulk shipments of chlorine have been discontinued and Norsk Hydro is reportedly operating its PVC plant at reduced capacity and using EDC imported from the US Gulf Coast. It is also understood that Norsk Hydro has given serious consideration to importing ethylene and chlorinating it in Norway. Another alternative being considered is construction of an oil refinery in Norway, possibly by Norsk Hydro, to provide petrochemical feedstocks, including ethylene, and henceforth not have to rely on imports and at the same time be able to consume their own chlorine for PVC manufacture. The chlorine business involved in this transaction has been lost, temporarily at least, and the chlor-alkali operation has been forced to reduce production of both chlorine and its co-product caustic soda. Imports of caustic soda to

Norway will undoubtedly show some increase in 1972 to make up the deficiency.

39.4.8. Imports - Imports of liquid chlorine to Norway are negligible and are confined to small tonnages in cylinders, for certain specific purposes and which have no significance for the purposes of this investigation. The values associated with these imports are not representative of commercial prices. As a matter of record, the imports are shown on APPENDIX VII. Until suitable ocean tankers for bulk chlorine shipments are constructed and become more generally accepted as a normal and safe means of water transportation, it is only prudent to suggest that off-shore sources of chlorine are not yet practical or reliable enough to be looked upon for the supply of an important raw material for continuous processes such as pulp and paper, chlorinated hydrocarbons and various petrochemicals.

39.4.9. Uses - The priciple uses for chlorine are in the manufacture of chlorinated hydrocarbons, including vinylchloride, chlorinated solvents and other chlorinated organics; pulp and paper bleaching chemicals; manufacture of pesticides and herbicides (this use is tending to decrease now because other less toxic materials are being substituted); bleaching, scouring and dyeing of textiles; disinfectants and sanitation; purification of water supplies; and many minor uses.

39.4.10. Chlorine consumption in Norway and indeed in all the Scandinavian countries, follows much the same pattern, namely chlorinations for PVC manufacture and for bleaching pulp and paper and textiles. Smaller consumptions for minor uses such as water treatment, disinfectants, aluminium processing, etc. are common to all countries.

39.4.11. Price - In the Scandinavian countries where very little chlorine is traded between countries it is difficult to ascertain prices or realistic cif or fob costs and the published statistics do not reveal much of value. This is understandable, too, because the tonnages reported are minor and certainly are not indicative of prices which would prevail for the movement of larger tonnages which are the only prices which would be of value to this Survey. The selling prices published in technical journals cannot be relied upon to realistically determine prices paid by the large bulk consumers. These transactions are "special deals" negotiated and covered by long-term contracts in most cases between the two parties. Such arrangements account for the major proportion of the output from most chlor-alkali operations.

39.4.12. The bulk selling prices mentioned in paragraph 39.4.5. above apparently apply to sales made by Norsk Hydro to BOC at Maydown, Northern Ireland and are belived to be representative and reasonably reliable for the purpose of this Survey. Prices for bulk quantities, say, in excess of 15,000 m.t. per year delivered in vessels carrying loads ranging from 1,500 to perhaps 5,000 m.t., very likely could be sold profitably at the reported fob price of US$ 40.00 to $ 43.00 per m.t. The ability to sell chlorine at this price is undoubtedly predicated on sales of the co-produced caustic soda at prices which will be high enough to reflect an overall profit to the chlor-alkali operation. During the course of a converation in one of the interviews with a person who is in a position to know about costs and prices, it was suggested that a chlorine producer in Iceland would be well-advised to estimate profitability on the basis of an fob cost of about US$ 35.00 per m.t. rather than on a figure approaching US$ 40.00 per m.t.

39.4.13. A statement made during an interview in Belgium on this important issue of fob works' prices is worthy of mention at this point. It serves to demonstrate what <u>can</u> happen in this industry during times when supply and demand fluctuations force manufacturers to extreme measures in order to dispose of material. A source believed to be reliable made the emphatic statement that a manufacturer in Italy is now selling chlorine in West Germany at a price of US$ 30.00 per m.t., delivered in tankcars. This is a very low price and undoubtedly will not be valid for an extended period but it illustrates the "panic" pressures which build up in the industry from time to time.

39.4.14. Customs duties - No customs duties apply on chlorine imports at this time but, as with the other commodities, E.E.C. affiliations may alter the entire taxing structure.

39.4.15. Marketing - Chlor-alkali plants are almost invariably constructed to serve some sizeable captive or nearby demand for one or both of the co-products, and any surplus productions are disposed of on a merchant basis to various consumers located within a "freight logical" distance. Chlorine in bulk is usually delivered in tank-cars and sales are transacted directly between supplier and customer. The same holds true for sales of liquid caustic soda. Shipments to captive or adjacent consumers of both chlorine and liquid caustic are frequently made by pipelines where such means is feasible. Pulp and paper mills, rayon plants (for caustic soda) and chlorinated hydrocarbon plants would fall into this category. This classical type of situation exists in Norway where both manufacturers are primarily concerned with supplying the products to captive users.

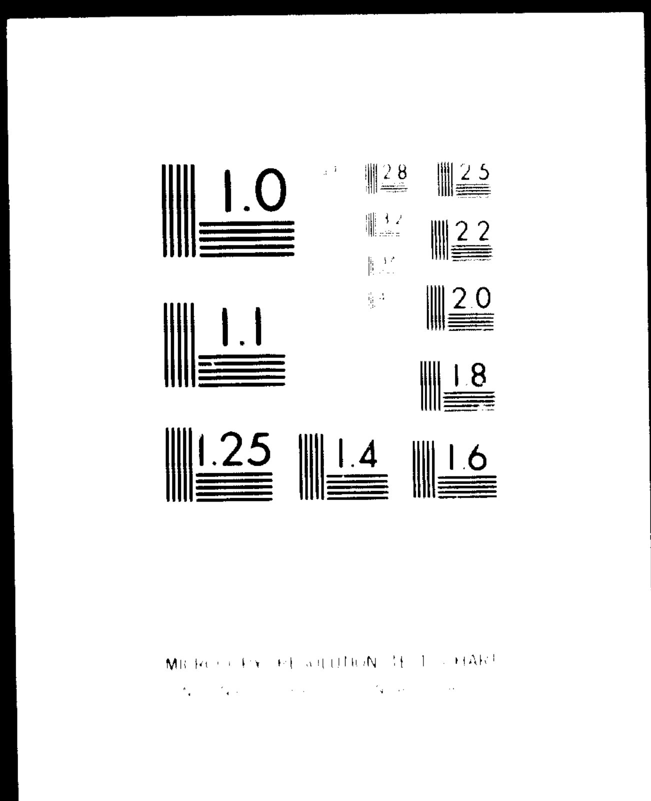
39.4.16. Sales of liquid chlorine for various miscell-aneous uses are usually made through dealers in steel pressure cylinders which contain about 150 pounds net of material. For the larger consumers such as water treat-ment plants and manufacturers of disinfectants, etc., it is sometimes more economical to purchase in special 1-ton

C-384

77.11.16

2 OF 4

07570



24×

A

steel containers. Cylinders and containers represent a considerable proportion of the delivered prices of chlorine as freight must be paid by the customer on the full loads and also on the "empties" when they are returned to the plant for re-filling. Off-shore sales of chlorine in Norway, and as projected for Iceland are effected in bulk quantities. Iceland is not presently concerned with other than bulk deliveries and when the time comes to consider packaged chlorine business, the increment in costs can be absorbed in the higher prices charged over the base bulk cost.

39.4.17. <u>The product</u> - Chlorine is sold and used in Norway as 100% Cl_2. A small percentage of the output is undoubtedly sold domestically as hydrochloric acid (HCl), commonly referred to in the trade as muriatic acid which is an aqueous solution of hydrogen chloride, a colorless and pungent gas, containing about 31.45% Cl_2 for the 20^o baume commercial grade. Shipments of muriatic acid are usually made in glass carboys or rubber-lined railway tankcars, or highway tankwagons. It is used industrially in such diversified fields as the pickling of metals for scale removal; manufacture of chemicals; sugar cane refining; synthetic rubber production; and many other applications.

39.5. SALT

39.5.1. Manufacture - No salt is produced in Norway and all requirements are imported.

39.5.2. Exports - In the absence of domestic resources of salt the exports from Norway are nil.

39.5.3. Imports - A few words of explanation about the official statistics published by the various Governmental statistical bureaux is appropriate. These offices were called on personally in each country surveyed in order to acquire the desired figures as accurately as possible. This sometimes proved to be a frustrating task as the identifying item numbers which are essentially supposed to conform with the so-called Brussels Nomenclature are not applied in practice in identical fashion in all countries. In certain countries it was found that salt imports were grouped together as "all salt" whereas in others certain specific types of salt such as refined and vacuum pan; sea salt; rock salt; salt for chemcal conversion; fishery salt; human salt and animal salt were shown as seperate items. The number of items specifically listed varied from country to country and in some instances after listing one or two grades, the balance was grouped under "other salt". Every effort has been made, however, to verify the figures and to present the available information as precisely and realistically as possible.

39.5.4. Imports of salt to Norway, and the other countries surveyed are tabulated on APPENDIX VIII which depicts the rising patterns of annual consumptions in all countries along with variations of cif prices. Consumptions in 1967 and 1971 and the cif prices per m.t. (shown in brackets) were as follows:

Grade of salt	Quantity imported in m.t. 1967	1971
Refined & vacuum	154,275 (US$ 13.40)	182,322 (US$ 15.10)
Fishery salt (sea)	81,303 (US$ 9.65)	133,816 (US$ 11.40)
Rock salt	31,970 (US$ 8.20)	54,309 (US$ 9.80)

39.5.5. Imports in 1971 originated principally from the following countries. The cif prices per m.t. are shown in brackets.

Vacuum pan	Fishery (sea)	Rock salt
Netherlands (US$ 14.28)	Italy (US$ 11.06)	W.Germany (US$ 10.64)
Great Britain (US$ 17.92)	Spain (US$ 11.76)	E.Germany (US$ 7.56)
W.Germany (US$ 14.28)	Tunisia (US$ 11.06)	Great Britain (US$ 13.86)

39.5.6. <u>Uses</u> - It is understood that sea salt is used in Norway as the raw material for soda ash manufacture and this will account for about 50,000 m.t. per year at present levels of production. The large part of the balance of the

133,816 m.t. imported from Italy and Spain in 1971 is used by the fishing industry for certain types of processing. Some will also be used in the food industry and for textile dyeing and finishing.

39.5.7. The bulk of the refined and vacuum pan salt is consumed in the manufacture of caustic soda and chlorine by the two established producers who use about 125,000 m.t. of the total imports of 182,322 m.t. Other consumers will be manufacturers of chemicals; soaps and detergents; textiles; and food processing. One large chemical manufacturer remarked that they could use more high quality vacuum pan salt if it could be obtained at acceptable prices as it was in good demand.

39.5.8. The imports of rock salt amounting to 54,309 m.t. in 1971 were largely used on the roads for de-icing purposes. Some rock salt is also used by the fishing industry for certain types of production.

39.5.9. Price - Reference to APPENDIX VIII will show the trends in cif prices to Norway and other countries and, as usually is the case, the trends are consistent to a considerable extent. The increased charges for transportation reflected in all countries on all the products surveyed is particularly noticeable on salt because it is a low-cost product.

39.5.10. One large importer of sea salt to Norway from the Mediterranean area reported when interviewed that sea salt was currently costing about US$ 7.00 per m.t. delivered. This is believed to be an unrealistically low figure, especially with the higher ocean freight rates prevailing in 1971 and 1972. For isolated cargoes, however, it is possible that some shipments are made at such low rates but on the average, delivered cif costs of US$ 11.00 to $ 12.00 per m.t. are belived to be realistic.

39.5.11. Customs duty - No duties are imposed on imports of salt to Norway. This situation may change, however, if Norway joins the E.E.C. as seems likely.

39.5.12. Marketing - There are relatively few importers of salt in Norway because the major consumers of salt are large organizations and purchase their salt requirements directly from the producers. Salt for the fishing industry, Government Roads Department and the smaller user are served through importers who operate out of warehouses, mostly in the nothern areas.

39.5.13. The costs of transportation almost invariably exceed the basic fob costs of the product at points of production. As the Survey progressed it became abundantly clear that ocean freight rates on salt were the prime consideration in the salt trade and the ability to be able to arrange for suitable vessels to be available for specific movements, either on an intermittent or regular scheduled basis, was the principle ingredient in the all -important delivered cost figure. From a dealer´s point-of-view, the salt is considered to be virtually a medium of exchange and profits on transactions vary up or down according to the margins of cost realized on the transportation factor.

39.5.14. The product - Iceland´s potential interest is in supplying vacuum pan salt for the chemical industries and other purposes where high purity material is essential. The possibility of supplying fishery grade coarse salt may pose some problems initially because of the established usage of solar, or sea salt from Italy and Spain and rock salt from Germany for certain types of fish processing. There is a great reluctance on the part of fish processors to change from established sources of salt for fear of adversely effecting the quality of the end product. Some experimenting with Iceland´s fishery grade salt will undoubtedly be required before significantly large orders can be expected. Experience in Iceland with the new fishery salt will, of course, be invaluable in soliciting new buisness abroad for the fishing industry.

40. **SWEDEN**

Products, Production, Exports and Imports

Year 1971 - In Metric Tons

PRODUCT	PRODUCTION	EXPORTS	IMPORTS	CIF VALUE US$/M.T.
Calcium chloride,77-80%	70,000	1,651	75,500	42.20
Soda ash,58%	NIL	26	134,763	45.45
Caustic soda, basis 100%				
-solid and flake	NIL	2,254	7,923	138.50
-liquid, 50%	390,000	5,050	34,012	54.50
Chlorine, liquid	350,000	7,161	2	97.00
Salt -refined and vac.pan	NIL	NIL	704,364	11.85
-table salt	-	-	11,376	73.50
-other	-	-	243,843	10.60
Potassium chloride,60-62%	NIL	NIL	171,429	35.40
Bromine, including other halogens except chlorine	NIL	NIL	75	-
Lithium compounds -				
Li carbonate	NIL	NIL	(est.)25	N/A
Li hydroxide	NIL	NIL	" 50	N/A

40.1. CALCIUM CHLORIDE, FLAKE, 77-80%

40.1.1. Manufacture - Unlike Norway which produces calcium chloride and soda ash in the conventional Solvay type process, the sole manufacturer of calcium chloride in Sweden, Boliden AB at Halsingborg, uses waste hydrochloric acid from their salt cake (sodium sulphate) operation. When 1,670 pounds of common salt, 1,500 pounds of sulphuric acid and 1,175 pounds of coal are reacted in a special type of furnace the resultant products are 1 ton of salt cake and 3,150 pounds of hydrochloric acid. The salt cake is used largely in the manufacture of kraft pulp in Sweden. The by-product hydrochloric acid is reacted with a weak calcium chloride brine or residues from their phosphatic fertilizer processes, purified and concentrated to the commercial flake grade material. Annual production from this operation, which is the only one in Sweden, is 70,000 m.t. and it is not likely that productive capacities will be increased in the foreseeable future.

40.1.2. Exports - Boliden exports about 2,000 m.t. each year to Denmark but apart from this movement to conveniently located Danish ports, exports elsewhere are negligible. Domestic production in neighbouring countries and severe competition on world export markets are limiting factors except in unusual circumstances. Calcium chloride as produced in Sweden is probably of higher cost than the co-product from a Solvay soda ash plant.

40.1.3. Imports - As exemplified in APPENDIX IV the domestic production has always had to be supplemented by imports to meet total requirements. Apparent consumptions in 1967 and 1971 were as follows:

	In Metric Tons	
	1967	1971
Domestic production	70,000	70,000
Imports	57,756	75,500
Apparent consumption	127,756	145,500

40.1.4. Imports originated principally in Belgium, West Germany, Poland and France. Several reputable dealers handling imports have decided to withdraw from the buisness because of intense competition from Solvay in Belgium and France, and from West Germany and Poland. As was the case in Norway, the cif prices in Sweden follow a consistently uniform pattern with other countries.

40.1.5. Uses - The same pattern of consumption exists here as in Norway and Finland. The preponderance of calcium chloride is used for dust control on gravel roads. Relatively minor quantities are used for de-icing, a total of about 5,000 m.t. being mentioned by one dealer. Other common uses such as for brine refrigeration; concrete treatment; tractor tire weighting; chemical and industrial manufacturing and miscellaneous smaller outlets account for the balance.

40.1.6. The State Board of Roads used about 90,000 m.t. of calcium chloride for dust control in 1971. In 1961, consumption was 220,000 m.t. per year. None is used for de-icing on government roads although the towns and villages probably use some. It is expected that annual tonnage will decrease slowly as more hard-top is installed, but more travel means more applications each season. The pattern of decreasing consumption will likely follow the trend forecast for Norway and in Sweden it is anticipated that it will level off at about 75,000 to 80,000 m.t. per year in the period 1975 - 1980. Money is tight for road up-keep, hence their road plan may lag and leave more gravel roads which must be treated for a longer period ahead.

40.1.7. All the calcium chloride used by the Roads Administration is purchased in plastic PE 50 kg. bags. Steel drums containing 200 kg. are seldom used now.

40.1.8. Their experience with magnesium chloride as a replacement for calcium chloride is entirely negative and they see no economic or practical advantages in it. It also has a tendency to cause more damage to concrete and is less effective for binding dust. In a dry climate, calcium chloride is more effective and even if the cost per ton were cheaper they would still use the traditional calcium chloride.

40.1.9. Price - The calcium chloride supplied to the Roads Administration comes partly from the manufacturer, Boliden AB and the balance is imported by dealers. Supplies from Boliden are withdrawn as required throughout the season and are generally applied in the southern areas. The dealers arrange to deliver imported materials at strategic locations in the northern areas in order to balance out, and minimize, delivered costs. Prices differ because of distances from ports at specified points of delivery, but the average price of material, when stored, and including transportation charges, is in the order of US$ 50.00 per m.t. Most of this imported material comes from Solvay in Belgium.

40.1.10. The approximate price of calcium chloride flake, in 50 kg. plastic bags, fob manufacturer's plant at Halsingborg is about US$ 40.00 per m.t. Reference to APPENDIX IV will show that the average cif price in 1971 was US$ 42.20 per m.t.

40.1.11. It was mentioned in several interviews in Sweden that considerable quantities of calcium chloride were used in winter for de-icing in Belgium, Switzerland and the Netherlands. Belgium reportedly used 70,000 m.t. for this purpose in 1971, spreading it three or four times a day when deemed necessary. The outcome, however, is a serious outcry from the populous against the pollution of rivers and streams by the run-off. This serious issue of further contribution to envirnmental pollution may result in a general deterrent to potential users of calcium chloride for de-icing purposes.

40.1.12. Customs duties - All chlorides and oxides, including magnesium chloride and metal salts, enter Sweden free of duty at the present time.

40.1.13. Marketing - Several of the major dealers interviewed handled Solvay material and others distributed Boliden's domestic production. Others represented manufacturers in West and East Germany, Poland and I.C.I. in England. The establishment of the Solvay subsidiary in Stockholm was certainly a valuable sales promotion aid to Solvay's dealers and products.

40.1.14. Notwithstanding the strong position of Solvay and others, several reputable and substantial dealers and importers expressed a genuine interest in knowing more about Iceland's products when they become available.

40.1.15. The Product - The same remarks apply in Sweden as were mentioned in the Norway sections, except that more emphasis was placed on the 50 kg. plastic bags rather than on multi-wall paper bags for product packaging.

40.2. SODA ASH, 58%, LIGHT & DENSE GRADES

40.2.1. Manufacture - Soda ash is not manufactured in Sweden and all requirements are imported.

40.2.2. Exports - Exports are negligible, amounting to 26 m.t. in 1971.

40.2.3. Imports - Consumption of soda ash in Sweden has remained at reasonably constant levels in recent years as the record of imports show in APPENDIX V. In 1967, consumption was 122,500 m.t. and in 1971 it had climbed to 134,763 m.t. Imports in 1971 originated in the following countries:

COUNTRY	QUANTITY
France	47,434 m.t.
Great Britain	33,370 "
East Germany	31,006 "
West Germany	12,448 "
Poland	10,435 "
TOTAL(APPROX.)	134,763 m.t.

40.2.4. One large international dealer represents FMC Corporation in the USA for soda ash but has not made any sales. He concurred that the cif prices reflected in official statistics are factual and he also expressed the opinion that soda ash was in short-supply lately in Europe.

40.2.5. Uses - The glass manufacturers represent the largest single consumers as is usual in developed economies. One large glass manufacturer located near Göteberg recieves bulk shipments by boat from West Germany.

Like in Norway, the aluminium industry manufactures metal from imported alumina and hence is not a potential large consumer at this time. Other industries such as pulp and paper; chemicals; textiles; soap and detergents will account for most of the balance of soda ash consumed along with the numerous miscellaneous small users.

40.2.6. One large manufacturer of sodium phosphates can use in excess of 40,000 m.t. of soda ash per year although some of this consumption could be converted to caustic soda. As usual, this type of decision resolves itself around the various factors of delivered cost, dependability of continuous supply, product quality and competitive pressures. Because of some shortages in Europe, consideration has been given to arranging imports from the United States. It was suggested that Iceland would represent a good potential source of supply and they wished to be kept informed of developments.

40.2.7. Price - Reference to APPENDIX V will illustrate the pattern of prices in recent years and how the fluctuations reflected in cif prices to Sweden are merely following world pricing policies plus the added factor of transportation. The increases noted for 1971 are largely due to higher ocean freight costs and only in small measure to higher fob prices at producing plants.

40.2.8. Customs duties - Soda ash currently enters Sweden duty free.

40.2.9. Marketing - Distribution is along the same pattern as decribed for Norway with the dealers performing a valuable and necessary function. An interesting notion expressed by a large importer/exporter firm was the importance attached to "grass roots" selling by dealers which have competent sales forces; are knowledgeable of markets and consumers; have adequate warehousing facilities to serve their trade; represent reputable manufacturers and are assured of being able to supply high-quality products at all times. While Solvay has a marketing and business office in Sweden they rely on selected dealers to handle all sales and distribution.

40.2.10. The product - As already mentioned, both dense and light grades of soda ash are imported with the consumption of dense ash in Sweden probably running about 70% of the total. Deliveries to the glass companies are mostly in bulk as well as to the manufacturer of sodium phosphates where factories are located on navigable waters.

40.3. CAUSTIC SODA

40.3.1. Manufacture - Sweden has eight manufacturers of caustic soda and co-product chlorine with a combined annual productive capacity of about 500,000 m.t. of caustic soda, basis 100%, and 450,000 m.t. of chlorine. Seven of these plants are "captive" to pulp and paper mills which they serve with both co-products. The eighth chlor-alkali unit is integrated with a PVC petrochemical complex at Stenungsund. Actual out-put of liquid caustic soda, 50%, in 1971 was about 390,000 m.t., basis 100%. Several of the plants had recently installed facilities for expanded production but due to the slackness of demand from the pulp and paper industry caused by a world-wide industry recession, all available capacity was not put into operation. All production in Sweden is liquid 50% grade except for an extremely small quantity of special high purity solid 100% grade material.

40.3.2. An authoritative opinion was advanced by a representative of Swedish chlor-alkali manufacturers that production capacities will be planned so as to consistently produce at levels slightly below total market requirements and thus be generally in the favourable position of operating continuously at optimum capacity levels. Any shortages will be made up by imports.

40.3.3. All the eight chlor-alkali plants are consumers of high quality chemical grade salt for conversion in conventional electrolytic mercury type cells. The chlor-alkali industry currently uses about 600,000 m.t. of high purity salt per year.

40.3.4. Exports - Statistics show exports of caustic soda as follows on following page:

	In Metric Tons - basis 100% NaOH			
	Liquid, 50%		Solid & flake	
YEAR	QUANTITY	FOB US$	QUANTITY	FOB US$
1971	7,458	24.20	2,254	276.00
1970	16,915	20.90	2711	255.00

The exports of solid material are undoubtedly of the high purity caustic soda referred to in the previous paragraph no. 40.3.1. as the high fob price indicates that it must be a special high purity grade. The statistics in Sweden do not show countries of destination of exports.

40.3.5. Imports - With the present policy of manufacturers to manufacture less than total national requirements, Sweden will continue to be a potential importer of caustic soda 50%. The apparent consumption of caustic soda in Sweden in 1967 and 1971 was as follows:

	In Metric Tons - basis 100% NaOH			
	1967		1971	
	Liquid 50%	Solid	Liquid 50%	Solid
Domestic prodn.	300,000	-	390,000	-
Imports	8,228	8,198	34,012	7,923
	308,228	8,198	424,012	7,923
Less Exports	1,223	1,724	5,050	2,254
Apparent consumption	307,005	6,474	418,962	5,669

40.3.6. Imports originate principally from the following countries:

Liquid, 50%		Solid grade	
Belgium	- 46,718 m.t.	W.Germany	- 1667 m.t.
E.Germany	- 7,181 "	France	- 1521 "
Italy	- 7,059 "	Great Briatain	- 1337 "
Netherlands	- 7,015 "	Italy	- 854 "
Finland	- 2,415 "	Poland	- 787 "
		E.Germany	- 731 "

40.3.7. APPENDIX VI shows the pattern of importations since 1967 and the more or less consistent trend in cif prices, paralleling the performance applicable to Norway.

40.3.8. Uses - Manufacturers of pulp and paper are the largest users, followed by chemicals; petroleum refineries; textiles; soap and detergents; food processors and a multitude of miscellaneous smaller uses. The manufacturer of sodium phosphates may use as much as 20,000 m.t. per annum as a replacement for soda ash, as mentioned in the previous section (40.2.5.). The glass industry undoubtedly represents a potential growth market as the tendency, and technology, to replace conventional soda ash gains wider acceptance, especially as all soda ash is imported.

40.3.9. Price - Like most basic chemicals, prices of caustic soda remain at relatively stable levels although the manufacturers and dealers have undoubtedly taken advantage of the short-supply of solid caustic 50%. The record of tonnages and cif prices are shown on APPENDIX VI.

40.3.10 Customs duties - Sweden imposes duties on imports of caustic soda as follows:

Grade	Item No.	RATE OF DUTY
Solid,100%	2817.110	-5% from all countries on cif value, except
		-free from EFTA countries
		-free from underdeveloped countries
Liquid	2817.120	-4.5% from all countries on cif value, except
		-free from EFTA countries
		-free from underdeveloped countries

40.3.11. Marketing - Distribution of the domestically produced liquid caustic will follow the Norwegian pattern, with direct sales by manufacturers to large bulk consumers and a few selected large wholesalers which have bulk storage tankage for trans-shipment to smaller users in highway tankwagons. Imports of liquid caustic are probably arranged between manufacturers in the respective countries although some sales may be negotiated by dealers.

40.3.12. Sales of solid caustic soda grades which are imported are transacted by dealers. As is the case for calcium chloride and soda ash, the historic influence and aggressiveness ascribed to the Solvay organization appears to give them some real or imagined competitive advantages. Most of the dealers interviewed expressed confidence that markets for caustic soda would continue to grow at a steady pace consistent with past growth patterns.

40.3.13. The product - Flake grade caustic soda is packed in 50 kg. waterproof polyethylene bags or light-weight steel drums weighing about 50 kg. or 200 kg. Solid grade is always packed in metal containers, or drums, weighing about 325 kg. net.

40.4. CHLORINE, LIQUID

40.4.1. Manufacture - As mentioned previously, production of chlorine in eight electrolytic chlor-alkali plants in 1971 totalled 350,000 m.t. against an installed capacity of about 450,000 m.t. in 1972. Much of this production is used captively in the seven pulp mills with which they are integrated plus the adjacent PVC plant at Stenungsund started up in 1967. With a production of 77,500 m.t. of PVC resins in 1970 and with production still increasing, it is not surprising that several chlor-alkali plants have expanded capacities by over 100,000 m.t. in the years

1971-1972. In 1971, the PVC plants are reported to have consumed over 50,000 m.t. of chlorine.

40.4.2. Exports - Surplus production of chlorine to the extent of 7,161 m.t. in 1971 was exported to West and East Germany and Finland and in 1970 the total was 14,916 m.t. No information was obtained during interviews to account for these exports or how the material was transported.

40.4.3. Imports - The statistics show that Sweden has imported liquid chlorine in relatively small quantities in recent years:

In Metric Tons & US$/m.t. (cif)

	1969		1970		1971	
Country of Origin	Quant.	Value	Quant.	Value	Quant.	Value
Norway	937	46.80	420	47.25	NIL	-
Denmark	NIL	-	201	55.80	NIL	-
E.Germany	NIL	-	294	52.50	NIL	-
USA	NIL	-	NIL	NIL	2	97.00

40.4.4. The method of transportation between Sweden and Norway was undoubtedly in railway tankcars. The movement from Denmark to Sweden was probably by rail tankcars loaded on barges to cross the narrow channel separating the countries between Copenhagen, Denmark and Malmo, Sweden and adjacent manufacturing centres located nearby on both sides. The two tons from the USA must have been some special consignment packed in steel pressure cylinders.

40.4.5. The cif values for chlorine imports are interesting and generally appear to conform to realistic price schedules considering the quantities involved and further assuming that the transactions were probably negotiated as "accomodation sales" for the particular benefit of one or both parties. This would appear to be another example of the lengths manufacturers go to in order to dispose of surplus chlorine and maintain balanced productions. The prices exemplified above should not be construed as a guide on which prices for larger tonnage transactions could be gauged.

40.4.6 Uses - The largest single use is for chlorinating hydrocarbons and for the production of vinyl chloride resins. Other major uses in probable order of importance are pulp and paper bleaching; chemicals, including insecticides; pesticides and disinfectants; textile bleaching; scouring and dying; purification of water supplies; and many minor uses.

40.4.7. Price - Selling prices of chlorine in Sweden are largely determined by the manufacturing costs as such a large proportion of the total output is consumed in captive plants having the same or affiliated ownerships. These transactions are often a matter of book-keeping and the "transfer" prices are highly confidential. These consumptions for pulp and paper, chlorinated solvents and hydrocarbons and PVC manufacture account for a large proportion of chlorine sales. No meaningful information on prices was obtained in any of the interviews and none were expected.

40.4.8. Customs duties - Sweden imposes customs duties on imports of chlorine (item no.2801.200) as follows:

- -5.5% from all countries, on cif value, except
- -free from EFTA countries
- -free from underdeveloped countries.

40.4.9. Marketing - Distribution is according to normal trade channels as described for Norway and also as in several significant circumstances covered in this section on chlorine in Sweden.

40.4.10. The product - While most of the production is sold in bulk it is likely that several producers have special compressing equipment for filling steel pressure cylinders and ton containers for distribution to the smaller users. The price increments charged over the going price for bulk chlorine to cover the extra work performed for compressing, handling, shipping, warehousing, etc. is included in the higher selling prices for these packaged sales.

40.5. SALT

40.5.1. Manufacture - Salt is not produced in Sweden and all requirements are imported. Salt deposits are known to exist but at very low levels and it has so far not been economical or practical to develop them.

40.5.2. Exports - No exports are reported from Sweden.

40.5.3. Imports - Imports of the different grades of salt are shown in APPENDIX VIII along with the average cif prices. In the following summary table it will be noted that classifications differ from those reported for Norway. Imports, and assumably consumption, in 1967 and 1971, and the cif prices per m.t. shown in brackets, were as follows:

Grade of salt	Quantity imported in m.t.	
	1967	1971
Refined & vacuum pan	521,140 (US$ 12.00)	704,364 (US$ 11.85)
Table salt	N/A	11,376 (US$ 73.50)
Other grades	302,918 (US$ 8.55)	243,843 (US$ 10.60)

40.5.4. Imports in 1971 originated principally from the following countries. The cif prices per m.t. (shown in brackets) were reported as follows on next page:

Vacuum pan	Table salt	Other salt
Netherlands (US$ 11.06)	Netherlands (US$ 69.65)	W.Germany (US$ 10.86)
Great Britain (US$ 12.03)	Great Britain (US$ 80.51)	E.Germany (US$ 6.98)
W.Germany (US$ 16.49)	W.Germany (US$ 31.62)	Poland (US$ 10.28)
		France (US$ 12.80)

40.5.5. Uses - The major consumer of salt in Sweden is the chlor-alkali industry which uses about 600,000 m.t. per year at present levels of production. Most of this will be vacuum pan salt although some high quality chemical grade solar salt is produced in Spain and Italy. Very little salt is used in the fishing industry and any consumption will be sea salt plus small quantities of vacuum pan grade for salting herring. One large chemical manufacturer uses about 90,000 m.t. of rock salt for the manufacture of salt cake. The State Roads Department uses about 80,000 m.t. per year of rock salt which is imported from East Germany for ice control. Sea salt is not as satisfactory for this purpose, it was stated, as the contaminents in it make it too hygroscopic for use on roads. Other conventional consumers of salt will be manufacturers of chemicals; soaps and detergents; textiles; and food processing.

40.5.6. Price - Reference to APPENDIX VIII will show the trends of cif prices in Sweden and on world markets. Increased costs in 1971 and which are reportedly continuing into 1972 are attributed to higher costs of ocean transport which are eventually paid for by consumers everywhere. The average cif cost of vacuum pan salt reflected in the statistics is probably realistic although some sales are definitely made at slightly lower delivered cif costs.

40.5.7. One important factor which influences the ocean freight rates and hence the cif costs is the rate at which the salt can be loaded on and off the vessels. A loading rate of about 3,000 m.t. in 24 hours is generally considered to be desirable. Another factor is the ability of the shipper to provide vessels of a suitable capacity and size that are capable of delivering material at consumers docks which are sometimes located in relatively difficult sites and in narrow waterways. Factors of this nature are all inherent to the ultimate delivered costs and must therefore be minimized to the utmost extent.

40.5.8. Rock salt from East Germany is landed in southern Sweden at a very low cost because of the short time of

9 hours required for the water transport. Also, suitable vessels are available for this trade which in one instance, amounts to over 70,000 m.t. per year.

40.5.9. Customs duty - No duties are levied on salt imported to Sweden as "all chlorides and oxides, including magnesium chloride and metal salts" are duty free.

40.5.10. Marketing - Salt imports to Sweden are almost entirely in the hands of two large importers. One of these dealers represents the Akzo group with their own salt manufacturing operations in the Netherlands, West Germany and Denmark. The other is an independent importer. It is reported that the salt business is extremely competitive.

40.5.11. Contracts with consumers of salt are usually on a calendar year basis with negotiations starting in October for the following year's supply. Large consumers must be assured of adequate and satisfactory deliveries, as they require them, and must have confidence in the dealer and in his sources of supply. As a general rule, the dealers in Sweden, and elswhere, appear to have the responsibility for arranging vessels and delivery schedules and to be responsible for product quality.

40.5.12. The product - The vacuum pan salt used by the chlor-alkali industry must meet stiff specifications as certain impurities or contaminents can cause serious and costly problems in the electrolytic plants. The specifications adhered to by I.C.I. on vacuum pan salt produced at Liverpool, England, are as follows, on a dry basis:

NaCl	- 99.9%
Na_2SO_4	- 0.08
Soluble alkali as Na_2CO_3	- 0.01
Insoluble (max) as $CaCO_3$	- 0.01
Soluble calcium & magnesium cmpds.	- Traces.

41. **FINLAND**

Products, Production, Exports and Imports

Year 1971 - In Metric Tons

PRODUCT	PRODUCTION	EXPORTS	IMPORTS	CIF VALUE US$/M.T.
Calcium chloride,77-80%	72,000	NIL	12,365	50.65
Soda ash,58%	NIL	84	91,150	44.80
Caustic soda, basis 100%				
-solid & flake	16,000 (est.)	NIL	706	150.00
-liquid,50%	195,000	562	14,698	63.40
Chlorine, liquid	190,000	NIL	1	33.80
Salt, all grades	NIL	NIL	470,766	11.30
Potassium chloride,60-62%	NIL	NIL	230,694	31.00
Bromine, including other halogens except chlorine	NIL	NIL	13.4	-
Lithium compounds, including rare earth and alkali earth metals.	NIL	NIL	18.3	192.00

41.1. CALCIUM CHLORIDE, FLAKE, 77-80%

41.1.1. Manufacture - Unlike Norway but similar to Sweden, manufacture of calcium chloride in Finland is achieved by using the by-product hydrochloric acid resulting from the manufacture of salt cake. The hydrochloric acid is reacted with lime to produce calcium chloride. As in Sweden, the salt cake is used in the kraft cooking liquors for the pulp and paper industry. The sole manufacturer of calcium chloride in Finland is the largest manufacturer of chemicals, Rikki Happo Oy, with annual production of about 72,000 m.t. per annum. It was stated that there are no plans to increase productive capacity unless increased urgent demands for more salt cake arise.

41.1.2. Exports - As Finland is an importer of calcium chloride as well as a manufacturer there is no need to export and the statistics bear this out.

41.1.3. Imports - Reference to APPENDIX IV will show the trend of imports since 1967 which are necessary to supplement domestic production to meet the total demand. Apparent consumptions in 1967 and 1971 were as follows:

	In Metric Tons	
	1967	1971
Domestic production	72,000	72,000
Imports	22,755	12,365
Apparent consumption	94,755	84,365

41.1.4. Imports originated pricipally from Solvay in Belgium with much less coming from West Germany. It is expected that imports will continue at more or less current levels for the foreseeable future.

41.1.5. Uses - The pattern of consumption in Finland differs somewhat to that prevailing in Norway and Sweden, where slightly over 50% of the apparent consumption is used by the State Roads Department. In Finland, about 70% is used for state roads and relatively much less is consumed for such conventional purposes as de-icing; brine refrigeration; concrete treatment; tire weighting and chemical manufacture.

41.1.6. The Department of Roads in Finland used 62,150 m.t. of flake calcium chloride for dust control in 1971. None is used by them for de-icing as it is considered too costly. In 1972 they have budgeted for 64,000 m.t. which is their approved quota. Rikki Happo Oy is the supplier and guarantees to deliver at least 60,000 m.t. Any requirements which they may be unable to supply from domestic production must be made up by purchases of imported material.

41.1.7. Consumption of calcium chloride for dust control, only for roads under State authority, has averaged close to 60,000 m.t. per year over the past decade. There are 70,000 km. of roads in Finland and 28,000 km. are hardtop. The State has taken over gravel roads from many communities, hence while this offers a tendency for the use of more calcium chloride, there is continually more hardtop being installed. More traffic on the gravel roads, however, increases the need for more dust-control applications of chemical. The cities and individual communities look after their own requirements for dust control and de-icing.

41.1.8. The Roads Department purchases all flake calcium chloride in 50 kg. waterproof multiwall paper bags which are bitumen treated on the outer surface. No metal drums are used because of difficulty in handling and storage. All supplies of flake material are stored at strategic storage depots around the country for application as required and expenses incidental to storage are the responsiblity of the Roads Department. They have had no experience with the use of magnesium chloride as a substitute for calcium chloride.

41.1.9. The Roads Department uses some calcium chloride as liquid which they prepare themselves by dissolving the flake in water. Liquid application is common in certain parts of the United States, especially in areas within a radius of no more than about 300 miles from manufacturers' plants. Because of freight costs, solutions are considered to be a "backyard" business. A 34% liquid is commonly used for dust control treatment although solutions with as high as 55% $CaCl_2$ have been used in the United States.

41.1.10. Price - The trend of cif prices in recent years is shown on APPENDIX IV and reflects the same general trends as those prevailing elsewhere and can be considered as realistic for the purposes of this Survey. The current price for flake material being sold by the manufacturer to the Department of Roads is reported to be FM. 179, equivalent to US$ 44.75 per m.t., fob works, in bags, loaded on cars or trucks. In the few instances where bulk deliveries are taken from the works, the price is reduced FM.10 or about US$ 2.50 per m.t. On any sales made by importers to the Roads Department, delivered prices are invariably based on the contract prices of the manufacturer plus freight to designated points of delivery, generally located at distant places so that delivered costs will approximate those which would have resulted had the manufacturer made the delivery.

41.1.11. The question of production in Europe and the effect which enforcement of rigid pollution control laws would have on calcium chloride pricing was discussed at Rikki Happo Oy and the attitude was that over-production and lower prices seemed inevitable.

41.1.12. Customs duty - There are no customs duty imposed on imports of calcium chloride to Finland.

41.1.13. Marketing - The pattern of distribution through dealers for the general trade parallels the practice in other countries with the sole manufacturer in this case reserving the right to deal directly with the large volume buyers.

41.1.14. Rikki Happo Oy is currently negotiating with Boliden AB in Sweden for the purchase of excess supplies which are temporarily available there. When Boliden were interviewed later it was learned that stocks of about 20,000 m.t. had been built up and that disposal, even at a sacrifice price may become necessary in the near future.

41.1.15. The product - No new ideas were forthcoming from interviews here.

41.2. SODA ASH, 58%, LIGHT & DENSE GRADES

41.2.1. Manufacture - No soda ash is produced in Finland and all requirements are imported.

41.2.2. Exports - The statistics show exports in 1971 of 84 m.t. but this is probably an isolated instance and is not relevant to this Survey.

41.2.3. Imports - Consumption of soda ash in Finland increased steadily in recent years as shown in APPENDIX V. In 1967 it was 57,869 m.t. and by 1971 the total was 91,150 m.t. Imports originated in the following countries: Poland, France, East Germany, U.S.S.R., U.K. and West Germany.

41.2.4. Uses - The consumption pattern in Finland follows traditional experience in the manufacture of glass; chemicals; pulp and paper; textiles; soap and detergents and numerous miscellaneous uses.

41.2.5. Price - As recorded in APPENDIX V the trend of cif prices follows the patterns of other countries except perhaps at slightly lower levels. It is possible that some sales are transacted on a barter basis between Eastern bloc countries because of currency problems and by Western standards the statistical figures may not be exactly comparable.

41.2.6. Customs duty - No customs duty is imposed on imports of soda ash to Finland.

41.2.7. Marketing - There are several large and influential importers in Finland which handle a large share of chemical products, and represent such well-known firms as Solvay and Akzo. Certain manufacturers may import directly from foreign producers but it is probable that the greater amount of chemical importations are handled through established importers and dealers.

41.2.8. The product - As in other countries, soda ash is supplied in 50 kg. waterproof plastic or multiwall paper bags and the large consumers such as the glass manufacturers take deliveries in bulk in order to realize lower delivered costs.

41.3. CAUSTIC SODA

41.3.1. Manufacture - There are three producers of caustic soda and chlorine in Finland using the electrolytic process. Production in 1971 was as follows on next page:

	Metric tons, basis 100%
Caustic soda, liquid 50%	195,000
" " , solid 100%	16,000 (est.)
Chlorine, liquid.	190,000

41.3.2. Vacuum pan salt for these three plants is imported from Belgium and the Netherlands, with current imports in 1972 amounting to about 335,000 m.t. This takes into consideration the expanded manufacturing capacity coming into operation this year at one of the plants.

41.3.3. Exports - Finland is currently "short" on supplies of caustic soda and "long" on chlorine and virtually no caustic soda is exported except for 562 m.t. of liquid 50% in 1971. No exports of solid or flake grades were reported.

41.3.4. Imports - As shown on APPENDIX VI, Finland is a consistent importer of both liquid and solid grades. It is interesting to note that imports of solid grades decreased markedly in 1971, probably because of the advent of new domestic production of solid grades in one of the three manufacturing plants. Apparent consumption of caustic soda in 1967 and 1971 were approximately as follows on following page:

	In Metric Tons, basis 100% NaOH			
	1967		1971	
	Liquid, 50%	Solid	Liquid, 50%	Solid
Domestic production	170,000 (est.)	10,000 (est.)	195,000	16,000
Imports	2,043	5,399	14,698	706
Apparent consumption	172,043	15,399	209,698	16,706

41.3.5. Imports originate principally from the following countries:

Liquid, 50%	Solid & flake
Belgium	Spain
Great Britain	France
	Great Britain

41.3.6. Uses - The pulp and paper industry is the largest consumer of liquid caustic soda, followed by chemical manufacturing; petroleum refining; textiles; food processing and many miscellaneous smaller uses. One of the largest chemical importers expects growth in basic chemicals such as salt, soda ash and caustic soda to increase at a rate of 3 to 5% per year.

41.3.7. Price - The only reference to prices that are available are contained in the statistical records as shown in APPENDIX VI. As is the pattern in the other Scandinavian countries, the cif prices remain fairly constant except for the noticeable increase in 1971, undoubtedly due to increases in transportation cost everywhere. The large increase of over 50% for solid grades in 1971 is also evident, but explainable, as much of the imports come from Western Europe and the U.K.

41.3.8. Customs duty - No duties are imposed on imports of caustic soda to Finland.

41.3.9. Marketing - The same pattern of marketing and distribution is followed in Finland as in Scandinavia and Europe and no exceptional differences were discovered. A large percentage of the caustic soda is used captively by adjacent pulp mills.

41.3.10. The product - No significant comments.

41.4. CHLORINE

41.4.1. Manufacture - The tree electrolytic chlor-alkali plants in Finland have a combined annual output of chlorine of about 190,000 m.t. at the present time. Rate of production is largely corelated to the levels of production of the pulp and paper industry.

41.4.2. Exports - No exports of chlorine were reported from Finland in 1971.

41.4.3. Imports - Imports are infinitismal in 197[illegible], with 1 m.t. being reported. Chlorine is generally in an over-supply position just now as the pulp and paper industry is suffering a period of recession and is just beginning to show some signs of recovery.

41.4.4. Uses - Same general pattern as in other countries, namely: pulp and paper; chlorinated solvents and hydrocar-[illegible], chemicals; water purification and numerous miscellaneous small uses.

41.4.5. Price - No price information is available and is not a factor of significance to this Survey.

41.4.6. Customs duty - No customs duties are imposed on imports of chlorine to Finland.

41.4.7. Marketing - The problems and methods of distribution are reported to be the same here as elsewhere.

41.4.8. The product - No significant differences from other countries surveyed.

41.5. SALT

41.5.1. Manufacture - There is no salt produced in [illegible]and and all requirements must be imported.

41.5.2. Exports - No exports of salt are reported from Finland.

41.5.3. Imports - All imports of salt to Finland are grouped for statistical purposes into one category so it is impossible to determine the quantities of the various grades used without extensive investigation. The trend of salt imports and cif prices is shown in APPENDIX VIII.

Consumption as represented by imports in 1967 and 1971 and corresponding average cif prices are reported as follows:

Year	Imports	Av. cif prices
1967	352,343 m.t.	US$ 6.70
1971	470,766 m.t.	US$ 11.30

41.5.4. Imports in 1970, and with a similar pattern being followed in 1971, originated principally from the following countries and are listed along with corresponding individual cif costs:

Country	Probable grade	Imports m.t.	Av.cif costs US$ / m.t.
Netherlands	Vac. pan	246,580	10.70
E.Germany	Rock	82,899	8.00
Gr.Britain	Vac. pan	51,430	10.65
Poland	Vac. pan	36,331	11.60
U.S.S.R.	Rock	30,898	6.60
Tunisia	Sea	20,683	12.55
France	Vac. pan	13,968	11.30

41.5.5. Uses - As in most countries surveyed, the largest single consumer of vacuum pan salt, because of its uniformly high purity, is the chlor-alkali industry, accounting for about 335,000 m.t. in 1971. Most of this salt comes from the Netherlands. Consumption will increase as soon as the demand for chemicls from the pulp and paper industry starts to regain normal production levels. Some 90,000 m.t. of rock salt is consumed by the large manufacturer of salt cake and again, as in Sweden, the State Roads Department used about 20,000 m.t. of rock salt on the roads, usually mixed with sand for maximum effectiveness. They have investigated the use of vacuum pan salt for ice control but discarded the idea because of high cost.

41.5.6. Price - The only meaningful information on prices gathered during interviews in Finland came from the Central Statistics Bureau and these "average" figures, as shown on APPENDIX VIII are useful only as a guide. The average cif prices shown above in the paragraph on imports (41.5.4.) are however, indicative of actual delivered costs of the various products from different countries and follow patterns existing in other countries.

41.5.7. Customs duty - No duties are assessed on imports of salt to Finland.

41.5.8. Marketing - The few large dealers apparently handle the imports and supply of salt to the large chemical manufacturers. One of the most prominent importers represents the Akzo group and reportedly handles a large share of the business.

41.5.9. The product - In several interviews in Finland considerable emphasis was expressed on the importance of high purity vacuum pan salt. Uniformly high quality and low moisture content is also important in the rock salt being imported to both Sweden and Finland for the manufacture of chemicals. Rock salt from East and West Germany is apparently preferred over the Polish material which is not quite as acceptable.

41.5.10. It was learned that Poland has announced a new vacuum pan salt project with an initial annual capacity of 150,000 - 200,000 m.t. and this will increase to 900,000 m.t. by 1980. This is another example of the increasing demands for salt in world markets and a further reminder of the competitive pressures which will prevail in the industry for many years to come.

42.

DENMARK

Products, Production, Exports and Imports

Year 1971 - In Metric Tons

PRODUCT	PRODUCTION	EXPORTS	IMPORTS	CIF VALUE US$/M.T.
Calcium chloride,77-80%	NIL	37	3,409	56.35
Soda ash,58%	NIL	61	68,970	47.20
Caustic soda, 100%				
- solid and flake	NIL	2,019	9,453	137.80
- liquid,50%	12,300	150	19,315	69.20
Chlorine,liquid	11,000	690	3	84.00
Salt - refined & vac.pan	275,000	8,532	-	-
- other salt	NIL	NIL	133,853	13.50
Potassium chloride,60-62%	NIL	NIL	252,345	36.40
Bromine	NIL	NIL	100	N/A
Bromine compounds	NIL	NIL	1) 134	790.00
Lithium compounds, including rare earths and alkaline earth metals.	NIL	NIL	1	335.00

NOTE: 1) Imports of 134 m.t. includes the 100 m.t. of Bromine.

42.1. CALCIUM CHLORIDE, FLAKE, 77-80%

42.1.1. Manufacture - There is no standard calcium chloride flake, 77-80% grade, or soda ash, manufactured in Denmark and all requirements are imported.

42.1.2. Exports - Statistics report exports of 37 m.t. in 1971 which are insignificant although important to Greenland and the Faeroe Islands to where 26 m.t. were destined. This quantity represents the combined consumption of these two Dependencies.

42.1.3. Imports - Imports, which presumably reflect consumption of calcium chloride in 1971 of 3,409 m.t., show a temporary decline over average annual imports of 8,000 to 10,000 in previous years as depicted in APPENDIX IV. The imports originate principally in Belgium, West Germany, France and with minor "accomodation" lots from Sweden. The opinion was expressed by several reputable dealers that imports will soon return to more normal levels.

42.1.4. Uses - Most of the roads and highways in Denmark are hardtop and only monor quantities of calcium chloride are used for dust control. The principal consumption is for de-icing in winter. The winters of 1971 and 1972 have been moderate and the lessened use of calcium chloride for de-icing was quickly reflected in lowered imports. There is some public agitation against the use of calcium chloride for de-icing because of the pollution caused by the run-off.

Sometimes a mixture of calcium chloride and urea is used for ice control but this is expensive compared with salt which is the cheapest of all and accounts for about 90% of the chemicals used for this purpose. Urea is being used in greater quantities for ice control on airport runways and at military establishments and, in all, about 1,000 m.t. is being used per annum.

42.1.5. It is evident from interviews and statistics that the other traditional uses for calcium chloride are of minor importance in Denmark.

42.1.6. Prices - The trend of cif prices on imports as shown on APPENDIX IV shows a similarity with other Scandinavian countries although the average price levels are higher. This is explainable by the absence of any large buyer such as the State Roads Departments in Norway, Sweden and Finland and the fact that sales are made through dealers which import in relatively small lots.

42.1.7. Customs duty - No customs duty is imposed on imports of calcium chloride to Denmark.

42.1.8. Marketing - The material marketed in Denmark comes almost entirely from Solvay in Belgium and is distributed by the dealers though their warehouses. The several dealers interviewed appeared to be substantial and aggressive and expressed an interst in knowing more about the projected manufacture in Iceland, as, if and when it becomes a reality.

42.1.9. <u>The product</u> - The product is all sold in uniform packages as supplied by Solvay and other recognized producers.

42.2. <u>SODA ASH, 58%</u>

42.2.1. <u>Manufacture</u> - No soda ash is manufactured in Denmark and all consumption is of imported material. With the presence of abundant supplies of rock salt in Denmark which can be used as raw material, it is most likely that domestic consumption of soda ash will soon reach the point where a Solvay type manufacturing operation, or some modification thereof, can be justified. The obvious reasons against this happening however, are the problems of disposing of co-product calcium chloride, already in great over-supply and the very real threat of natural soda ash being able to penetrate markets in Europe. At a sea-coast location it may be possible to dump the calcium wastes back into the sea. This is definitely a contentious issue between the Solvay and Akzo groups and resolution of it will undoubtedly be forthcoming in the foreseeable future.

42.2.2. <u>Exports</u> - Statistics show that 61 m.t. of soda ash were exported in 1971. Of this total the Faeroe Islands received 7 m.t. and Greenland 22 m.t.

42.2.3. <u>Imports</u> - Total imports, and presumably apparent consumption in Denmark in 1971, were 68,970 m.t. as published in statistics as shown on APPENDIX V. In 1967 the imports were 39,952 and have increased at a steady rate every year since. The imports come essentially from France, West Germany, Poland and U.K.

42.2.4. Uses - Apart from the glass industry there are not any other major consumers in Denmark so that usual channels of distribution will be to the industries which manufacture chemicals; soap and detergents; textiles and miscellaneous smaller users.

42.2.5. Price - The trend of cif prices as shown in APPENDIX V is comparable with the other countries surveyed. No specific price information was divulged during interviews, except as noted hereunder and of minor consequence. As found elsewhere there is a reluctance to reveal prices but actually this Survey is only interested in cif prices. Also, Denmark is not a logical market for Iceland's soda ash.

42.2.6. Customs duty - Soda ash enters Denmark free of duty at the present time. Membership by Denmark in the E.E.C. may bring changes, of course.

42.2.7. Marketing - One large dealer interviewed reported imports of about 15,000 m.t. per year of light grade soda ash from West Germany and Poland. These sources are unable to supply dense grade material to Denmark at competitive prices.

42.2.8. The product - Some so-called "free-flowing" soda ash has been imported by one dealer for un-loading by air pressure. It was supplied in 3 - container wagons and transported by ship. Each container held about 8 m.t. and the lot of three netted about 25 m.t. Their experience with this method of delivery was of doubtful value as the actual delivered cost was about equal to the conventional 50 kg. bags.

42.3. CAUSTIC SODA, BASIS 100%

42.3.1. Manufacture - Denmark has one chlor-alkali manufacturer producing in 1971 at the rate of 12,300 m.t. of liquid chlorine. This production, especially of caustic soda, is well below the total domestic requirements. Production is carried out in 16 Krebs mercury type electrolytic cells in a plant at Copenhagen.

42.3.2. Dansk Sojakagefabrik was founded originally on the basis of a business which hydrogenated vegetable oils such as soya, copra, etc. In order to obtain a captive source of hydrogen it was decided in 1936 to install an electrolytic caustic soda/chlorine plant which produced hydrogen as a by-product, or waste product, to the two main co-products. Previously the supply of hydrogen was obtained by the electrolysis of water, a process which is more costly than electrolysing salt and selling three products instead of one. This company is a wholly-owned subsidiary of the East Asiatic Company.

42.3.3. If more sales outlets could be found for chlorine it would undoubtedly be feasible to expand this plant because caustic soda is presently in great demand. This chlor-alkali plant is the second largest consumer of salt in Denmark, accounting for about 25,000 m.t. per year.

42.3.4. Exports - Statistics reveal exports in 1971 of caustic soda, 100% basis, as follows:

Liquid, 50%	-	150 m.t.
Solid & flake, 100%	-	2,019 m.t.

Shipments of solid and flake grades to Faeroe Islands in 1971 totalled 71 m.t. and to Greenland only 6 m.t., in both cases being material imported from other countries.

42.3.5. Imports - As domestic production is insufficient to meet requirements, considerable importations of liquid and solid grades are essential, as illustrated in this tabulation:

	In Metric Tons-basis 100% NaOH			
	1967		1971	
	Liquid, 50%	Solid	Liquid, 50%	Solid
Domestic production	12,300	NIL	12,300	NIL
Imports	11,697	9,053	19,315	9,453
	23,997	9,053	31,615	9,453
Less exports	1	25	150	2,019
Apparent consumption	23,996	9,028	31,465	7,434

42.3.6. Uses - Consumption of caustic soda is for conventional purposes with no large single outlets. Major users are the oil refineries; textiles and dyeing; soaps and detergents; food industry and many small consumers.

42.3.7. Price - The price trends, here again, follow the established patterns in the other Scandinavian countries, as depicted in APPENDIX VI. A combination of domestically produced material and importations from neighbouring countries contribute to uniformity of delivered prices at points of consumption.

42.3.8. Customs duty - Caustic soda may be imported to Denmark free of duty at the present time.

42.3.9. Marketing - In the absence of many large individual buyers it is inevitable that most of the business is handled through dealers. The single manufacturer of liquid 50% grade undoubtedly sells the bulk of the output in tankcars to the larger consumers, but a portion of it is detailed in smaller quantities through dealer warehouses. Distribution of imported solid and flake grades will follow the same lines as for calcium chloride and soda ash.

42.3.10. The product - As commercial chemicals of international trade, the characteristics of the products and packaging are essentially the same as prevail elsewhere.

42.4. CHLORINE

42.4.1. Manufacture - The sole manufacturer in Denmark, Dansk Sojakagefabrik in Copenhagen, as described in the preceeding section dealing with caustic soda, produces 11,000 m.t. per annum. Of this amount, 7,000 m.t. is sold on the open market and the balance is used for captive purposes including the manufacture of hydrochloric acid and bleaching chemicals such as sodium hypochlorite bleach, both solid and liquid grades.

42.4.2. Permission to install additional manufacturing facilities for expanded production may pose serious problems. Government and municipal authorities are becoming increasingly more conscious of environmental pollution from chemical plant effluents and the incipient dangers inherent to the storage and transportation of so-called hazardous or poisonous chemical products. This particular plant is located in an industrial area of Copenhagen and already the day-to-day operations are being affected by the application of by-laws which have, as elsewhere, every prospect of becoming ever more rigid. For instance, it was learned that regulations are in effect which limit on-site storage of chlorine at the plant to no more than 200 m.t. at one time, the equivalent of one week's production, because of the danger factor.

42.4.3. Exports - While the short supply situation on caustic soda continues in Europe and neighbouring countries, the situation with respect to chlorine is just the contrary. With a domestic production of only 11,000 m.t., and with

4,000 m.t. used captively by the producer, the fact remains that a country the size of Denmark has problems at this time of disposing of 7,000 m.t. a year. Exports in 1971 totalled 690 m.t. and included sales to Iceland in steel cylinders of 72.5 m.t. and 2 m.t. to Faeroe Islands. Other shipments went to Sweden and West Germany.

42.4.4. Imports - For reasons given in the foregoing paragraph, imports to Denmark of chlorine are unnecessary. The official statistics reproduced on APPENDIX VII show imports of only 3 m.t. in 1971, although in 1967 there were 529 m.t. imported.

42.4.5. Uses - No specific consumers of chlorine were interviewed and distribution is widespread over a number of relatively small consumers for use in bleaching; water treatment; chemical manufacturing; and miscellaneous small users.

42.4.6. Price - Because of the general over-supply situation on chlorine the selling prices in Denmark, as elsewhere, are somewhat depressed. In 1970 some Danish chlorine was exported to Germany at an fob price of US$ 65.50 per m.t. On sales at the present time this price has deteriorated to US$ 43.70 per m.t. This is a dramatic example of the supply /demand situation which more or less always plagues manufacturers of chlorine and caustic soda. Similar problems of balancing productions and reconciling prices in international trade also continually confront manufacturers of soda ash and calcium chloride using the Solvay process.

42.4.7. Customs duty - Chlorine is the only projected chemical product surveyed on which Denmark currently imposes a duty. The rate is 8 øre per kg. equivalent to US$ 10.70 per m.t. Imports from EFTA countries are duty free.

42.4.8. Marketing - Sales of chlorine in tankcars are made directly by the manufacturer to the consumer, either for domestic or export destinations. A minor proportion of the 7,000 m.t. of chlorine available for merchant sales is packaged in steel pressure cylinders for distribution by dealers to various small consumers. Danish chlorine is already being supplied, through a dealer, to Iceland and in 1971 the imports were 72.5 m.t., in cylinders.

42.4.9. When the hypothetical question of potential imports of Icelandic chlorine to Denmark was raised the answer was negative. Situations were visualized whereby Denmark may in future require considerable quantities of chlorine without corresponding amounts of caustic soda, and rather than the manufacturer constructing new capacity it was suggested that imports from Iceland might prove very acceptable. The reply clearly indicated the probability that in such an event the demand would be served somehow by a domestic manufacturer.

42.4.10. The product - Chlorine gas as manufactured in a modern electrolytic chlor-alkali plant is of high purity when liquified for shipment and invariably meets acceptable standards.

42.5. SALT

42.5.1. Manufacture - Production of vacuum pan salt in Denmark by Dansk Salt I/S at Mariager in 1971 was reported below full capacity of 275,000 m.t. and it is understood that plans are being made by the Akzo owners to increase this output to meet increasing demands in international trade. The plant in Jutland already produces in excess of the domestic demand for vacuum pan salt. One report in Sweden indicated that Danish salt carried a rather higher content of potassium chloride than could be tolerated for some purposes.

42.5.2. Exports - Official statistics show that 8,532 m.t. of salt were exported in 1971 and this quantity will undoubtedly increase in 1972 and future years as this production in Denmark only became fully operational in 1971. Of the 8,532 m.t. exported, 5,600 m.t. of this was destined for Sweden. Norway is another important market for Danish vacuum pan salt.

42.5.3. Imports - Published statistics indicate importations of "other salt" in 1971 of 133,853 m.t. comprising rock salt, sea salt and table salt. These imports originated mostly from West Germany, Poland, East Germany and

U.S.S.R. Only minor quantities of sea salt from Spain and Italy are imported. Reference to APPENDIX VIII will show the trends of imports and cif prices since 1967 and illustrate the impact in 1971 of the emergence of domestic production.

42.5.4. Uses - The single chlor-alkali manufacturer consumes about 25,000 m.t. per annum of vacuum pan salt. Imports from Israel were tried at one time but were discontinued because of the high percentage of bromine impurity which was not compatible with the electrolytic process and other chemical applications. Rock salt from West and East Germany is used on the roads for ice control, sometimes mixed with urea in a 90 - 10% ratio.

42.5.5. Price - No specific price information was obtained in the interviews and the only reliable background is in the published statistics as shown in APPENDIX VIII.

42.5.6. Customs duty - No duties are assessed on imports of salt to Denmark at the present time. Their probable association with the E.E.C. may cause some changes for Iceland.

42.5.7. Marketing - There are two large and reputable salt importers in Denmark that handle the special requirements of the smaller industries such as chemical manufacturers; food processors; textile scouring and dyeing; de-icing; etc. These importers distribute salt and other similar basic chemicals in Denmark and at least one of them is also engaged in exporting chemicals to other countries, including Iceland.

42.5.8. Profit margins on the manufacture of salt, whether solar sea salt, refined salt, vacuum pan salt or rock salt are minimal at today's highly competitive price levels. It is a high-volume, low-price business and, as the interviews progressed, it became increasingly evident that any hope of making profits in international trade depended on the ability of the traders to provide suitable vessels and to negotiate reasonable freight rates which would enable deliveries to be made at lowest possible cif costs. In other words, any estimated margins of profit can be quickly dissipitated in the shipping and proper handling of this function is the key to making even modest profits on the sale of salt itself.

42.5.9. The product - Quality of product is a most important consideration in international trade of salt. A manufacturer or dealer can easily lose large accounts if quality and grade fail to be consistent with agreed specifications. Great care must be exercised in shipping to prevent contamination en route and the general practice is to carefully line the holds of vessels with plastic membranes. In many instances the salt is a chemical raw material entering into the manufacture of numerous products which are produced to exacting specifications and are processed in plants where contaminents usually cause operating problems which are both inconvenient and costly.

SALT - FAEROE ISLANDS

42.5.10. Introduction - The largest industry by far in the Faeroe Islands is fishing and fishery salt represents a major import. While this section will deal primarily with salt, the other imports of chemicals are also listed for comparison:

Product	Quantity m.t.	Value D.Kr('000)	Cif Value US$ / m.t.
Salt - fishery	17,695	1644	12.50
- table	134	76	76.00
Caustic soda			
- solid & flake	71	100	188.00
Chlorine	2	5	346.00
Calcium chloride	15	13	166.00
Soda ash	7	7	134.00

42.5.11. Imports - Salt is purchased from the Mediterranean solar salt operations in Spain. Table and other salt is imported from Denmark. Several salt importers in the Faeroe Islands handle the salt trade. The various other chemicals listed are also imported from Denmark.

42.5.12. Price - Except for salt, the delivered prices of the other chemicals are unusually high but this is due to the very small quantities which makes the costs of handling and transportation out of proportion to the actual European prices for the goods. This potential market for Iceland salt is a natural and logical development when the Sea Chemicals Project becomes operational.

SALT - GREENLAND

42.5.13. Introduction - The Royal Greenland Trade Corporation in Copenhagen purchases the salt and other requirements of chemicals and arranges transportation to destinations in Greenland. As will be seen in the following tabulation, salt is the most important chemical consumed as the fishing industry is one of the major occupations.

Product	Quantity m.t.	Value D.Kr('000)	Cif Value US$ / m.t.)
Salt - fishery	4099	809	19.50
- table	432	221	68.40
Caustic soda			
- solid & flake	6	14	313.00
Calcium chloride	11	13	157.00
Soda ash	22	26	157.00

42.5.14. Imports - The preferred source of fishery salt is sea salt from Spain, used essentially for salting cod. Spain is apparently undergoing serious problems with supply as adverse weather conditions have curtailed production. Spain's exports of sea salt in 1972 are greatly reduced and Greenland will not be able to secure supplies this year. They have about a year's supply on hand in Greenland and this is expected to be sufficient for 1972 requirements. They do not wish to purchase elsewhere, say from Italy, as the fish processors are most reluctant to mix Italian salt, or any other, with Spanish salt for fear of contamination and a deleterious effect on the salting operation. Spain is reportedly buying 200,000 m.t. of salt from Italy this year to alleviate some of their supply problems.

42.5.15. Price - As mentioned for the Faeroe Islands, the delivered costs of salt and other chemicals are excessively high, but understandable, because of geography and economics of transportation and handling. This Greenland market will represent another prime objective for Iceland's salt and other chemicals when the time comes.

43. WEST GERMANY

Products, Production, Exports and Imports

Year 1971 - In Metric Tons

PRODUCT	PRODUCTION	EXPORTS	IMPORTS	CIF VALUE US$/M.T.
Calcium chloride	N/A	N/A	N/A	N/A
Soda ash, 58%	1,334,117	59,169 (fob US$ 44.80)	55,999	48.85
Caustic soda, 100%	1,681,696			
- solid and flake	-	N/A	114,745	125.50
- liquid, 50%	-	N/A	123,497	47.20
Chlorine, liquid	1,726,403	N/A	99,873	49.70
Salt - vac.pan	N/A	N/A	337,743	6.25
- rock salt	9,187,000	N/A	N/A	-
- sea salt	746,000	230	210	11.65
- human	N/A	442,467	10,988	27.80
- other	N/A	N/A	34,413	11.45
Potassium chloride, 60-62%	1,863,000	1,360,154 (fob US$ 30.50)	34,123	34.40
Bromine	3,000 (est.)	366 (fob US$ 545.00)	1,046	425.00
Lithium compounds	N/A	N/A	N/A	N/A

NOTE: Reference to APPENDIX IV to XI will give historical trends for these 1971 statistics over period 1967 - 1971.

43.1. Introduction - All the chemicals proposed for production in Iceland are produced in much greater quantities in West Germany, using extensive reserves of salt and potash. Iceland, therefore, does not pose any serious threat to Germany's products and certainly cannot expect to ship significant imports of any of its products with the possible exception of bromine and lithium compounds. These two chemicals are in growing demand in West Germany as their manufacturing position for them is not entirely favourable.

43.2. Interest in this market is two-fold: a) because of the large manufacturing and consumption positions with respect to domestic and international trade in these basic products, conditions and trends of manufacturing and marketing have a great influence on world prices and trade. Some knowledge of this market and an appreciation of the influence it exerts on others is imperative. And b), because of the large number of very well established and aggressive trading firms with far-flung international markets it is entirely probably that one or several may be anxious to market some of Iceland's projected chemicals. Their intimate knowledge of marketing conditions in Europe and around the world was very useful for the purposes of this Survey.

43.3. As West Germany is definitely not a significant potential market for Iceland, only details which are pertinent to this Survey will be mentioned. The historical statistics shown in APPENDICES IV to XI are for reference purposes. In this section on West Germany and for the Netherlands, Belgium and the U.K. which follow, only scant mention is made of potassium chloride, bromine and lithium compounds. The three products will be treated separately in more detail later on.

43.4. Calcium chloride & Soda ash - These two basic chemicals are mostly, but not entirely, produced in Germany as co-products of Solvay type plants. Other manufacturing processes produce them singly in West Germany. Calcium chloride production is potentially available from Solvay type plants in relatively large quantities and greatly in excess of available market capacities, especially if productions from similar plants in Belgium and France are considered. It has been stated that only about 25% of the calcium chloride which could be produced as a finished product in Europe ever reaches the market and that the raw brines containing the balance are discarded as waste. It is these calcium ion wastes which are arousing irate public opinion because of environmental pollution. Should the manufacturers decide or be forced to recover this waste, the resulting amount of calcium chloride would glut the markets of the world and present pricing policies would crumble.

43.5. Caustic soda & Chlorine - These two co-products are manufactured in great quantities using domestic salt deposits as the source of raw material brine. Two huge new installations are scheduled to come into production in late 1972 at Stade, near Hamburg, each with a designed capacity of about 200,000 m.t. per annum. The chlorine component will be used essentially for the manufacture of chlorinated solvents and vinyl chloride in Europe. The caustic from the Dow Chemical unit will go largely to the expanding aluminium industry in Europe and that from the Alusuisse unit will be shipped mostly to their new aluminium reduction plant in Australia. These instances are mentioned to illustrate the magnitude of the chlor-alkali operations in Germany and their ability to manufacture and trade on world markets in salt-based chemicals and the secondary products such as solvents, plastics, chemicals,etc.

43.6. Salt - West Germany, as well as East Germany, is endowed with abundant reserves of rock salt and these serve as low-cost raw materials for their extensive salt-based chemical and allied industries. The limited imports are therefore only mediums of trade and any internal consumption of them depends on low delivered costs which can at least meet domestic competitive delivered prices. A sizeable quantity of sea salt is produced by solar evaporation, totaling 746,000 m.t. in 1971.

43.7. Potassium chloride - West Germany has a long historic position in world trade in potash with current annual production being at the rate of about 2.5 million tons. Their reserves are, however, becoming of lower grade and recovery costs are tending to rise but on the whole it is expected that they will continue to be competitive in Europe for the balance of this century.

43.8. Bromine - Production comes from potash brines and it is reported that the bromine content is lessening and hence bromine supply is diminishing and manufacturing costs are increasing. Current production is running at about 3,000 m.t. but this level is not expected to be sustained. The apparent consumption is about 4,000 m.t. of which about 1,000 m.t. is imported.

43.9. Lithium compounds - Very little solid information could be located in the limited time available. Germany imports spodumene ore from Canada from which it manufactures various lithium compounds, some of which are exported. In 1971 Germany imported 29.5 m.t. of lithium chloride, mostly from U.S.S.R.

43.10. Export potential - Several large international import/export dealers remarked that Iceland's only hope for its products was to get qualified traders to sell them as "transit" chemicals on export markets. Similar opinions were advocated in Belgium, Netherlands and U.K., voicing remarks heard in many other interviews. The relatively long distance from Iceland to markets in Europe where all these products are in good supply obviously means higher delivered costs because of the freight factor; hence the opinion that overseas markets away from Europe may prove to be more attractive. The situation in Scandinavia, however, is not parallel for most products, as has already been mentioned, and good opportunities should be found there as time goes on.

43.11. Import potential - One large import/export firm ventured the theory that there is a free market in Germany and even with over-production in certain lines, it is still possible to sell imported products, price and quality being right, of course. Production in Germany was up 6% in 1971 whereas imports were up 11%. For Iceland's chemicals the main target in Germany will be for a share of the bromine and lithium compounds business. Opportunities for the sale of other chemicals appear to range from minimal to zero.

43.12. Several established import/export firms of proven reputation and ability to sell on export markets expressed an interest in discussing selling arrangements as, if and when the Salt Chemicals Project becomes operational.

43.13. Customs duty - European Economic Community rates of duty applying in West Germany are as follows:

Calcium chloride	6.4%
Soda ash	10.4
Caustic soda	12.8
Chlorine	11.2
Salt-for chemical conversion	$ 1.00/m.t.
Potassium chloride, 60-62%	free
Bromine	12
Lithium compounds	5.6

44. NETHERLANDS

Product, Production, Exports and Imports

Year 1971 - In Metric Tons

PRODUCT	PRODUCTION	EXPORTS	IMPORTS	CIF VALUE US$/M.T.
Calcium chloride	NIL	831	7,539	48.45
Soda ash, 58%	400,000 (est.)	38,158	1,917	51.00
Caustic soda, 100%	350,000 (est.)			
-solid and flake	-	N/A	12,868	86.80
-liquid, 50%	-	N/A	19,662	47.20
Chlorine, liquid	325,000 (est.)	339	27,333	52.50
Salt - vac.pan	3,150,000	1,221,943	2,031	8.15
- sea (chem.conv.)	NIL	NIL	61,789	7.65
- other	NIL	NIL	22,365	12.20
- human	NIL	NIL	158	18.90
Potassium chloride, 60-62%	NIL	44	131,323	31.50
Bromine compounds	NIL	N/A	847	400.00
Lithium compounds	NIL	N/A	1.6	198.00

44.1. Introduction - The supply/demand situation in the Netherlands is similar in character to West Germany but on a smaller scale with respect to Iceland's chemicals. With abundant reserves of high grade rock salt, the country is a low-cost manufacturer of salt-based chemicals. Transportation costs are relatively low and there is a choice of road, rail, canal and good deep-water harbours for ocean transport. Water transport from Rotterdam up the Rhine River through Germany and into Switzerland contributes to making manufactured goods competitive at many inland European locations. Electrical energy is now available at comparatively low cost since the huge gas fields in the northern Province of Groningen became operational. Electrical energy is now cheap enough to attract an aluminium industry along with other newcomers.

44.2. Competition from foreign competitors, all E.E.C. members, such as Belgium, France, West Germany and the U.K. are located nearby to effectively prevent Iceland's products from participation in their markets. Also, tariffs to be assessed by E.E.C. countries could be disasterous for Iceland unless some compromises in policy are arranged by Iceland with members of the E.E.C. Many big chemical and petrochemical plants in the Netherlands are owned by foreign companies such as Dow Chemical, DuPont and Esso Chemical from the U.S.A; I.C.I from the U.K.; Hoechst from

West Germany; and the powerful Solvay organization of Belgium which has salt-based chemicals and other chemical, plastics and petrochemicals plants located in Europe and around the world.

44.3. The biggest obstacle to Iceland's projected salt-based chemicals industry is perhaps the Akzo, n.v. organization, headquartered in the Netherlands. Akzo is a large international organization with an annual turnover in 1970 in excess of US$ 2 billion. Members of this group are producers of rayon, synthetic fibres, chemicals, pharmaceuticals, pesticides, cosmetics, and salt. Their subsidiaries producing vacuum pan salt outside of the Netherlands have operations at Stade, West Germany; Dansk Salt I/S, Denmark; and International Salt Co. at Clark's Summit, Penn., USA. Other subsidiaries are producing sea salt, using solar evaporation, and are located at Macau, Brazil and in the Netherlands Antilles at Bonaire. In the Netherlands, Akzo companies produce, in addition to salt-based chemicals, carbontetrachloride; perchloroethylene; methylene chloride; chloroform; chloroacetic acid; and vinyl chloride. Mention is made of these chlorinated chemicals to illustrate the extent of integration between the raw material salt and manufactured secondary products which offer assured captive markets for chlorine, caustic soda, soda ash and other co-products. These industries have a solid base for supplying both domestic and export markets competitively in world trade.

44.4. Historical background statistics of imports and cif prices for the various products are shown on APPENDICES IV to XI for reference purposes.

44.5. Calcium chloride - Informants again stressed the acute over-supply of calcium chloride in Europe and elsewhere. One large international trader in chemicals stated that they had tried for over a year to make sales for an East European manufacturer but can find no outlets whatsoever. Calcium chloride is not produced in the Netherlands, probably not being recovered as such from the soda ash plant at Delfzijl and all requirements are imported. Imports of 7,539 m.t. in 1971 were used for de-icing, brine refrigeration and for de-icing oil-drilling platforms in the North Sea. Volume of imports fluctuate up or down according to the severity of winter weather. Two large importers split the available business, one representing a German manufacturer and the other representing Solvay. Material is packed in cheapest possible containers, usually waterproof multiwall paper bags or 50 kg. polythylene plastic bags.

44.6. Soda ash - A large import/export firm mentioned that supplies are tight in Europe with a tendency for the manufacturers to make sales direct to consumers and by-pass the dealers. Some increase in price has also been made effective at the manufacturing levels followed by increases instituted by the dealers. An opinion was expressed that Akzo probably produces more soda ash than Solvay in the Netherlands with total domestic annual production estimated at about 400,000 m.t.

44.7. Caustic soda and Chlorine - Due to the current shortage of caustic soda in Europe the prices of solid and flake grades have escalated and the position of the dealers is becoming intolerable as many manufacturers are dealing directly with consumers. One dealer believed the demand was showing signs of lessening. The price of liquid grade has not been advanced very much as most manufacturers want to maintain a spirit of good-will and confidence with the large volume consumers against the day when the supply position may be reversed. There is a tendency for chlorine to be in slight over-supply and this situation may deteriorate when the two new plants at Stade, West Germany come into production later this year. While domestic chlorine production is in the order of 325,000 m.t. there are still some imports, mostly from Belgium, presumably for Solvay's subsidiary at Rotterdam. Domestic production is believed to be in about equal quantities by Akzo and Solvay for both chlorine and caustic soda.

44.8. Salt - The Akzo salt works at Hengels, with a capacity estimated at 3.15 million tons of vacuum pan salt for industry and human consumption, exported 1.22 million tons in 1971. Sea salt for the food industry and rock salt for de-icing are imported. Akzo's large and low-cost salt in both the Netherlands and Denmark, together with their world-wide resources and aggressive selling policies, all combine to make them a formidable competitor in world markets.

44.9. POTASSIUM CHLORIDE - All requirements of potash in the Netherlands are imported, mostly from W. Germany, France, Canada and the U.S.S.R. Considerable trade in potash is conducted by international dealers and the Canadian association of potash manufacturers operates a bulk warehousing facility in Rotterdam in order to provide competitive delivery services.

44.10. BROMINE - This high-priced chemical is important to the Netherlands because the Dead Sea Works in Israel has established a bulk warehousing storage facility at Rotterdam, served by two special vessels bringing bromine from Israel. Practically all of Europe can be serviced at competitive prices from this admirably located distribution centre. Consumption of bromine for industrial and pharmaceutical purposes in the Netherlands is believed to be of little consequence at the present time. Its use for flame retardants for textiles and plastics will undoubtedly lead to greater interest in manufacture in the near future.

44.11. LITHIUM COMPOUNDS - Present market potential is believed to be minimal but as more uses for these versatile products become more widespread the demand in this industrialized and growing economy will undoubtedly develop.

44.12. Export potential - As was the case in West Germany, a few of the recognized large import/export dealers expressed a possible interest in Iceland's chemicals when they become available. It is thought that trade opportunities can be found outside of Europe, probably in Eastern Europe, South Africa and South America. Several exporters said they are already supplying Iceland with some chemicals, and would be interested in a two-way trading arrangement.

44.13. Import potential - Selling Iceland's chemicals in the Netherlands will be virtually impossible with the exception of Bromine and Lithium compounds where there may be some isolated opportunities. Dealers for bromine produced in Israel have the advantage of a bromine bulk terminal warehousing facility at Rotterdam and very keen competition is anticipated henceforth in Europe, especially at consuming locations situated at or near Rhine river ports or ocean ports in Europe and Scandinavia. As a "second source of supply", bromine from Iceland may find some solid market demand. The same may hold true for lithium compounds.

44.14. Customs duty - Imposition of duties at the present time is as follows on next page:

Statistical number	Commodity	Rate of duty
25.01.00	Pure sodium chloride for chemical use	H.fl. 3,62/1000 kg.
25.01.10	Denatured salt or salt for industrial use	" 9,05 "
25.01.20	Salt for human consumption	" 28,96 "
28.30.15	Calcium chloride	6.4%
28.01.15	Chlorine	11.2%
28.01.20	Bromine	12.0%
28.17.00	Caustic soda, solid	12.8%
28.17.10	Caustic soda, lye	12.8%
31.04.00	Potassium chloride	free

44.15. Member countries of E.E.C. are exempt. Duties are imposed on the cif prices. The "value added tax" is imposed on all these products at the rate of 14% except for potassium chloride where it is 4%.

45. **BELGIUM**

Producte, Production, Exports and Isports

Year 1971 - In Metric Tons

PRODUCT	PRODUCTION	EXPORTS	IMPORTS	CIF VALUE US$/M.T.
Calcium chloride	150,000 (est.)	N/A	N/A	-
Soda ash,58%	325,000 (est.)	13,476	35,922	47.10
Caustic soda, 100%	200,000 (est.)			
- solid and flake	N/A	N/A	5,551	104.00
- liquid,50%	N/A	N/A	8,797	50.90
Chlorine, liquid	180,000 (est.)	34,865 (fob$ 59.90)	4,851	64.75
Salt - vac.pan	NIL	N/A	377,966	10.15
- sea(chem.conv.)	NIL	N/A	620,059	7.70
- human	NIL	N/A	108,206	28.60
Potassium chloride,60-62%	NIL	5,556 (fob$ 32.35)	451,704	37.90
Bromine	NIL	NIL	14.4	780.00
Lithium compounds	NIL	N/A	92.6	131.80

45.1. Introduction - The salt-based chemicals industry is well established in Belgium although in the absence of its own salt resources it must rely on imports. Belgium, like the Netherlands, is well situated for world trade with connections through the port of Antwerp. Competition for markets resembles that in other West European countries and only the fittest are able to survive. Belgium is, of course, closely allied with Luxemburg as a co-partner in an economic union. Statistics shown for Belgium also include those of Luxemburg. The historical statistics of imports and cif prices are shown on APPENDICES IV to XI for reference purposes.

45.2. The head office of the powerful Solvay & Cie is in Brussels, and operates several manufacturing establishments and warehouses in Belgium for the production and distribution of soda ash; calcium chloride; caustic soda and chlorine; hydrogen peroxide; chlorinated solvents; vinyl chloride and PVC resins and plastics. This powerful group, with efficient and extensive salt-based European plants in Belgium, France, Netherlands, Austria, Germany, Italy, Spain and Portugal will always be a threat to new producers which try to penetrate their established markets. Solvay is capable of producing about 3.4 million tons of soda ash and over 1.2 million tons of chlorine and caustic soda in all of its plants.

45.3. As in the Netherlands, a number of well-known European and foreign manufacturers are established in Belgium, sometimes using raw or semi-manufactured intermediate materials imported from the U.S.A.; U.K., France, Canada and elsewhere. A very large basic fertilizer industry has been developed on the natural resources of pyrites for the manufacture of sulphuric acid and phosphatic fertilizers, as well as ammonium sulphate and nitrogeneous fertilizers. Potash from Alsace in France plays a considerable role in the Rhine traffic of Antwerp, some of which is used in Belgium for mixed fertilizers and the balance exported to world markets.

45.4. CALCIUM CHLORIDE & SODA ASH - No reliable information on the production of calcium chloride is available but it is estimated that annual output is in the order of 150,000 m.t. About 70,000 is used on the roads for ice control in winter. Soda ash production is likewise not published but a concensus of several estimates indicates annual production at about 325,000 m.t.

45.5. CAUSTIC SODA & CHLORINE - Reliable statistics or even unofficial estimates are difficult to locate in Europe, especially for highly competitive and controversial products such as calcium chloride, soda ash, caustic soda and chlorine. Caustic soda output in Belgium is believed to be about 200,000 m.t. Some 40,000 m.t. of caustic potash is believed to be co-produced with chlorine in one of the two electrolytic manufacturing operations. As usual in Europe, the major use for chlorine is in the manufacture of vinyl chloride where the annual growth rate in 1970 was about 16%. This rate could not be sustained and it is now in the order of 8 to 9% and as a consequence the demand for chlorine has decreased accordingly. It is expected that the demand for vinyl chloride and other chlorinated chemicals, and hence chlorine, will soon be on the up-trend again.

45.6. Exports of chlorine from Belgium as reported in statistics are also interesting although probably they have a tendency to be on the high side, especially as they may represent inter-company transactions or accommodation sales arranged to save excessive freight charges between different suppliers and customers.

Exports of chlorine from Belgium

Year	Quantity in m.t.	fob value
1971	34,865	US$ 59.90 / m.t.
1970	47,880	63.70
1969	36,935	58.25
1968	34,862	58.00

45.7. SALT - Not much can be said about salt in Belgium as all requirements are imported. Being located on the sea with the large port of Antwerp, deliveries of vacuum salt from the Netherlands, sea salt from the Mediterranean areas and rock salt from Germany down the Rhine are facilitated at relatively low delivered costs. This is a rather unusual situation when it is considered that the Solvay soda ash process which uses salt as the basic raw material was developed and first operated at a plant in Belgium.

45.8. POTASSIUM CHLORIDE - Belgium is basic in the fertilizer industry in that it is an important producer and exporter of nitrogeneous and phosphatic fertilizer materials as well as prepared fertilizers containing potash. Dependence for supplies of potash rests almost entirely on the deposits in Alsace. Much of the potassium chloride is used as such for fertilizer formulations but some is dissociated by electrolysis to produce caustic potash and some is manufactured into potassium sulphate and, to a lesser extent, into potassium nitrate, both being essential ingredients in compound fertilizers.

45.9. BROMINE - Consumption of bromine in Belgium is negligible at present, amounting to about 14.4 m.t. in 1971 as reflected by imports and as confirmed from a highly reliable source. This is a potential market for Iceland's bromine as new uses for it are inevitably going to be developed in this progressive chemical manufacturing economy.

45.10. LITHIUM COMPOUNDS - Here again, consumption is small and it was not practical to conduct a more extensive search at this time for compounds which are only recently coming into prominence as valuable raw materials.

45.11. Export potential - Except for bromine and lithium compounds, imports from Iceland face virtually insurmountable barriers and must therefore not be given serious consideration. Unlike the Germans and Dutch, international traders seem to concentrate more on distributing domestic goods abroad.

45.12. Import potential - Several dealers and traders in chemicals expressed a desire to be given consideration for representation when Iceland's products come on the market, especially for bromine and lithium compounds.

45.13. Customs duty - Imports of salt are subject to the following duties:

A. Common salt (including rock salt, sea salt and table salt) whether or not in aqueous solution:

1) Intended for chemical transformation (seperation of Na from Cl) for the manufacture of other products

(a).......B.Fr. 50.- per 1,000 kg. net weight.

2) Other:

a) Denatured or intended for other industrial purposes (including refining), excluding preservation or preparation of foodstuffs

(a).......B.Fr. 175.- per 1,000 kg. net weight.

b) Not specified......B.Fr. 560.- per 1,000 kg. net weight.
(Salt intended for human consumption;other)

B. Salt liquors; sea water..........Free

46. UNITED KINGDOM

Products, Production, Exports and Imports

Year 1971 - In Metric Tons

PRODUCT	PRODUCTION	EXPORTS	IMPORTS	CIF VALUE US$/M.T.
Calcium chloride	N/A	N/A	N/A	-
Soda ash, 58%	over 1,000,000	N/A	N/A	-
Caustic soda, 100%				
-solid and flake	N/A	-	4,540	78.00
-liquid,50%	N/A	-	-	-
Chlorine,liquid	N/A	N/A	10,650	71.00
Salt - vac.pan	N/A	N/A	N/A	-
- sea(incl.other)	NIL	-	71,420	12.45
- fishery (course)	NIL	-	52,429	13.00
(1) Potassium chloride,60-62%	Prod'n in 1973	N/A	34,829	24.00
Bromine	17,000 (est.)	N/A	1,645	405.00
Lithium compounds	N/A	N/A	18	-

NOTE: 1) Production of high grade potassium chloride in England is due to commence in 1972 or early 1973. The imports in 1971 and low cif value is not representative of K Cl 60-62% grade and is probably a low potash content slag.

46.1. Introduction - England is a prime producer of vacuum pan salt and salt-based chemicals and, with the exception of lithium compounds, produces all of the products visualized for Iceland and in very much larger quantities. Located close to the enormous potential markets of Europe and Scandinavia, and with established channels of communication and trade, the chemical industry in the U.K. is capable of competing successfully in most countries of the world. New manufacturers entering into competition for business with the strongly-entrenched British salt-based chemicals industry, to say nothing of those equally well endowed and established in Western Europe, will do well to assess the risks of finding profitable markets for their products. Study of the calculated risks should include evaluation of comparative costs of manufacture and the capability of delivering the finished goods at competitive cif prices in selected consuming areas.

46.2. Perhaps the largest single producer of salt and salt-based chemicals in the world is the giant Imperial Chemical Industries, Ltd., ranking in size and importance in a class with Solvay and Akzo. The I.C.I. soda ash plant at Northwich, in Cheshire, producing over 1 million tons annually, is sitting on what is probably the largest deposits of high-grade rock salt in the world. Low-cost energy in the form of by-product steam from power generation as well as from the new finds of natural gas in the North Sea all contribute to minimizing manufacturing costs.

46.3. The statistical information published by the U.K. Government is very inadequate from the point-of-view of a market researcher as great care is taken not to divulge information which could be detrimental to domestic manufacturers or which might endanger the competitive position of their products in domestic and world markets. The apparent consumption of the products being surveyed in the U.K. are summarized on the lead page. Historical background statistics of imports and cif prices, such as are available, are detailed on APPENDICES IV to XI for reference purposes.

46.4. CALCIUM CHLORIDE & SODA ASH - Very little more can be said about these two co-products. It seems obvious, however, that only a small percentage of the calcium chloride co-product is recovered for sale and that most of it is discarded as waste to the sea from whence it came. Interviews in England again confirmed the conviction that over-supply in Europe due to pollution controls forcing plants to recover more calcium chloride will inevitably lead to lower prices and will tend to discourage any new producers seeking to encroach on established markets. Recovery of calcium chloride may, in some cases, prove cheaper, even if the material is sold at low prices, than the expense of installing additional pollution control facilites to preserve soda ash production. The alternative for some producers at inland locations may be to close down their operations and make other arrangements for the supply of soda ash from other sources as is being done in the United States.

46.5. CAUSTIC SODA AND CHLORINE - Production capability is unknown but it is very considerable. Solid and flake grades of caustic soda are exported to many countries. The imports of chlorine shown for 1970 and 1971 are for bulk shipments from Norsk Hydro in Norway. It was transported in a special vessel to Maydown in Northern Ireland where it was used to chlorinate ethylene to ethylene dichloride which was then returned to Norway as a raw material for vinyl chloride. Due to the imposition of more rigid safety and pollution control regulations, as well as for certain other technical reasons, this water movement was discontinued. The growing demand for chlorinated solvents and vinyl compounds keeps the chlorine/caustic soda productions in Great Britain in reasonably good balance.

46.6. SALT - Here again, there is no information which is readily available to assess the annual production of salt. Much of the production is used captively by I.C.I. for chlor-alkali and soda ash manufacture and much of it is exported. The Scandinavian market has long been recognized as a stronghold for I.C.I. and their reputation there for quality and service is enviable. Along with Akzo, they present formidable competition to newcomers seeking to enter the Scandinavian markets with high purity vacuum pan salt.

46.7. In addition to the vast reserves of high purity rock salt in Cheshire, there are other large and still un-tapped reserves elsewhere, including a large deposit on the coast near Belfast, Ireland. Proximity to established and growing markets is a valuable characteristic of the U.K. salt and salt-based chemicals industry.

46.8. POTASSIUM CHLORIDE, 60-62% - Since the decision was made several years ago to develop the large reserves of potash in Yorkshire, England, the imports for mixed fertilizer manufacture have diminished. Domestic production is scheduled for late 1972 or early 1973 with planned initial capacity in the order of 1 million m.t. of potassium chloride per annum. The operation known as Cleveland Potash Ltd. is jointly owned by I.C.I. and Charter Consolidated Ltd. and will immediately place the U.K. in a strong position as an exporter.

46.9. BROMINE - Consumption of bromine in England exceeds the productive capability of the two domestic producers and in 1971, imports of 1,645 m.t. were necessary, mostly of material from Israel. In spite of a slackening in the use of bromine for manufacture of anti-knock fluids (tetraethyl lead) for petrol, the consumtion of bromine is expected to show a steady increase over the range, but a temporary reversal in the upward trend is expected in the succeeding few years.

46.10. LITHIUM COMPOUNDS - Very little realistic information resulted from interviews. It is a reasonable assumption that demand for lithium compounds will increase and that a potential market for Iceland will be found here.

46.11. Export potential - The historic and geographical ties between Iceland and the U.K., although strained at times, may over a period prove to be of some importance for certain of Iceland's chemicals. Chlorine, caustic soda and soda ash may be products which British manufacturers or traders may wish to have access. It is conceivable that situations in some of their large industries may arise where new requirements may not justify construction of new manufacturing capacity, for some reason or another, and the void could perhaps be filled by imports from Iceland. The movement of sizeable volumes of liquid chlorine from Norway to Northern Ireland by I.C.I. is an example of what could happen. When production in Iceland commences, even if it is on a small scale in the initial stages, it will be appropriate to maintain close contacts with involved parties in the U.K. either for consumptions in Great Britain or in other spheres of their operations around the world.

46.12. Import potential - At the present time the most likely products for consideration in the U.K. are bromine and lithium compounds and prospects should be carefully studied at the appropriate time.

46.13. Customs duty - Duties presently applicable on imports to the U.K. are as follows:

	FULL	C'wealth	EFTA
Calcium chloride	16%	free	free
Soda ash	8	"	"
Caustic soda	10	"	"
Chlorine	8	"	"
Salt-Fishery	free	"	"
-Other	5	"	"
Potassium chloride	free	"	"
Bromine	"	"	"
Lithium compds.	8%	"	"

After entry to the E.E.C. is accomplished later this year some changes in customs duty to conform with E.E.C. standards will undoubtedly become effective. Depending on what treatment is accorded E.F.T.A. countries, of which Iceland is a party, some adverse tariffs may be imposed later on.

47. **UNITED STATES OF AMERICA**

Products, Production, Exports and Imports

Year 1971 - In Metric Tons

PRODUCT	PRODUCTION	EXPORTS	IMPORTS	CIF VALUE US$/M.T.
Calcium chloride,				
- dry	680,000	N/A	N/A	-
- liquid	300,000	N/A	N/A	-
Soda ash, 58%	-	[1] 294,000	-	-
- Synthetic	4.3 m	-	N/A	-
- Natural	2.9 m	-	N/A	-
Caustic soda, 100%				
- solid and flake	180,000	[1] 80,600	N/A	-
- liquid, 50 & 73%	8.5 m	[1] 656,000	73,500	54.25
Chlorine, liquid	8.34 m	23,850	31,850	62.85
Salt	[1] 44.2 m	[1] 647,500	13.1 m	N/A
Potassium chloride, 60-62% K_2O	450,000	115,000	411,500	25.80
Bromine	2,500	NIL	[2] 3,310	N/A
Lithium	N/A	N/A	N/A	-

NOTES: - Figures followed by an (m) means millions of metric tons.
- 1) Some statistics for soda ash, caustic soda and salt are for the years 1969, the latest obtainable.
- 2) Imports of bromine included Iodine, crude and sublimed and hence are not entirely meaningful. In fact, other information sources indicate little or no bromine, as such, was imported.

47.1. Introduction - All the chemicals projected for Iceland are manufactured in huge quantities in this greatest industrial nation of the world. Mass production, advanced technology and enormous domestic markets enable manufacturers to capitalize on production processes which are capable of turning out materials of highest possible excellence and at minimal cost.

47.2. The comparatively small volumes of the chemical products proposed for production in Iceland cannot possibly compete successfully in the general U.S. market. This very fact of "bigness", however, may perhaps be converted into an asset insofar as it may be practical and economically beneficial if Iceland were to serve consumers in "freight logical" areas with certain products. Interviews and study of the various products and situations pertaining to the markets leads to a strong indication of potential out-lets for calcium chloride and soda ash at selected locations along the north-east coast of the United States and the eastern ports of the four Maritime Provinces of Canada. (Canada will be dealt with separately in the succeeding section). Transportation from Iceland will be by water and it seems reasonable to speculate that ocean rates will not be subject to increases to the same extent as rail rates in North America in the years ahead, hence the probability that the freight factor from Iceland will remain comparatively favourable.

47.3. As usual, the crux of the matter comes down to geography, economics and marketing. The element of distance in this vast country which sometimes separates suppliers and consumers often brings into focus the relatively high cost of transportation, either by all rail; rail and water; all water; or by road transport. The geography factor relates particularly to the cost of transportation which will be shown to reflect favourably on the estimated delivered costs of Iceland's calcium chloride and soda ash. The economic factor relates particularly to elements associated with production, plant locations, manufacturing costs and selling prices.

47.4. A third factor, probably the single most important decision to be made when the marketing function for the Project becomes active, relates to the manner in which penetration of export markets for each of the products is to be handled. The degree to which satisfactory arrangements can be consummated with established manufacturers and /or distributors which would be willing to supplement their existing material supplies with imports from Iceland, will spell the difference between profits and losses. This applies to markets in Scandinavia and Europe as well as in North America. Only in this way will it be practical and economically feasible to "slide" into markets without serious disruption of established supply procedures and pricing policies. Avoidance of emotional or panic reactions by competitors which can only lead to serious price deterioration must be accomplished by careful planning and prudent selling policies.

47.5. Until exploitation of the natural soda ash deposits in Wyoming and California commenced about a decade ago, all the soda ash produced was synthetic Solvay process material from plants located in the East, mostly on top of the salt deposits in Louisiana, Texas, Ohio, Michigan, Virginia and New York. The single plant in Virginia and one of the two plants in each of the States of Texas and Ohio have recently been closed, essentially because of their failure to remain economically profitable in the face of costly rehabilitation of plants which has become necessary in order to conform to anti-pollution legislation. Other valid economic and practical onsiderations undoubtedly were also contributing factors. It seems inevitable that further shut-downs will ensue over the next few years. Meanwhile the natural soda ash plants in the West are installing greatly expanded production facilities, ostensibly to meet the forthcoming plant-closings in the East, and by 1975 the supply will be more than ample to meet all expected domestic requirements. The probability of over-production by 1975 is a distinct possibility.

47.6. <u>CALCIUM CHLORIDE</u>

Calcium chloride supply patterns will likely be subject to certain changes as a result of the realignments in the soda ash industry. While all the synthetic manufacturers of soda ash were potentially producers of about equal quantities of co-product calcium chloride the fact is that many of them apparently did not recover any or all of it and ran off much of the calcium and chloride ion effluents into rivers and streams. Production from natural brines, on the other hand, has traditionally accounted for about half of the total calcium chloride produced for sale in the United States. Much of it comes from brines from which bromine and magnesia are extracted in the States of Michigan and West Virginia in the East and in the States of Arizona, Nevada and California in the West. There should not be any overall shortage even if more synthetic plants are closed but with the cost of freight from Michigan and West Virginia on natural material shipped to the northeast Coast becoming higher, and as the sources from synthetic plants tend to shift west and, in effect, "back away" from these eastern markets, the opportunities for importation from Iceland become more attractive.

47.7. Production of calcium chloride in the United States is reported below:

PRODUCER	LOCATION	CAPACITY-M.T.
Allied Chemical	Syracuse, N.Y.	245,000
Dow Chemical	Midland and Ludington, Mich.	525,000
Michigan Chemical	St. Louis, Mich.	72,500
P.P.G.	Barberton, Ohio	122,000
Wyandotte Chemical	Wyandotte, Mich.	110,000
Others		22,500
Total capacity, basis 78%		1,097,000

The PPG plant at Barberton, Ohio is scheduled to cease production before the end of 1972 and Wyandotte Chemical has recently closed down its calcium chloride production but still operates the soda ash plant. The largest producers of liquid grades from brines are Dow and Michigan Chemical. All make 77-80% while Dow also makes 94-97% and Michigan makes 90-93% material. The total market in 1971 approximated 900,000 m.t. and by 1973 the forecast is for 1 million m.t., basis 78% $CaCl_2$. Expected annual growth in demand is estimated to be about 3.1 percent in the years ahead.

47.8. Markets for calcium chloride in the heavily industrialized northeastern States conceivably could absorb much of Iceland's production. Summer dust-control and winter de-icing control together with a sizeable industrial consumption, plus the use for brine refrigeration, tractor tire weighting and concrete treating offer sizeable potential markets. As already mentioned in the case of soda ash, the markets will be highly competitive and successful penetration will, as always, depend on freight costs and comparative economics.

47.9. Investigations in Scandinavia and Europe did not reveal any markets for anhydrous grades containing in excess of 77-80% $CaCl_2$. In the U.S.A. and Canada, however, it was suggested several times that Iceland should seriously consider the production of anhydrous grades containing up to 97% $CaCl_2$ as there was a good demand for this more concentrated material and the potential savings in transportation costs would be significant bringing about reductions in delivered costs by eliminating the paying of freight on the 17% difference in water contents. It is a relatively simple processing matter to apply more heat to the 77-80% material to drive out excess water to get the higher concentrated grades. The following prices published in Chemical Marketing Reporter, May 8, 1972, show the various grades offered in the U.S.A.:

	US$ per ton	
	Per N.T.	Per M.T.
Calcium chloride, conc., reg. grade		
77-80%, flake, bulk, c.l.,		
works, frt. equald.	33.00	36.45
100-lb. bgs., c.l., same basis	44.00	48.55
powd., 100-lb., bgs., c.l., same	52.00	57.40
anhydrous, 94-97%, flake or pellet		
bulk, c.l., same basis	42.00	46.35
80-lb. bgs., c.l., same basis	55.40	61.15
90-93%, gran., bulk, c.l., same basis	40.20	44.35
80-lb. bgs., c.l., same basis	52.65	58.10

NOTE: These list prices may be subject to certain trade or quantity discounts, thus tending to lower the fob costs at works.

47.10. The closest and only calcium chloride (and Solvay soda ash) plant in the northeastern U.S.A. is Allied Chemical at Syracuse, N.Y. and other manufacturers will equalize freight (f.e.) on the basis of the rate from that point.

Basis of pricing for U.S. northeast coast-

	US$ per m.t.	
	Bags.	Bulk
Calcium chloride, 77-80% flake,	48.55	36.45
Frt.rate (from Syracuse)	10.55	10.55
Delivered price, fob New York.........	59.10	47.00
Calcium chloride, anhyd, 94-97%	61.15	46.35
Frt.rate (from Syracuse)	10.55	10.55
Delivered price, fob New York.........	71.70	56.90

47.11. The foregoing delivered prices, fob. New York are, therefore, the prices which Iceland must be prepared to meet. In order to arrive at net-back prices, fob dockside at Straumsvík, Iceland, it seems prudent to include these assumptions:

a) that Iceland will produce both 77-80% flake and anhydrous 94-97% flake and, possibly, pellet grades and is prepared to ship both grades in either bags or bulk cargoes;

b) that a seller's or distributor's commission, or fee, will be negotiable at the appropriate time and, for present pruposes, an arbitrary figure of US$ 2.50 per m.t. is being used;

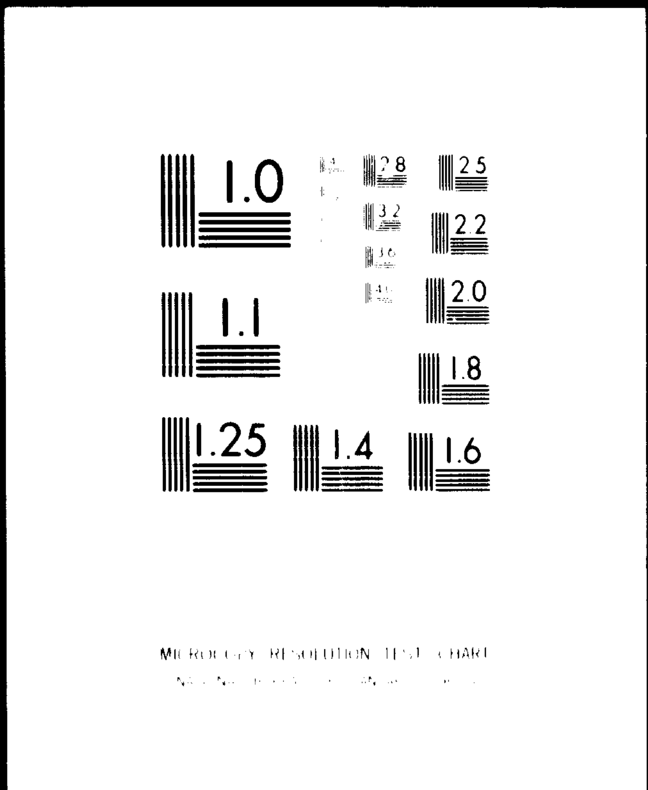
c) in order to provide for contingencies and normal pricing deviations expected in competitive markets, such as trade or quantity discounts, etc., an amount

C-384

77.11.16

3 OF 4

07570



24×

A

of 10% of the fob New York price has been allowed. The published prices are invariably higher than actual commercial selling prices.

Net-back fob Staumsvik from dlvd. N.Y. prices

			US$ per metric ton	
Calcium chloride,77-80% flake			**Bags**	**Bulk**
fob New York price			59.10	47.00
Deduct-	Bags	Bulk		
Ocean frt.	10.75	10.00		
Comm´n.	2.50	2.50		
Cont.	5.90	4.70	19.15	17.20
Estimated price,fob Straumsvik			39.95	29.80
Calcium chloride, anhyd. 94-97%				
fob New York price			71.70	56.90
Deduct-	Bags	Bulk		
Ocean frt.	10.75	10.00		
Comm´n.	2.50	2.50		
Cont.	7.20	5.70	20.45	18.20
Estimated price,fob Straumsvik			51.25	38.70

NOTE: See APPENDIX XII for prevailing estimated ocean freight rates from Straumsvik, Iceland to New York and other representative northeast coast ports.

47.12. SODA ASH, 58%

Production of soda ash in the United States is, as mentioned before, in the hands of a few large corporations. The shifting of production capacities from east to west as the natural material in Wyoming is quickly replacing the synthetic soda ash traditionally produced in the east, is bringing about a drastic change in distribution for the manufacturers and in supply for the consumers.

Soda ash manufacturers in U.S.A.

		ESTIMATED CAPACITY-M.T.	
PRODUCER	LOCATION	SYNTHETIC	NATURAL
Allied	Baton Range, La.	710,000	-
"	Syracuse, N.Y.	900,000	-
"	Green River, Wyo.	-	1,000,000
Kerr-McGee	Trona, Calif.	-	950,000
Diamond Shamrock	Painesville, Ohio	720,000	
FMC	Green River, Wy.	-	1,130,000
Olin Chem.	Lake Charles, La.	340,000	-
PPG	Corpus Christi, Tex.	220,000	-
Stauffer Chem.	Westend, Calif.	-	145,000
" "	Green River, Wy.	-	1,360,000
Wyandotte Chem.	Wyandotte, Mich.	720,000	-
Hooker Chem.	Searles Lake, Calif.	-	136,000
		3,610,000	4,721,000

NOTE: Capacity for synthetic plants is for year 1972 and natural plants year 1974.

47.13. Demand for soda ash in the United States is great at present as withdrawal of synthetic production has not yet been replaced by equivalent new natural production in the west. Though the market is tight now, when expansions by Stauffer and FMC are completed by year-end the overall market is expected to be in balance. Observers are aware of the world-wide shortage of Na_2O in any and every form in the past few years and although the U.S. exports only about 4 percent of production, the demand from foreign markets is strong. By 1975, the forecasts in the United States include a sizeable increase in exports. Expected annual growth rate for soda ash is estimated to be 2 to 3 percent in the years ahead.

47.14. Markets and distribution by industry in the U.S.A.

INDUSTRY		% of consumption
Glass	-	47
Chemicals	-	23
Pulp & paper	-	9
Soap & detergents	-	5
Water treatment	-	3
Exports	-	4
Miscellaneous	-	9

Published price schedules in the May 8, 1972 issue of Chemical Marketing Reports are as follows on next page:

	Per net ton East	Per net ton West	Per metric ton East	Per metric ton West
	US$ per ton			
Soda ash, dense,58%,paper bgs. c.l.,works,frt.equald.	49.50	47.50	54.55	52.35
bulk,c.l.,same basis,	35.50	33.50	39.15	36.90
light 58%,paper bgs.,c.l. same basis,	49.50	47.50	54.55	52.35
bulk,c.l.,same basis,	35.50	33.50	39.15	36.90

NOTE: These list prices may be subject to certain trade or quantity discounts, thus tending to lower the fob costs at works.

47.15. The closest soda ash plant to the northeast coast is Allied Chemical, at Syracuse. N.Y., on which point other manufacturers equalize freight, where applicable, in order to meet competitive offerings. It will be noted that the prices for both grades are identical except for the differential for bags.

Basis of pricing for U.S. northeast coast-

	US$ per m.t. Bags	US$ per m.t. Bulk
Soda ash, 58%, dense and light	54.55	39.15
Frt. rate from Syracuse	10.55	10.55
Delivered price, fob New York...........	65.10	49.70

47.16. The foregoing delivered prices, fob New York are, therefore, the prices which Iceland must be prepared to meet. As mentioned previously for calcium chloride, similar assumptions prevail for soda ash, namely:

a) Iceland will produce light and dense grades and will be prepared to make cargo shipments in either bags or in bulk;

b) a seller´s or distributor's commission, or fee, to be negotiated, but for present purposes a figure of $ 2.50 per m.t. is being used;

c) a contingency of 10% as protection against price erosion due to trade or quantity discounts,etc.

Net-back fob Straumsvík from dlvd. N.Y. prices

			US$ per metric ton	
Soda ash, 58% dense & light			Bags	Bulk
fob New York prices			65.10	49.70
Deduct-	Bags	Bulk		
Ocean frt.	12.75	12.00		
Comm´n.	2.50	2.50		
Cont.	6.50	5.00		
Duty	2.60	2.60	24.35	22.10
Estimated prices,fob Straumsvík			40.75	27.60

NOTE: See APPENDIX XII for prevailing estimated ocean freight rates from Straumsvík, Iceland to New York and other representative northeast coast ports.

47.17. Information obtained from several reliable sources in New York provided information on American freight rates used in this Report. The rate from Syracuse, N.Y. to New York City is $ 9.60 per net ton, equivalent to US$ 10.55 per m.t. The all-rail rates from Wyoming to the East coast are in the order of $ 23.00 to $ 24.00 per net ton, say, US$ 25.00 per m.t. Based on published prices the delivered prices of natural soda ash, exclusive of any freight equalizations, in the greater New York City area, work out as follows:

	In US$ per metric ton	
Soda ash, 58%, dense or light	Bags	Bulk
Price, fob Green River, Wy.	52.35	36.90
Freight rate to N.Y.	25.00	25.00
	77.35	61.90
MEMO - Syracuse soda ash	(65.35)	(49.85)

A news item published several years ago indicated that the natural soda ash producers in Wyoming absorbed an average of about $ 11.00 per m.t. in freight equalizations on all material shipped. This approximately accounts for the differential between Wyoming and Syracuse prices.

47.18. OTHER PRODUCTS

The results from interviews and other sources, and from personal experience, are not conducive to further consideration of markets in the U.S.A. at this time for salt; chlorine and caustic soda; potassium chloride; bromine or lithium compounds. Another discouraging factor in this market is the high customs duty protection afforded U.S. industries. While calcium chloride is permitted to enter free of duty the rate of duty on soda ash imports of $ 2.60 per metric ton, as detailed in paragraph 47.16, is quite formidable. As a matter of record, current rates of duty are as follows:

Calcium chloride	-	free
Soda ash	-	12 cents/100 lb.
Chlorine	-	5% ad valorem
Caustic soda	-	15% ad valorem
Salt, in bulk	-	0.8 cents per 100 lb.
, not in bulk	-	free
Potassium chloride	-	free
Bromine	-	5 cents per pound.
Magnesium	-	20% ad valorem

48. **CANADA**

Products, Production, Exports and Imports

Year 1971 - In Metric Tons

PRODUCT	PRODUCTION	EXPORTS	IMPORTS	CIF VALUE US$/M.T.
Calcium chloride	200,000	N/A	20,650	37.35
Soda ash, 58%	370,000	N/A	1) 156,000	1) 34.50
Caustic soda, 100%	1.1 million			
- solid and flake	50,000 (est.)	N/A	535	185.00
- liquid, 50%	-	N/A	75,725	87.25
Chlorine, liquid	1 million	30,500	975	70.80
Salt	3) 4.9 m	3) value (US$ 7.03 m)	2) 833,000	2) 4.75
Potassium chloride, 60-62% K_2O	4) 6.3 m	4) 6.0 m	57,000	31.75
Bromine	NIL	NIL	NIL	-
Lithium -				
- Li.Carbonate	2,250	N/A	NIL	-
- Li.Hydroxide	900	N/A	N/A	-

NOTES: 1) Import statistics for soda ash include imports of sal soda so as not to reveal actual facts and hence are not meaningful.
2) Import statistics for salt include brine and therefore are misleading for the purpose of this Survey.
3) Exports of salt and brine, essentially all to the U.S.A., show only the value, in million $. The production of salt in Canada is shown in millions of m.t.
4) Production and exports of potassium chloride (muriate of potash) are shown in millions of m.t.

48.1. Introduction - Canada, like the United States, is a producer of all the chemicals projected for Iceland with the exception of bromine, supplies of which are imported from the U.S.A. As shown on the preceding page, Canada is a comparatively large importer and exporter of these chemicals as well as being a sizeable manufacturer. The chemical industry in Canada is quite capable of making enough chemical products for its entire needs but suffers from several inherent problems, namely:

1) the long distances separating major manufacturing locations and marketing areas; 2) the inability to take full advantage of the economics of size of domestic manufacturing plants which produce these high-volume/low-profit chemicals; 3) being vulnerable on both east and west coasts to worldwide imports by water from large foreign manufacturers; and 4) being so closely linked economically and physically with the greatest industrial nation in the world and the ease with which imports can be brought in by rail or water across a border 3,000 miles in length from the giant American producers where volumes of output are higher and manufacturing costs generally lower.

48.2. A knowledge of these conditions and the facts relating to Iceland's specific marketing objectives suggests the possibility that certain of the products might find homes in Eastern Canada to where port-to-port water-borne shipments can be made. It has often been stated that Canada acts as a bridge between "the old country" and "the new world". In many lines of chemicals, including dyestuffs and specialty chemicals, Canada is frequently looked upon as a dumping ground for imports and the prices of domestically produced material very often cannot compete successfully and, inevitably, many manufacturers have been forced to go out of business. It is not an easy market to penetrate especially when it is considered that over two-thirds of the investment in the chemical industry in Canada is in the hands of multinational corporations with large operations in Great Britain, Europe and the United States, or wherever.

48.3. CALCIUM CHLORIDE & SODA ASH - These products are manufactured in a Solvay type plant located in central Canada at Amherstburg, Ontario, by Allied Chemical Canada Ltd. which is virtually the sole Canadian manufacturer. There is a small independent calcium chloride producer in Western Canada and also a small soda ash operation, producing 18,000 m.t. per year by using carbon dioxide to treat chlor-alkali cell liquor, at Brandon, Manitoba. Neither is significant for the pruposes of this Survey. With rail freight rates continuing to increase it seems logical that established markets in the Maritime Provinces situated along the eastern shores should be prime targets for Iceland´s material. During the course of interviews in Canada, and from a first-hand knowledge of the markets in that general area, it became evident that important consumptions of both items conceivably could be developed. Hopefully, markets for a sizeable percentage of the projected annual production of 58,000 m.t. of calcium chloride and 100,000 to 120,000 m.t. of soda ash are available with perhaps 70% of tonnages being in bulk and the balance in 50 kg. PE plastic bags. The key problem is how to sell it without incurring a price-war.

48.4. The opening up of these markets will, of course, require a major sales effort by Iceland, as historically, these markets have been jealously and ruthlessly guarded by the established manufacturers and suppliers such as Dow Chemical, Allied Chemical, Canadian Industries Limited (I.C.I's Canadian Subsidiary) and other major foreign suppliers, some of which deal through Canadian distributors. The intelligent means of entry is to seek an arrangement with one of the larger established manufacturers or distributors which would be willing to supplement their own manufactured material with the products from Iceland. In this way it should be practical and economically feasible for Iceland to gain entrance into this logical and expanding market without serious disruption to established supply procedures and pricing policies.

48.5. This suggested approach to marketing in Eastern Canada is the same, in principle, to that suggested for Scandinavia for these and certain other of the projected products, especially salt and potassium chloride. In the case of these latter two products the preferred approach would be through the larger importers and distributors. Any other "frontal attack" on these major market areas, either to the east or west of Iceland, may well prove devastating to the Project in the face of such giants and influential forces in the industry as I.C.I.; Akzo; Solvay, Kalk; Norsk Hydro: Dow; Allied; PPG; FMC Corp; Diamond Shamrock; Olin; Canadian Industries; and Standard Chemical (PPG´s Canadian subsidiary).

48.6. Entry into eastern Canada or northeastern U.S.A. markets will not be easy but it must be logical and sound on both practical and economic grounds. Trends and events in the industry for both calcium chloride and soda ash appear to be developing in Iceland´s favour. The over-riding considerations, as in the United States, are functions of GEOGRAPHY, ECONOMICS and MARKETING. The subject of marketing has been amply covered previously.

GEOGRAPHY

The large Canadian manufacturer of calcium chloride and soda ash, Allied Chemical Canada Ltd., is located over 1,000 miles from markets in the Maritime Provinces which are currently largely served by means of rail transport although some deliveries are made by water through a bulk storage facility located near Bathurst in Northern New Brunswick. Other suppliers competing in this marketing area inevitably base their pricing policies on Allied´s position, whether the materials come from the U.S.A., Great Britain, Europe or elsewhere. In these instances the transportation rates will certainly be no less, on the average, than from Allied's plant at Amherstburg and it is for this reason that Iceland appears to have a distinct advantage. Dow Chemical Canada Ltd. also ships calcium chloride to this market from their plant at Sarnia, which is located not far distant from Amherstburg, Ontario.

48.7. A conservative average freight charge from the Amherstburg/Sarnia area to markets in the Maritimes, say, to Halifax, is US$ 19.05 per metric ton for bulk shipments. Some large movements in bulk cargoes, by water transport, may cost less. In comparison, the estimated boat rate for bulk material from Iceland to Halifax, Nova Scotia is US$ 8.35 per m.t. In other words, the costs of transportation from Iceland for calcium chloride and soda ash to ocean ports in the Maritime Provinces is lower than the average rail and water rates from manufacturing locations in Central Canada. Rates from the more distant manufacturing locations in the U.S.A. and Europe will be even more unfavourable, thus benefiting Iceland's position further. The imposition of Customs duty on imports is, however, an added cost factor.

48.8. <u>ECONOMICS</u>

Recent history in all countries, and probably to a greater extent in highly developed countries, shows that marked increases in costs of transportation are prevalent everywhere, in spite of many cost-saving innovations and improvements to minimize upward revisions. While increases in production of goods and greater productivity, brought about in part by automation has helped to keep basic manufacturing costs down, there has been an appreciable increase in the costs of deliveries to consuming locations in the United States and Canada. This situation, however, should have a beneficial effect in the marketing of Iceland's calcium chloride and soda ash in Eastern Canada. With transportation costs for deliveries becoming ever higher, a point is reached where it may be more economical for one or more of the present suppliers of Maritime markets in Eastern Canada and the United States to seriously consider substituting Icelandic material for their own in the interests of efficient and economical service to their customers and for the benefit of their overall corporate profitability.

48.9. Another factor influencing the situation at the present time is in the area of social economics. Calcium chloride and soda ash manufacturing operations in Canada are being subjected to ever more demanding anti-pollution regulations as are plants in the United States and Europe. The heavy capital expenses required to maintain future operations in Solvay type plants is good reason to believe that the selling prices of both calcium chloride and soda ash will not deteriorate from present levels, and if any change does occur it will most likely be upwards. This seemed to be the general consensus of opinions expressed in interviews conducted in North America.

48.10. Canada, like the United States, has tariff protection against imports of foreign goods. Current rates of duty were provided by the Customs and Excise Department of the Department of National Revenue, Ottawa:

	British Preference	Most Favoured Nations
Calcium chloride, Item 92830-1	free	15%
Sodium carbonate, Item 92842-1	10%	15%
Sodium Hydroxide Item 92817-3	10%	15%
Chlorine Item 92801-1	free	15%
Salt - all (except table) Item 92501-1	free	free
Potassium chloride Item 92801-1	free	free
Bromine Item 92801-2	free	free

NOTE: When commodities are imported for use in the manufacture of goods, for sale on export markets, about 99% of the amount of customs duty paid on the imported material is subject to refund as a draw-back when the finished goods are exported. This, of course, has a beneficial effect on certain imported goods and could be helpful for certain of Iceland's chemicals.

48.11. CALCIUM CHLORIDE - The only published prices in Canada for calcium chloride are as follow on next page:

		US$ per m.t.
Calcium chloride, 77-80%, flake,		
carloads, fob. works	- In bags	47.50
ditto	- In bulk	40.90

These prices are undoubtedly subject to some freight equalizations in order to meet competitive offerings. Also, they are slightly lower than published U.S. prices. Estimating average delivered costs at representative ports in the Maritime Provinces is largely conjecture because of so many conflicting factors. The following estimates are based on a general knowledge of the overall situation relating to these particular products. In compiling an estimate it is appropriate to include several assumptions as was done for the U.S. delivered prices, i.e.

a) as in the United States calculations, a seller's commission of $ 2.50 per m.t. is arbitrarily allowed;
b) a contingency of 10% of the probable delivered average fob cost is provided for trade and quantity discounts or other unforeseen charges against selling prices;
c) an average "freight equalization" allowance in the order of US$ 8.00 per m.t. on calcium chloride is realistic as an essential cost factor for determining plant net-backs at Amherstburg and Straumsvik. In the case of soda ash in the following paragraphs, the average freight allowance used is $10.00 per m.t.

48.12. CALCIUM CHLORIDE, ANHYD, 94-97% FLAKE

No prices are published in Canada for anhydrous, 94-97%, flake or pellet grades. In order to provide a comparison with U.S. prices and to give an estimate for the benefit of the Sea Chemicals Plant, the competitive build-up of prices is given below:

Basis of pricing for Maritime locations

	US$ per metric ton	
	Bags	Bulk
1) Calcium chloride,77-80% flake		
fob Amherstburg price	47.50	40.90
Plus freight to Maritimes	26.70	19.05
	74.20	59.95
Less av.frt. allowance	8.00	8.00
Estimated fob price, Halifax	66.20	51.95
2) Calcium chloride, anhyd.94-97%		
fob Amherstburg	60.00	50.00
Plus freight to Maritimes	26.70	19.05
	86.70	69.05
Less av.frt. allowance	8.00	8.00
Estimated fob price, Halifax	78.70	61.05

NOTES: 1) The freight rates to Halifax from Amherstburg, Ont. are: Bags or Bulk (min.80,000 lbs.)-US$ 26.70/m.t.
Bulk only (min.100,000 lbs.)-US$ 19.05/m.t.

2) The prices for anhydrous, 94-97%, flake and pellet grades are based on the differentials prevailing in the United States and adapted to Canadian prices for the purposes of this Survey.

48.13. Continuing the calculations to determine the prospects for Iceland to compete successfully in the Eastern Canadian market, the various factors to be considered are:

Net-back fob Straumsvík from dlvd. Halifax prices

			US\$ per metric ton	
Calcium chloride, 77-80% flake			Bags	Bulk
fob Halifax price			66.20	51.95
Deduct-	Bags	Bulk		
1) Ocean frt.	9.10	8.35		
Comm´n.	2.50	2.50		
Cont.	6.60	5.20		
2) Duty-15%	5.25	4.50	23.45	20.55
Estimated prices, fob Straumsvík			42.75	31.40
Calcium chloride, anhyd. 94-97%				
fob Halifax price			78.70	61.05
Deduct-	Bags	Bulk		
1) Ocean frt.	9.10	8.35		
Comm´n.	2.50	2.50		
Cont.	7.90	6.10		
2) Duty-15%	7.15	6.00	26.65	22.95
			52.05	38.10

NOTES: 1) See APPENDIX XII for prevailing estimated ocean freight rates from Straumsvík, Iceland, to Halifax, Nova Scotia, which are used as being representative for east coast Maritime ports.

2) The duty draw-back privilege will probably not be very effective in the case of calcium chloride as most of it, if not all, will be consumed domestically. Customs duties are arbitrarily based on fob. Strausvík prices:

		Bags	Bulk
77-80% flake	-	35.00	30.00
94-97% anhyd.	-	47.50	40.00

48.14. SODA ASH, 58%

The published prices in Canada for soda ash are generally at higher levels than prevailing U.S. prices:

	In US$ per metric ton	
	Bags	Bulk
Soda ash, 58%, fob works, light	57.85	46.85
" " " " dense	61.15	49.05

These prices are undoubtedly subject to freight equalizations in order to be competitive with imports from certain U.S. locations and from foreign sources to consuming locations, especially those on the east coast that can be served by water transport. It will be difficult to establish, therefore, the average delivered costs at eastern coast points in the Maritime Provinces and the same assumptions will have to be made to arrive at a realistic figure as was done for calcium chloride in the previous paragraphs.

Basis of pricing for Maritime locations

	US$ per metric ton	
Soda ash, 58%, dense.	Bags	Bulk
fob Amherstburg price	61.15	49.05
Plus freight to Maritimes	36.40	19.05
	97.55	68.10
Less av.frt.allowance	10.00	10.00
Estimated fob price, Halifax	87.55	58.10
Soda ash, 58%, light.		
fob Amherstburg price	57.85	46.85
Plus freight to Maritimes	36.40	19.05
	94.25	65.90
Less av.frt.allowance	10.00	10.00
Estimated fob price, Halifax	84.25	55.90

NOTES: The freight rates to Halifax from the only Canadian soda ash plant, at Amherstburg, Ont. are:

Bags only (min. 80,000 lbs.) - US$ 36.40/m.t.

Bulk only (min.100,000 lbs.) - US$ 19.05/m.t.

48.15. Continuing the calculations to determine the prospects for Iceland to compete successfully in the Eastern Canadian market, the facts appear to be:

Net-back fob Straumsvík from dlvd. Halifax prices

			US$ per metric ton	
Soda ash, 58%, dense.			Bags	Bulk
fob Halifax price			87.55	58.10
Deduct-	Bags	Bulk		
1) Ocean frt.	11.10	10.35		
Comm'n.	2.50	2.50		
Cont.	8.80	5.85		
2) Duty - 15%	5.25	4.20	27.65	22.90
Est. prices, fob Straumsvík			59.90	35.20
Soda ash, 58%, light.				
fob Halifax price			84.25	55.90
Deduct-	Bags	Bulk		
1) Ocean frt.	11.10	10.35		
Comm'n.	2.50	2.50		
Cont.	8.45	5.60		
2) Duty - 15%	4.75	3.90	26.80	22.35
Est. prices, fob Straumsvík			57.45	33.55

NOTE: 1) See APPENDIX XII for prevailing estimated ocean freight rates from Straumsvík, Iceland to Halifax and other representative east coast ports.

2) The privilege of duty draw-back may be very helpful to Iceland for soda ash used in the manufacture of pulp and paper, alumina or other products which are largely manufactured in Canada for export. Customs duties are arbitrarily based on fob Straumsvík prices:

	Bags	Bulk
Dense	35.00	28.00
Light	31.70	25.80

48.16. Other import opportunities exist in Eastern Canada for soda ash other than through the established manufacturers or distributors. Large volume consumers such as the pulp and paper mills and the Aluminum Company of Canada at Arvida, Quebec, which can use either caustic soda or soda ash interchangeably as a source of Na_2O, are always potential buyers on world markets. One interesting possibility for Iceland's natural soda ash is at Kaiser Aluminum's new strontium recovery plant in Nova Scotia. It is understood that the residual chloride content in synthetic soda ash is not compatible with their process requirements and they will insist on trona derived material, i.e. with low chloride ion content.

48.17. SALT

Ample supplies of domestic salt are available in the Maritime Provinces and several extensive new high-grade deposits of rock salt are currently being considered for exploitation in New Brunswick, Cape Breton Island (N.S.) and Newfoundland. Domestic production has to compete, however, with imported chemical grade solar salt from the Caribbean which is delivered at prices of US$ 7.75 to 8.85 per m.t. at east coast ports. Opportunities for Iceland's salt appear limited but more intensive investigation of available markets for fishery and high-grade vacuum pan salt at certain more remote locations, and where comparative freight rates may be more favourable for Iceland, may very well uncover some profitable opportunities for trade. Such outlets may be developed in Newfoundland and the Gulf of St. Lawrence for the fishing industry or at Arvida or Port Cartier for chemical grade salt. No customs duties are payable on fishery salt.

48.18. BROMINE

This is another product which has good potential for sale in Canada, especially as it can be imported free of duty. The market at present is relatively small but it is capable of development as requirements will undoubtedly increase.

48.19. OTHER PRODUCTS

Very little encouragement can be found for profitable sales of other products in Eastern Canada. Caustic soda and chlorine, potassium chloride and lithium compounds are in abundant supply.

49. POTASSIUM CHLORIDE, 60-62% K_2O

49.1. Introduction - The format for reporting the findings of the investigations in the various countries as used heretofore will be changed for Potassium chloride, Bromine and Lithium compounds. These are considered as minor products for the purposes of this Survey and the relatively lesser amount of data gathered will be more clearly presented by reporting for each of the three in individual sections which include all countries. Only minor reference was devoted to each in the "by country" reports.

49.2. Manufacture - Only West Germany, United States and Canada of the countries surveyed are producers of potassium chloride, or potash as it is commonly referred to in the trade. East Germany, Italy, Spain, Israel and the U.S.S.R. are the other major producing countries. The deposits which are being worked in the various countries all have two characteristics in common; all consist of soluble potash minerals and, with the exception of brine lakes, all have been formed by the evaporation of sea water. Of the reserves currently being worked, by far the largest are those in Saskatchewan, Canada, and the Uralkali and Byeloruskali deposits located in Western and Baltic Sea areas of Russia, respectively.

49.3. The potash ore is almost entirely recovered from subterranean deposits by conventional mining methods, similar to those used for coal. The potassium may be separated from the other materials, or impurities, in the crude or by leaching, dissolving and crystallization or by simple flotation after dissolving out any magnesium chloride present. Potash-bearing brines, on the other hand, normally contain complex mixtures of salts and in effect are usually some form of partially evaporated sea water. They are relatively dilute, requiring much evaporation and many processing steps to separate the various salts present. Economic exploitation of these sources of potash generally requires some special factor such as exceptional concentration, low-cost fuel or solar energy, etc., and the marketability of the by-products. The projected production in Iceland comes under this last category.

49.4. Solution mining is another technique for recovering potash from deep beds without sinking a shaft. This method has the advantage of bringing to the surface otherwise inaccessible material at depths below those considered feasible for conventional mining. Only one such mine is in commercial production, this being at Belle Plaine in Saskatchewan, Canada.

49.5. All the countries surveyed have extensive manufacturing facilities for mixing their own prepared fertilizer formulations, many of which are designed specifically to be compatible to the soils and promotion of plant growth in the individual countries.

49.6. Norsk Hydro in Norway, Boliden AB in Sweden, Rikki

Happo OY in Finland, Superfos AKI a/s in Denmark, and Chemiques De Tessenderloo in Belgium are probably the largest manufacturers and formulators of fertilizers in their respective countries. Constructive interviews were held with these chemical and fertilizer manufacturers which are producing many of the basic fertilizer materials such as calcium nitrite, urea, liquid ammonia, ammonium nitrate, superphosphates, dicalcium phosphate, ammonium sulphate, etc. These manufacturers usually are also manufacturers of mixed fertilizer preparations and in such cases in the aforementioned countries, requirements of potassium chloride and potassium sulphate must be imported.

49.7. Exports - The matter of exports of potash is not critical to this Survey. World reserves of potash are enormous and supplies will be available to meet the demands around the world for many hundreds of years ahead. International trading patterns for exports from producing to consuming countries are now well established. It seems certain, however, that the competitive factors prevalent today will continue in future and more sophisticated policies and procedures for exports and imports will be instituted over the years. In the U.S.A. and Canada there are many similar manufacturers and formulators of fertilizers but no attempt was made to cover them, as the potential markets for Iceland's relatively minor production of potassium chloride will undoubtedly be in Scandinavia if for no other reason than the potential freight savings involved.

49.8. <u>Imports</u> - Reference to APPENDIX IX will illustrate the trend of rising imports and show how the cif costs vary, more or less in unison, as the pressures of supply and demand are reflected in world pricing policies which originate in the major potash-producing nations. The highly competitive, large tonnage international trade in potash is so intense that all selling prices quickly gravitate to a more or less common level. Elaborate procedures are incorporated in pricing policies to provide for freight equalizations so that one competitor does not enjoy any particular sales advantage by being able to deliver material to consumers in various countries which will exclude another manufacturer from participating. As with trade in salt and other bulk commodity chemicals, the means of transporting and delivering cargoes of potash to points of consumption is perhaps the most decisive factor in the process of marketing and distribution.

49.9. Imports in all the Scandinavian countries have consistently increased as the demands on agriculture become more urgent to feed expanding populations. Most of Norway's requirements come from West Germany, France and Canada. Sweden's imports originate in West and East Germany, Canada, France, U.S.S.R., Israel and U.S.A. Finland secures its supplies mostly from East and West Germany, Belgium, Spain, France, Canada and Russia. Denmark draws its supplies chiefly from West Germany, East Germany, France and U.S.S.R.

49.10. Norway, Sweden, Finland and Denmark are potentially logical importers of potash from Iceland and any one of them can, and undoubtedly will, readily absorb the entire projected output of some 20,000 m.t. of KCl per year. It is assumed that the balance of the total projected output, amounting to 5,000 m.t. will be consumed in Iceland.

49.11. Apparent consumption of potassium chloride in the Scandinavian and European countries surveyed, in the years 1967 and 1971, was as follows:

Imports of Potassium chloride, KCl, 60-62%

In Metric Tons

	1967		1971	
	Quantity	cif $US	Quantity	cif $US
Norway	176,400	39.00	157,963	34.20
Sweden	160,993	38.20	171,429	35.40
Finland	68,608	29.45	230,694	31.00
Denmark	239,998	33.70	252,345	36.40
Netherlands	100,224	33.10	131,323	31.60
Belgium	652,930	35.30	451,704	31.50

The figures for Belgium are mis-leading because a considerable proportion of the imports are re-exported. (The balance is used in prepared fertilizers, much of which is also exported). In 1967, exports of 396,647 m.t. of KCl were reported, valued at US$ 35.10 per m.t. fob. In 1971, exports reported totalled only 5,556 m.t. with an fob value of US$ 32.35 per m.t. West Germany and France, of course, are the big European producers and principal exporters to world markets. The new Canadian production is gradually encroaching on European and world markets because of its high quality and competitive price.

49.12. Uses - Practically the only use in Scandinavia for potassium chloride is incorporated in mixed fertilizers. In several individual electrolytic chlor-alkali plants it is used for the manufacture of caustic potash where it replaces sodium chloride (common salt) as the electrolyte. Some KCl is processed in Belgium to make potassium sulphate (K_2SO_4) and potassium nitrate (KNO_3).

49.13. Price - APPENDIX IX shows that the cif prices have remained fairly constant over the period 1967 to 1971. Authoritative opinions expressed in all countries surveyed were to the effect that cif prices would probably increase during the next few years to US$ 36.00 to $ 37.00 per m.t. It is expected that the worldwide upward trend in prices already in evidence will continue as the demand gradually approaches the level of parity with productive capability in the industry which, since 1968, has been seriously overproduced. It is further expected that transportation rates on potash will also be increased during the next few years, and having the effect of increasing the aforementioned forecast cif price of US$ 37.00 above that figure.

49.14. The present fob price in Europe for potassium chloride, 60-62%, granular, in bulk quantities, is reported to be US$ 28.00-$ 30.00 per m.t. of KCl at Rotterdam, Antwerp or Hamburg. On sales of bulk potash it is customary for suppliers to allow one-half of one percent "weight-allowance" to compensate for losses in handling from ship to storage at points of destination. As with the cif prices, it is expected that the fob European ports' prices will improve slightly during the next few years and that a greater degree of stability will return to the markets as the supply/demand situation comes into better balance. Also, the industry is adjusting to the opening up of new markets in China and the Far East.

49.15. Customs duties - Duties on fertilizer materials are usually nil in all countries and potash is no exception. This situation conceivably could change upon the entrance of Norway and Denmark to the E.E.C., especially as Italy, France and West Germany are major basic potash producers and may insist on protection against American, Canadian, Israeli and East Bloc imports.

49.16. Marketing - Under present conditions there are no significant marketing problems associated with potash in the Scandinavian countries. One complicating factor, however, that sometimes comes to the surface is with regard to supplies of potassium sulphate (K_2SO_4). This is a major fertilizer ingredient in certain mixed fertilizer preparations and for use in some specialized applications such as tobacco which is the outstanding example where the chloride ion is not desirable. European producers of potash have been known to negotiate "couple sales" of potassium chloride along with requirements of potassium sulphate. This latter material is not nearly in as good supply position as the chloride salt, and when certain import requirements also include potassium sulphate formulations the pressure to purchase from the manufacturer or supplier of both products is quite impelling. One of the factors motivating the use of increasing quantities of potassium sulphate is the demand from growers for more sulphur in fertilizer mixes.

49.17. The marketing, and distribution, function for Icelands potash should definitely be handled by one of the established firms of "international traders" which know the markets and can arrange for vessels and deliveries in the most efficient and economical way. Only in this fashion will it be possible to prevent emotional or panic reactions on the part of other suppliers to the advent of new tonnage from Iceland into the marketplaces.

49.18. The product - The preferred grade of potassium chloride, fertilizer grade, 60 to 62% K_2O content, is granular. Other popular grades are coarse and standard. Supplies are purchased in bulk quantities by Norsk Hydro, for example, with cargoes from West Germany averaging 2,000 to 3,000 m.t., but from other sources bulk cargo lots run as high as 5,000 m.t. This pattern of shipment and delivery seemed to be customary with the various parties interviewed. Some deliveries are, of course, made in larger quantities in some special instances.

50. BROMINE

50.1. Introduction - An independent Market Study on bromine was prepared for the National Research Council in 1968 by a well-known consulting firm. No effort was made to elaborate on their findings. In the course of this investigation however, it was both practical and possible to gather some current information and data which was considered important for the purposes of the Project and the present Market Survey. The information and facts presented here are fragmentary and incomplete but they are important as they were gathered from sources believed to be reliable during interviews in the countries surveyed.

50.2. Norway - There is no production of bromine in Norway and as far as could be ascertained there is none used. Some bromine compounds are undoubtedly imported for use in pharmaceuticals and certain chemical compounds but only in minor quantities. The imported TEL anti-knock fluids used as additives to raise the octane number in petrol are, of course, manufactured in processes which consume important quantities of bromine compounds. Due to more stringent anti-pollution regulations and enforcement this market for lead alkyl additives is beginning to deteriorate and may be reduced to very small proportions within the next four or five years.

50.3. The general resistance to the continued use of TEL (tetraethyl lead) additives in petrol for automotive engines was evident in all countries surveyed and a rapid decline in its use appears certain. Responsible people are optimistic that losses of bromine consumption to be sustained in TEL business will be largely offset by growth in use of other bromine compounds, especially those used as flame-retardants and de-sizing agents for textiles. The concensus of opinion seems to be that the bromine industry may suffer a temporary set-back but will eventually recover and continue to expand at a modest rate towards the end of this decade.

50.4. Sweden - Here, as in almost all countries surveyed, the official statistics do not segregate bromine to show imports and exports, and trade figures are grouped in a classification with "other halogens, excepting chlorine". Statistical information is therefore unreliable with respect to bromine in most countries and, as a result, it is a time-consuming exercise to secure realistic information on production, imports, exports and apparent consumption in any individual country. Government statistices report 75 m.t. of "bromine and other halogens" imported to Sweden in 1971.

50.5. No indication of any direct use of bromine in Sweden was uncovered although several firms interviewed were importers of bromine compounds. The largest importer brought in about 50 tons of sodium and potassium bromides. The potassium bromide is used for photographic and pharmaceutical manufacture and sells for about 50 US cents per kg. Imports come from Israel, East Germany, Poland and Netherlands. Another large importer is bringing in about 10 m.t. of potassium bromide and 5 m.t. of sodium bromide per year, split between the U.S.S.R. and the Dead Sea Works in Israel. Another importer/exporter with extensive international connections emphasized the growing use of bromine compounds for flame retardants for textiles and plastics for treating materials used in hotels, public places and conveyances. He claimed that it is planned to treat all plastics used in the 1973 models of automobiles produced in the United States with flame retardants.

50.6. Finland - No useful information on bromine resulted from interviews in Finland. Very little, if any, bromine appears to be used although some bromine compounds undoubtedly are imported in some form or other. The observation was made that TEL in petrol is "on the way out" because of public opinion against atmospheric pollution by lead in exhaust fumes from automobiles.

50.7. Denmark - Bromine is being imported and consumed here in ever-increasing quantities, mostly for the manufacture of pharmaceuticals and certain specialty chemicals. It was learned from a very reliable source that consumption in 1971 was in the order of 100 m.t. and increasing quantities are visualized for the future. It is likely that the growth trend reflected in the published statistics, as listed in APPENDIX X, are indicative of the trend of bromine imports, and therefore annual consumptions. The statistical totals include "other halogens, except chlorine" but of the 134 m.t. imported under the category in 1971, it is reasonably certain that 100 m.t. were bromine. The balance was probably iodine and fluorine. Imports of bromine and other halogens come from Israel, East Germany, Netherlands, England and France, all of which are producers of bromine and bromine compounds. (Most of world's supply of iodine originates from Japan, Chili and the U.S.A.). In 1967 the actual government statistics recorded bromine imports of 28.5 m.t. valued at US$ 610.00 per m.t. as a separate item but discontinued this practice thereafter.

50.8. West Germany - It was learned on good authority that the volume of annual production of bromine is starting to decrease from a maximum level of about 3,000 m.t. per year. The waste brines from their potash operations from which the bromine is extracted are beginning to contain lesser percentages of bromine and hence costs of recovery are increasing as the quantities produced decrease.

50.9. The advent of huge bromine production at the Dead Sea Works in Israel, which by 1973 will have facilities capable of producing 20,000 m.t. per year, has shaken the established patterns of production and distribution in Europe. Israel is reported to have two special vessels which transport bromine to European and American ports. The Israelis have opened a bulk warehousing facility at Rotterdam to serve as a bulkbreaking point for trans-shipments to European, Scandinavian and U.K. consuming locations. The West German bromine industry is confronting a serious threat to its existence now that the relatively cheaper material from Israel is penetrating established markets along with the traditional competitive, but much smaller, bromine producers in France, Spain and Italy. Spain produces about 1,000 m.t annually in a novel operation by the direct oxidation of the bromine content of sea water for use in the manufacture of fumigants, fire extinguishing agents and flame retardant resins. Japan is another important world producer with 7,118 m.t. of elemental bromine in 1969 and 536 m.t. of potassium bromide.

50.10. A number of bromine compounds are produced from the elemental bromine for conventional purposes. Great Lakes Chemical Corporation of the United States and Chemische Fabrik Kalk G.m.b.H. of Cologne, have recently agreed to interchange technology, patents, and rights to manufacturing and marketing bromine flame retardants produced by both companies, according to a U.S. Bureau of Mines bulletin.

50.11. Deliveries in bulk are made in West Germany in lead-lined railway tankcars of 18 to 20 m.t. net capacity. One reputable dealer volunteered that selling prices in West Germany of bulk material are currently as follows:

For German bromine - US$ 435.00 per m.t.

For Israeli bromine - US$ 494.00 per m.t.

Shipments in bulk are now made only by rail but it is expected that road transport will be permitted in the near future. Another reliable source confirmed the above selling prices and it would appear that the market is meeting a supply/demand crisis and that product quality and service are becoming important factors.

50.12. Apparent trade of Bromine in W.Germany

YEAR	IMPORTS	VALUE	EXPORTS	VALUE
1967	318 m.t.	US$ 436/m.t.	112 m.t.	US$ 625/m.t.
1970	1,470 "	" 425 "	20 "	" 1,535 "
1971	1,046 "	" 425 "	400 "	" 545 "

Most of the 1971 exports were consigned to Switzerland and Poland. It would appear that the consumption of bromine in West Germany is increasing while domestic production is decreasing and the anomalous situation undoubtedly accounts for the suggestions made by several reputable import/export firms that they would be very interested in handling material from Iceland as, if, and when it becomes available, both for internal sale and for export.

50.13. Netherlands - No new information was gathered during interviews in The Hague and Amsterdam except that several import/export dealers expressed an interest in Iceland's projected production. It is evident that consumption is negligible although trade is growing because of the bulk warehousing facilities established by Israel at the port of Rotterdam which is so well located strategically for distribution purposes in Europe, Scandinavia and the U.K.

50.14. Belgium - The principal distributor of bromine in Brussels was able to confirm the accuracy of the import statistics as shown for Belgium, and as tabulated in APPENDIX X. Consumption was only about 14 m.t. in 1971 although there are indications that some new demands may develop soon. The present demand which has remained static over the last ten years is almost entirely for pharmaceuticals. One new project in view is for a flame retardant for flame-proofing paper although the consumption is expected to be small in the initial stages.

50.15. Bromine for Belgium originates from West Germany where supplies are becoming short. Shipments to Belgium are made in glass bottles, packed four to a box, with a net weight of 15 kg. per box. The bottles are packed, or stabilized, in the box with kieselguhr or other similar inert material. The cif price of US$ 780.00 reflected in the statistics is realistic, to which the dealer adds his charges for warehousing, handling and profit. Dealers are well aware of the strong position being built up by Israeli dealers in the Netherlands and elsewhere in Europe and the U.K. and expect more aggressive competition for business in future along with the possibility of slightly lower selling prices as competitive pressures increase. One dealer in Antwerp who formerly handled bromine no longer does so because of low volume and competitive activities.

50.16. United Kingdom - Associated Octel is by far the largest producer, reportedly with an annual capacity of about 16,000 m.t., of which about 14,000 m.t. are used captively in the manufacture of TEL fluids for petrol additives. Two other much smaller producers of bromine from sea-water formerly handled the balance of the commercial requirements not served by Octel; however, it was reported that the smaller of the two, producing about 1,000 m.t. per annum, had recently ceased operations because it became uneconomical to continue. Israeli competition, which is aggressive and intelligent, was given as one of the reasons for closure. The remaining smaller producer is still in business but his total annual output is considerably more than his former small competitor.

50.17. Apparently Associated Octel is beginning to feel the effects of cut-backs in the demand for TEL and may be facing problems of over-production of bromine. Hopefully, the increasing consumptions visualized for use in flame retardants, potassium and sodium bromides for pharmaceuticals, and organic bromides for fungicides and algaecides, which are being developed to replace the mercury compounds that are coming into disrepute bocause of the hazards of environmental pollution which they create, will alleviate a potentially serious supply /demand situation in the industry.

50.18. Berk Ltd. is probably the largest consumer of bromine for flame retardants. May & Baker are reported also to be large users for their line of organic bromides. These two companies are thought to use a total of about 5,000 m.t. of bromine per annum. Lunevale Products Co; which was recently purchased by Great Lakes Chemical Corp; and Ciba - Geigy use bromine for pure chemical compounds and for pharmaceuticals, fungicides and algaecides, other bromine products and intermediates.

50.19. It is estimated that current consumption in the U.K. is between 8,000 and 9,000 metric tons if the quantity used for TEL manufacture is excluded. The "going price" for bromine in bulk is about 17 1/2 US cents per pound (US$ 385.00/ m.t.) but the larger buyers undoubtedly pay something less for contract purchases. Some Israeli bromine is already being sold in England. As tabulated in APPENDIX X, imports to the U.K. in 1970 and 1971 were 1,820 and 2,390 metric tons, respectively. It is not possible to determine values from the published statistics and no other pricing information was made available.

50.20. <u>United States</u> - Bromine is recovered from well brines in Arkansas and Michigan and from the alkaline deposits at Searles Lake in California by six different companies. The one plant in Texas which produced bromine from sea water was closed down in 1969 because this method was more expensive than recovery from brines. Production in 1970 was reported to be about 164,200 m.t. Installed annual capacity is estimated at 200,000 m.t. The manufacture of ethylene dibromide, a major constituent in the manufacture of tetraethyl lead, accounts for about 73 percent of consumption. Bromine and bromine compounds consume about 22 percent and methyl bromide about 5 percent.

50.21. In 1969, consumption of bromine in the United States was accounted for as follows:

	In metric tons		Value
	Quantity	Br_2 content	US$(1000)
Elemental bromine	27,800	27,800	12,276
Ethyl bromide	800	575	677
Methyl bromide	8,400	7,150	6,902
Other, including ethylene dibromide, sodium bromide, ammonium bromide, and potassium bromide.	142,883	117,750	70,975
TOTAL	179,883	153,275	90,830

50.22. In addition to the major use in the manufacture of ethylene dibromide used mainly as a lead scavenging agent in antiknock gasoline additives (TEL), other applications for bromine and bromine compounds include fire extinguisher charges; flame retardants for plastics, textiles, and other materials; pharmaceuticals; photographic chemicals; intermediates; agricultural chemicals; sanitizers; hydraulic and gauge fluids; and water treatment chemicals. The foregoing statistics and information orginated with the U.S. Bureau of Mines, Washington, D.C.

50.23. As far as could be determined in the interviews and from published information and statistics, no elemental bromine is imported into the United States. The statistics shown in APPENDIX X, which include imports of iodine from Chili amounting to almost the total shown, bear this out. Some bromine compounds, however, are imported, chiefly potassium bromide and ethylene dibromide from West Germany. The customs duty on bromine entering the U.S.A. is currently 5 cents per pound (US$ 110.25 per m.t.), this effectively discouraging importations.

50.24. The outlook for continuance of the historical annual growth rate of 3 to 5 percent is pessimistic because of the predictable curtailment of lead alkyls in automotive gasolines and the consequent lessened demand for ethylene dibromide. Some observers in the trade, according to Chemical Marketing Reporter, forecast a declining market of 5 to 10 percent per year in the foreseeable future. These observers believe the inevitable decline can only be offset to any appreciable extent by the rapid growth expected for bromine in such uses as flame retardants and textile processing. This is considered to be a big "if".

50.25. The anticipated demand for flame retardant chemicals in 1972 is 136,000 m.t. and by 1977 the volume is expected to double, according to Stauffer Chemical Company forecasts published in Chemical Marketing Reporter. Three years ago this market totalled about 13,600 m.t. New government regulations and standards are expected by Stauffer to push the demands to forecast levels as shown in the following table:

Fire - Retardant Outlets - In M.T.

	1972	1977
Carpets and rugs	94,000	128,000
Construction	17,900	38,600
Electrical/Electronics	6,800	20,300
Apparel	1,000	4,500
Home furnishings	2,100	12,400
Transportation	6,200	36,200
Misc. Non-Durables	8,000	17,000
TOTALS	136,000	257,000

50.26. Chemical Marketing Reporter in the U.S.A. published bromine prices as follows:

	Price per lb.
Bromine, purif., cs., cl., t.l., dlvd.	US$ 0.49
" , in returnable dms., c.l.,t.l.,dlvd.E. of Rockies	0.30
" , bulk, t.c.,t.t.(45,000 lb. min), dlvd. E. of Rockies	0.17

NOTE: Dlvd. prices for dms. and bulk shipped W. of Rockies, 1 cent per lb. higher. Bulk T.T. prices are 1 cent per lb. higher for 30,000 lb. min. and 2 cents per lb. higher

for 15,000 lb. min. Prices fob Midland and Ludington, Michigan, frt. equalized are 1 cent per lb. lower.	US$
Ethyl bromide, tech.,98%,dms.c.l., frt.all'd. East	0.68
Ethylene dibromide, dms.,cl.frt. equalized	0.25
" tanks,frt.equal'd.	0.20
Potassium bromide, NF, gran.dms.,c.l.	0.43 1/2
Potassium bromate, gran.,powd.,200 lb.dms., c.l.,frt.all'd.,	0.64

50.27. As mentioned in the reports gathered in Scandinavia and Europe, a similar trend for bromine consumption is expected there with the overall market showing no great tendency to growth but rather a struggle to prevent deterioration from reaching seriously low levels. In any case, the U.S. market appears to be adequately served with bromine and bromine compounds and particularly in view of the extremely high tariff on imports, the prospects for Iceland's bromine in this market are poor indeed.

50.28. Canada - No import statistics are published, as indicated on APPENDIX X, and as no bromine is produced in Canada there are also no exports. There are, however, two large manufacturers and consumers of bromine compounds, namely Ethyl Corporation Canada Ltd. and DuPont Canada Limited, both subsidiaries of large U.S. multi-national corporations and share the market for lead alkyl additives for automotive ethylene dibromide for TEL and MEL additives and also other bromine compounds consumed in Canada. Supplies of bromine and whatever other bromine chemicals are required to produce the lead alkyl additives, as well as for pharmaceutical, photographic and other purposes, and which are not actually manufactured by either of these two companies, are imported from their American parents. Imports of ethylene bromide in 1971 were 7,057 m.t. valued at US$ 2,143,000. (US$ 304.00/m.t.) all coming from U.S.A.

50.29. Bromine is not produced in Canada and therefore may be imported free of duty. Because of time limitations it was not possible to determine the total potential Canadian market which is relatively small at the present time. The potential market, exclusive of that imported by U.S. subsidiaries from Ethyl Corp. and DuPont, is estimated to be in the order of 25 m.t. per year. This market should, however, be attractive to Iceland and strong efforts should be made to develop a substantial sales outlet when material becomes available. The demand in Canada is bound to grow and if for no other reason, bromine from Iceland may be desired as an alternative or "other" source of supply to one of the American suppliers.

51. LITHIUM

51.1. Introduction - The investigation on lithium compounds was definitely superficial because there are no firm plans available as to the precise chemical compounds which will be produced in Iceland. The most common forms in which lithium is traded are lithium carbonate and lithium hydroxide monohydrate. West Germany imported about 30 m.t. of lithium chloride from the U.S.S.R., U.S.A. and E.E.C. countries in 1971 and about the same each year since 1968.

51.2. The statistics published in all the countries surveyed are not meaningful as lithium and lithium compounds are grouped with "rare earth and alkaline earth metals, including yttrium and scandium". The tabulation given in APPENDIX XI is therefore very inadequate and can only be viewed as indicative of trends of imports for all these materials combined.

51.3. Norway - No imports are reported in Norway and no valid evidence was gathered in any of the interviews to indicate that any consumption existed or was contemplated.

51.4. Sweden - The situation here was more encouraging as there are several consumers, the principal being the four manufacturers of alkaline batteries which use a combined total of about one metric ton per year of lithium hydroxide. Some of the imported lithium carbonate comes from South Africa which apparently is a major source of supply for many countries. Lithium Carbonate is used in fluxes for brazing precious metals and for enamelling. Lithium is the most expensive of all the alkali metals. Another large importer in Göteberg stated that they sell small quantities of lithium hydroxide and lithium carbonate. A larger importer in Göteberg indicated sales of lithium compounds amounting to about 50 m.t. and valued at about US$ 50,000.00 in the ratio of about 35 m.t. of hydroxide to 15 m.t. of the carbonate. The carbonate is used mostly in the glass industry and the hydroxide in the manufacture of greases. This firm also imports spodumene from Foote Mineral in the U.S.A. It would appear, in summary, that the present market in Sweden consumes about 50 m.t. of lithium hydroxide and 25 m.t. of lithium carbonate. This estimate is in line with the import statistics which report 75 m.t. of lithium and other compounds in 1971.

51.5. Finland - No specific information resulted from interviews beyond the statistics which are of doubtful value as shown in APPENDIX XI.

51.6. Denmark - One reliable manufacturer tried to ascertain some helpful information and all he could find was that very little lithium is consumed in the country.

51.7. West Germany - Imports are grouped so as not to disclose classified information. One large import/export dealer said that they have their own lithium mine (spodumene) in South Africa and import to Germany but they do not transform it into salts themselves. This firm stated that demand for lithium chloride was increasing, much of it going into air drying for use in the space programme and new consumption is anticipated for nuclear fusion. The use pattern for lithium compounds in Europe was believed to be as follows:

Glass and ceramics	-	40%
Grease	-	25
Air drying for space programme	-	10
Pharmaceutical	-	11
Alkaline batteries and misc.	-	14

51.8. Another multi-national firm in Frankfurt advised that Montacatini-Edison in Italy had produced lithium compounds and some sales had been made in Germany. This trade has ceased, however, as the imports are not competitive and Germany has a better and more economical raw material base for manufacture. This person also advised that one large German importer brings in spodumene from Quebec Lithium Corporation in Canada and this is one of the items which contributes to the comparatively large importations of "lithium compounds" reported in the statistics. It is reasonable to assume that Iceland can develop a satisfactory market here for lithium carbonate and lithium hydroxide.

51.9. Netherlands and Belgium - Interviews in these countries failed to produce any new information except that Belgium-Luxembourg reports imports of 92.6 m.t. of lithium chloride in 1971 valued at US$ 131.80 per m.t. The countries of origin were France and Canada. Imports of 1.6 m.t. in the

Netherlands came from France, West Germany and U.S.A. Several large dealers in Amsterdam believe the demand for lithium compounds will grow and expressed an interest in Iceland's products.

51.10. Great Britain - The import statistics are not meaningful and very little could be learned of consumption except that the demand was increasing. One reputable dealer expressed a desire to be kept informed of Iceland's product and suggested that annual quantities for re-sale in the range of 200 m.t. would be realistic.

51.11. United States - Domestic output of lithium minerals and lithium carbonate has been mostly from brines. This production is diminishing because of unfavourable economics and the best prospect for future domestic supplies is from the bitterns resulting from the gigantic mineral complex being developed at Great Salt Lake, Utah. Process problems have caused serious delays in production of all mineral values and manufacturers of lithium chemicals have to rely on imports to supplement domestic supplies.

51.12. Most of the imports of lithium minerals come from South Africa. Supplies from Rhodesia have been discontinued because of sanctions against that country. Imports of organic lithium salts came mostly from Japan with minor quantities from Canada and West Germany, totalling 26,951 pounds valued at US$ 12,195.00 in 1968.

51.13. The prices of lithium metal and compounds published in the May 8, 1972 issue of Chemical Marketing Reporter, New York, are as follows:

	Price in lb.
Lithium bromide, anhyd.drums,ton lots,dlvd.	US$ 1.70
" " ,sol´n.,same basis	1.04
Lithium carbonate, pow.,dms.,c.l.,t.l.,dlvd.	.50 1/2
" " ,10,000 lbs.to t.l.,same basis	.54 1/2
(NOTE: Annual contract quantities of 500,000 lbs. or more cost 4 ₵ less than t.l. price)	
Lithium chloride, anhyd.,c.l.,t.l.,dlvd.	.89
" " ,l.t.l., same basis	.91
" " , sol´n.,c.l.,t.l.,dlvd.	1.05
Lithium fluoride, dms.,c.l.,t.l.,dlvd.	1.56
Lithium hydride, c.l.,t.l.,dlvd.	8.05
Lithium hydroxide, monohydrate, dms., c.l.,t.l.,dlvd.	.61
Lithium hypochlorite,c.l.,t.l., works	.33
Lithium metal, 1,000-lb. lots or more,dlvd.	8.18
Lithium nitrate, tech.,dms.,100 lb.lots	1.25
Lithium stearate, 50-lb. ctns.,c.l.,frt.alld.	.58
" " ,ctns.,l.c.l.,ton lots,same basis	.59

Fused lithium stearate is 3c. per lb. less.

Lithium sulfate. dms.,100-lb. lots	US$ 1.20

51.14. The large dealers in the U.S.A. are all aligned with one of the basic manufacturers such as Lithium Corporation of America; Foote Mineral Co.; or Kerr-McGee Chemical at Trona, California. Ad valorem tariffs in 1969 on lithium metal were 20% and on lithium compounds 8% while lithium mineral concentrates were duty free. No import statistics are published for lithium or its compounds.

51.15. The foregoing price list is indicative of the numerous chemicals which are produced in the United States for a wide variety of applications, including greases; air conditioning; ceramics; metallurgy; welding and brazing; swimming pool sanitation; and the production of hydrogen. Recent reports tell of a newly developed lithium sulphide battery which could be the power source for an all-electric automobile within ten years. Alkaline batteries reportedly can produce, pound-for-pound, from ten to one hundred times more electricity than the commonly-used lead-acid battery. They are powered with water and a light alkali metal such as sodium or lithium.

51.16. Canada - The two principal lithium mineral deposits, in Lacorne township, Quebec, and at Bernic Lake in southeastern Manitoba, are pegmatities which contain spodumene as the main ore mineral. The Quebec Lithium Corporation has a

20 million ton spodumene ore deposit and a capacity to produce 5 million pounds of lithium carbonate and 2 million pounds of lithium hydroxide monohydrate per annum. Production has ceased, however, because of a world-wide over-supply situation and the imposition of effective tariff barriers by certain countries which prevents profitable export trade to the larger consuming nations. Shipments continue to be made from inventories in certain cases. It is not known when this unfortunate situation will right itself. It is assumed that the same dilemma faces the producer in Manitoba whose operations are on a much smaller scale.

51.17. The main uses for lithium compounds in Canada are enamelling; brazing fluxes; and automotive greases. Two oil refineries produce lithium greases and produce the compounds "in situ" at their grease plants. A small quantity of lithium hydroxide is used by one chemical specialty manufacturer interviewed for lithium stearate which is used as a lubricant in powder metallurgy. No prices for lithium compounds are published and there is a definite reluctance to divulge them. As was the case in the United States, no import or export statistics are published.

[illegible]

FORECAST OF MARKETS AND PRICES

52. PREAMBLE

The information to be presented here is the "key" to the entire Survey. Reporting of the information and impressions gained from interviews and numerous other sources pertaining to the various countries visited was given at considerable length in the SURVEY section. The many facts and details recorded were deemed important as being contributory to the peculiar circumstances and conditions associated with the different products and future operations of the Sea Chemicals Plant. In some cases in reporting on markets for bromine and lithium, mention is make that inadequate information was obtainable. Actually, the scope of the Survey was extended to include only a superfical investigation for these two items which could be conducted simultaneously with the other major products. To secure more details would have entailed considerable extra time.

53. It is further believed that the many first-hand details and situations recorded about the products; consumption patterns; industry trends; markets and marketing; etc. will provide a useful background, not only for the purposes of this Survey, but for the people who will eventually be actively concerned with implementation of the Project and the marketing of the products. The forecasts, by countries and

products, are based on reliable facts gained from personal interviews with official and authoritative sources and verified by checking and cross-checking with others. Further substantiation was gained from written information accumulated during the course of the Survey and from the technical and trade press, personal files and experience, etc. Great effort was made to minimize the basing of forecsts and recommendations on unsubstantiated opinions, feelings, conjecture, imagination and to the use of generalities.

54. In presenting the forecasts, only significant information has been included and irrevelant or inconsequential statistical details have been omitted. The ocean freight rates applicable to Scandinavia and European ports used in arriving at the probable net-back prices, fob. Straumsvík, Iceland are listed on APPENDIX XIII. It should be noted that any increases or decreases in ocean freight rates, which are very competitive, will be general and will also apply to all imports which Iceland's material will have to compete against. As the proportionate element of ocean freight costs included in cif prices applicable to Iceland's products is, on average, considerably greater than for shipments, say, from Liverpool, Antwerp or Hamburg to Scandinavian ports, the average net-backs at Straumsvík will be relatively more adversely effected by freight rate increases than for the products of most

competitors. It should be noted that it is not possible to forecast the percentage increase in freight rates up to 1980 with any degree of accuracy; a view which was emphasized by the responsible officials of steamship lines and others interviewed. Quoted rates can usually be improved upon at the time when actual movement of goods is imminent.

55. In the calculations of probable net-backs from sales, fob Straumsvík, no provision is included for payments to sellers or distributors of commissions or fees, or for sales expenses other than the port-to-port ocean freight costs. In the estimates prepared for Scandinavia and Europe it was assumed that Iceland would be competing almost entirely with cif prices. Iceland's potential market objectives will be, essentially, that proportion of total consumption of each of the products which is served by imported material. Iceland cannot expect to displace domestically manufactured materials. For this reason, no provision has been allowed either in the estimated ocean freight rates listed in APPENDIX XIII, or elsewhere, for the cost of unloading cargoes from vessels. The time factor for the vessel while loading and unloading in port has been included in the freight rates. Loading costs at Straumsvík are included in the fob cost. The estimates prepared for the United States and Canada, however, include an allowance for unloading as the situations there are expected to be different.

56. Another "hidden" element of cost, which has not been included in any of the estimated net-back prices, fob Straumsvík, is the customary weight loss allowance of 1/2 of 1% for loss of weight in handling bulk material. It will be prudent to also provide for some potential breakage and loss to shipments in bags. This Survey assumes that provisions for such losses will be included in the price build-up for the various products, fob dock at Straumsvík.

57. In presenting estimates of fob and cif costs, this Survey has made no provision for Selling Expenses inherent to marketing, distribution and servicing of the products of the Sea Chemicals Plant. Salaries and expenses of a top-flight Director of Marketing and his staff, travel, advertising and other incidental costs chargeable against sales or gross profit will be a significant item on the Balance Sheet.

58. Another major assumption applying to the sales effort for all the products in order to gain satisfactory penetration in all the logical markets is the absolute necessity of pursuing aggressive and intelligent marketing policies. Iceland's products must displace imports presently being supplied by the large multi-national corporations and each of them will strongly resist new competition which threatens them with loss of business and prestige. The value of working through local manufacturers, importers and distributors which have

an intimate knowledge of markets and consumers cannot be over-stated.

59. POTENTIAL MARKETS & TRADE BALANCES

In planning a sales strategy for Iceland's chemicals it will be prudent to take into consideration the Balance-of-Trade position between Iceland and the countries where particular emphasis is planned for exploiting business potential. This unfavourable balance may now be converted or at least alleviated by sales of Iceland's new chemical products. See table below:

Potential Export Markets - By Trade Balance
In '000 US$

COUNTRY	Trade Balance - or -		
	1969	1970	1971
West Germany	- 11,419	- 7,853	- 24,436
Denmark	- 5,622	- 11,230	- 11,628
Netherlands	- 3,966	- 8,169	- 11,351
U.K.	- 619	- 3,051	- 10,066
Norway	- 5,983	- 6,332	- 8,177
Sweden	+ 693	+ 1,830	- 6,185
France	- 1,421	- 2,980	- 4,024
Belgium	- 1,596	- 1,314	- 3,223
U.S.S.R.	- 343	- 1,073	- 2,658
Finland	- 701	- 1,734	- 2,126
Canada	- 272	- 226	- 653
East Germany	- 539	- 90	- 325
Luxemburg	- 20	- 27	- 105
Ireland	+ 172	+ 244	- 66
Greenland	- 132	- 5	+ 1
Poland	- 131	- 497	+ 119
Faeroe Islands	+ 1,146	+ 1,381	+ 1,185
U.S.A.	+ 19,092	+ 31,285	+ 22,631

60. Another possible benefit for Iceland will be derived from ocean transportation where the adverse Balance-of-Trade, in terms of tonnage received versus tonnage exported, can be used as a lever to negotiate more favourable ocean rates than might otherwise be possible. The cargoes of chemicals will fill otherwise empty holds on out-going vessels. In 1971, the adverse balance amounted to about 214,800 metric tons. The planned production of chemicals for the UNIT I stage of the Project to be attained during the third year of operation is in the order of 275,000 m.t. consisting essentially of salt, calcium chloride and potassium chloride.

61. ICELAND

Forecast Consumptions

SALT - FISHERY "COARSE"

CONSUMPTION	ACTUAL 1971	FORECAST 1975	FORECAST 1980
Imports - m.t.	51,004	51,000	53,000
cif Value - US$/m.t.	17.05	-	-
- minimum	-	17.00	17.00
- maximum	-	20.00	19.00

COMMENTS - Some human and animal salt is also imported. It is anticipated, of course, that imports of fishery grade will be entirely replaced by the product of the Sea Chemicals Plant.

Experience with the new Iceland salt will be invaluable in promoting sales abroad, particularly because users of fishery salt are reluctant to switch brands as they fear changes in their final products. Introduction of Iceland's salt to the fish treating plants may be a slow process before enough confidence is gained to purchase it in large quantities. Present supplies for Iceland's fishing industry are imported from Italy, Spain and Tunisia.

SODA ASH, 58%, Light, in Bags

CONSUMPTION	ACTUAL 1971	FORECAST 1975	1980
Imports - m.t.	2,362	2,300	2,500
cif Value - US$/m.t.	44.45	-	-

POTASSIUM CHLORIDE, 60-62% K_2O

CONSUMPTION	ACTUAL 1971	FORECAST 1975	1980
Imports - m.t.	3,910	5,300	5,900
cif Value - US$/m.t.	45.80	-	-

PRICES - The matter of pricing to domestic consumers will have to be determined internally at the appropriate time.

62. FAEROE ISLANDS

Forecast Consumption & cif Values

SALT - FISHERY "COARSE"

CONSUMPTION		ACTUAL 1971	FORECAST 1975	FORECAST 1980
Production	- m.t.	NIL	NIL	NIL
Imports	- m.t.	17,695	19,000	20,000
Consumption	- m.t.	17,695	19,000	20,000
cif Value	- US$/m.t.	12.50	-	-
	- minimum	-	11.00	11.00
	- maximum	-	13.00	13.00

COMMENTS - This is the most logical export market for Inceland's salt and the measure of success achieved in gaining entrance here will undoubtedly be reflected in efforts to secure business in Greenland, Norway, Sweden and Canada. Imports of fishery salt originate in Italy, Spain and Tunisia. Imports of other of the projected chemicals are negligible.

SHARE OF MARKET EXPECTED

The objective should, of course, be to gain 100% of the total requirements.

Forecast share of market & Net-back prices

YEAR	SHARE	CIF VALUE	FREIGHT	FOB STRAUMSVÍK
1976	6,000 (31%)	11.50	4.00	7.50
1977	10,000 (52%)	11.50	4.00	7.50
1978	15,000 (75%)	12.00	4.00	8.00
1979	20,000 (100%)	12.00	4.00	8.00
1980	20,000 (100%)	12.50	4.00	8.50

63. **GREENLAND**

Forecast Consumption & cif Values

SALT - FISHERY "COARSE"

CONSUMPTION		ACTUAL 1971	FORECAST 1975	FORECAST 1980
Production	- m.t.	NIL	NIL	NIL
Imports	- m.t.	4,099	5,000	6,000
Consumption	- m.t.	4,099	5,000	6,000
cif Value	- US$/m.t.	19.50	-	-
	- minimum	-	16.00	16.00
	- maximum	-	20.00	20.00

COMMENTS - This is another logical market for Iceland salt and no great problems should be encountered here provided the salting plants find they can produce as good or better product than with the salt presently imported from Spain and Italy. Imports of other chemicals are negligible. All the salt and chemical requirements are purchased by the Royal Greenland Trade Corporation, Copenhagen.

SHARE OF MARKET EXPECTED

The objective should, here again, be to gain 100% of this potential business.

Forecast share of market & Net-back prices

YEAR	SHARE	CIF VALUE	FREIGHT	FOB STRAUMSVÎK
1976	2,000 (40%)	17.00	4.50	12.50
1977	4,000 (77%)	17.00	4.50	12.50
1978	5,000 (90%)	17.00	4.50	12.50
1979	5,500 (95%)	17.00	4.50	12.50
1980	6,000 (100%)	17.00	4.50	12.50

NOTE: Freight rate to Greenland is based on the east coast port of Angmagssalik.

64. NORWAY

Forecast Consumptions and cif Values

64.1. CALCIUM CHLORIDE, 77-80% flake, bags

CONSUMPTION		ACTUAL 1971	FORECAST 1975	1980
Production	- m.t.	30,000	30,000	30,000
Imports	- m.t.	45,883	45,000	42,500
Consumption	- m.t.	75,883	75,000	72,500
cif Value	- US$/m.t.	49.80	-	-
	- minimum	-	43.00	40.00
	- maximum	-	50.00	45.00

COMMENTS - Approximately 65% of the consumption of calcium chloride is used on government and municipal roads for dust-control in summer. Much lower quantities are used by municipal authorities for de-icing in winter. The Government Roads Department will apply at about the same rate until 1975, after which consumption will begin to decrease. Some moderate increase in consumption for other purposes can be expected. Prices of domestic produced materials generally conform to the cif cost of imports at points of consumption. Some price erosion is anticipated on imports from Europe due to over-production brought about by the effects of anti-pollution legislation but higher transportation costs and other inflationary tendencies will be off-setting factors.

Forecast share of market & Net-back prices

	Share of Mkt.		US$ per metric ton		
YEAR	M.T.	%	CIF VALUE	FREIGHT	FOB STRAUMSVÍK
1976	5,000	11	38.00	6.75	31.25
1977	6,500	14	38.00	6.75	31.25
1978	8,000	18	39.00	6.75	32.25
1979	10,000	23	39.00	6.75	32.25
1980	12,000	28	39.00	6.75	32.25

64.2. SODA ASH, 58%, light & dense, in bags

CONSUMPTION		ACTUAL 1971	FORECAST 1975	FORECAST 1980
Production	- m.t.	26,137	26,200	26,200
Imports	- m.t.	35,218	38,800	48,800
Consumption	- m.t.	61,355	65,000	75,000
CIF VALUE	- US$/m.t.	48.50	-	-
	- minimum	-	46.00	47.00
	- maximum	-	50.00	51.00

COMMENTS - All the domestic production is light grade material and the largest percentage is shipped in bags although some deliveries are made in bulk. The cif values, however, represent a composite of bagged and bulk prices for light and dense grades. The dense material is imported mostly for use in the manufacture of glass. Imports of soda ash have shown a steady annual increase and the upward trend is expected to continue. No evidence of increased production of domestic material was gathered during interviews and at foreseeable levels of consumption it can be expected that importations will increase with domestic production levels remaining constant.

Forecast share of market & Net-back prices

	Share of Mkt.		US$ per metric ton		
YEAR	M.T.	%	CIF VALUE	FREIGHT	FOB STRAUMSVÍK
1976	5,000	13	47.00	8.75	38.25
1977	7,500	18	47.00	8.75	38.25
1978	10,000	24	48.00	8.75	39.25
1979	14,000	31	48.00	8.75	39.25
1980	18,000	37	49.00	8.75	40.25

NOTE: Shipments of dense grade, in bulk, will not bear the charge for bagging and, therefore, should be equally profitable at the fob Straumsvík level.

64.3. CAUSTIC SODA - LIQUID 50% (Basis 100%)

CONSUMPTION		ACTUAL 1971	FORECAST 1975	FORECAST 1980
Production	- m.t.	70,000	75,000	85,000
Imports	- m.t.	6,390	10,000	10,000
Consumption	- m.t.	76,390	85,000	95,000
CIF VALUE	- US$/m.t.	59.30	-	-
	- minimum	-	58.00	58.00
	- maximum	-	64.00	64.00

COMMENTS - Any manufacture of caustic soda in Iceland will undoubtedly be liquid grade and therefore no forecast is included for solid and flake grades. Meaningful international trade is invariably in bulk shipments of liquid 50%. Production from the two Norwegian manufacturers can be expected to increase as new consumptions develop to meet normal growth demands. The pulp and paper industry, now in world-wide recession, is beginning to recover and their return to normal demands will require gradually increasing quantities of both chlorine and caustic soda over the next decade. It is unlikely that the two established manufacturers will permit imports to reach significant proportions. Only in special cases, therefore, are imports necessary, or economical. Domestic manufacturers are quite content to tolerate minimal imports to supplement their own productions and when the volume of imports become high enough to warrant expansion of productive capacities they are not backward in doing so. Without previously arranged market outlets it is impossible to suggest a meaningful export potential for Iceland at this time.

64.4. CHLORINE, LIQUID

CONSUMPTION		ACTUAL 1971	FORECAST 1975	FORECAST 1980
Production	- m.t.	60,000	65,000	76,000
Imports	- m.t.	NIL	NIL	NIL
		60,000	65,000	76,000
Exports	- m.t.	10,650	2,000	2,000
Consumption	- m.t.	49,350	63,000	74,000
FOB VALUE	- US$/m.t.	43.20 (on exports)	-	-
	- minimum	-	40.00	40.00
	- maximum	-	45.00	45.00

COMMENTS - Practical and economic difficulties mitigate against exports or imports of chlorine in any sizeable quantities. The unique export movement in bulk between Norway and Northern Ireland which operated for several years was discontinued in 1971. The only foreseeable exports henceforth are accommodation sales to Sweden. No cif values are available for importations. The two domestic manufacturers will undoubtedly install increased facilities to meet expanding requirements at the appropriate time. Further, it is impractical and, most probably uneconomic, to ship liquid chlorine, as such, from Iceland. If relatively large quantities of liquid chlorine become available as a by-product, the only practical and economic means of over-coming the problem of disposal is to convert it into some "shipable" form, such as calcium chloride; superphosphate fertilizers (using the Israeli process which acidulates phophate rock with hydrochloric acid instead of the customary sulphuric acid); dicalcium phosphate fertilizer and/or animal feed additive, or vinyl chloride monomer. Without reservation, this was the view of everyone interviewed in ten countries in addition to the writer's long experience with situations of this nature.

64.5. SALT

CONSUMPTION		ACTUAL 1971	FORECAST 1975	1980
Production	- m.t.	NIL	NIL	NIL
Imports (i.e.Consumption)				
Vac.pan	- m.t.	182,322	200,000	220,000
Solar	- m.t.	133,816	140,000	160,000
Rock	- m.t.	54,309	65,000	75,000
CIF VALUE				
Vac.pan	US$/m.t.	15.10	-	-
	- minimum	-	12.50	13.00
	- maximum	-	14.50	15.00
Solar	US$/m.t.	11.40	-	-
	- minimum	-	10.50	11.00
	- maximum	-	12.50	13.00
Rock	US$/m.t.	9.80	-	-
	- minimum	-	9.50	9.50
	- maximum	-	11.00	11.00

COMMENTS - The major consumers of vacuum pan salt are the two chlor-alkali manufacturers and their requirements are expected to show a modest increase when they install additional production facilities to meet greater demands. Solar salt will likely increase as some slight growth in the demands by the fishing industry is expected. Rock salt for de-icing of roads and for use in food processing and other industries is also expected to show a modest increase. Severe competition can be expected, however, from Akzo´s plants in Denmark and the Netherlands and I.C.I. at Liverpool as well as from Mediterranean sea salt producers. Norway does have a substantial requirement for high purity salt if it can be obtained at what they consider to be a "right price" and this appears to be a market which Iceland must seek.

Forecast share of market and Net-back prices

VACUUM PAN SALT

	Share of Mkt.		US$ per metric ton		
YEAR	M.T.	%	CIF VALUE	FREIGHT	FOB STRAUMSVÍK
1976	50,000	25	12.50	6.00	6.50
1977	60,000	29	12.50	6.00	6.50
1978	75,000	36	13.00	6.00	7.00
1979	85,000	40	13.50	6.00	7.50
1980	100,000	45	14.00	6.00	8.00

Forecast share of market and Net-back prices

FISHERY " COARSE" SALT

YEAR	M.T.	%	CIF VALUE	FREIGHT	FOB STRAUMSVIK
1976	7,000	5	11.50	6.00	5.50
1977	12,000	8	11.50	6.00	5.50
1978	20,000	13	12.00	6.00	6.00
1979	30,000	19	12.00	6.00	6.00
1980	40,000	25	12.50	6.00	6.50

64.6. POTASSIUM CHLORIDE, 60-62% K_2O, Bulk

CONSUMPTION		ACTUAL 1971	FORECAST 1975	FORECAST 1980
Production	- m.t.	NIL	NIL	NIL
Imports	- m.t.	157,963	200,000	275,000
Consumption	- m.t.	157,963	200,000	275,000
CIF VALUE	- US$/m.t.	34.20	-	-
	- minimum	-	35.00	36.00
	- maximum	-	38.00	40.00

COMMENTS - The use of potassium chloride in prepared fertilizers is increasing on a world-wide scale and the Norweigian fertilizer industry is constantly expanding with much of the production being exported. This is the most logical market for Iceland's potash. Sales of potash on world markets are transacted by a select group of international traders.

Discussions with several of these firms gave the clear indication that the 20,000 m.t. to be available could be disposed of with ease. There is every indication that Norway would be the country of destination for the entire quantity.

Forecast share of market & Net-back prices

YEAR	SHARE	CIF VALUE	FREIGHT	FOB STRAUMSVÍK
1976	20,000	36.00	8.00	28.00
1977	20,000	37.00	8.00	29.00
1978	20,000	37.50	8.00	29.50
1979	20,000	37.50	8.00	29.29.50
1960	20,000	38.00	8.00	30.00

NOTE: Iceland's share of market would be about 7%

64.7. BROMINE

No production, imports or consumption of bromine were identified in Norway. At the appropriate time when a demand arises this will be a potential market which should be capable of exploitation by Iceland.

64.8. LITHIUM COMPOUNDS

No production, imports or consumption of lithium compounds were identified in Norway. At the appropriate time, as for bromine, this will be a logical market to be developed.

65. **SWEDEN**

Forecast Consumptions and cif Values

65.1. CALCIUM CHLORIDE, 77-80% flake, bags

CONSUMPTION		ACTUAL 1971	FORECAST 1975	FORECAST 1980
Production	- m.t.	70,000	70,000	70,000
Imports	- m.t.	75,500	72,000	65,000
Consumption	- m.t.	145,500	142,000	135,000
Cif Value	- US$/m.t.	42.20	-	-
	- minimum	-	40.00	40.00
	- maximum	-	45.00	45.00

COMMENTS - With dust-control on Government roads consuming about 65% of the total consumption and requirements expected to diminish during the next few years, Iceland's potential share of the total imports will be lessened. Competitive suppliers will, of course, strive to retain their present shares. Only limited growth can be expected for other uses.

Forecast share of market & Net-back prices

	Share of Mkt.		US$ per metric ton		
YEAR	M.T.	%	CIF VALUE	FREIGHT	FOB STRAUMSVIK
1976	6,500	9	37.00	8.30	28.70
1977	7,500	10	37.00	8.30	28.70
1978	11,000	16	37.00	8.30	29.70
1979	13,000	19	38.00	8.30	29.70
1980	15,000	23	38.00	8.30	29.70

65.2. SODA ASH, 58%, bags

CONSUMPTION		ACTUAL 1971	FORECAST 1975	FORECAST 1980
Production	- m.t.	NIL	NIL	NIL
Imports	- m.t.	134,763	150,000	175,000
Consumption	- m.t.	134,763	150,000	175,000
CIF VALUE	- US$/m.t.	45.45	-	-
	- minimum	-	45.00	46.00
	- maximum	-	50.00	51.00

COMMENTS - The average cif prices in Sweden are lower than in Norway and Denmark because more bulk shipments are received, mostly of dense grade for the glass industry and for the manufacture of chemicals. This has the effect of reducing the average cif price by about US$ 5.00 per m.t. as the works' prices for bulk versus bagged material are about US$ 10.00 per m.t. lower. This market has shown steady growth and this is one reason why Iceland should be able to gain a relatively larger share than in other countries where consumption is not rising as quickly.

Forecast share of market & Net-back prices

YEAR	M.T.	%	CIF VALUE	FREIGHT	FOB STRAUMSVÍK
1976	15,000	10	45.00	8.70	36.30
1977	25,000	16	45.00	8.70	36.30
1978	33,000	21	46.00	8.70	37.30
1979	40.000	24	46.00	8.70	37.30
1980	45,000	26	47.00	8.70	38.30

NOTE: The rate of US$ 8.70/m.t. applies to shipments of bags to Göteberg and is selected as a representative average rate for Sweden.

65.3. CAUSTIC SODA - Liquid 50% (Basis 100%)

CONSUMPTION		ACTUAL 1971	FORECAST 1975	FORECAST 1980
Production	- m.t.	390,000	600,000	700,000
Imports	- m.t.	34,012	20,000	20,000
		424,012	620,000	720,000
Exports	- m.t.	5,050	5,000	5,000
Consumption	- m.t.	418,962	615,000	715,000
CIF VALUE	- US$/m.t.	54.50	-	-
	- minimum	-	54.00	54.00
	- maximum	-	60.00	60.00

COMMENTS - Sweden's chlor-alkali industry is very large and well organized. Total production is deliberately planned to be just under total demand in order that all plants will be operated efficiently and profitably at all times. There is no possibility of Iceland being able to supply this market.

65.4. CHLORINE, LIQUID

CONSUMPTION		ACTUAL 1971	FORECAST 1975	FORECAST 1980
Production	- m.t.	350,000	540,000	625,000
Imports	- m.t.	-	-	-
		350,000	540,000	625,000
Exports	- m.t.	7,161	8,000	10,000
Consumption	- m.t.	342,839	532,000	615,000

COMMENTS - Sweden's chlor-alkali industry anticipates expanding requirements as evidenced by the recently installed new manufacturing facilities which will increase productive capability to about 450,000 m.t. of chlorine per annum before the end of 1972.

65.5. SALT

CONSUMPTION		ACTUAL 1971	FORECAST 1975	FORECAST 1980
Production	- m.t.	NIL	NIL	NIL
Imports (i.e. consumption)				
Vac.pan	- m.t.	704,364	900,000	1,000,000
Other	- m.t.	243,843	300,000	400,000
CIF VALUE				
Vac.pan	- US$/m.t.	11.85	-	-
	- minimum	-	11.00	11.00
	- maximum	-	13.00	13.00
Other	- US$/m.t.	10.60	-	-
	- minimum	-	10.00	10.00
	- maximum	-	12.00	12.00

COMMENTS - Included in the "other salt" category is rock salt from East and West Germany and Poland and some refined salt from France. The vacuum pan salt is from the Netherlands, Great Britain and West Germany, with Dutch salt coming in at a cif price of US$ 11.06. Iceland´s interest is obviously to supply vacuum pan salt to the chemical industry. With the demand growing so rapidly it may offer Iceland a much-needed opportunity to gain a position in Sweden without causing too great a disruption. If one reputable distributor could be pursuaded to act as agent it is reasonable to project that sizeable inroads could be made.

Forecast share of market & Net-back prices

VACUUM PAN SALT

YEAR	Share of Mkt.			US$ per metric ton	
YEAR	M.T.	%	CIF VALUE	FREIGHT	FOB STRAUMSVİK
1976	100,000	11	11.00	5.50	5.50
1977	125,000	13	11.00	5.50	5.50
1978	150,000	16	11.00	5.50	5.50
1979	175,000	18	11.50	5.50	6.00
1980	200,000	20	11.50	5.50	6.00

NOTE: The estimated freight of US$ 5.50 per m.t. is a realistic quotation for a port-to-port movement of bulk cargoes at this time. For actual shipments a lower rate is possible.

65.6. POTASSIUM CHLORIDE, 60-62% K_2O, Bulk

CONSUMPTION		ACTUAL 1971	FORECAST 1975	FORECAST 1980
Production	- m.t.	NIL	NIL	NIL
Imports	- m.t.	171,429	190,000	220,000
Consumption	- m.t.	171,429	190,000	220,000
CIF VALUE	- US$/m.t.	35.40	-	-
	- minimum	-	35.00	36.00
	- maximum	-	38.00	40.00

COMMENTS - As mentioned for Norway, the market in Sweden could easily absorb Iceland's projected output of 20,000 m.t. and the large international dealers would have no major problems in selling it.

Forecast share of market & Net-back prices

YEAR	SHARE	CIF VALUE	FREIGHT	FOB STRAUMSVÍK
1976	20,000	36.00	7.95	28.05
1977	20,000	36.00	7.95	28.05
1978	20,000	37.00	7.95	29.05
1979	20,000	37.00	7.95	29.05
1980	20,000	38.00	7.95	30.05

NOTE: - Iceland's share of market would be about 10%

65.7. BROMINE

Statistics give no indication of the extent of imports to Sweden and only minor amounts, if any, are imported. Some sodium and potassium bromides are imported for pharmaceutical, photographic and chemical purposes. It is impossible to forecast bromine requirements with present information but this is certainly a potential market which Iceland should develop.

65.8. LITHIUM COMPOUNDS

About 75 tons of lithium carbonate and lithium hydroxide are consumed at the present time. The potential market for Iceland's products is visualized as follows, based more on speculation than on any substantial evidence:

YEAR	PROBABLE MARKET	ICELAND'S SHARE
1976	100	50
1978	125	65
1980	150	80

66. FINLAND

Forecast Consumptions & cif Values

66.1. CALCIUM CHLORIDE, 77-80% flake, bags

CONSUMPTION		ACTUAL 1971	FORECAST 1975	FORECAST 1980
Production	- m.t.	72,000	72,000	72,000
Imports	- m.t.	12,365	10,000	10,000
Consumption	- m.t.	84,365	82,000	82,000
CIF VALUE	- US$/m.t.	50.65	-	-
	- minimum	-	40.00	42.00
	- maximum	-	46.00	47.00

COMMENTS - This market is not greatly attractive to Iceland because it is relatively small and the net-back due to the comparatively high rate of freight is not entirely favourable. Any penetration of this market will be at the expence of present importers and competition will be active to prevent it. Only modest sales can be forecast and only if a friendly distributor can be enlisted.

Forecast share of market & Net-back prices

	Share of Mkt.		US$ per metric ton		
YEAR	M.T.	%	CIF VALUE	FREIGHT	FOB STRAUMSVIK
1976	1,000	10	45.00	8.75	36.25
1977	1,200	12	45.00	8.75	36.25
1978	1,500	15	46.00	8.75	37.25
1979	1,700	17	47.00	8.75	38.25
1980	2,000	20	47.00	8.75	38.25

66.2. SODA ASH, 58%, light & dense, in bags

CONSUMPTION		ACTUAL 1971	FORECAST 1975	FORECAST 1980
Production	- m.t.	NIL	NIL	NIL
Imports	- m.t.	91,150	100,000	150,000
Consumption	- m.t.	91,150	100,000	150,000
CIF VALUE	- US$/m.t.	44.80	-	-
	- minimum	-	44.00	45.00
	- maximum	-	49.00	50.00

COMMENTS - This is a potential market which is worthy of serious effort to penetrate, assuming the same distributor will also handle the calcium chloride. The danger is, however, that volume of consumption is reaching the point where domestic manufacture can be justified. On the other hand, there are no salt deposits developed thus far in Finland which could serve as the source of raw material.

Forecast share of market & Net-back prices

	Share of Mkt.		US$ per metric ton		
YEAR	M.T.	%	CIF VALUE	FREIGHT	FOB STRAUMSVIK
1976	5,000	5	45.00	10.75	34.25
1977	8,000	7	45.00	10.75	34.25
1978	12,000	10	46.00	10.75	35.25
1979	16,000	12	46.00	10.75	35.25
1980	20,000	13	47.00	10.75	36.25

NOTE: Shipments of dense grade, in bulk, will not bear the charge for bagging and, therefore, should be equally profitable at the fob Straumsvik level.

66.3. CAUSTIC SODA - LIQUID 50% (Basis 100%)

CONSUMPTION		ACTUAL 1971	FORECAST 1975	FORECAST 1980
Production	- m.t.	195,000	220,000	250,000
Imports	- m.t.	14,698	15,000	15,000
Consumption	- m.t.	209,698	235,000	265,000
CIF VALUE	- US$/m.t.	63.40	-	-
	- minimum	-	60.00	60.00
	- maximum	-	68.00	68.00

COMMENTS - Finland apparently maintains a position of self-sufficiency, like Sweden, and the potential for imported material is virtually non-existent.

66.4. CHLORINE, LIQUID

CONSUMPTION		ACTUAL 1971	FORECAST 1975	1980
Production	- m.t.	190,000	220,000	250,000
Imports	- m.t.	-	-	-
Consumption	- m.t.	190,000	220,000	250,000

COMMENTS - As with caustic soda, the potential for imports of chlorine into Finland are virtually zero.

66.5. SALT - ALL GRADES

CONSUMPTION		ACTUAL 1971	FORECAST 1975	1980
Production	- m.t.	NIL	NIL	NIL
Imports	- m.t.	470,766	500,000	625,000
Consumption	- m.t.	470,766	500,000	625,000
CIF VALUE	- US$/m.t.	11.30	-	-
	- minimum	-	11.00	11.00
	- maximum	-	13.00	13.00

COMMENTS - Imports of vacuum pan salt for use in the chlor-alkali plants and which will be the prime target for Iceland's material, amount to about 335,000 m.t. and should increase steadily. The long freight haul from Iceland compared with the short hauls enjoyed by competitors in Denmark, Netherlands and Poland may, however, prove to be unprofitable.

Forecast share of market & Net-back prices

	Share of Mkt.		US$ per metric ton		
YEAR	M.T.	%	CIF VALUE	FREIGHT	FOB STRAUMSVIK
1976	50,000	10	11.00	8.00	3.00
1977	75,000	14	11.00	8.00	3.00
1978	100,000	16	11.00	8.00	3.00
1979	100,000	16	11.00	8.00	3.00
1980	100,000	16	11.00	8.00	3.00

NOTE: Only the vacuum salt for chemical transformation has been considered in this forecast. Markets for Iceland's salt for other purposes may be possible of exploitation. The cif value of salt from the Netherlands (Akzo) in 1971 was US$ 10.70/m.t.

66.6. POTASSIUM CHLORIDE, 60-62% K_2O, Bulk

CONSUMPTION		ACTUAL 1971	FORECAST 1975	FORECAST 1980
Production	- m.t.	NIL	NIL	NIL
Imports	- m.t.	230,694	250,000	275,000
Consumption	- m.t.	230,694	250,000	275,000
CIF VALUE	- US$/m.t.	31.00	-	-
	- minimum	-	32.00	33.00
	- maximum	-	35.00	37.00

COMMENTS - This represents another large potential market but the current low average cif price and the higher freight rate from Iceland will make it less profitable here than in Norway, Sweden or Denmark.

Forecast share of Market & Net-back price

YEAR	SHARE	CIF VALUE	FREIGHT	FOB STRAUMSVIK
1976	20,000	32.00	10.00	22.00
1977	20,000	32.00	10.00	22.00
1978	20,000	33.00	10.00	23.00
1979	20,000	34.00	10.00	24.00
1980	20,000	35.00	10.000	25.00

NOTE: Iceland's share of market would be about 8%.

66.7. BROMINE

No substantial information was obtained relating to potential markets for bromine although very minor quantities are imported. As with the other Scandinavian countries, this is a logical potential market for Iceland but it will have to be developed.

66.8. LITHIUM

The same comments as for Bromine apply here.

67. DENMARK

Forecast consumption & cif Values

67.1. CALCIUM CHLORIDE, 77-80% flake, bags

CONSUMPTION		ACTUAL 1971	FORECAST 1975	FORECAST 1980
Production	- m.t.	NIL	NIL	NIL
Imports	- m.t.	3,409	10,000	12,000
Consumption	- m.t.	3,409	10,000	12,000
CIF VALUE	- US$/m.t.	56.35	-	-
	- minimum	-	40.00	40.00
	- maximum	-	45.00	45.00

COMMENTS - This is a relatively small potential market, at best, and for Iceland's purposes at the present time is not worth serious consideration. When the project is implemented, however, this market for marginal tonnages should not be overlooked, even though the business here will be highly competitive.

Forecast share of Market & Net-back price

	Share of Mkt.		US$ per metric ton		
YEAR	M.T.	%	CIF VALUE	FREIGHT	FOB STRAUMSVIK
1976	200	2	47.00	8.90	38.10
1977	350	3	47.00	8.90	38.10
1978	500	5	48.00	8.90	39.10
1979	750	7	48.00	8.90	39.10
1980	1,000	8	48.00	8.90	39.10

NOTE: An addition of US$ 2.00/m.t. was arbitarily made to the cargo freight rate to compensate for small lot quantities.

67.2. SODA ASH, 58%, in bags

CONSUMPTION		ACTUAL 1971	FORECAST 1975	FORECAST 1980
Production	- m.t.	NIL	NIL	NIL
Imports	- m.t.	65,970	85,000	135,000
Consumption	- m.t.	65,970	85,000	135,000
CIF VALUE	- US$/m.t.	47.20	-	-
	- minimum	-	46.00	46.50
	- maximum	-	50.00	50.00

COMMENTS - While this market will be extremely competitive it is a growing market and worthy of serious attention by Iceland. By adopting a policy of trying to "ease" into it in small increments it should be possible to gradually increase participation, assuming an aggressive distributor can be enlisted.

Forecast share of Market & Net-back price

	Share of Mkt.		US$ per metric ton		
YEAR	M.T.	%	CIF VALUE	FREIGHT	FOB STRAUMSVIK
1976	2,000	2	47.00	8.90	38.10
1977	4,000	4	47.00	8.90	38.10
1978	6,000	6	48.00	8.90	39.10
1979	8,000	7	48.00	8.90	39.10
1980	10,000	8	48.00	8.90	39.10

67.3. CAUSTIC SODA, LIQUID 50%, (Basis 100%)

CONSUMPTION		ACTUAL 1971	FORECAST 1975	FORECAST 1980
Production	- m.t.	12,300	12,300	12,300
Imports	- m.t.	19,315	24,000	30,000
Consumption	- m.t.	31,615	36,300	42,300
CIF VALUE	- US$/m.t.	69.20	-	-
	- minimum	-	60.00	60.00
	- maximum	-	68.00	68.00

COMMENTS - While the demand for caustic soda is increasing there appears to be little chance that the only chlor-alkali producer will expand because of the great difficulty in disposing of the relatively small quantities of co-product chlorine currently available. Any imports will certainly not originate off-shore when there are so many manufacturers in neighbouring countries with low-cost materials to offer.

67.4. CHLORINE LIQUID

CONSUMPTION		ACTUAL 1971	FORECAST 1975	FORECAST 1980
Production	- m.t.	11,000	11,000	11,000
Imports	- m.t.	NIL	1,500	5,000
		11,000	12,500	16,000
Exports	- m.t.	690	-	-
Consumption	- m.t.	10,310	12,500	16,000

COMMENTS - For reasons explained in the SURVEY section, expansion of existing plant production in Denmark will only be implemented if assured demands for more chlorine are available. Product imbalances can be adjusted by imports or exports until some major new demands materialize.

67.5. SALT - VACUUM PAN

CONSUMPTION		ACTUAL 1971	FORECAST 1975	FORECAST 1980
Production	- m.t.	275,000	350,000	500,000
Imports	- m.t.	-	-	-
		275,000	350,000	500,000
Exports	- m.t.	8,532	300,000	400,000
Consumption	- m.t.	266,468	50,000	100,000

COMMENTS - The published production figure of 275,000 m.t. is the capacity of the plant which only came on stream late in 1971. The actual consumption in 1971 of vacuum pan salt was probably in the order of 50,000 m.t. Imports of "other salt" include rock salt for use on roads, food products, etc. Iceland will, of course, have no potential market here.

67.6. POTASSIUM CHLORIDE, 60-62% K_2O, Bulk

CONSUMPTION		ACTUAL 1971	FORECAST 1975	FORECAST 1980
Production	- m.t.	NIL	NIL	NIL
Imports	- m.t.	252,345	260,000	275,000
Consumption	- m.t.	252,345	260,000	275,000
CIF VALUE	- US$/m.t.	36.40	-	-
	- minimum	-	35.00	36.00
	- maximum	-	38.00	40.00

COMMENTS - Denmark is reportedly the largest consumer of fertilizers, per capita, in the world. Some modest increase in potash consumption can be expected. Along with Norway and Sweden this market is equally desirable for Iceland and no marketing problems are visualized in any of these countries.

Forecast share of Market & Net-back price

YEAR	SHARE	CIF VALUE	FREIGHT	FOB STRAUMSVIK
1976	20,000	36.00	8.15	27.85
1977	20,000	36.00	8.15	27.85
1978	20,000	37.00	8.15	28.85
1979	20,000	37.00	8.15	28.85
1980	20,000	37.00	8.15	28.85

NOTE: Iceland's share of market would be about 7.5%.

67.7. BROMINE

CONSUMPTION		ACTUAL	FORECAST	
		1971	1975	1980
Production	- m.t.	NIL	NIL	NIL
Imports	- m.t.	100	175	250
Consumption	- m.t.	100	175	250
CIF VALUE	- US$/m.t.	790.00	-	-
	- minimum	-	500.00	450.00
	- maximum	-	600.00	500.00

COMMENTS - This is a good solid potential market for Iceland's bromine and the market is expected to grow steadily. The cif prices will deteriorate as more economical means of delivering bulk quantities are implemented.

Forecast share of Market & Net-back price

YEAR	SHARE	CIF VALUE	FREIGHT	FOB STRAUMSVIK
1976	50	450.00	50.00	400.00
1977	125	450.00	50.00	400.00
1978	175	450.00	50.00	400.00
1979	200	450.00	50.00	400.00
1980	200	450.00	50.00	400.00

NOTE: An arbitrary freight rate, presumably on the high side, has been used as the rate from Iceland to Copenhagen and also include for the return freight on empty containers.

67.3. LITHIUM COMPOUNDS

No substantial information was obtainable on present or future consumption of lithium compounds. It is felt that this is one of the markets which will develop and must be considered by Iceland.

68. WEST GERMANY

FORECAST OF SALES

This is not a logical market for most of Iceland's products as they are all produced here and in neighbouring countries. The added cost factor of ocean freight will discourage possibilities of trade on a sustained basis. No effort will be made, therefore, to forecast share of markets or cif prices as it would be a futule and meaningless exercise, except in the cases of bromine and lithium compounds.

68.1. The foregoing remarks do not, however, rule out the possibility of transactions with large German firms which distribute chemicals in various countries of Europe and the Far East and around the world. Interviews with a number of them elicited a genuine interest in Iceland's products which would be termed "transit" chemicals. While it is premature to discuss details of tonnages or prices there is no doubt that these "international traders" in West Germany will provide a valuable auxiliary outlet for most of the projected chemicals.

68.2. BROMINE

Forecast Consumption & cif Values

CONSUMPTION		ACTUAL 1971	FORECAST 1975	FORECAST 1980
Production	- m.t.	3,000	2,500	2,000
Imports	- m.t.	1,046	2,000	3,000
		4,046	4,500	5,000
Exports	- m.t.	400	200	200
Consumption	- m.t.	3,646	4,300	5,800
CIF VALUE	- US$/m.t.	425.00	-	-
	- minimum	-	375.00	325.00
	- maximum	-	450.00	425.00

COMMENTS - West Germany consumes more bromine than it produces. Several distributors and international trading firms expressed a genuine interest, both for sales in Europe and for exports abroad. The following forecast is based on estimated sales potential in West Germany.

Forecast share of Market & Net-back prices

YEAR	1) Share of Mkt. M.T.	%	CIF VALUE	US$ per metric ton 2) FREIGHT	FOB STRAUMSVIK
1976	400	20	375.00	60.00	315.00
1977	500	20	375.00	60.00	315.00
1978	500	20	350.00	60.00	290.00
1979	600	20	350.00	60.00	290.00
1980	600	20	350.00	60.00	290.00

NOTE: 1) The potential market for Iceland is considered to be the quantity of imported material and the share of markets is calculated on this basis.

2) An arbitrary freight rate, presumably on the high side, has been used as the rate from Iceland to Hamburg in bulk containers. It is assumed this rate will also include return freight on empty containers.

68.3. LITHIUM COMPOUNDS

No reliable statistics or other information was available on which a meaningful forecast of potential markets can be made. It is known that West Germany imports spodumene ore to manufacture lithium chemicals such as lithium chloride, lithium carbonate and lithium hydroxide. In view of the high degree of industrialization, and knowing that lithium chemicals are exported, it is safe to assume that a potential market exists here for Iceland. Bearing in mind that Iceland's projected output of the carbonate and hydroxide compounds is only about 500 metric tons, the forecast below is conservative:

Forecast share of Market

YEAR	SHARE
1976	150
1977	175
1978	200
1979	225
1980	250

69. NETHERLANDS

FORECAST OF SALES

As remarked for West Germany, very similar conditions exist here. Several substantial international trading firms wish to be kept informed of Iceland's plans. It is believed that a sizeable market can be developed for "transit" chemicals, when the appropriate time comes.

70. **BELGIUM**

FORECAST OF SALES

The potential market in Belgium does not offer much encouragement for Iceland except for Bromine and Lithium chemicals. Information gathered from interviews gave the clear impression that markets for these chemicals are capable of being developed.

BROMINE

Forecast Consumption and cif Values

CONSUMPTION		ACTUAL 1971	FORECAST 1975	1980
Production	- m.t.	NIL	NIL	NIL
Imports	- m.t.	14.4	35	75
Consumption	- m.t.	14.4	35	75
CIF VALUE	- US$/m.t.	780.00	-	-
	- minimum	-	400.00	325.00
	- maximum	-	475.00	425.00

COMMENTS - Imports for sale in Belgium come from West Germany is glass bottles, packed in cases, and this accounts for the relatively high price compared with bulk deliveries. New uses for flame proofing paper, textiles and plastics are being planned.

Forecast share of Market & Net-back prices

YEAR	1) Share M.T.	%	CIF VALUE	2) FREIGHT	FOB STRAUMSVIK
1976	25	70	425.00	55.00	370.00
1977	30	75	400.00	55.00	345.00
1978	40	80	400.00	55.00	345.00
1979	45	75	375.00	55.00	320.00
1980	50	70	375.00	55.00	320.00

NOTES: 1) All consumption is of imported material.

2) An arbitrary freight rate, presumably on the high side, has been used as the rate in bulk containers from Iceland to Antwerp. It is assumed that this rate will also include return freight on empty containers.

71. UNITED KINGDOM

FORECAST OF SALES

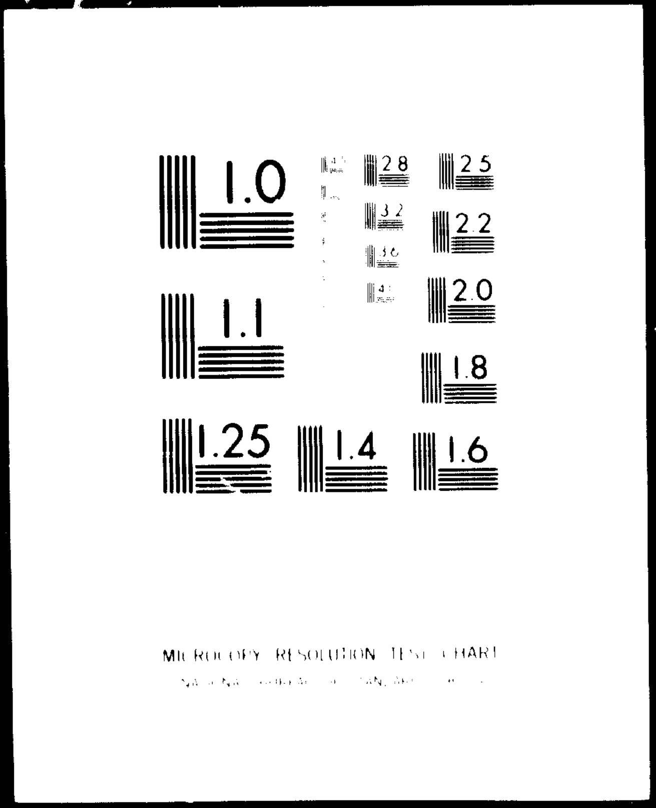
Here again, the outlook for business in Great Britain is decidedly pessimistic for the same general and specific reasons as mentioned in the case of West Germany. Bromine and Lithium compounds stirred up some interest and one reputable distributor said they would give serious consideration to lithium carbonate and lithium hydroxide. Annual quantities in excess of 100 tons each were mentioned as being appropriate. It may also be possible to develop a market for bromine, depending on

C-384

77.11.16

4 OF 4

07570



24x

A

how the supply/demand situation works out for the domestic manufacturers during the next few years.

72. UNITED STATES OF AMERICA

FORECAST OF SALES

72.1. FOREWARD - Calcium chloride and Soda ash are the only two of the projected chemicals which will have any chance of being marketed here on a sustained basis. There are strong indications that some established distributors may wish to import to northeast coast locations. Several sources suggested production of calcium chloride, anhydrous, 94-97%, flake, and possibly pellets, for shipment in bags and bulk in addition to the 77-80% flake grade.

72.2. CALCIUM CHLORIDE, 77-80% basis

Northeast Coast Locations

Estimated Consumption & cif Values

	1) Consumption M.T.	2) Prices-US$/m.t. cif N.Y.	Prices-US$/m.t. fob Iceland
Flake 77-80% - Bags	10,000	59.10	39.95
- Bulk	15,000	47.00	29.80
3) Flake 94-97% - Bags	10,000	71.70	51.25
- Bulk	5,000	56.90	38.70

NOTES: 1) This is a "guesstimate" of minimal demands for Iceland material.

2) The cif New York prices are based on current published prices.

3) Tonnage shown for anhyd. 94-97% grade are 78% basis as is customary in the trade.

72.3. Estimated consumption, or market potential, for calcium chloride is impossible to predict with any degree of certainty as it will depend on which manufacturer or distributor can be persuaded to import Iceland's material. The ratio of standard flake 77-80% grade consumed is about 60-40% with anhydrous 94-97%. In any event, the market potential in the densely populated centres of New England States on the north-east coast is undoubtedly in excess of 100,000 m.t. Output from Allied Chemical's plant at Syracuse, the nearest producer to the coast, is reported to be 240,000 m.t. per annum and others undoubtedly serve tnis market as well. Dow Chemical transports liquid calcium chloride in barges up the east coast, mostly for de-icing in winter. No effort has been made to forecast growth to 1980 as it would be pure specualtion and serve no practical purpose.

72.4. SODA ASH, 58%

Northeast Coast Locations

ESTIMATED CONSUMPTION & CIF VALUES

		1) Consumption M.T.	Prices-US$/m.t. 2) cif N.Y.	Prices-US$/m.t. fob Iceland
Light grade	- bags	10,000	65.10	40.75
	- bulk	25,000	49.70	27.60
Dense grade	- bags	5,000	65.10	40.75
	- bulk	25,000	49.70	27.60

NOTE: 1) This is a "guesstimate" of minimal demands for Iceland material.

2) The cif New York prices are based on current published prices.

72.5. As was the case for calcium chloride, potential sales of soda ash in the northeastern States will depend entirely on the capability of the chosen manufacturer or distributor. The consensus of opinions mentioned during interviews indicated better prospects for marketing soda ash than for calcium chloride.

72.6. OTHER PRODUCTS

Bromine is the only other of Iceland's chemicals which may have a potential for sale in the U.S.A. on a sustained basis but the present customs duty of 5 cents per pound (US$ 110.25) would seem to be an insurmountable obstacle. No market forecasts are being made, therefore, for bromine or for other of the projected chemicals.

CANADA

Forecast of Sales

73.1. FOREWARD - Similar to reactions gained from interviews in the U.S.A., the possibility of marketing calcium chloride and soda ash in the eastern Maritime Provinces is very real. In actual fact, the factor of rail freight incidental to deliveries in Eastern Canada from the producing locations in central Canada and adjoining areas in Michigan where the salt-brine wells are located is becoming ever more formidable. Some relief is afforded by water transport through the St. Lawrence Seaway but this is time-consuming and relatively expensive. No one interviewed would express any indication of their true positions or plans for the future. The notion that Iceland's chemicals would receive a favourable reception is actually the result of bits and pieces of information together with an appreciation of the manufacturing and distribution problems, both present and future, confronting those engaged in the industry. Possibilities for sales of calcium chloride and soda ash appear optimistic and Iceland's ability to negotiate for reliable sales representation will be of great importance to the Project. The potential market for bromine should also be developed at the appropriate time.

73.2. CALCIUM CHLORIDE, 77-80% basis

Maritime Province Locations

ESTIMATED CONSUMPTION & CIF VALUES

	1) Consumption M.T.	Prices-US$/m.t. 2) cif Halifax	fob Iceland
Flake, 77-80% - bags	12,000	66.20	42.75
- bulk	16,000	51.95	31.40
3) Flake, anhyd. 94-97% - bags	15,000	78.70	52.05
- bulk	7,000	61.05	38.10

NOTE: 1) This is a "guesstimate" of probable demands for Iceland material.

2) The cif Halifax prices are based on current published selling prices, ex-Works at Amherstburg, Ont.

3) The prices for anhyd, 94-97% are based on the differentials prevailing in the United States and adapted to Canadian prices for the purpose of this Survey. Also, tonnages are basis 78%.

73.3. SODA ASH, 58%

Maritime Province Locations

ESTIMATED CONSUMPTION & CIF VALUES

	1) Consumption M.T.	Prices-US$/m.t. cif Halifax	Prices-US$/m.t. fob Iceland
Light grade - bags	10,000	84.25	57.45
- bulk	10,000	55.90	33.55
Dense grade - bags	5,000	87.55	59.90
- bulk	20,000	58.10	35.20

NOTES: 1) This is a "guesstimate" of minimal demands for Iceland material.

2) The cif Halifax prices are based on current published selling prices, ex-Works, Amherstburg, Ont.

APPENDIX I

UNITED NATIONS

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

UNIDO 18 August 1971

Request from the Government of the Republic of Iceland

for Special Industrial Services

JOB DESCRIPTION

ICE-041-D (SIS) Rev.1**

POST TITLE	Chemical Industry Expert (Market study of salt, calcium chloride, soda ash, caustic soda and chlorine)
DURATION	Six months
DATE REQUIRED	As soon as possible
DUTY STATION	Reykjavik, with trips to neighbouring countries
PURPOSE OF PROJECT	To make a comprehensive market survey of salt, calcium chloride, soda ash, caustic soda and chlorine; to study the possibility of exporting these chemicals to other countries and to recommend policies and ways Iceland should adopt in order to enter into these markets.
DUTIES	The expert will be assigned to the National Research Council of Iceland and will be expected to:

1. carry out a comprehensive market study for calcium chloride for Northern Europe and selected locations in the United States and Canada. All major producers and consumers as well as market trends should be established aimed at reliable forecasting;

2. analyse the market for soda ash and caustic soda with the view to establishing the most attractive market locations for an eventual Icelandic producer;

** The revision of this Job Description is being issued due to changes in the text.

id.71-6261

.../..

Applications and communications regarding this Job Description should be sent to
Personnel Services, UNIDO, P.O. Box 707, A-1010 Vienna, Austria

3. analyse the market for chlorine taking into consideration the shipping problem, both in terms of unloading facilities and the possibilities for transshipments (barges, railroad, etc.) as these can greatly affect the marketing possibilities;

4. estimate the possible share of an Icelandic producer in the project markets for each of the above products in the years 1975 and 1980.

QUALIFICATIONS	University degree or equivalent in chemical engineering or Industrial Chemistry with extensive experience in market study of chemicals.
LANGUAGE	English
BACKGROUND INFORMATION	For several years the National Research Council of Iceland has sponsored studies on the recovery of salt and various minerals from seawater and geothermal brine, with the aid of natural steam from the thermal field at Reykjanes. A recent investigation revealed that by making use of the thermal brine and steam a plant producing 250,000 tons of vacuum salt, 58,000 tons of of 80 % calcium chloride, 25,000 tons of potash and 700 tons of bromine, would be feasible if all of these products could be sold at a reasonable price. Eventually it is anticipated that the salt will find a local market when a chemical and metallurgical industry is developed sufficiently. One possible such project is the production of magnesium chloride and metallic magnesium. At present the N.R.C. is sponsoring studies of the production of $MgCl_2$ by a process developed locally, where an ion-exchange step is involved with NaCl as the regenerating agent and soda ash as by-product. The technical studies and feasibility analyses on these projects are proceeding smoothly with the present resources of the Council. However, there are important market studies which remain to be done for several of the proposed products.

CANDIDATES REQUESTED BY 29 SEPTEMBER 1971

APPENDIX II

MARKET SURVEY ITINERARY

INVESTIGATION IN SCANDINAVIA,
NORTHERN EUROPE & GREAT BRITAIN.

Reykjavik, Iceland

February 1 - Embassy of United States of America, Mr. Dennis C. Goodman, Second Secretary.

" 10 - The Iceland Steamship Co. Ltd.

" 10 - Ólafur Gíslason & Co. Ltd.: Chemical and salt importers.

" 16 - Central Bank of Iceland.

" 18 - Icelandic Aluminium Company Limited, Straumsvík.

" 18 - Union of Icelandic Fish Producers.

" 18 - Government Road Construction Department.

" 23 - Canadian Consulate, Mr. H.F. Hallgrímsson.

" 23 - Icelandic Fertilizer Plant Ltd.

" 23 - Icelandic Diatomite Company Limited.

Oslo, Norway

February 28 - Embassy of Canada, Mr. J.R. Caux, Commercial Secretary.

" 28 - Ambassador of Iceland, Mr. Agnar Kl. Jónsson.

" 28 - Government of Norway, Bureau of Statistics.

" 28 - Government of Norway, Department of Industry.

" 29 - Federation of Norwegian Industries.

" 29 - Stolt-Nielsen Shipping A/S.

" 29 - Norsk/Hydro, chemical manufacturers.

March 1 - Heim & Lundin A/S; chemical dealers

" 1 - Paus & Paus A/S; chemical dealers and importers (Solvay)

" 1 - Carl Bøyesens EFTF, A/S; chemical importers and dealers.

" 1 - Government of Norway, Department of Roads.

" 2 - A/S Klorsalg; chlor-alkali sales.

" 2 - Government of Norway, Department of Fisheries.

Stockholm, Sweden

March 3 - Embassy of Iceland, Mr. Sveinn Björnsson, First Secretary.

" 3 - Government of Sweden, Industri-departementet, Storkirkobrinken.

" 3 - Government of Sweden, Board of Trade, Statistics Department.

" 3 - A/B Svenska Klorfabrikanter (Association of chlor-alkali manufacturers).

" 3 - Sveriges Kemiska Industrikontor.

" 6 - AB Montoil; Chemical importers and dealers.

" 6 - Canadian Embassy, Mr. Jon L. Swanson, Commercial Secretary and Mr. Donald C. Butler, Assistant Commerical Secretary.

" 6 - Government of Sweden, Central Bureau of Statistics.

" 6 - Boliden AB; chemical and Fertilizer Manufacturers.

" 6 - Svenska Ackumulator Jungne A/B; alkaline battery manufacturers.

March 7 - Statens Vägverk, Board of Roads, Govt. of Sweden.

" 7 - AB Gerber & Hesslow; Chemical dealers.

" 8 - Alfort & Cronholm AB; Chemical importers and dealers.

Helsinki, Finland

March 9 - Embassy of Iceland, Mr. Kai Juuranto, Consul.

" 9 - Lejos Oy; Chemical importers and dealers.

" 9 - Government of Finland, Statistika Centrallyrän

" 9 - Canadian Embassy, Mr. Knox.

" 10 - Government of Finland, Department of Roads.

" 10 - Rikki Happo Oy; Chemical manufacturers

" 10 - Lejos Oy; Salt and plywood importers.

Göteborg, Sweden

March 13 - Elof Hansson; Chemical importers/exporters.

" 13 - Malmsten & Bergvall AB; Chemical importers and dealers.

" 13 - Hanson & Mohring AB; Salt importers and wholesalers.

Copenhagen, Denmark

March 14 - Canadian Embassy, Mr. Thorkild W. Harboe, Commercial Officer.

" 14 - Embassy of Iceland, Mr. Bjornsson, Counsellor.

" 14 - Mr. Finn Munch-Petersen, Special Representative, United Nations Development Programme.

" 15 - Mr. Heikki Keto, Junior Professional Officer, UNDP.

March 15 - Dansk Sojakagefabrik A/S; Chlor-alkali manufacturers.

" 15 - Brøste A/S; Chemical dealer.

" 15 - The Royal Greenland Trade Corporation, Mr. Henrik Juul-Poulsen, Kontorchef.

" 15 - Government of Denmark, Bureau of Statistics.

Hälsingborg, Sweden

March 16 - Boliden Aktiebolag; Chemical manufacturers.

Landskrona, Sweden

March 16 - Boliden AB; Forenade Superfosfatfabriker (SUPRA)

Copenhagen, Denmark

March 17 - Superfos Aki a/s; Fertilizer manufacturers.

" 17 - Danish Chemical Manufacturers Association.

" 17 - Danish Pharmaceutical Industry Association.

" 17 - Kemitura A/S; Chemical manufacturers and dealers.

" 17 - Scandia-Rhodia A/S; Chemical dealers.

Hamburg, West Germany

March 20 - Canadian Consulate General, Mr. D.D. Van Beselaere, Consul.

" 20 - Wilhelm Biesterfeld & Co.; International chemical importers/exporters.

" 20 - Ascalia Fabrik Chemisch-Technischer Produkte; International chemical dealers.

Düisberg, West Germany

March 21 - Klöckner & Co.; Chemical manufacturers and international chemical importers/exporters.

Düsseldorf & Bonn, West Germany

March 21 - Canadian Embassy, Mr. Michel E. Perrault, Commercial Attache and Mr. Schroder, Commercial Officer.

" 21 - Embassy of Iceland, Mr. Thorleifur Thorlacius, Counsellor.

Wiesbaden, West Germany

March 22 - Government of W.Germany, Central Bureau of Statistics.

Frankfurt, West Germany

March 23 - Verband der Chemischer Industrie, eV. (Chemical Industry Statistics)

" 23 - Montan-Chemsa GmbH.; Representatives of Montecatini Edison SpA, Milan, Italy.

The Hague, Netherlands

March 24 - Canadian Embassy, Mr. W. Rekker, Commercial Officer.

" 27 - Government of the Netherlands, Central Bureau of Statistics.

" 27 - Netherlands Council for Trade Promotion.

Amsterdam, Netherlands

March 27 - Philipp Brothers (Holland) B.V.; International dealers in chemicals, fertilizers & minerals.

" 28 - Heybrock & Co's Handel Mij, N.V.; Chemical dealers.

" 28 - N.V.N. Jacobson & Co.; chemical dealer.

" 28 - N.V. Chemimpo; Chemical importer/exporter

" 28 - Joba N.V.; Chemical importer.

Brussels, Belgium

March 29 - Canadian Embassy, Mr. R. Spruyt, Commercial Officer.

" 29 - Government of Belgium, Ministry of Economic Affairs, Mr. Van Hoof, Section of Chemical Industries.

" 29 - Government of Belgium, Institut National des Statistiques.

" 29 - Embassy of Iceland,

" 30 - A. Christiaens SA; Pharmaceutical manufacturers.

" 30 - S.P.R.L. Gustave Adam; Chemical importer/exporter.

" 30 - Produits Chimiques De Tessenderloo; Chlor-alkali, fertilizer, plastics and chemical manufacturers.

" 31 - Pharmachemie SA; Antwerp (telphone interview), Chemical importer/exporter.

London, England

April 4 - High Commissioner for Canada, Mr. G. Bruneau, Second Secretary.

April 4 - Embassy of Iceland, Mr. E. Benedickz, Counsellor.

" 4 - Government of Great Britain, Department of Trade, Industry, Economics & Statistics.

" 5 - L.R.B. Pearce Ltd.; Chemical dealer.

" 5 - Diamond Fertilizer & Chemical Co. Ltd; Chemical and fertilizer manufacturers, and dealers.

<u>Northwich, Cheshire, England</u>

April 6 - Imperial Chemical Industries Limited; Chlor-alkali, plastics and chemical manufacturers and international traders.

NOTE: Particular reference must be made to the various Embassies of Iceland and Canada which furnished, in advance, much valuable statistical and chemical industry information, thus facilitating the market survey by making it possible to utilize available travel and visiting time to maximum effectiveness.

APPENDIX III

MARKET SURVEY ITINERARY

INVESTIGATION IN UNITED STATES OF

AMERICA AND CANADA:

New York, U.S.A.

May 10 - Canadian Consulate General (Commercial)

" 10 - Allied Chemical Corporation, International Division; Chemical manufacturers.

" 11 - Allied Chemical Corporation, Industrial Chemical Division.

" 11 - Millmaster Chemical Co; chemical manufacturers and distributors.

" 11 - Diamond Shamrock Chemical Company; chemical manufacturers.

" 11 - McKesson Chemical Company; chemical distributors.

" 12 - Stauffer Chemical Company; chemical manufacturers.

" 12 - Philipp Brothers, Division of Engelhard Minerals & Chemicals Corporation; international dealers in bulk fertilizers, minerals and chemicals.

Montreal, Canada

May 15 - Allied Chemical Canada, Ltd.; chemical manufacturers.

" 16 - Standard Chemical Company Ltd.; chemical manufacturers.

" 16 - Aluminum Company of Canada Ltd.

May 17 - Harrisons & Crosfield (Canada) Ltd.; chemical importers and distributors.

" 18 - H.L.Blachford Ltd.; speciality chemical manufacturers.

Ottawa, Canada

" 19 - Government of Canada -

- Department of Industry, Trade & Commerce.
- Department of Energy, Mines & Resources.
- Information Canada.

New York, U.S.A.

" 22 - FMC Corporation; chemical manufacturers.

" 22 - Commercial Chemical Development Association.

" 23 - Prior Chemical Corporation; international dealer in bulk chemicals and minerals.

" 23 - Olin Chemicals, Industrial Chemicals Division.

" 23 - McKesson Chemical Company.

" 24 - Diamond Shamrock Chemical Company.

" 24 - Millmaster Chemical Co.

" 24 - Returned to Reykjavík in evening.

APPENDIX IV

CALCIUM CHLORIDE, 77-80% $CaCl_2$

Flake Grade, in 50 kg. PE bags

IMPORTS (in metric tons) & cif VALUE (in US$/m.t.)

COUNTRY	UNIT	1967	1968	1969	1970	1971
NORWAY	m.t.	29,418	32,036	42,351	39,998	45,883
	cif	43.70	44.50	45.00	45.20	49.80
SWEDEN	m.t.	57,756	76,992	67,556	81,653	75,500
	cif	—	38.80	39.40	40.50	42.20
FINLAND	m.t.	22,755	15,221	15,591	9,713	12,365
	cif	27.15	38.20	40.00	48.00	50.65
DENMARK	m.t.	5,496	8,561	10,002	8,613	3,409
	cif	45.75	49.30	47.50	52.75	56.35
W. GERMANY	m.t.	N/A	N/A	N/A	N/A	N/A
	cif	-	-	-	-	-
NETHERLANDS	m.t.	10,087	12,905	11,624	15,758	7,539
	cif	41.40	40.40	39.64	36.40	48.45
BELGIUM	m.t.	141	116	426	131	715
	cif	158.00	212.00	71.20	147.00	80.80
U.K.	m.t.	N/A	N/A	N/A	N/A	N/A
	cif	-	-	-	-	-
U.S.A.	m.t.	N/A	N/A	N/A	N/A	N/A
	cif	-	-	-	-	-
CANADA	m.t.	17,300	30,800	26,250	14,820	20,650
	cif	N/A	38.20	36.10	38.50	37.35

NOTES: -Statistics for West Germany, the United Kingdom and U.S.A. are not published as there are less than three producers and importers, except in the U.S.A., they do not want to divulge the figures.

APPENDIX V

SODA ASH, 58%

Light & Dense Grades, in bags & bulk cargo lots.

IMPORTS (in metric tons) & cif VALUE (in US$/m.t.)

COUNTRY	UNIT	1967	1968	1969	1970	1971
NORWAY	m.t.	22,752	23,955	28,375	28,489	35,218
	cif	43.60	44.00	43.85	44.60	48.50
SWEDEN	m.t.	122,500	112,395	134,005	140,389	134,763
	cif	38.60	39.80	40.50	41.80	45.45
FINLAND	m.t.	57,869	38,260	71,961	82,806	91,150
	cif	30.90	39.20	39.80	41.00	44.80
DENMARK	m.t.	39,952	44,000	50,495	60,754	68,970
	cif	38.20	40.95	41.05	43.20	47.20
W.GERMANY	m.t.	1,040	1,129	1,643	58,148	55,999
	cif	47.80	51.30	55.00	47.50	48.85
NETHERLANDS	m.t.	6,670	4,330	4,575	5,271	1,917
	cif	39.20	45.25	46.95	50.25	51.00
BELGIUM	m.t.	12,148	16,042	36,635	36,408	35,922
	cif	47.80	48.10	47.35	46.85	47.10
U.K.	m.t.	N/A	N/A	N/A	N/A	N/A
	cif	-	-	-	-	-
U.S.A.	m.t.	N/A	N/A	N/A	N/A	N/A
	cif	-	-	-	-	-
CANADA 1)	m.t.	N/A	161,000	218,000	162,100	156,500
	cif	-	34.80	34.40	35.55	34.50

NOTE: 1) Statistics for Canada include Sal Soda along with the Soda Ash and hence are not very meaningful.

APPENDIX VI

IMPORTS OF CAUSTIC SODA, BY COUNTRIES

QUANTITY (IN METRIC TONS) and cif VALUE (IN US$ PER M.T.)

BASIS 100% NaCH

COUNTRY	GRADE	UNIT	1967	1968	1969	1970	1971
NORWAY	LIQ.50%	m.t.	3,100	8,459	8,140	7,159	6,390
		cif	59.30	55.80	52.90	55.70	58.30
	SOLID	m.t.	6,905	6,550	8,377	7,979	7,827
		cif	[illegible]	101.50	99.50	105.50	182.00
SWEDEN	LIQ.50%	m.t.	8,228	24,735	33,810	28,607	34,012
		cif	59.00	51.80	50.20	50.00	54.50
	SOLID	m.t.	8,198	8,248	10,233	9,342	7,923
		cif	83.90	83.20	78.50	90.45	138.50
FINLAND	LIQ.50%	m.t.	2,043	6,325	8,329	9,995	14,698
		cif	N/A	51.00	50.00	52.40	63.40
	SOLID	m.t.	5,399	6,037	7,435	3,758	706
		cif	53.60	58.70	60.45	88.50	150.00
DENMARK	LIQ.50%	m.t.	11,697	12,062	8,209	19,262	19,315
		cif	60.00	58.40	49.90	57.50	69.20
	SOLID	m.t.	9,053	10,147	25,475	12,119	9,453
		cif	74.50	74.50	48.00	84.50	137.80
W.GERMANY	LIQ.50%	m.t.	38,338	50,163	103,031	90,777	123,497
		cif	38.90	45.00	44.80	41.60	47.20
	SOLID	m.t.	8,939	8,492	12,246	8,707	114,745
		cif	94.00	85.50	84.40	93.00	125.50
NETHERLANDS	LIQ.50%	m.t.	22,619	17,161	9,431	12,084	19,662
		cif	36.60	37.40	39.20	38.60	47.20
	SOLID	m.t.	13,595	15,341	14,026	13,708	12,868
		cif	74.90	72.30	73.25	75.50	86.80
BELGIUM	LIQ.50%	m.t.	3,836	5,641	11,346	9,900	6,797
		cif	45.10	49.00	45.00	44.80	50.90
	SOLID	m.t.	9,961	8,060	7,131	6,642	5,551
		cif	91.20	95.50	97.50	103.00	104.00
U.K.	LIQ.50%	m.t.	N/A	N/A	N/A	N/A	4,550
		cif	-	-	-	-	77.60
	SOLID	m.t.	866	N/A	N/A	11,377	N/A
		cif	107.00	-	-	108.00	-
U.S.A.	LIQ.50%	m.t.	N/A	35,000	36,250	57,100	73,500
		cif	-	37.00	48.25	48.75	54.25
	SOLID	m.t.	N/A	N/A	N/A	N/A	N/A
		cif	-	-	-	-	-
CANADA	LIQ.50%	m.t.	N/A	40,775	62,250	75,750	75,725
		cif	-	104.00	86.80	88.80	87.25
	SOLID	m.t.	N/A	1,325	855	890	535
		cif	-	144.00	185.00	175.00	185.00

NOTE: Use of these cif prices must be tempered with caution and an intimate knowledge of certain special circumstances which justified the importations. The imports, and exports, between Canada and the U.S.A., for instance, are often accomodation or trading sales on opposite coasts in order to save on freight charges and for the benefit of customers and suppliers alike.

APPENDIX VII

CHLORINE, LIQUID

In Bulk Shipments

IMPORTS (in metric tons) & cif VALUE (in US$/m.t.)

COUNTRY	UNIT	1967	1968	1969	1970	1971
NORWAY	m.t.	1,476	141	253	60	1
	cif	63.00	63.50	63.60	74.50	-
SWEDEN	m.t.	537	1,303	937	915	2.0
	cif	65.00	52.90	46.80	50.80	97.00
FINLAND	m.t.	-	-	-	-	1
	cif	-	-	-	-	33.80
DENMARK	m.t.	529	122	21	64	3
	cif	65.20	71.20	198.00	149.00	84.00
W.GERMANY	m.t.	64,291	91,484	183,091	175,451	99,873
	cif	47.50	48.50	50.50	56.50	49.70
NETHERLANDS	m.t.	4,916	7,812	2,302	16,233	27,333
	cif	51.20	50.45	55.10	51.50	52.50
BELGIUM	m.t.	480	1,080	2,149	3,681	4,851
	cif	61.20	44.20	74.50	59.20	64.75
U.K.	m.t.	N/A	N/A	N/A	16,420	10,650
	cif	-	-	-	64.50	71.00
U.S.A.	m.t.	48,650	38,000	20,500	22,600	31,850
	cif	73.85	68.60	71.65	77.75	62.85
CANADA	m.t.		31,500	20,400	9,245	975
	cif		63.00	56.40	58.60	70.80

APPENDIX VIII

IMPORTS OF SALT, BY COUNTRIES

QUANTITY (IN METRIC TONS) and cif VALUE (IN US$ PER M.T.)

IN BULK CARGO LOTS

COUNTRY	GRADE	UNIT	1967	1968	1969	1970	1971
NORWAY	VAC.PAN	m.t.	154,275	173,133	171,358	193,858	182,322
		cif	13.40	13.40	13.80	13.70	15.10
	SEA	m.t.	81,303	98,513	85,213	90,891	133,818
		cif	9.85	11.40	11.30	11.85	11.40
	ROCK	m.t.	31,970	50,[illegible]34	52,500	55,011	54,309
		cif	8.20	8.40	8.20	9.30	9.80
SWEDEN	VAC.PAN	m.t.	521,140	575,104	840,805	705,738	704,384
		cif	12.00	11.45	10.85	11.25	11.85
	TABLE	m.t.	N/A	8,591	12,757	12,990	11,376
		cif		58.50	59.40	83.25	73.50
	OTHER (INCL.ROCK)	m.t.	302,918	354,459	339,712	383,886	243,843
		cif	8.55	8.85	8.70	9.85	10.80
FINLAND	ALL	m.t.	352,343	434,869	427,298	490,416	470,766
		cif	8.70	10.15	10.15	10.45	11.30
DENMARK	VAC.PAN	m.t.	39,987	28,013	249,590	454,206	N/A
		cif	18.00	22.55	12.95	11.85	-
	OTHER	m.t.	107,987	157,654	INCL.IN	INCL.IN	133,853
		cif	10.05	11.40	VAC PAN	VAC PAN	13.50
FAEROE IS.	SEA (FROM SPAIN)	m.t.	35,841	30,094	30,145	16,105	17,695
		cif	7.65	9.60	10.90	12.25	12.50
	OTHER	m.t.	741	165	2,204	130	134
		cif	27.75	70.60	19.50	65.00	76.00
GREENLAND	SEA (FROM SPAIN)	m.t.	9,040	16,313	8,656	2,062	4,099
		cif	11.15	12.20	14.60	19.90	19.50
	OTHER	m.t.	411	260	592	690	432
		cif	59.50	75.25	53.10	56.50	68.40
W.GERMANY	VAC.PAN (CHEM CONV.)	m.t.	109,924	122,528	140,143	257,237	337,743
		cif	5.45	5.40	5.50	5.75	6.25
	OTHER	m.t.	6,923	N/A	24,273	38,144	34,413
		cif	15.45	N/A	18.25	16.65	11.45
NETHERLANDS	SEA (CHEM.CONV.)	m.t.	22,458	10,057	18,586	259,434	61,789
		cif	7.40	5.20	8.50	7.50	7.65
	OTHER	m.t.	39,939	24,651	21,904	86,370	22,365
		cif	—	8.05	9.90	8.90	12.20
BELGIUM	VAC.PAN (& REFINED)	m.t.	567,395	899,711	885,789	348,118	377,968
		cif	7.05	7.25	7.85	11.40	10.15
	SEA (CHEM.CONV.)	m.t.	28,184	316,189	389,211	927,019	820,059
		cif	10.55	6.90	7.40	6.45	7.70
U.K.	FISHERY (COURSE)	m.t.	N/A	N/A	N/A	91,320	52,429
		cif	-	-	-	12.45	13.00
	SEA (INCL.OTHER)	m.t.	39,377	32,913	45,116	47,029	71,420
		cif	9.20	13.00	10.75	12.35	12.45
U.S.A. 1)		m.t.	7.7m	10.4m	10.8m	12.0m	13.1m
		cif	N/A	N/A	N/A	N/A	N/A
CANADA 2)		m.t.	N/A	582,500	630,000	560,000	833,000
		cif	N/A	5.35	4.90	5.05	4.75

NOTE: 1) Tonnages shown for U.S.A. are in millions of metric tons and include Sodium chloride; Salt in brine; Bulk salt, etc.

2) Import statistics for salt into Canada include brine and are therefore not comparable with other countries.

APPENDIX IX

POTASSIUM CHLORIDE, 60-62% K_2O

IMPORTS (IN METRIC TONS) and cif VALUE (IN US$/M.T.)

GRANULAR, IN BULK CARGO LOTS

COUNTRY	UNIT	1967	1966	1969	1970	1971
NORWAY	m.t.	176,400	132,222	140,399	156,860	157,963
	cif	39.00	33.60	31.60	31.60	34.20
SWEDEN	m.t.	160,993	189,118	183,067	183,621	171,429
	cif	38.20	34.80	31.65	32.25	35.40
FINLAND	m.t.	88,608	88,550	170,858	201,123	230,894
	cif	29.45	34.70	30.00	28.60	31.00
DENMARK	m.t.	239,998	200,676	220,510	217,855	252,345
	cif	33.70	32.20	34.80	34.75	36.40
W.GERMANY	m.t.	68,887	74,995	84,026	21,726	34,123
	cif	39.00	37.00	34.20	34.85	34.40
NETHERLANDS	m.t.	100,224	125,441	128,236	125,068	131,323
	cif	33.10	29.90	26.25	26.80	31.50
BELGIUM	m.t.	852,930	686,380	606,820	838,574	451,704
	cif	35.30	32.25	30.15	30.80	37.90
U.K. 1)	m.t.	718,854	751,272	35,944	23,937	34,829
	cif	35.70	37.80	18.60	20.80	24.00
U.S.A.	m.t.	2,480,000	3,220,000	3,470,000	3,865,000	4,115,000
	cif	25.65	21.35	18.50	23.00	25.80
CANADA	m.t.	16,600	21,750	18,950	21,250	57,000
	cif	29.70	24.55	29.45	33.90	31.75

NOTE: 1) No explanation of a reliable nature is available to explain the inconsistent quantities and values. With the domestic production of potassium chloride scheduled to commence in late 1972, it seems likely that imports of 60-82% potash ceased in 1969 and that the imports reported are merely lower grade crude potassium chloride salts or slag. In any event, the U.K. will be more than self-sufficient by 1973.

APPENDIX X

BROMINE

IMPORTS (in metric tons) & cif VALUE (in US$/m.t.)

COUNTRY	UNIT	1967	1968	1969	1970	1971
NORWAY	m.t.	NIL	NIL	NIL	NIL	NIL
	cif	-	-	-	-	-
SWEDEN	m.t.	3	N/A	N/A	N/A	75
	cif	-	-	-	-	-
FINLAND	m.t.	NIL	NIL	1.6	8.8	13.4
	cif	-	-	-	-	-
DENMARK	m.t.	28.5	23.0	57.0	49.0	134.0
	cif	610.00	1,510.00	715.00	920.00	790.00
W.GERMANY	m.t.	318	456	1,036	1,470	1,046
	cif	436.00	418.00	417.00	425.00	425.00
NETHERLANDS	m.t.	746	675	768	1,080	847
	cif	597.00	646.00	372.00	375.00	400.00
BELGIUM	m.t.	15.8	21.6	38.60	43.4	14.4
	cif	625.00	608.00	619.00	635.00	780.00
U.K.	m.t.	N/A	N/A	N/A	973	1,645
	cif	-	-	-	418.00	405.00
U.S.A.	m.t.	1,570	2,675	2,595	2,785	3,310
	cif	N/A	N/A	N/A	N/A	N/A
CANADA	m.t.	N/A	N/A	N/A	N/A	N/A
	cif	-	-	-	-	-

NOTES:
- In the four Scandinavian countries imports include "bromine and other halogens, except chlorine". In Denmark in 1967, the reported imports are for bromine but in subsequent years, bromine is not shown as a separate item. Imports in 1971 are very reliably reported to be 100 m.t.
- Statistics reported in Netherlands, Belgium, West Germany and U.K. show bromine imports separately.
- The cif prices shown are average and include both bulk and small container quantities which are higher in cost; i.e. Belgium compared to Netherlands.

APPENDIX XI

[1] LITHIUM COMPOUNDS

IMPORTS (in metric tons) & cif VALUE (in US$/m.t.)

COUNTRY	UNIT	1967	1968	1969	1970	1971
NORWAY	m.t.	NIL	NIL	NIL	NIL	NIL
	cif	-	-	-	-	-
SWEDEN	m.t.	NIL	NIL	NIL	NIL	75.0
	cif	-	-	-	-	-
FINLAND	m.t.	21.9	17.0	62.5	53.0	18.3
	cif	-	-	-	-	192.00
DENMARK	m.t.	NIL	2.0	1.0	1.0	1.0
	cif	-	-	-	-	335.00
W.GERMANY [2]	m.t.	6,307	10,791	7,675	10,843	N/A
	cif	-	-	-	-	-
NETHERLANDS	m.t.	N/A	6.0	4.3	1.9	1.6
	cif	-	54.00	120.00	189.00	198.00
BELGIUM [3]	m.t.	43.4	142.8	228.9	63.8	92.6
	cif	122.00	100.00	100.00	140.50	131.80
U.K.	m.t.	11.6	16.0	12.4	N/A	18.0
	cif	-	-	-	-	-
U.S.A.	m.t.	N/A	N/A	N/A	N/A	N/A
	cif	-	-	-	-	-
CANADA	m.t.	N/A	N/A	N/A	N/A	N/A
	cif	-	-	-	-	-

NOTES:

1) The published statistics in all countries are not meaningful as lithium and lithium compounds are grouped with "rare earth, alkaline earth metals, including yttrium and scandium". The statistics are therefore inadequate and can only be viewed as indicative of trends of imports for all the materials combined.

2) West Germany imports spodumene ore from Canada from which it manufactures various lithium compounds.

3) Imports for Belgium are reported for Lithium Carbonate (Item 2842.55) and they were listed seperately. Imports in 1971 were from France and Canada.

ESTIMATES OF FREIGHT RATES
FROM
ICELAND TO NORTHEAST PORTS OF NORTH AMERICA

FROM STRAUMSVÍK TO:	DISTANCE NAUTICAL MILES	COMMODITY-RATES IN US$/M.T.			
		SALT & CL.CHL. BULK	CAL. CHL. BAGS	SODA ASH BULK	SODA ASH BAGS
U.S.A.					
NEW YORK, N.Y.	2495	10.00	10.75	12.00	12.75
NORFOLK, VA.	2677	10.50	11.25	12.50	13.25
CANADA					
HALIFAX, N.S.	1941	8.35	9.10	10.35	11.10
ST. JOHNS, NFLD.	1416	6.70	7.45	8.70	9.45

NOTES: - Basis for estimating rates was U.S.$ 0.75/m.t./24 hours in a 2000 DWT vessel travelling at 10 nautical miles/hour, port-to-port, assuming there is a return cargo. Also, assume 1 day for loading and 2 days for unloading. For bags, another extra day of loading and unloading was added.

APPENDIX XIII

ESTIMATES OF OCEAN FREIGHT RATES

FROM

ICELAND TO SCANDINAVIAN AND EUROPEAN PORTS

FROM STRAUMSVÍK TO:	DISTANCE NAUTICAL MILES	COMMODITY - RATES IN US$/M.T. SALT BULK	CAL.CHL. BAGS	SODA ASH BAGS	SODA ASH & POTASH BULK
EUROPE					
ANTWERP	1240	6.10	6.85	8.85	8.10
ROTTERDAM	1182	5.90	6.65	8.75	7.90
HAMBURG	1238	6.10	6.85	8.85	8.10
LONDON	1281	6.25	7.00	9.00	8.25
NORWAY					
TRONDHEIM	969	5.30	6.05	8.05	7.30
BERGEN	860	4.95	5.70	7.70	6.95
OSLO	1208	6.00	6.75	8.75	8.00
CHRISTIANSAND	1040	5.50	6.25	8.25	7.55
SWEDEN					
GOTEBERG	1175	5.95	6.70	8.70	7.95
STOCKHOLM	1700	7.55	8.30	10.30	9.55
FINLAND					
ABO	1800	7.85	8.60	10.60	9.85
HELSINGFORS	1850	8.00	8.75	10.75	10.00
DENMARK					
COPENHAGEN	1250	6.15	6.90	8.90	8.15
FAEROE ISLANDS					
THORSHAVN	516	4.00	4.75	6.75	6.00
GREENLAND					
ANGMAGSSALIK	600	4.50	5.25	7.25	6.50

NOTES:
- Basis for estimating rates was US$ 0.75/m.t./24 hours in a 2000 DWT. vessel travelling at 10 nautical miles/hour, port-to-port, assuming 1 day for loading bulk and 2 days for unloading. For bags, another extra day for loading and unloading was added.
- Equalized freight for bulk salt would probably be about US$ 5.50 on "tramp terms".
- The rates for Calcium chloride, in bags, are minimal rates.
- The rates for potassium chloride and soda ash, in bulk, are estimated to be US$ 2.00 per m.t. greater than for bulk salt.

C-384

77.11.16