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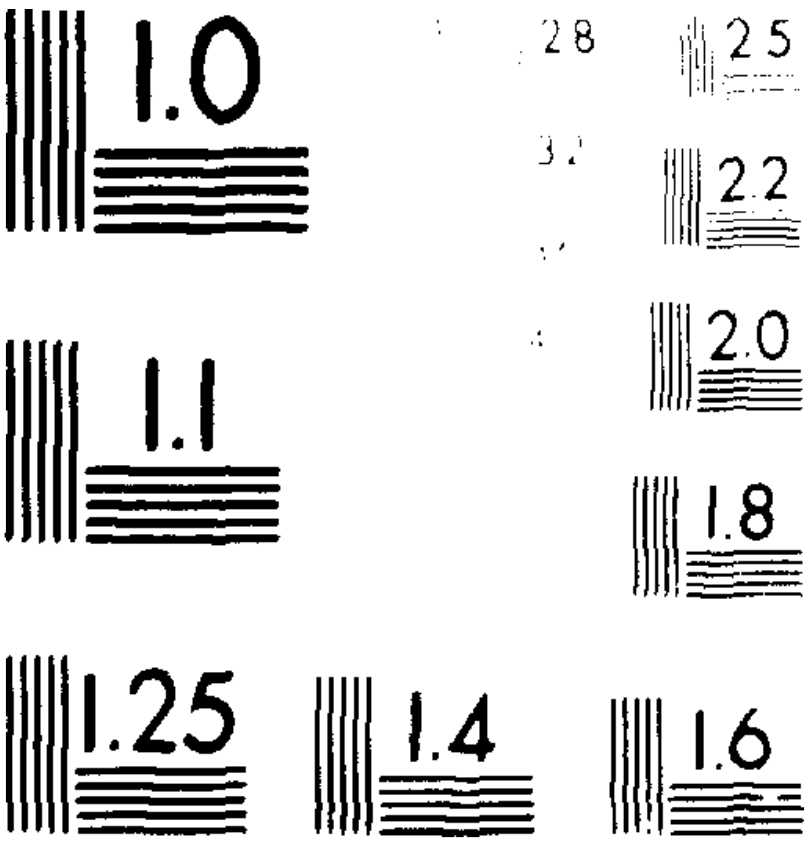

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18 April 1984 Restricted

Burma. Production of Potassium Chloride.

TERMINAL REPORT.

SI/ BUR/ 83/801

Prepared for the Government of the
SOCIALIST REPUBLIC OF THE UNION OF BURMA

BY

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C O N T E N T S

INTRODUCTORY

The Salt Industries Corporation of Burma, A Public Sector Undertaking has sought UNIDO's assistance for a suitable technology for the production of Potassium Chloride at their HTHAN PIN GYANNG SALT WORKS where they are producing about 8000 tons of Salt per annum and have available bitterns the mother liquor left over aftet the separation of salt. They are presently recovering some magnesium sulphate, crude Pottassium choloride and magnesium chloride as by-products by utilising a small quantity of available bitterns.

Field work consisting of evaluation of data available from laboratory experiements carried out at the salt works and at their Research Station at Thakeda Industrial Estate near Rangoon, inspection of Salt works and examination of conditions obtaining for manufacture of salt, bitterns and mixed salt were carried out by the expert during period 2-12 April,1984.

The Government counter part for this mission was Mr. U.Kololay, the Chief Chemist of the Research Division and Assistant General Manager of the Corporation. Detailed and meaningful discussions were held with him and the staff at the Research Laboratory at THAKEDA and also at the Salt Works where the by-products recovery plant is located. These discussions have greatly helped to arrive at conclusions regarding the choice of technology and limitations upto which recovery of potassium chloride from the available raw material is possible.

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The findings of the expert are contained in the following chapters of this report, which was written at New Delhi during the period 14-18 April,1984.

The Job Description of the mission is given hereunder:

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANISATION
(U N I D O)

JOB DESCRIPTION
SI/BUR/83/801/11-01/32.1.C

Post title	:	Potassium Chloride Expert.
Duration	:	3 Weeks.
Date required	:	March,1984.
Duty Station	:	Rangoon with travel in the country.
Purpose of project	:	To develop the production of potassium chloride.
Duties	:	A high level salt expert experienced in the production of potassium salts will discuss with the Management of the Salt Industries Corporation.

a) Proposals how to produce potassium chloride from brines and bitterns available in the country;

b) The different technologies available to produce potassium Chloride from brines and salt bitterns;

c) Development of research strategies how to strengthen the research and training capabilities of the Salt Industires Corporation for their future work.

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The expert will write a final report with observations and recommendations.

Qualifications : Chemical Engineer or industrial Chemist with extensive experience in the production of potassium chloride.

Language : English.

Background Information : There exists a potassium choenite pilot plant in Burma which was presented by the Government of India. The Government has requested the services of ahigh level salt expert experienced in the production of potassium salts from brines abd bitterns, to investigate the possibility of producing potassium chloride in the country, and to develop research strategies to strengthen the research and training capabilities of the Salt Industries Corporation.

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SUMMARY AND CONCLUSIONS

1. For the manufacture of potassium chloride on an economic basis from sea water, bitterns are required in large quantities as the percentage of potassium chloride in the sea water and bitterns (mother liquor left over after separation of salt) is very small.

2. The bitterns available from the HTHAN PIN GYANG SALT works are not sufficient to sustain the requirement of an economically viable potassium chloride recovery plant.

3. The situation is further accentuated by the fact that mixed salts (bitterns rich in potassium chloride) cannot be manufactured at the salt works on account of humid climatic conditions. The storage of mixed salts is also beset with the same difficulty of unsuitable climate

4. Therefore bitterns of 30-B concentration is the only available raw material from which recovery of KCl could be contemplated. Large storage arrangements for these bitterns which are in liquid form, are called for and would involve cost which may not be commensurate with the expected benefits of the project of recovery of KCl alone from bitterns. It should be examined in the context of recovering other salts like magnesium sulphate and magnesium chloride which can be recovered from the same bitterns by continuous process so that the over all efficiency of the complex as a whole may prove viable.

....(v)

5. A partof the available bitterns are already being utilised on an experimental basis at the by-products recovery plant at HTHAN PIN GYAUNG SALT WORKS, and magnesium sulphate, pottassium chloride and magnessium chloride are being recovered therefrom on an experimental scale.

from 30 Be bitter

6. The technology applicable for recovery of KCl/should be simple, effective and not costly. For perfecting such a technology, further reasearch work is required to be undertaken in hand so that percentage recovery of the by-products may be as high as possible.

RECOMMENDATIONS

In view of the useful work being carriedout at the Research Division of the Salt Industries Corporation of Burma both at THAKEDA and at the salt works site, the UN assistance may be in the following form :

1. (i) to provide advance type of apparatus, instruments etc. for research and quality control of by-products of salt, for the laboratory.

   (ii) to provide facility of training for an official of the Research Division in a Research Institute outside.

2. The Research Division may also be encouraged to develop suitable process for manufacture of speci varieties of salt.

CHAPTER - I

SALT WORKS HTHAN PIN GYANNG

1.1 The HTMAN PIN GYANNG SALT WORKS is situated in Mon State of Burma. Its area is approximately 1100 acres but only 500 acres has so far been brought under salt cultivation. The Production of Salt from the cultivated areas is 7000-8000 tons per annum or 14-16 tons per acre.

1.2 Besides production of salt a by-product recovery plant from the available bitterns at this salt work has also been set up. A visit to the salt works was made with a view to study the

(i) the availability of bittern- its quality.

(ii) the storage arrangementsfor bitterns.

(iii) the feasibility of manufactureof mixed salts.

(iv) the plants erected for recovery of $Mgso_4$, $6H_2O$ Kcl and $Mgcl_2$, $6H_2O$.

1.3 The crude $Mgso_4$ and Kcl as recovered, are being transported to Rangoon and experiments on their purification are being carried out. $Mgcl_2$ as recovered is coming upto the required specifications.

1.4 The visit to the salt works helped a great deal to appreciate the conditions under which research for a suitable technology for recovery of Kcl may be visualised.

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CHAPTER- 2

QUALITY OF BITTERNS FOR RECOVERY OF BY-PRODUCTS

2.1 The percentage of recovery of bitterns is reported to be 70% per ton of salt produced.

2.2 In arid zones where humidity is low, it is possible to concentrate the bitterns in different stages after the separation of salt by fractional crystalisation, in open natural ponds and by exercising proper quality control. From the point of view of recovery of potassium chloride (KCl) the maximum enrichment of KCl in the bitterns is reached at a density of 36/37 B(18-20%). Such bitterns are called as Mixed Salt. Having manufactured mixed salts these should be stored in dry and covered sheds otherwise the KCl content depletes sharply, as has been seen at one of the salt works in India where thequality of the mixed salt manufactured for a KCl plant was found to be containing about 12/13% KCl only against the contemplated planned content of 18/20% KCl.

2.3 In Burma, the climatic conditions are averse to the manufacture of mixed salts. The humidity is very high and therefore, in the first instance the bitterns will fail to reach the required concentration easily and if at all, a short hot and dry spell comes and some mixed salt is precipitated, it will not be of the required KCl content and will soon deteriorate on storage etc. In view of the above conditions, the manufacture of mixed saltsin Burma appears to be not only very difficult but even well high impossible. Efforts have been made to manufacture mixed salts at the HTHAN PIN GYAUNG SALT WORKS but without success, which is understandable.

been made to manufacture mixed salts at the HTHAN PIN GYAUNG SALT WORKS but without success, which is understandable.

2.4 Therefore, the starting point for the recovery of KCl would out of compulsion have to be bitterns of lower density than that of the mixed salts. The obvious choice should be to start with the bitterns of 30/31 B bitterns, recover magnesium sulphate as a first step then recover Potassium Chloride (KCl) and finally recover magnesium chloride. All these salts are required in Burma for industrial use.

2.5 The technology visualised for recovery of these products is described in Chapter- 3.

2.6 By that technology, the production of different products is likely to be as under:

<u>For Salt production of 8000 tons per Annum as at present.</u>

Bitterns 31-B	5600 tons.
Magnesium Sulphate	240 tons.
Pottassium Chloride	40 tons.
Magnesium Chloride	350 tons.

CHAPTER-3

APPROPRIATE TECHNOLOGY FOR THE RECOVERY OF POTASSIUM CHLORIDE.

3.1 It has already been stated in Chapter 2 that mixed salts which contain a high percentage of KCl cannot be manufactured in the prevailing climatic condition in the salt works of Burma. Therefore a technology suited to the recovery of KCl from the bitterns of 31/32-B which can be produced, should be considered as the starting point.i.e.

(i) De-sulphation of 31/32 B/bitterns to remove sulphate by precipitation of magnesium sulphate /Calcium Sulphate.

(ii) To convert the desulphatedbitterns to form Carnalite- a double salt having a composition of KCl, $MgCl_2$, $6H_2O$.

(iii) To separate KCl from Carnalite.

(i) above is the most difficult, Several methods are in practice to achieve desulphation, viz. by

(a) chellation.

(b) ion-exchange.

(c) refrigeration.

(d) use of additives .

3.1.1. (a) and (b) are very costly and not recommended. Therefore (c) and /or (d) are to be considered. Experiments have been carried out at the laboratory of the Research Division at THAKEDA of the Salt Industrial Corporation of Burma to desulphate bitterns by cooling the bitterns to zero degree centrigrade. The desulphation takes place

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partially only and the desulphated bitterns after freezing still contains sulphate . Therefore it is suggested that after removal of magnesium sulphate to the extent it is precipitated by freezing, the remaining partially desulphated bitterns may be desulphated further by treating with lime to precipitate sulphate as calcium sulphate and thereby enrich the bitterns both in KCl and $MgCl_2$ contents to enable formation of carnalite for further separation of KCl. The experiements when successful should be utilised for proper and effective desulphation of bitterns.

3.1.2. Having succeeded in these experiements, the subsequent process (ii) of conversion of desulphated bitterns into carnalite and recovery of KCl(iii) above are comparatively easy and magnesium chloride an other by-product in demand, can also be recovered at the end.

3.2 A flow diagram showing the different processes may be seen at Appendix-A.

3.3. The chemical composition of bitterns of HTHAN PIN GYAUNG Salt Works at different stages of their processing according to the method described above may be seen at appendix- B.

CHAPTER- 4

RESEARCH AND DEVELOPMENT WORK

4.1 The Research Division of the Salt Industries Corporation has its laboratoriesat THAKEDA Industrial Estate on the suburb Rangoon and also at the Salt works HTHAN PIN GYAUNG. The activities of this Division at present are related to research and development.

AT THAKEDA.

1. Quality Control of salt and by-products.
2. Packaging of magnesium chloride.
3. Purification of crude magnesium sulphate and KCl as received from the Salt works.
4. Recovery of magnesium hydrozide.
5. Research on desulphation of bitterns.
6. Research on washing of salt.

ATHTHAN PIN GYAUNG SALT WORKS:

7. Processing and Storage of bitterns.
8. Recovery of (i) magnesium sulphate, (ii) pottasium chloride and (ii) magnesium chloride from bitterns on a small scale.
9. Analytical control on the quality of bitterns (original, desulphated, decarnallited) and on $MgSO_4$ $6H_2O$, KCl , and $Mgcl_2$, $6H_2O$ as recovered.

4.2 Recovery of crude KCl from the bitterns by refrigeration and desulphated bitterns has not so far reached the desited level. Therefore further investigateions by desulphation of bitterns in two stages (i) by refrigera tion and them(ii) by treatment with lime has been agreed

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to be taken up in hand and the results of such investigations may be awaited. Apart from the above work, it is suggested that the Research Division may enter the fields of developing suitable processes for manufacture of special varities of salt viz.

(i) Refined Salt.

(ii) Table Salt.

(iii) Iodised Salt.

(iv) Cattle Licks and Cattle feeds plain and mineralised.

(v) Fortification of salt with calcium.

(vi) Light magnesium carbonate.

The requirement of specifications for the above products may be obtained from the concerned Departments of Health.

4.3. For the successful carrying out of the various functions of the Research Division, necessary assistance in the form of (i) modern apparatus (ii) Sensitive instruments (iii) Reference books and (iv) training of personnel may be given.

CHAPTER- 5

TRAINING OF PERSONNEL

5.1. UNIDO, Vienna has approved a project for training of three Burmese Nationals for a period of one month in three countries, India, Indonesia and Australia, to study and observe different methods of manufacture of solar salt and recovery of by-products. The training should be such as to prove useful to the Salt industry of Burma.

5.2 The conditions of manufacture of salt in Burma from sea water by solar evaporation are not very favourable and suffer from a number of handicaps- poor salinity of sea water/humid climate etc. Therefore training should be arranged at places where conditions are identical or partly so, so that the practices and methods adopted for overcoming or mitigating the effects of adverse conditions adopted in the countries selected for training could be studied and the experience gained therefrom could be utilised to solve such problems faced in the salt works of Burma.

5.3 Bearing the above point in mind, the following Check-list has been drawn up for study and observation of different operations in particular localities in three countries mentioned above:

I. (a) <u>Manufacture of Salt in high rain prone areas:</u>

Name of the Salt Work : GOGTE SALT WORKS, BASSEIN, MAHARASHTRA STATE, INDIA (Rainfall 116/120 Inches)

Subjects to be Studied :

: (i) Pumping of sea water at high tides.

(ii) Depth and density control in evaporators(condensers).

(iii) Consolidation of beds of Crystalising ponds.

(iv) Draining of Salt works after heavy rainy showers, and measurers for containing flood water from flash floods.

(v) Pan washing and heaping of harvested salt including harvesting operations.

(B) INSTITUTE OF WIND MILL TECHNOLOGY GUINDY, MADRAS (INDIA)

(i) Construction, installation, Operation and maintenance of windmills for pumping water.

(C) DHARANGDHARA CHEMICAL WORKS, ARGUMUNERI, TAMIL NADU STATE, INDIA.

(i) Making of impervious crystaliser beds by the use of Polythene lining.

(ii) Visit to Chemical Works.

(D) VISIT TO CHEMICAL COMPLEX OF TAMIL NADU INDUSTRIAL DEVELOPMENT CORPORATION TUTICORIN.

II. Installation and working of wind-mills for pumping and transferring of brines in the salt works, including study of salt manufacturing operations in Indonesia.

(Detailed names of the Salt works and its address to be enquired from the Government of Indonesia.

III. SALT WORKS OF ICI(AUSTRALIA) Gelong and at another places, in Australia where recovery of KCl may be carried out from bitterns.

SUBJECTS TO BE STUDIED

(i) Climatic and soil conditions.

(ii) Lay out of the Salt work.

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(iii) Mechanical washing of salt for the requirements of chemical industry.

(iv) manufacture of special variety of salt:

(a) Refind salt.

(b) Iodised salt.

(c) Table Salt.

(d) Cattle Licks-plain and mineralised.

(v) Storage and utilisation of brines in deep ponds.

(vi) Storage arrangement for bitterns

(vii) Methods used for recovery of by products-KCl, $MgSo_4, 6H_2O$ and $Mgcl, 6H_2O$.

CHAPTER -6

MANUFACTURE OF CATTLE LICKS

6.1. Burma has an agriculturist economy. Cattle wealth is a part of this economy. The requirement of salt by different cattle and sheep and goat and poultry can be met from cattle licks and cattle feeds suiting different purposes asper the health of the animal. Besides salt, other traces minerals like salts of calcium, iron, manganese, phosphorus, iodine etc. can also be administered from mineralised cattle licks and cattle feeds.

6.2 While cattle feeds is essentially a process of grinding and mixing of the different iggredients in the required ratios, in solid form, the manufacture of cattle licks can be achieved by subjecting grounds salt and other minerals and forming a mass by the addition of a little water or mollases. The thick viscous mass is then filled into moulds of required shape and size and weight and subjected to pressure in a manually operated or mechanical press depending upon the compactness and hardness required to be achieved.

6.3 The proposal was discussed with the counterpart. (Chief of the Research Division of the Corporation) and he was informed that pressing of salt in moulds of small sizes is possible with the help of manually operated screw type and hydraulic presses of small capacity and requiring small man power. The broad details of manually operated screw-type press were explained to him and it was suggested

that experiementsmay be taken up in hand to manufacture cattle licks by fabricating a press indgenously.

6.4 The specifications of different typesof cattle licks for cows, buffalows, horses, sheeps and goat, poultry etc. could also be made available.

APPENDIX -A

PROCESS DIAGRAM SHOWING DIFFERENT STAGES OF EXTRACTION OF $MgSo_4$, $7H_2O$, KCl and $Mgcl_2$, $6H_2O$

I. Bitterns 29/30Be —Evaporate→ Bitterns 31/32Be —Freeze to 0° C→ $MgSO_4$, $7H_2O$ + Desulphated bitterns

I(a) (Proposed) Desulphated bitterns + lime treatment → Desulphated Bitterns + $CaSO_4$ —filter→

II. Desulphated bitterns —heat 123°C filter & cool.→ Carnallite Kcl, $Mgcl_2$ $6H_2O$ —Hydrolysis filter & centrifuge→ Crude Kcl + Mgcl liquor

III. $Mgcl_2$ liquor —Heat in 2 stage 130° /140°C, Cool and Centrifuge→ $Mgcl_2$, $6H_2O$ Industrial Grade + Waste mother liquer

APPENDIX- B

HTHAN PIN GYAUNG SALT WORKS

Composition of bitterns at different stagesof processing
(% Weight / volume)

	From Ponds	From Storage Tanks.	Desulphated	After removal of Carnallite.
Be	29/30 Be	31.5 Be	--	36.5 - 37.5
Nacl	13.98-15.51	6.24	7.95-9.89	0.88- 1.75
$Mgso_4$	7.75-8.17	11.25	5.15 - 7.18	4.39-4.79
Kcl	1.46 - 1.53	2.24	2.23 - 2.24	0.54- 0.93
$Mgcl_2$	11.81-19.94	19.79	17.03 - 19.85	35.52-39.97