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ACKNOWLEDGEMENTS

The team gratefully acknowledges the valuable assistance received from:

Dr. L.E. Ramirez-Boettner, Resident Representative of UNDP in Chile, Dr. P. Frangs, his Deputy, and the staff of the UNDP office who provided a second home and office for the team.

Mr. Alfredo Pflucker, Senior Interregional Field Adviser for UNIDO in Chile who helped to initiate the project and provided valuable advice.

Mr. B. Venable, President of Dow Quimica Chilena, Mr. Jorge Booth, Director of Petroquimica Dow and the staff of those two companies who gave much of their time and energy to assist the team in carrying out its work.

Mr. Adolfo Couve B. of ASIQUIM;
Mr. Francisco Said of ASIPLA and Mr. Juan Tampier B., President of the Instituto Chileno del Plastico who individually and through their organisations gave the team much help and hospitality.

Finally a special personal acknowledgement must be made to:

Mr. Mario Antunez V., Plastics Sales Manager of Dow Quimica Chilena;

Mr. Miguel Abarca ..., Manager of the Instituto Chileno del Plastico.

In addition to developing programmes, arranging interviews, providing office accommodation, typing services, transport and other facilities which have made the work of the team possible, these two gentlemen gave generously of their own personal time and hospitality to make the team's stay in Chile a memorable experience.

ABBREVIATIONS

ABS	Acrylonitrile-butadiene-styrene copolymers
ALALC	Asociacion Latinoamericana de Libre Comercio
ASIQUIM	Asociacion de Industrias Quimicas
ASIPLA	Asociacion de Industriales del Plástico de Chile
CESMEC	Centro de Servicios Metalurgicos
CORFO	Corporacion de Fomento de la Produccion
ENAP	Empresa Nacional de Petroleo
GP	General Purpose (polystyrene)
HDPE	High density polyethylene
HI	High impact (polystyrene)
ICDP	Instituto Chileno del Plastico
INACAP	Instituto de Capacitación Professional
INDITECNOR	Instituto Nacional de Investigaciones Tecnológicas y Normalización
INTEC	Instituto Tecnológico de Chile
LAFTA	Latin American Free Trade Agreement
LDPE	Low density polyethylene
MT/a	Metric tons per annum
ODEPLAN	Oficina de Planificacion Nacional
PETROQUIM	Petroquimica Dow
PP	Polypropylene
PS	Polystyrene

PU	Polyurethane
PVC	Polyvinyl chloride
SAN	Styrene-acrylonitrile copolymers
UNDP	United Nations Development Programme
UNIDO	United Nations Industrial Development Organization
VCM	Vinyl chloride monomer

1. INTRODUCTION

1.1 Three United Nations missions with objectives connected with the plastics industry have visited Chile since 1960 and have prepared reports. These are:

(a) J. Delorme - "Promotion of the Plastics Industry in Chile - 1960";

(b) S. Levine - "Food Packaging in Chile - 1960";

(c) K. Honda - "The Use of Plastics in Agriculture in Chile - 1969".

These reports have provided useful background information for this mission but have only limited relevance to the educational, technological and commercial problems of the plastics fabrication industry in Chile which were the main subjects for study by the mission.

1.2 The Mission and its Objectives

1.2.1 In mid 1969, a further request from the Government of Chile was transmitted to UNIDO headquarters in Vienna by Dr. L.M. Ramirez-Boettner, Resident Representative to the United Nations Development Programme in Chile. This request, developed with the help of Mr. Wilfredo Pflucker, Senior Field Adviser to UNIDO in Chile, was for a more detailed examination of the Chilean plastics fabrication industry by a mission to be led by Dr. F. Fay. The request referred to the considerable

manufacturing capacity for basic petrochemical raw materials being constructed in Concepcion, to the substantial quantities of polyethylene and PVC to be produced in Chile for the first time during 1977 and to the need to ensure that markets could be found for these quantities of material and that the plastics fabrication industry in Chile should have both the know-how and the equipment to satisfy these markets.

1.2.2 Before the mission started work a preliminary visit was made by W. Kay, team leader, to the Dow Chemical Latin American Area Organization at Coral Gables, Florida, which is responsible for all Dow Chemical Company operations in Central and South America. This visit yielded valuable information on the relationship between the Chilean Government and the petrochemical and plastics industries together with economic and market data which considerably shortened the time the mission had to spend on preliminary enquiries in Chile.

1.2.3 After assembling in Santiago the mission was briefed at a series of meetings by the UNDP Resident Representative and by the Instituto Chileno del Plastico on the existing situation in the Chilean Plastics Industry and especially on the relationships between Government, the Universities and the industry. From these meetings it became clear that, although the existing industry was quite substantial,

development was somewhat uneven and that extensive changes were taking place. It was also apparent that reliable information on consumptionsand market demands over a period of years, which could form the basis of projections, was not available.

1.2.4 The mission was fortunate, however, in finding that a quite detailed estimate of production and consumption of all plastics with a projection to 1972-75 had recently been prepared by the Instituto Chileno del Plastico and this was supplemented and reinforced by a similar estimate for PVC provided by Dow Latin American Agency. It was clear that these were likely to be much better estimates than could be made by the mission in the time available, that they should be accepted at least as far as past and current production and consumptions were concerned and that the mission's efforts could be most usefully concentrated on identifying and studying those problems which seemed likely to hinder the development of the industry, especially that part of it engaged in plastics fabrication, and to prevent attainment of the expected growth rates. The revised objectives of the mission can thus be stated:

1.2.4.1 To study the present and future roles of Governmental and Educational Institutions in development of the plastics industry with special reference to plastics fabrication;

1.2.4.2 To study the plastics fabrication industry, especially the availability and utilization of fabricating equipment, availability of suitable operating and technical personnel and the range of products and to assess how well these will match up to future demands;

1.2.4.3 To study the plastics fabrication industry, its present and planned future range of products in relation to present and potential markets, the need for establishment of quality standards and its ability to provide the market research, product development, sales promotion and technical assistance services which will ensure the right product at the right price for a rapidly expanding market.

1.2.5 These three objectives coincided fairly well with the fields of specialization of the three members of the team, Messrs. Hay, Lohé and Gait, in that order. There was inevitably some overlap but by constant consultation, duplication of effort was avoided and a fairly complete cover was obtained in the limited time available. Although the work to be done fell naturally into three sections the conclusions reached cannot be so neatly subdivided since many of them cover the whole field. The report which follows is presented, therefore, under more logical subject headings leading to related conclusions and recommendations irrespective of who did the work.

1.3 Counterpart Services

1.3.1 For the duration of the mission's stay in Chile counterpart services were provided by both public and private organizations. These services were channelled through IPDP by Government agencies such as [illegible] and Petroquimica Chilena on the one hand and [illegible] from the private industry sections on the other. The people involved were professionally qualified with good knowledge of their industry both in Chile and abroad.

1.3.2 Petroquimica Chilena, [illegible] representatives on the Council of the Institute gave much practical help as well as moral support and the Manager of IPDP, his temporary assistant and part-time secretary, constituting the total staff of the Institute at present, devoted virtually the whole of their time to helping the mission. By providing office accommodation, arranging interviews, making transport available, by efficient organisation and by acting as interpreters they contributed a great deal to the work of the mission and to any success it may achieve. It is worth noting that although assistance in interviews was required from time to time, the mission concluded that, in Chile at least, a knowledge of Spanish is useful but not essential for those working at the professional level.

2. DEVELOPMENT AND INDUSTRY IN CHILE

2.1 The plastics fabrication industry cannot stand on its own but must depend on both internal and imported supplies of raw material on the one hand and on internal and export markets on the other. It also has to develop with the general economic, commercial and technological background of the country. This section and the next one are devoted therefore, to a very brief review of the internal situation in Chile and of Chile's relations with her immediate neighbours.

2.2 Government Policy for Industry

2.2.1 Government participation in Chilean industry began many years ago and an important early step was the formation in 1939 of the Corporacion de Fomento de la Produccion (CORFO), for which a suitably descriptive English title might be the Chilean Development Corporation. CORFO's method of working in recent years has been to promote the formation of Corporations when production is required and of Institutes when services are needed. CORFO is guided in its operations by the Oficina de Planificacion Nacional (ODEPLAN) which produces studies and recommendations on desirable developments in industry. Both organisations are guided by and, presumably, have some influence in forming Government policy for industry.

2.2.2 This policy may be broadly stated as control by Government of basic raw materials production, manufacture and services through complete or majority ownership of the operating corporations promoted by CORFO while encouraging the development of consumer oriented manufactures and ancillary services by the private sector.

2.2.1 Corporations promoted by CORFO may be financed entirely by Government, partly by Government and partly by private capital, or in suitable cases, entirely by private capital. Institutes are mainly financed by Government but at least in the case of the Plastics Institute, some of the finance is being provided by private industry. Since finance is essential for industrial development it is perhaps worth noting that Chile, although having a favourable balance on external account, is faced with a severe rate of inflation which cannot fail to cause difficulties in internal generation of capital for development.

2.3 Private Industry and Government

2.3.1 On the side of private industry the major organisation for contact and negotiation with Government is the Confederacion de Produccion y Comercio which represents the commercial and manufacturing sides of industry as well as trade in general. On the purely manufacturing side is the Sociedad de Fomento Fabril and this in turn is made up of a number of associations representing different branches of industry. There are two such associations of importance to the plastics industry - ASIQUIM and ASIPLA. These two associations are contributing finance to the Chilean Plastics Institute and will have three members each on the Governing Council. The two associations are the points of contact with Government for these matters of specific concern to the chemical and plastics industries respectively.

2.3.2 Government participation in this industry is relatively new and it may be that there has not been sufficient time for a

proper understanding to develop. It did appear to the mission however, that neither side has, as yet, developed a satisfactory means of conversing although efforts are being made on both sides to improve the situation. In the present situation of rapid change it is of fundamental importance that they should do so.

4. CHILE AND THE NEIGHBOURS

4.1 Much attention has been given by United Nations to the possibility of co-operation in both manufacture and marketing between developing countries whose domestic market is not large enough to support a manufacturing plant of an economic size. Arrangements of this kind are especially important in the petrochemicals and plastics industries where the economics of size can be very important. Chile, with a population around ten million and relatively small indigenous resources of coal, oil and natural gas, but with moderately well developed chemical and plastics industries, is certainly in a position to benefit from such arrangements.

4.2 There is an important agreement, known in South America as ALALC and to the outside world as LAFTA which in effect creates a free trade area embracing the whole of South America. While ALALC does not provide for co-operation in manufacture a further agreement has been negotiated within it between Chile and her four immediate neighbours, Bolivia, Colombia, Ecuador and Peru embracing a total population of about fifty millions. This agreement, the Andean Sub-Area Agreement, has as its

objective the rationalisation of manufacture into economically sized units by allocation of specific projects to individual countries. It also provides for associated marketing arrangements which will permit the output from such projects to be marketed economically throughout the region. This agreement is still new and its full implementation is likely to be spread over a period of years. A special council has been set up in Lima to co-ordinate and expedite the development of projects under the agreement. A start has been made in the petrochemical and plastics sector, to which Ecuador has not subscribed, and the effects of this agreement cannot be ignored in considering the medium and long-term future of the Chilean plastics industry.

4. BASIC RAW MATERIALS FOR PLASTICS IN CHILE

4.1 Coal, Oil and Gas

4.1.1 Chile has only small reserves of coal and, in consequence, the production of plastics raw materials from coal carbonisation by-products is insignificant. There are very small productions of benzene and toluene as shown in Table 2 below and about 1,000 MT of phenol per annum are produced in the Santiago area. Chile is also unfortunate in having only small known reserves of crude petroleum but is somewhat better off for natural gas. Her neighbours in the Andean Sub-Area, are however, better off for crude oil so that the total for the Sub-Area is substantial. The position is given in Table 3.

Table 1

Reserves of Crude Petroleum and Natural Gas and Production, Exports and Imports of Crude Petroleum in the Andean Sub-area.

Sources: Natural Gas - Abrahams and Gersumky, UNIDO Baku Petrochemical Symposium 1969.

Petroleum - "EL INFORMATIVO ANDINO", Santiago 16.12.1969

Country	Reserves of Natural Gas $10^6 m^3$	Reserves of Crude Oil 1967 $10^6 m^3$	Production of Crude Oil 1967 $10^6 m^3$	Exports of Crude Oil 1966 $10^6 m^3$	Imports of Crude Oil 1966 $10^6 m^3$
BOLIVIA	142	95.8	2.3	0.3	-
CHILE	85	23.8	2.0	-	1.4
COLOMBIA	99	317.9	11.0	5.7	-
ECUADOR	4	52.5	0.35	0.07	0.6
PERU	50	55.6	3.9	0.3	0.15

4.2 Olefins and Plastics Intermediates

4.2.1 Until now the important plastics raw materials ethylene and propylene have not been produced in Chile and production has only just started in Colombia. Production of other plastics raw materials is also very small throughout the Andean Subregion as is shown in Table 2.

Table 2

Production of Plastics Raw Materials and some Intermediates in the Andean Subregion 1960-69. 10^3 tons.

Source: "EL INFORMATIVO ALALC", Montevideo 16.12.1969

Product	Bolivia	Colombia	Chile	Ecuador	Peru
Benzene	-	47	6	-	under development
Toluene	-	7	0.7	-	under development
Xylene	-	40	0.2	-	under development
Methanol	-	-	-	-	-
Penta Erythritol	-	-	3	-	-
Formaldehyde	-	6	13	-	negligible
Acetaldehyde	-	under development	2	-	-
Phtalic anhydride	-	3	-	-	-
Phthalates	-	8	12	-	-
Urea	-	80	-	-	-

Oil Refineries and Plastics Development

Chile. The situation in Chile is now changing rapidly. Many years ago there existed the Empresa Nacional de Petroleo (ENAP), which held even the ownership of all indigenous oil and natural gas reserves and is currently responsible for all crude oil production and refining in Chile. Some three to four years ago the Chilean Government decided, as a matter of policy in order to reduce the bill for imports, to promote the development of a petrochemical and chemical industry in Chile and it was envisaged

that [illegible]F would build a cracking plant adjacent to its refinery at Concepcion for production of 60,000 MT/a ethylene and 40,000 MT/a propylene.

4.6.2 A petrochemical company, Petroquimica Chilena, was formed in which CCPC and [illegible]F have equal shares. It was decided that Petroquimica Chilena would build a chlorine/caustic plant at Concepcion to produce 30,000 MT/a of liquid chlorine, 15,000 MT/a of hydrogen chloride and 75,000 MT/a of caustic soda.

4.6.3 Petroquimica Chilena, in turn formed Petroquimica Dow (PETRODOW), a joint company with Dow Chemical Company of Midland, Michigan, USA, the Dow share being seventy per cent. Petrodow is building plants at Concepcion to produce 18,000 MT/a of VCM, 15,000 MT/a of PVC and 20,000 MT/a of LDPE. Construction of these plants is well advanced and it is planned that the whole complex will be on stream during the last quarter of 1971.

4.6.4 Petroquimica Chilena is also presently seeking partners for the construction of a further complex to use the remainder of the ethylene and some of the propylene from the Concepcion cracker to produce about 20,000 MT/a of polyvinyl acetate and a range of plasticisers and other chemicals. This is unlikely to be on stream before mid 1972 at the earliest.

5. PRODUCTION OF POLYMERS FOR PLASTICS IN CHILE

5.1 From the very small local production of raw materials shown in Table 2, it will be clear that Chilean production of polymers must, at present, be based mainly on imported monomers. In order to encourage local production the Chilean customs tariff admits monomers at nil or low rates of duty whereas the total duties on polymers are generally in excess of one hundred per cent on c.i.f. value. In spite of this, transport difficulties have so far precluded the importation of the gaseous monomers ethylene, propylene and vinyl chloride and requirements for the major thermoplastics polyethylene, polypropylene and PVC are met by direct importation of polymers. Styrene monomer and raw materials for thermosetting resins are mainly imported and polymerised in Chile. Ancillary materials such as plasticisers, stabilisers, etc. are, in general, made locally from imported base chemicals. The production and installed capacity for these materials in 1968 are shown in Table 3.

Table 3

Production and Installed Capacity for Plastics Polymers and Ancillary Materials in Chile - 1968

Source: Instituto Chileno del Plastico

Product	Production Metric Tons	Installed Capacity MT/a
Polystyrene GP	1,500	2,000
Polystyrene HI	500	
Unsaturated Polyesters	1,000	2,000
Phenolic Resins	800	2,500 (1)
Urea Resins	-	1,000 (1)
Melamine Resins	-	1,000 (1)
PVC Compounds	600	2,000 (2)
Phthalate Plasticizers	1,600	12,000 (1)
Epoxidized Oils	300	1,000
Stabilizers	200	500

(1) New plant coming on stream and included in installed capacity.

(2) Compounding is also carried out by manufacturers of end products.

The difference in the figures for phthalates in Tables 2 and 3 is due to the fact that Table 2 refers to a later time period when much new plant had come into operation. Nevertheless the figure given in Table 2 is extremely high in relation to the apparent rate of consumption of PVC in Chile and must be regarded as of doubtful accuracy.

5.2 The figures in the above table are all relatively small and it is obvious that the bringing on stream of the Petrodow plants for 15,000 MT/a PVC and 20,000 MT/a LDPE represent a great upsurge in local production of these thermoplastics. The quantities are considerably in excess of those currently being processed and marketed in Chile and the plastics fabrication industry may well find itself under some pressure to use these materials in order to optimise the economics of the Government owned ethylene and chlorine plants.

5.3 At the same time plans are being made for a substantial increase in polymerisation capacity for styrene with an associated increase in imports of styrene monomer. Although quantities as high as 20,000 MT/a were being talked of in Chile, it seems likely that the first stage will take capacity to about 6-8,000 MT/a. This will still further increase the load on the plastics fabricating industry and will call for additional efforts in technical service, product development and sales promotion - an area where adequately trained and qualified staff are not at present available.

5.4 Although the present mission has studied the processing capacity for all plastics its attention has been specially directed to the problems created by this sudden upsurge in production of thermoplastics. It is worth noting that 15,000 MT/a of [illegible]

6. PLASTICS CONSUMPTION AND THE MARKET FOR PLASTICS PRODUCTS IN CHILE

General Situation

6.1.1 Plastics do not have a good image in Chile. They tend to be regarded by the general public as a rather unsatisfactory substitute for the traditional materials previously used. Moreover, until now, the price of plastics products has been so high that they cannot compete with traditional materials in applications where a substantial penetration of the market has been achieved in Western Europe, North America and Japan on a price/quality relationship.

6.1.2 This has been a common experience in countries with highly developed plastics industries during the earlier stages of development. It is brought about by a combination of factors such as poor quality of resin, lack of technical service to processors, poor design of product, use of a material in applications for which its properties are unsuitable, unsatisfactory processing techniques, lack of proper quality standards and many others. These problems are often exacerbated by failure on the part of the ultimate user to understand the properties of the material and by his misuse of it.

6.1.3 The seeds of these troubles are already sprouting in the Chilean plastics industry. In developed countries they have been gradually overcome over a period of thirty years or so, largely by a process of trial and error but are not, even yet, completely eliminated. Developing countries cannot afford this

time span, but shortening it demands close collaboration between technical service, product design, sales promotion and market research experts as well as the normal manufacturing, processing and sales staff.

Sales A further problem is that, when a plastic is replacing a traditional material in say the food packaging industry or the building industry, existing official regulations and specifications may have to be modified. This can be a time consuming process and is often hindered by opposition from those having a vested interest in the material being replaced. Additionally these problems may not be foreseen. It is all too often assumed that when a material - say PVC - becomes available then its application is straight forward. There are many different grades of PVC and even more ways of compounding and processing it. The whole sequence right down to the final product has to be optimised if satisfaction is to be assured.

[illegible] Plastics Consumption in Chile

Table The plastics consumption in Chile for 1963, 1966 and 1969 with an estimate for 1969 and a projection to 1972-75 are given on Table 4.

Table 4

Consumption of Plastics Resins in Chile - MT/a

Source: Instituto Chileno del Plastico

Resins	1963	1966	1968	Estimated 1969	Projection 1972-75
Low Density Polyethylene LDPE	1,250	6,000	7,100	8,320	20,000
High Density Polyethylene HDPE	300	800	900	1,080	1,500
Polypropylene PP	420	700	950	1,140	3,000
PVC Suspension Grade	2,750	5,000	4,400	5,280	15,000
PVC Emulsion Grade	550	1,000	1,300	1,560	3,500
PVC Copolymers	400	1,000	1,850	1,660	2,500
Polystyrene - general purpose	1,600	1,900	1,800	2,160	6,000
Polystyrene - high impact	650	1,000	1,500	1,800	3,500
Polystyrene - expanded	280	600	800	960	2,500
Acrylates - methyl methacrylate	200	400	700	840	1,400
ABS	10	20	80	96	800
SAN	-	10	100	120	800
Cellulose Derivatives	100	150	150	180	800
Unsaturated Polyesters	350	600	800	960	3,000
Phenolic Resins	600	700	800	960	3,000
Urea Resins	340	450	600	720	1,600
Melamine Resins	150	200	250	300	800
Polyurethanes	200	350	500	600	3,000
Total Resins:	10,000	20,000	24,000	28,800	80,000
Plasticizers	2,000	4,000	5,000	6,000	15,000

6.2.2 As stated on page 2, reliable information on consumptions is very difficult to get in Chile. It should be added that the ICDF figures for suspension grade PVC consumption in 1968 are the same as those given by Dow Chemical Latin American Area and that the whole estimate is in general agreement with the limited amount of information available to the mission from other sources. The figures for past consumption up to 1968 must therefore, be accepted as the best available.

6.2.3 As far as the estimate for 1969 is concerned, this appears to have been arrived at by assuming a twenty per cent growth for all plastics between 1968 and 1969 with the exception of PVC copolymers where the growth is 32.8 per cent. These growth rates are substantially higher than the averages for the preceding five years and confirm the belief held by some informed observers in Chile that the 1969 estimates are too high. If the 1969 estimates are ignored and it is assumed that the projected consumptions will not be reached until the end of 1975, the growth rates for thermoplastics to be produced in Chile for the seven year period, compared with those of the preceding five years from the end of 1963 through 1968 are as shown in Table 5.

Table 5

Growth Rates for Thermoplastics Consumption shown in Table 4

Product	Consumption MT/a 1963	Consumption MT/a 1968	Growth Rate 5 yr. average %	Consumption MT/a 1975	Growth Rate 7 yr. average %
LDPE	3,250	7,100	16.9	20,000	16.0
PVC suspension grade	2,750	4,400	9.8	15,000	19.2
PVC copolymer	400	1,250	25.6	2,500	10.5
Polystyrene GP	1,600	1,800	2.4	6,000	18.8
Polystyrene HI	650	1,500	18.2	3,500	16.6
Polystyrene expanded	280	800	23.1	2,500	17.7
Total: All Plastics	12,248	24,025	14.4	67,150	15.8

6.2.4 The future growth rates are of doubtful value since there is no satisfactory basis for estimating future growth. It is however, interesting to compare them with the rates for the preceding five years which are more soundly based. LDPE at 16 per cent is slightly down and it may be that a higher rate would be possible. In any case, if the 20,000 MT/a plant currently under construction does not reach capacity until 1975 the economic effects will be serious and strenuous efforts will be needed to achieve a higher growth rate.

6.2.5 Similar considerations apply to PVC but in this case the average growth rate will have to double if maximum plant capacity is to be attained by 1975. A growth rate of twenty per cent or over may well be possible but there are many problems to be overcome which are discussed on pages 66-74.

6.2.6 For the other thermoplastics listed the situation is less urgent since indigenous production capacity will come on stream later. The estimated growth rate for PVC copolymer is very low but it is likely to be 1972-73 at the earliest before local production of polyvinyl acetate is available and, in any case, much of the polymer is likely to go into surface coatings which are outside the scope of this report.

6.2.7 Growth rates estimated for polystyrene are reasonable, but the total estimated consumption by 1975 is not large enough to support a domestic monomer plant so that production of this material is likely to depend on imported monomer for some years to come. Polymerisation plant is relatively cheap and easy to install so that serious economic problems are not so likely to arise.

6.2.8 Finally looking at the industry as a whole, the consumption figures do not include any plastics imported in the finished state. While the customs duties discourage importation of finished plastics as such there are likely to be substantial imports of finished plastics as components of other imported articles and equipment-insulators, pneumatic hoses, bearings, gears and so on - which are not classified as plastics imports.

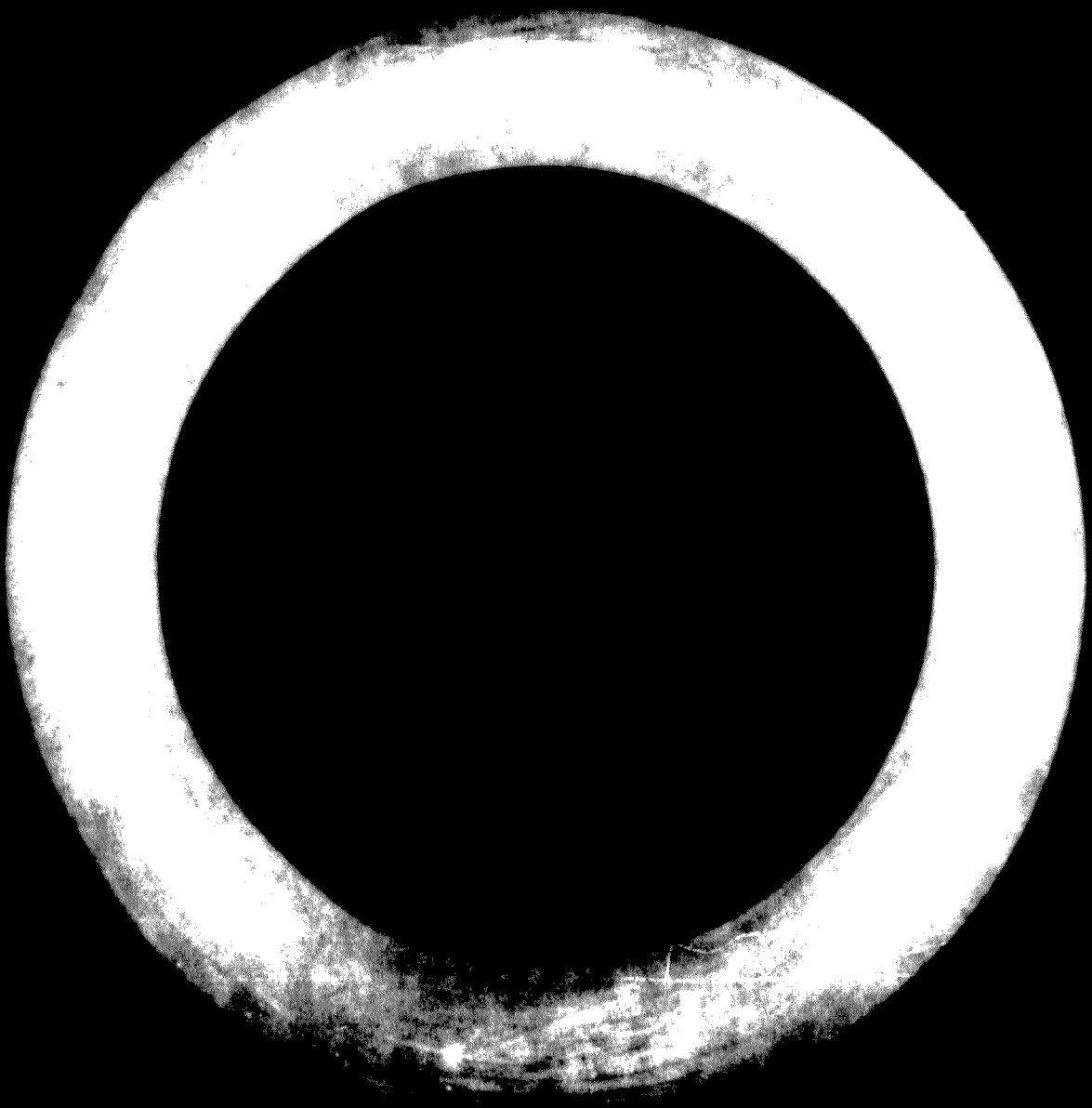
These problems are discussed more fully in the discussion on plastics markets.

6.3 The Market for Plastics in Chile

6.3.1 Early development of the market

The plastics market, has developed, in general, from initial importation of finished plastics. Then as consumption grew, Government felt the need to reduce the cost of imports and local businessmen saw opportunities for profitable investment, a process of backward integration started, first to the importation of finished resins and compounding agents for domestic processing, then to the importation of monomers for polymerization and to local manufacture of compounding agents and, finally, to local production of basic raw materials. The last stage has been partially completed for thermosetting resins through local production of formaldehyde from imported methanol, and some phenol but the most important example is the ethylene and plastics complex at Concepcion described in Section 4 which will shortly come on stream.

6.3.1.2 For other plastics all stages of development are found, back to importation of monomer, according to the nature of the plastic and the size of the market. The Chilean plastics market is very diverse as can be seen from the estimated distribution of consumption for 1968 given in Table 6.



It will be noted that the totals of Table 6 are in general,

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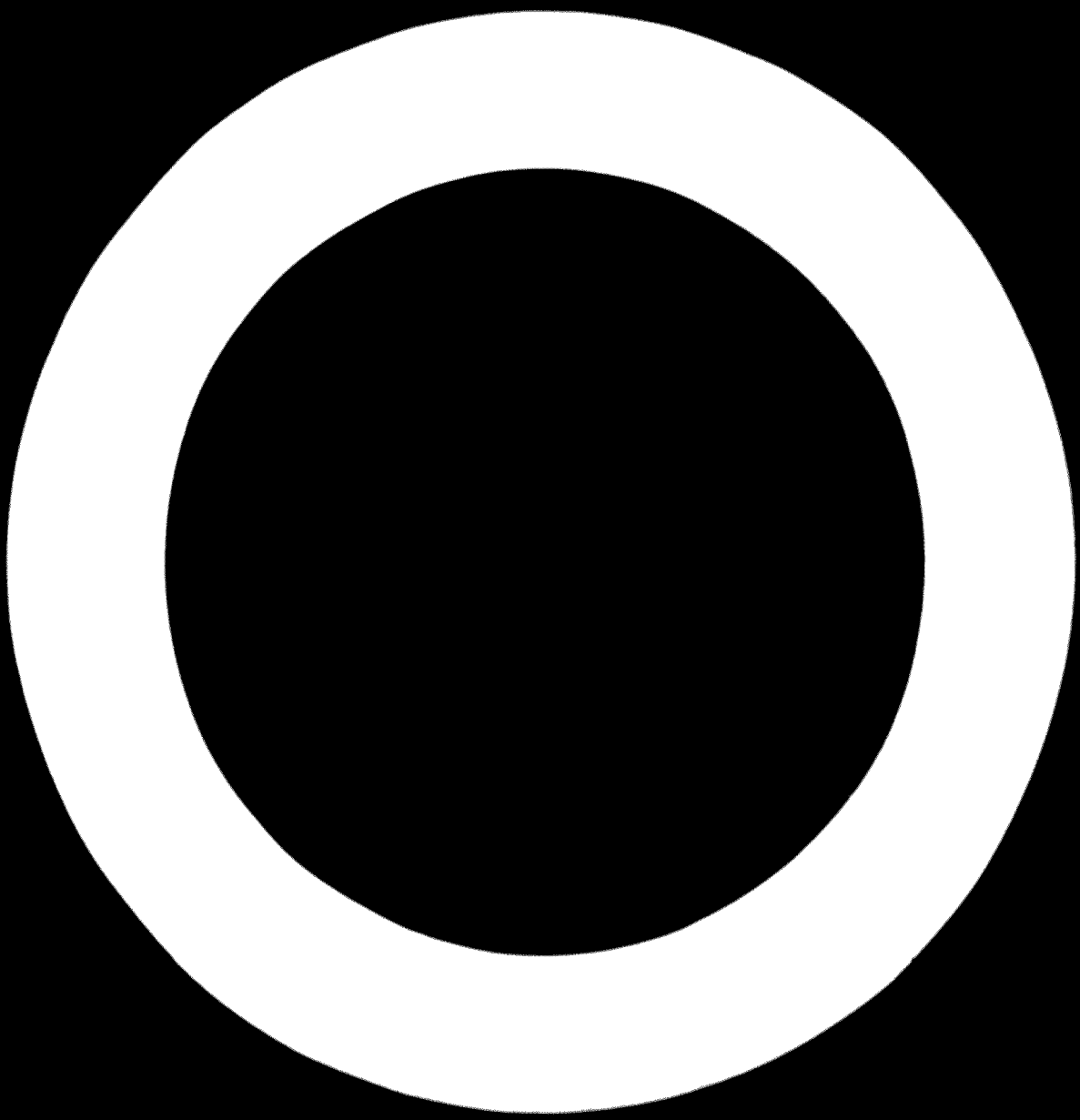
TABLE 6: ESTIMATED DISTRIBUTION OF CONSUMPTION OF PLASTICS IN WESTERN EUROPE IN [illegible]
Source: Institute [illegible] des Plastiques

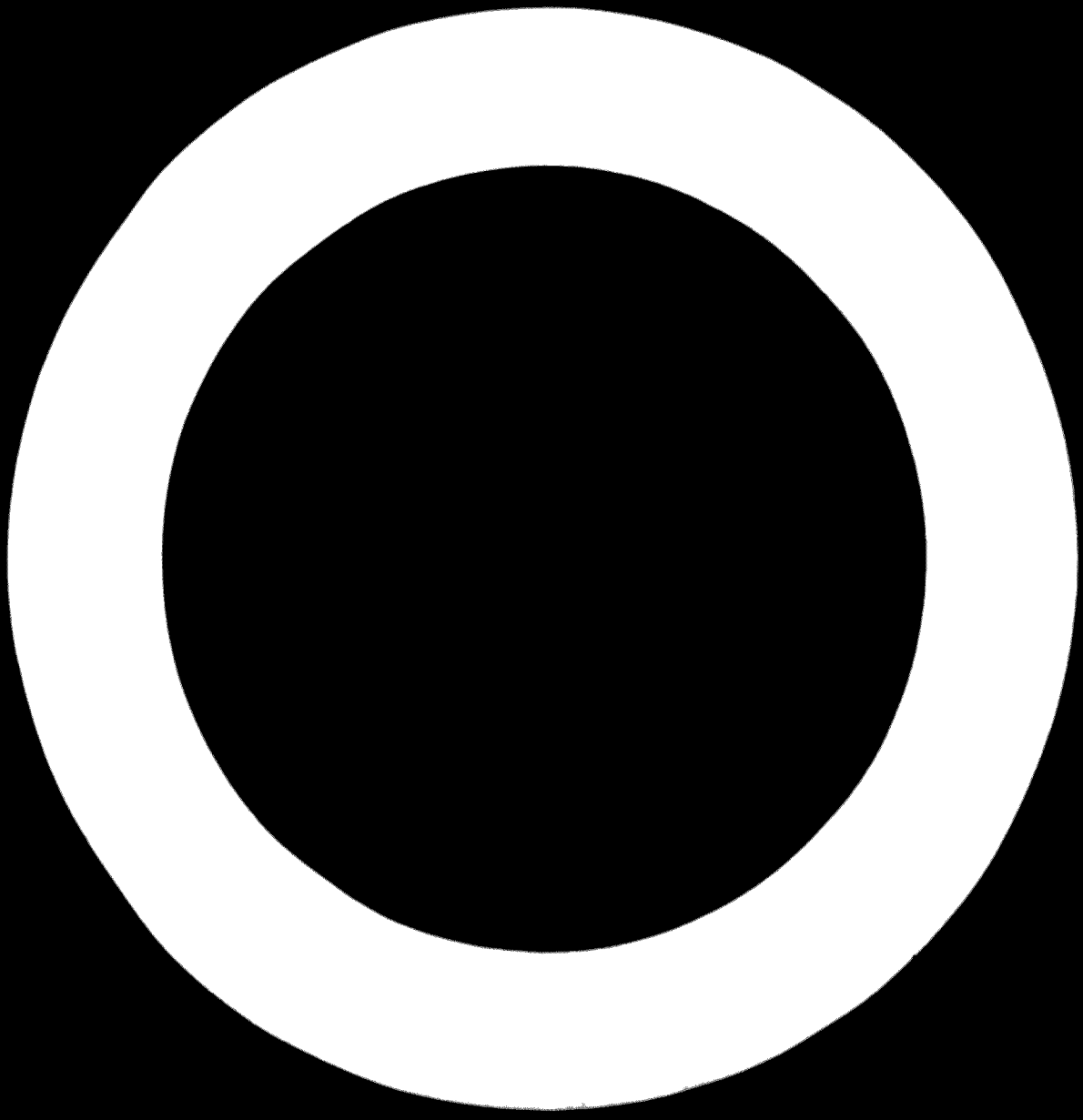
Application	[illegible]	[illegible]	Poly Propylene	PVC Suspension	PVC Emulsion	PVC Copolymers	Polystyrene	Polystyrene Foam	Polyethylene	Urea and Melamine Formaldehyde	Polyurethanes	Acrylics	Cellulose Plastics
Film for all purposes	[illegible]			[illegible]									
Blow mouldings (including blow moulded bottles)	[illegible]	200		120									[illegible]
Various injection mouldings	[illegible]	[illegible]	[illegible]				[illegible]	[illegible]					[illegible]
Water and gas pipes	[illegible]	[illegible]		[illegible]									
Hoses				[illegible]									
Screw seals			[illegible]										
Footwear				[illegible]									
Cable covering and insulation	[illegible]			[illegible]									
Compounds for sale - outlets unknown				[illegible]									
Flooring				[illegible]	[illegible]								
Electrical conductors [illegible] Conduit				[illegible]									
Roofing sheets				[illegible]							[illegible]		
Profiled sheets				[illegible]									
Artificial leather - supported and unsupported				[illegible]	[illegible]								
Gramophone records					[illegible]	[illegible]							
Containers and laminates for containers						[illegible]							
Laminates and sheets for thermal forming							[illegible]						
Sheets and blocks for thermal insulation								[illegible]					
Sheets for various uses												[illegible]	
Injection moulded articles for technical uses										[illegible]			
Extruded sheets and laminates													[illegible]
Bodywork sections and parts for automobiles											[illegible]		
Moulded articles, e.g. protective helmets, chairs etc.											[illegible]		
Polyurethane foam for upholstery and small uses in shoes											[illegible]		



It will be noted that the totals of Table 6 are in general, lower than for the consumptions of the basic resins shown in Table 5. It is not possible to determine all small users and no attempt has been made to get a precise agreement.

6.6.6.3 Table 4 can be roughly divided into two parts. The upper part deals with the major thermoplastics, the polyolefines, PVC and polystyrene. The lower part deals with the minor thermoplastics and the thermosetting resins.

6.6.6.4 In the lower part of the table only the phenol, urea and melamine/formaldehyde resins, the unsaturated polyesters, the polyurethanes and polymethylmethacrylate are expected to attain four figure tonnages by 1975. None of them are likely to justify domestic production of the basic raw materials for many years to come and many will probably continue to be imported as such or in the form of monomers. Some of them may become basic by accident. The formaldehyde based resins are already made from domestic formaldehyde produced from imported methanol and there is some domestic phenol. If a fertiliser project, at present planned for the Magallanes region in Chile and an aromatic project, primarily designed for synthetic fibre raw materials, were to come to fruition in Chile or in the Andean Sub-Region then small but economic projects might be possible for phenol, methanol, urea and melamine for the formaldehyde based resins. This should speed up development of these thermosets but is unlikely to affect their growth before 1975.



6.1.1.5 In the event that availability of aromatic hydrocarb could promote local manufacture of phthalic anhydride, maleic anhydride and di-isocyanates thus boosting the growth rate for unsaturated polyesters and polyurethanes. This is not unlikely before 1975.

6.1.1.6 It is then the major thermoplastics which are expected to grow most rapidly in the period up to 1975 and especially 1975 and subsequently PVC for which new production capacity is expected on stream by the end of 1971. Polystyrene is expected to grow less rapidly but it too could be made from domestic raw materials should aromatics become freely and cheaply available in Chile. The characteristics of the Chilean market for these materials are, therefore, of fundamental importance. The casual observer is immediately struck by the great emphasis on plastics toys in the shops and some 2,466 tons or 13.5 per cent of total thermoplastics consumption is estimated to have gone into this outlet in 1969. It is likely that further growth possibilities in this field are limited. Other applications, common in Europe and North America, are less obvious and the various applicational areas are reviewed in the following paragraphs. The main emphasis is on thermoplastics but thermosets have been included at appropriate points.

6.1.2 Future Development of the Market

There are three major outlets for thermoplastics which, in Western Europe and North America, consume the greater part of the output of these materials. These are packaging, appliances and building. Agriculture is commonly regarded as an area which

should rival these applications but many agricultural applications can be included under packaging and some potential developments are slow to materialise. Other important outlets are in automobile furnishing, footwear and general industrial uses. Development in these fields has so far been limited in Chile and there are great possibilities for growth of consumption and very considerable problems to be solved before substantial and continuing growth is possible.

6.3.2.1 Packaging

6.3.2.1.1 In the United Kingdom more than half the total consumption of LDPE - about 87,000 tons in 1967 - are processed to film and sheet, virtually all of which is used in some form of packaging and much of it in food packaging. HDPE, polypropylene and more recently, unplasticised PVC films are also being increasingly used in packaging applications and, in addition, there is a substantial usage of blow moulded bottles of LDPE, HDPE and PVC and of containers for margarine, jams, etc. which are usually of polystyrene. It is useful therefore, to examine the conditions in Chile which might favour or hinder the increases in the use of thermoplastics for packaging purposes.

6.3.2.1.2 Food packaging imposes the most stringent requirements on packaging materials, because of the need to avoid contamination and maximise shelf life. Moreover the large variety of materials to be packed and the vast numbers of small packages mean that no one packaging film will meet the requirements and that virtually each packaging application needs a specific film material and packaging method. Use of the wrong film may lead to substantial

deterioration and spoilage of the foodstuff and may engender a quite unjustified distrust of plastics packages on the part of the customer. S. Levine in his study made in 1968 and referred to on Page 1, particularly stressed these problems.

6.1.2.1.3 Development of the food supermarket with its need for prepackaging has undoubtedly been one of the factors which has greatly accelerated the use of plastics in food packaging in the highly industrialized countries. This process is just beginning in Chile and it is important therefore, to understand the problems and avoid some of the snags.

6.1.2.1.4 At present supermarket developments are almost entirely confined to the Capital, Santiago, which has about 25 per cent of the total population of the country. In January 1970 supermarkets were estimated to sell 22 per cent of the food in Santiago and expansion already planned should take this to 46 per cent in two or three years. This expansion will undoubtedly force the smaller shopkeepers to adopt some of the supermarket methods - particularly prepackaging and deep-freeze storage of perishables - as it has done in Western Europe and North America.

6.1.2.1.5 Plans are already in hand to start supermarkets in Valparaiso - the next largest city - and as approximately 40 per cent of the total population are concentrated in a belt about 200 miles wide between Valparaiso and Santiago, the practice can be expected to spread throughout this area fairly rapidly. Progress in the remainder of the country may be somewhat slower. It should be noted that the degree of prepackaging is variable and there appears to be no uniformity in packaging systems.

6.3.2.1.6 Polyethylene bags and film and some polypropylene net are the plastics used - mainly for frozen chickens and meat, fresh fruit and vegetables and some dry goods. Coated cellophane is used for cheese, ham and similar products; most bulk produced bread is packed in coated cellophane and many materials are still packed in paper. Increases in the use of packaging films for foodstuffs will be accelerated when a wider range of films such as unplasticized PVC and special laminated films become available. Attainment of these increases will however, depend on considerable reorganization and capital investment in the food industry to provide wrapping machinery, refrigerated and deep-freeze storage and transport for distributors and refrigerated storage and display cabinets for retailers. A considerable number of staff with specialized knowledge of food packaging and handling will be required as well as a general education programme for retailers and consumers on the handling of prepacked foods in the final stages before they appear on the table. The broiler chicken indust is well developed - for example - in the week ending 20 December 19 about 430,000 chickens were processed for the main cities of the central zone - but only about seven per cent of these were frozen and bagged. Most of the remainder were sent out chilled to 0°C, but not packed, because of lack of equipment and knowledge at the retail end for the proper handling of frozen chickens. Prepackaging of meat has only made limited progress for similar reasons.

6.1.2.1.7 The cost of glass is very high in Chile and blow moulded plastic bottles should be a cheap and attractive alternative. Some are already used for cooking oil, vinegar, etc. but supplies are limited. It should also be possible, with suitable publicity, to market the cheaper grades of wine in non-returnable PVC bottles, thus opening up a substantial market which, together with the potential market for PVC film in food packaging, would assist considerably in bringing PVC resin sales up to the capacity of the new plant coming on stream. Estimated consumption of plastics (excluding cellophane) for food packaging in Chile in 1969 was 2,300 tons and there is no reason why this figure should not be quadrupled over the next seven years if the foreseen problems can be solved.

6.1.2.1.8 Industrial packaging, in which is included packaging of cosmetics and pharmaceuticals and the wrapping of textiles, etc. for retail sale, is an even larger market than food packaging largely because many of the industrial outlets use thick walled containers and relatively heavy gauge film which consume more material. Considerable progress has been made in this field in Chile and the estimated consumption of plastics (excluding cellophane) in 1969 was 4,780 tons. For industrial packaging specifications required are not so stringent as for food packaging, with the possible exceptions of pharmaceuticals and cosmetics. For wrapping textiles for retail sale, clarity and feel are of major importance whereas for industrial sacks, barrels and similar containers strength and chemical resistance may be the major factors. LDPE and PVC are ideally suited for

many of these applications and progress will depend largely on the growth of Chilean industry, effective sales promotion and price.

6.1.2.2 Appliances

6.1.2.2.1 This outlet is particularly for such things as vacuum cleaners, refrigerators, washing machines etc. commonly called consumer durables, and is largely influenced by the national per capita income, as a measure of the standard of living, and by the price of the appliances. The per capita income in Chile is relatively high for Latin America but very much lower than for the USA or Western Europe. Wages are in general, rather low and it is doubtful if the mass market is yet open to the more expensive consumer durables. Great efforts are being made to expand Chilean production of these goods and the demand for plastics for their manufacture can be expected to increase. Unfortunately the demand is mainly for the more sophisticated plastics such as ABS and polypropylene, which must at present be imported either as resins or as finished mouldings. No useful tonnage figures can be given and this is an outlet requiring a detailed market survey followed by product development and sales promotion activities.

6.1.2.3 Plastics in Building

6.1.2.3.1 The use of plastics in building and construction is an application where maximum development has not yet been reached in Western Europe and America and where development in Chile has barely started. So far, even in highly industrialised countries, the use of plastics in building has largely been

confined to flooring, cold water and sanitary piping, fittings, some decorative panels and internal partitions, skylights, transoms, rainwater goods and similar applications. Really massive applications to such things as doors, door frames, window frames, internal walling, etc. for which the modern microcellular plastics and plastic foams are well suited have not yet developed on a large scale. This may be due partly to price, partly to doubts about the long term durability of these plastics products and partly to lack of knowledge in the building industry.

[illegible] In Chile, where buildings must always be designed with the earthquake situation in mind, the very high strength/weight ratio of plastics should make them attractive for many structural applications. In fact it became clear from discussions that the Camara Chilena de la Construccion had no information on the actual use of plastics in building in Chile and very little knowledge of their potential.

[illegible] Intensive building programmes are being undertaken in Chile, both in the rehousing of families in new estates on the outskirts of cities and in the redevelopment of urban areas. It is also clear that these must be intensified in the future. At present about 50,000 dwelling units per year are being completed. It is however, estimated that with a 2.2 per cent per annum population growth, 72,000 dwelling units per annum will be required for the next century to provide for the population growth alone. It is obvious to the casual observer that a great deal of rehousing is urgent and a

proportion of the houses, at present satisfactory, will need to be replaced in the years to come so that the actual requirement is likely to be about 100,000 units per annum.

6.1.2.1.4 Currently the only substantial use of plastics in building is of PVC for floor tiles. There is some small scale use of LDPE, HDPE and PVC for piping and small quantities of methyl methacrylate and polyester sheets are used for skylights, porches, etc. Also some 800-1,000 MT/a of polystyrene foam is said to be used for insulation but it is doubtful if much of this goes into domestic building at the present time. There is however, great scope for the use of polystyrene and polyurethane foams in building for both thermal insulation and sound proofing.

6.1.2.1.5 Considerable progress has been made in use of plastics in building in West Germany, where the present average use in new building is about 110 kg. per dwelling unit. Developing countries, with a great need for easily erected cheap houses could be expected to use more than this and a really imaginative development of plastics for building in Chile could lead to quantities of 250 kg. per dwelling unit quite quickly and to even higher figures in a few years, i.e. to a total requirement of 25,000 MT/a or more. Much of this could be PVC and foamed polystyrene but the more advanced applications will need substantial quantities of other plastics such as polypropylene, ABS, polymethylmethacrylate and, among the thermosets, polyurethanes and reinforced polyesters.

[illegible] There is urgent need for an extensive survey of possible outlets and tonnage requirements of plastics for the building industry. This would provide the basis both for the development of suitable products and for initiation of the extensive publicity and training programmes which will be needed to spread knowledge of new techniques throughout the building industry.

[illegible] Plastics in agriculture.

[illegible] The applications of plastics in agriculture, including horticulture are many and diverse. J.D. Clarke presented an excellent paper on this subject at the UNIDO Interregional Symposium on the Development of the Petrochemical Industries in Developing Countries held at Baku in October 1969. From the figures given by Clarke for western Europe, Japan and North America, it would appear that on a proportionate size and population basis the potential for plastics usage in Chilean agriculture and horticulture could be at least 10,000 MT/a, excluding scope for fertilisers and for produce. Actual current usage is no more than a few hundred tons per annum at the most.

[illegible] The mission had neither the time nor the opportunity to study Chilean agriculture in depth. From discussions held with the Government Departments it became clear that Chile is implementing an extensive programme of agrarian reform and that Government circles are concerned that Chilean agriculture and horticulture should make use of all modern techniques applicable under Chilean conditions. It also became apparent that many of the applications detailed in Clarke's paper could not be

transferred directly to Chilean conditions and that an extensive market survey would be necessary to determine just what the needs of the industry are. This survey would then need to be followed by effective product development and sales promotion programmes to develop the potential uses in the industry. Assuming that the 15,000 MT/a potential consumption given above is attainable, it is probable that at least 80 per cent of this would be for LDPE and PVC and it would therefore, make a useful contribution to Chilean consumption of these plastics.

6.1.2.5 Automobiles

6.1.2.5.1 The automobile industry is an attractive market for plastics since some 15-20 kg. plastics can be used per car. Most of this is made up of polyurethane foam fillings for seats and back rests and PVC coated cloth for seat and back rest covers, door and roof linings, etc. The remainder comprises miscellaneous plastics for ornamental trim, knobs, switches, ignition and coil parts, battery cases, etc.

6.1.2.5.2 The estimated production of automobiles in Chile in 1970 is 40,000 cars, 7,000 pick ups and 15,000 lorries, buses, etc. - a total of 62,000 units. Since this is about 75 per cent above the probable figure for 1969 it must be accepted with reserve. If it is attained it suggests a potential usage of 930 to 1,240 MT of plastics for automobiles in that year.

6.1.2.5.1 Growth is likely to depend on price of automobiles as much as on the price of plastics. The current prices for automobiles in Chile are 3.8 times the equivalent prices in the USA. On the assumption that the Chilean prices can be reduced to no more than twice the USA prices then production for 1980 is estimated as 70,000 cars, 15,000 pick ups and 31,000 lorries, buses, etc. - a total of 116,000 units or between 1,740 and 2,320 MT of total plastics. These quantities are relatively small and it seems probable that it will be many years before the Chilean automobile industry is a significant outlet for plastics unless the all-plastic car body becomes a practical proposition for large scale production.

6.1.2.6 Footwear

6.1.2.6.1 There is quite a substantial usage of plastics for footwear in Chile - about 1,000 tons in 1960. Suspension grade PVC is used for injection moulded shoes, which are mainly for children, and emulsion grade material for coated fabrics used for footwear. Various combinations of PVC and leather are used and high impact polystyrene is used for heels. Uppers of "Corfam" or similar synthetic materials do not appear to be produced yet.

6.1.2.6.2 High growth rates are not expected; one estimate put the increase by 1970 at 8% per annum. Leather is still relatively cheap and appears to be preferred by the shopping public, but a substantial differential in favour of PVC could shift the price differential enough in favour of plastic footwear and might permit a higher growth rate.

6.1.2.7 Furniture and Furnishings

6.1.2.7.1 In this area the distinction between synthetic fibres and plastics tends to become a little blurred. There is some usage of plasticized PVC sheet for shower curtains and the like but the true bulk usage of plastics in the form of foam for upholstery, injection mouldings for chair seats, etc. appears to have made little headway, possibly due to the poor public image of plastics referred to on page 16. The newer microcellular plastics and the possibilities for their use in furniture construction appear to be virtually unknown in Chile. Unfortunately most of these applications are not open to LDPE or PVC but require polyurethanes, polypropylene and ABS.

6.1.2.7.2 With the substantial programmes of rehousing and urban redevelopment which are going on it should be possible, given a reasonable price for raw material and a well designed programme of product development and sales promotion, to develop substantial outlets for plastics in the furniture industry.

6.1.2.8 Miscellaneous Applications

6.1.2.8.1 These can in total, make up a substantial usage of plastics some of which, for example domestic hollowware, handbags and luggage, can be for LDPE or PVC. Established uses for thermosets, such as electrical fittings from the formaldehyde based resins and boat hulls from glass fibre reinforced polyesters, have been included under this heading. These outlets have considerable potential for development but are unlikely to equal the major thermoplastic routes in tonnage. Many of these miscellaneous

applications however, are for small quantities of sophisticated plastics and will be met by importation of finished products or, at the best, by importation of resins or monomers.

6.4 Summary and Conclusions

6.4.1 In the preceding paragraphs an attempt has been made to highlight the important factors affecting the consumption of plastics in Chile and the future development of the market. It has not been possible, however, to quantify these and it will not be possible to do so until there is a better basis than exists at present for estimating future consumption and requirements.

6.4.2 In order to provide such a basis detailed market research is essential in the important areas of plastics application. Market research on this scale is time consuming and relatively expensive and was not practicable for the present mission.

6.4.3 In conjunction with market research a programme of educational advertising to inform the ultimate user of the properties and advantages of plastic materials, backed by well designed products made to a uniformly high standard could have a marked effect in speeding up development of the market. Faults in design or quality followed by claims due to ignorance by the ultimate user, can only cause serious delay in development.

7. THE PLASTICS PROCESSING INDUSTRY IN CHILE

7.1 General Notes

7.1.1 The economics of scale are much less important in plastics processing than in the production of raw materials and resins. Processing units are limited in size and both capital and operating costs tend to increase linearly with the number of units. This means that the industry is attractive to the small operator since a business can start with one moulding press in a shed and extend from that according to the owner's skill in making well designed high quality products and in selling them.

7.1.2 The Chilean industry bears all the signs of having developed in this way. From its early beginnings about 1960 it has grown so that there are currently about 240 processors employing some 16,000 people. The companies vary in size from those employing only a few people to those having up to 800 employees. Great differences in management efficiency were also found and the largest companies were by no means always the most efficient. In general the industry suffers from the disadvantages to be expected from its manner of development.

7.1.2.1 Dependence on imported supplies of raw materials so that supplies are sometimes uncertain and prices unstable.

7.1.2.2 The lack of technical service in use of resins customarily supplied by resin manufacturers in developed countries.

1.1.2.3 Dependence on imported fabricating plant and equipment and lack of the technical service commonly given by machinery and equipment manufacturers in their home markets. This problem is made worse by a serious shortage of spare parts and by the time required to import them from abroad.

1.1.2.4 The absence of adequate facilities for the training of tool-makers, machine operators and mechanics.

1.1.2.5 The obvious shortage of skilled production technicians and engineers.

1.1.2.6 The non-availability of experts in the field of plastics application and application engineering.

1.1.2.7 The lack of facilities in the country's higher education system for training qualified engineers, chemists and technicians specifically for the plastics industry.

1.1.3 The industry has achieved its present status only through an impressive amount of highly skilled improvisation which has helped to bridge the gaps caused by the adverse factors listed above. These factors remain however, as serious obstacles to growth in the industry and are the basic cause of some of the adverse comments made below.

7.1.4 It has already been noted that 15,000 MT/a of PVC and 20,000 MT/a of LDPE are to be produced in Chile and will shortly become available; this will solve some of the industry's problems and present it with others. It has also been noted on page 53 et seq. that steps are being taken by ICDF and other Government sponsored and educational institutions to provide help for the industry. This programme is however, not likely to be fully effective for some years and help to speed up the process is badly needed.

7.1.5 The mission was able to visit many factories, to examine their plant and processes and to have discussions with technical, commercial and managerial staff. The notes which follow are believed to be fairly applicable to the majority of the Chilean plastics processing industry. Where criticisms are made these are generalised and are not directed at any one company or individual.

7.2 Injection Moulding

7.2.1 Injection moulding of thermoplastics is, after compression moulding of thermosets, the oldest part of the conversion industry. Thus a number of disadvantages have been inherited which still reflect on efficiency and performance. It was found that approximately thirty per cent of the injection moulding machines in use are out of date and should be replaced by modern, fast operating machines with output rates at least 200 to 300 per cent higher than those to be displaced. About 60 per cent of the equipment appears still to be in fair condition and could probably be rebuilt to meet modern standards. The cost of such a

rebuilding programme, involving primarily modification of the injection systems and hydraulic circuits would be comparatively low and would be justified by the higher output rates obtainable and the improved quality of the finished products. It would further step up production and reduce costs if the smaller type machines could be converted to automatic operation. This too is not an expensive operation and could even be done by the manufacturer's own personnel with expert advice.

1.8.2 In general, machines were not well kept and no general maintenance schemes existed, resulting in high downtime because of breakdowns and errors normally eliminated by planned regular checks. However, the low plant utilisation and low productivity rates, which seldom exceeded fifty per cent were not due entirely to these factors but also to lack of mould standardisation (to allow a quick change of mould in the case of short runs) and to out of date mould design. For instance, pin point or hot runner systems are not used and the so called "submerged gating" systems are practically unknown. Better cooling systems for moulds, which allow cooling time to be reduced to the minimum and thus make a substantial contribution to increased productivity, were also needed. In many cases also the feeding and metering systems for raw materials did not exist or were out of order - a fault which could readily be repaired, giving higher output and lower scrap rates. Finally cycle times are much longer and the scrap rate much higher than they should be.

7.2.3 A fair number of the machines still in use are of the old plunger type which is a handicap when mouldings of high precision and quality are required. Even with the more up-to-date screw injection moulding machines however, low injection speeds were observed. The reason is that most of these machines are, by European standards, hydraulically underpowered. This again is a matter which could easily be remedied at low cost by modifying the hydraulic system and the instrumentation.

7.3 Blow Moulding

7.3.1 This section of the plastics conversion industry is relatively new and made a favourable impression in spite of the fact that machines were not, in most cases, operated to maximum capacity. Only extrusion blow moulding was seen and it was noticed that the parisons extruded were considerably larger than necessary and that the use of multi-cavity moulds appeared to be completely unknown. The moulds themselves as far as the surface etc. were concerned were mostly up-to-date and in excellent condition. The beryllium casting method appeared to be well known and handled. Most of the products appeared to be of medium quality.

7.3.2 Most of the manufacturers of blow moulded containers claim that they often have problems with raw materials, especially with lack of uniformity of the products. This makes after treatments, such as printing, very critical. The majority of the printing and other decorating machines seen in operation were manually operated.

1.4.3 The plant utilisation was in the neighbourhood of sixty per cent which compares well with the figure of seventy per cent usually considered optimum for fully mechanized operation. The output rates were however, well below those generally considered acceptable. Existing output rates could be increased and down-time on equipment due to mould changes reduced by standardizing moulds and extrusion heads.

1.4.4 The injection blow moulding process, utilizing the injection moulding method for the manufacture of parisons, is not yet commercially used in Chile. Because of the cost and quality advantages of this system it appears to be worth while for manufacturers in Chile to change over to it. Some existing, or even obsolete, injection moulding machines could possibly be converted cheaply to injection blow moulding equipment by attaching the necessary fixtures.

1.5 Extrusion

The manufacture of sheet, foil, film, pipes, hoses and profiles by means of extrusion is the major part, both for capital invested and output tonnage, of the whole Chilean plastics conversion industry. It may be noted that in the production of sheet, foil and film, as in calendering operations described in the next section, modern high capacity equipment is bulky and expensive and this section of the industry is the field of the larger manufacturer.

7.4.1 Sheets

7.4.1.1 A variety of thermoplastic sheets is made using PS, ABS, PVC and other materials, including a small amount of polymethylmethacrylate sheet made by monomer casting. The fabrication systems in use are more or less in line with those of developed countries but output and quality are considerably below world averages. There are many reasons for this; mainly it is because most of the extruders available are out of date on account of screw geometry, diameter and length. Also the existing heating and cooling systems are not able to cope with increased output.

7.4.1.2 Laminating devices - for example to put a high gloss film on PS sheet - do not exist and the production of PVC and PVA sheet combinations seems to be completely unknown. This is a most interesting product area for the electrical appliance industry.

7.4.2 Foil and Film

7.4.2.1 Foils and films are thinner and more flexible than sheets and represent the largest outlet for extruded thermoplastics in Chile. There are four main kinds of film used:

7.4.2.1.1 Blown tubular film (light) primarily used for packaging food, textiles and other consumer products;

7.4.2.1.2 Blown tubular film (heavy) - also called heavy duty film - used for packaging bulk products such as fertilisers, cement etc. These films differ only in thickness and are sometimes called lay flat

film because the tube is flattened and rolled up for transport;

1.4.2.1.3 Slit tubular film used in agriculture, building industries, weather protection and, to some extent, in packaging;

1.4.2.1.4 Multi-ply film, a new type of film in which, by multilayer construction, the chemical and physical properties of various plastics such as PE, PP, Saran, Nylon, EAA etc. can be combined. This type of film is not yet made in Latin America but is of the greatest importance for the future development of packaging with plastic films.

1.4.2.2 Also in the area of new films biaxially oriented films, particularly polypropylene film, are becoming increasingly important for the packaging industry. At present there is a considerable world wide shortage of PP film and the fact that PP capacities are being extended so rapidly is an indication of the growing importance of this material in the packaging field. At the present time there is only one PP film orienting line in Chile; this was successfully started up in January 1970.

7.4.2.3 The efficiencies observed in the production of films were generally low and were especially low in the case of light tubular film. This was mainly because the design of tools, take-off equipment, cooling devices and control systems was not up to date. With the expenditure of a relatively small amount of money and some technical assistance it would be possible to effect major improvements in both productivity and product quality.

7.4.3 Pipes, Hoses and Profiles

7.4.3.1 Most of the extruded shaped articles produced are of PE or plasticized PVC but some unplasticised PVC is also used. While product quality was excellent, production efficiencies varied between 25 per cent and 45 per cent. The reason is that, as well as the skilled and efficient producers, a number of smaller fabricators exist who have not brought their facilities up to date. The comments made on extrusion of foils and films also apply in this area.

7.4.3.2 Output rates on extruders depend to a great extent on the type of products made and it is extremely difficult to arrive at reliable efficiency figures. Defining efficiency as plant utilisation multiplied by productivity the average figure in Chile appeared to be somewhat below 0.5, which is generally considered to be acceptable for a wide range of manufactures. Figures above 0.7 may be obtained when long runs on one product are possible.

2.4.4 Film Conversion

Film conversion in Chile is carried out both by the film producers and by independent converters. The equipment seen was mostly new and of modern design. Output rates and product quality were fully up to world standards and the printing and other decorating systems were also excellent. The reason is that this part of the industry is new and it also appears that the transfer of know how and skill has been easier than in other areas. The only handicap is a serious shortage of capable package designers, packaging engineers and printing pattern specialists.

2.4.5 Calendering and Coating

2.4.5.1 The existing calendering and coating facilities are, in general, well laid out and with all the necessary auxiliary equipment available, so that a wide range of products may be manufactured from PVC and other materials. The largest volume products made are floor tiles, coated fabrics and soft goods of various kinds. There are however, no unplasticised PVC packaging films made by calendering or by any other method. Moreover the users of calenders apparently have no intention of entering this important area of plastics fabrication which in other parts of the world is an important outlet for modified and plasticised PVC.

7.4.5.2 The plant utilisation was approximately sixty per cent which is a fairly good figure if the wide range of the product-mix is taken into account. The two calendering companies visited stated that they intend to extend their production considerably. It was evident however, that little thought had been given to the installation of cheap and easy to run continuous coating machines. If this were done it would be possible to make sufficient calendering capacity available for manufacture of PVC packaging film and thus provide an immediate outlet for several thousand tons of PVC per annum. The importance of this course for the rapid build up of PVC demand cannot be over emphasised.

7.4.5.3 It must also be mentioned that the capacity of the existing calenders could be increased by improving pre-mixing, compounding and refining facilities. This would not only reduce the present high scrap rate but would also improve the quality of the finished product.

7.5 Moulding of Thermosets

7.5.1 The processing of thermosets by compression or transfer moulding was the starting point of the plastics processing industry in Chile and it is still a very important source of components for the electrical and associated industries. Many household goods, furniture components, etc. are made by this method.

1.5.2 The majority of the moulding equipment for thermosets is out of date and even purely hand operated spindle presses are still in operation. Plant utilisation and productivity of the equipment seen was extremely low and there is scope for a future investigation in this field. However, the introduction of a simple mould standardisation scheme to speed up mould changes and reduce down-time of presses, the replacement of some ancillary equipment and rebuilding the best of the existing machines would result in a substantial increase in overall efficiency. There are however, few indications that processors have any plans for reorganising moulding operations.

1.5.3 The injection moulding technique for thermosets does not appear to be used in Chile. The processors claim that the reason is that Chilean made thermosetting moulding powders are not of the required quality and uniformity and that moulding powders for injection systems would have to be imported. The procedure for doing this appears to be complicated and approval by Government authorities uncertain.

1.6 Polyesters and Plastics

1.6.1 There is a small but rapidly growing polyester converting industry in Chile. At present, all products, particularly those reinforced with fibre glass, are made by manual methods using patterns of non-ferrous metals or of wood, plastics or similar materials. The efficiency is remarkably high for a manual system and the implementation of plans to install even more efficient mechanical fabricating systems depends on the factors

7.6.1.1 Availability of suitable qualities of glass fibre which are not yet made in Chile; and

7.6.1.2 The creation of new outlets.

7.6.2 The process is claimed that a substantial increase in production of glass fibre reinforced products for the building and agricultural industries would be possible if the duties on imported rovings, currently 20% per cent if imported from Europe and 60 per cent if bought in from ALALC, were to go down to 10 per cent or 20 per cent. There are other import restrictions which prevent long range planning in this field and hold up at least part of the possible development.

7.6.3 The processors of polyesters and similar products are also examining the use of PU rigid foams in sandwich combinations with glass reinforced polyester sections. It is anticipated that there will be a rapidly growing market for such materials in manufacture of prefabricated housing in the near future. It is probable that this could be one of the fastest growing sectors of the plastics conversion industry if it were possible for the present import restrictions to be relaxed.

7.6.4 Epoxies are used in Chile only for special purposes and to the extent of a few tons per annum. No rapid growth in this sector is anticipated.

7.7 Decoration of Plastics

7.7.1 Plastics decoration (printing, hot stamping, metallizing, chromium plating) is not much practised in Chile. The main reason is that the automotive and electrical appliance industry has not yet reached the minimum level where the installation of sophisticated decorating equipment is justified. This is only a matter of time and fabricators should be encouraged to enter this important field of production as soon as it is feasible to do so.

7.8 Rotocasting

7.8.1 Rotocasting is very little used in Chile in spite of the fact that tooling and other costs are low and the method is ideal for short run production of thermoplastic products. For example it is an excellent method for production of shipping containers and it is surprising, in a country like Chile with major problems in the shipping of agricultural products, that the technique is not used more widely. The method requires emulsion grade polymer and would not therefore, be an outlet immediately for Chilean produced PVC. Nevertheless it is desirable that the method should be introduced to the plastics fabricating industry and it would also encourage the production of emulsion grade polymer.

7.9 Foamed Plastics

7.9.1 Foamed plastics, both rigid and flexible, are becoming increasingly important and world production is expanding rapidly. So far, the production of these materials in Chile is a long way behind world-wide averages. Unfortunately the most promising field is for PU foams for which Chile must at present

depend on imported raw materials. Polystyrene foam has however, many uses, especially as an insulator for refrigerated stores and vehicles and many uses for foamed PVC are developing. Unfortunately for these uses also emulsion grade PVC is required.

7.9.2 It is difficult at this stage, to predict whether flexible or rigid foams will predominate but in the long run it seems probable that the large potential outlets in the building industry will swing the balance in favour of rigid foams. At present production of polystyrene foam should be able to develop freely; conditions for PU foam have been dealt with in the paragraph on polyesters.

7.10 Summary - The Status of the Plastics Processing Industry in Chile

7.10.1 The mission arrived at the following conclusions on the status of the industry:

7.10.1.1 The industry covers a wide range of raw materials and finished products and has a certain amount of obsolete or obsolescent equipment;

7.10.1.2 In spite of this it would be possible at relatively small capital cost to increase the production capacity of the industry by approximately 50 per cent within 12-18 months. Much of this increase would be in the field of PE, PVC and PS where it is most needed.

7.10.1.3 The industry needs substantial skilled assistance in the production, marketing and management science areas. The provision of this is dealt with in the next two sections and in the Recommendations.

8. EDUCATION, TRAINING AND SERVICE FOR THE PLASTICS INDUSTRY

8.1 Personnel and Training

8.1.1 The difference between education and training is merely one of degree. In this section education is considered as a relatively long term process for production of qualified personnel to act as chemists, chemical, mechanical and electrical engineers, as technical service and product development experts and even as salesmen. A proportion of these qualified people should, as they gain experience, progress to senior managerial positions in the industry.

8.1.2 Training on the other hand is a relatively short term process designed to produce, plant operators, plant foremen, maintenance engineers, instrument mechanics, electronic and laboratory technicians - in short the multitude of people with specialised skill required in a modern, technologically advanced industry.

8.1.3 The mission was able to have discussions with University Departments and with training institutions. It was not possible to make a study in any depth but a number of points emerged which appear relevant to the future progress of the plastics industry as a whole and more particularly of the plastics processing industry.

8.2 The Universities

8.2.1 The universities, of which there are three in Santiago, and others in the main cities throughout the country, are generally similar to universities elsewhere. Up to the present time, at least as far as Santiago is concerned, they seem to have been rather academic in outlook with little contact with industry or understanding of its problems. Their degree courses seem to be extremely long - mostly six years - and this, together with the academic outlook, may make it difficult for graduates to fit into industry at the lower levels, where they can get real practical experience, before going on to the more senior managerial posts.

8.2.2 The situation may be changing. The engineering department of the Catholic University in Santiago will in 1970 introduce new courses on high polymers, petrochemistry and its relation with plastics and the properties of plastics materials. Three semesters on one of these subjects will be introduced into the six year first degree course. Graduation from the school will be six to seven in 1970 but is expected to increase to 25 per year by 1972. This will make a contribution, albeit a small one at first, to the needs of the plastics industry.

8.2.3 The University of Chile in Santiago has a School of Industrial Design as part of the general Department of Design. The curriculum for the design school is under review and greater emphasis will be placed on the need for knowledge of the properties of materials, especially plastics, metals and wood.

The course lasts for four years and is being extended to five years. There is a serious shortage of teachers in this field. The design centre co-operates with the Chilean Plastics Institute which is described on pages 56 and 57.

8.2.4 A more interesting institution for industry is the third university in Santiago, the Chilean Technical University. This is a national institution with nine campuses throughout the country and concentrates on training people for technological careers, especially engineering. Courses are of four years for field engineers and six years for more highly qualified practitioners. There is also an intermediate two year course for technicians (tecnico) in, for example, quality control, plastics etc., which started in 1968. This course ends with a six months training period in industry, making two and a half years in all. A joint committee of the university and industry representatives decides where the student will go for training and assists in placing him afterwards.

8.2.5 The university has no equipment for training in industrial processes and equipment for quality control and pilot plant work is badly needed. This problem is discussed further on page 62 et seq.

8.3 The Institutes

The formation of Service Institutes by CORFO has already been referred to on page 6. Those important to the plastics industry are the Instituto Chileno del Plastico (ICDP), Instituto Tecnológico de Chile (INTEC), Instituto de Capacitacion Profesional (INACAP), Instituto Nacional de Investigaciones Tecnológicas y Normalizacion (INDITECNOR) and Centro de Servicios Metalurgicos (CESMET). The most important of these for the plastics industry is the Chilean Plastics Institute (ICDP).

8.3.1 The Chilean Plastics Institute

8.3.1.1 ICDP is an Institute sponsored by CORFO from which it may receive some financial assistance. It will also be financed to a considerable extent by contributions from private industry through the industrial associations ASIQUIM and ASIPLA (see page 7). The legal formalities for its formation had not been completed when the mission left Chile. When they are it will be controlled by a Council consisting of three members appointed by CORFO, three by ASIQUIM and three by ASIPLA.

8.3.1.2 In the present early stages of its establishment the organization of the Institute is rudimentary and its functions not yet defined. As noted on page 5 the Institute provided counterpart services to the mission in Chile and it should obviously provide, or at least co-ordinate, counterpart services for any follow up assistance decided on as a result of this report.

The Institute can play a vital role in furthering development of the plastics industry in Chile and assistance in establishing it and defining its functions might well be one of the first follow up operations to be undertaken; its organization and functions will therefore, be dealt with at some length. The collective views of this mission on the functions and organization of ICDF are as follows.

8.3.1.3 Functions

8.3.1.3.1 The Institute will provide services to manufacturers, processors and users of plastics. It is a non-executive body in all matters other than its own internal management;

8.3.1.3.2 As a joint body the Institute will act as bridge between the Government and private interests in the plastics industry. It will not usurp the negotiating functions of ASIQUIM and ASIPLA but will provide a forum for discussion giving technical and economic information to both sides as required;

8.3.1.3.3 The Institute will also act as a bridge between the industry and the Universities and other educational and training institutions, translating the industry's needs for manpower in both quality and quantity to the Universities and Institutes and advising the industry on future out turn of trained personnel. It should also act as a catalyst to promote much closer contact between industry and the Universities than exists at present;

8.3.1.3.4 The Institute will consult with other interested bodies and will take the initiative in developing quality standards for plastics products in Chile and in doing the necessary missionary work to make these acceptable to all concerned;

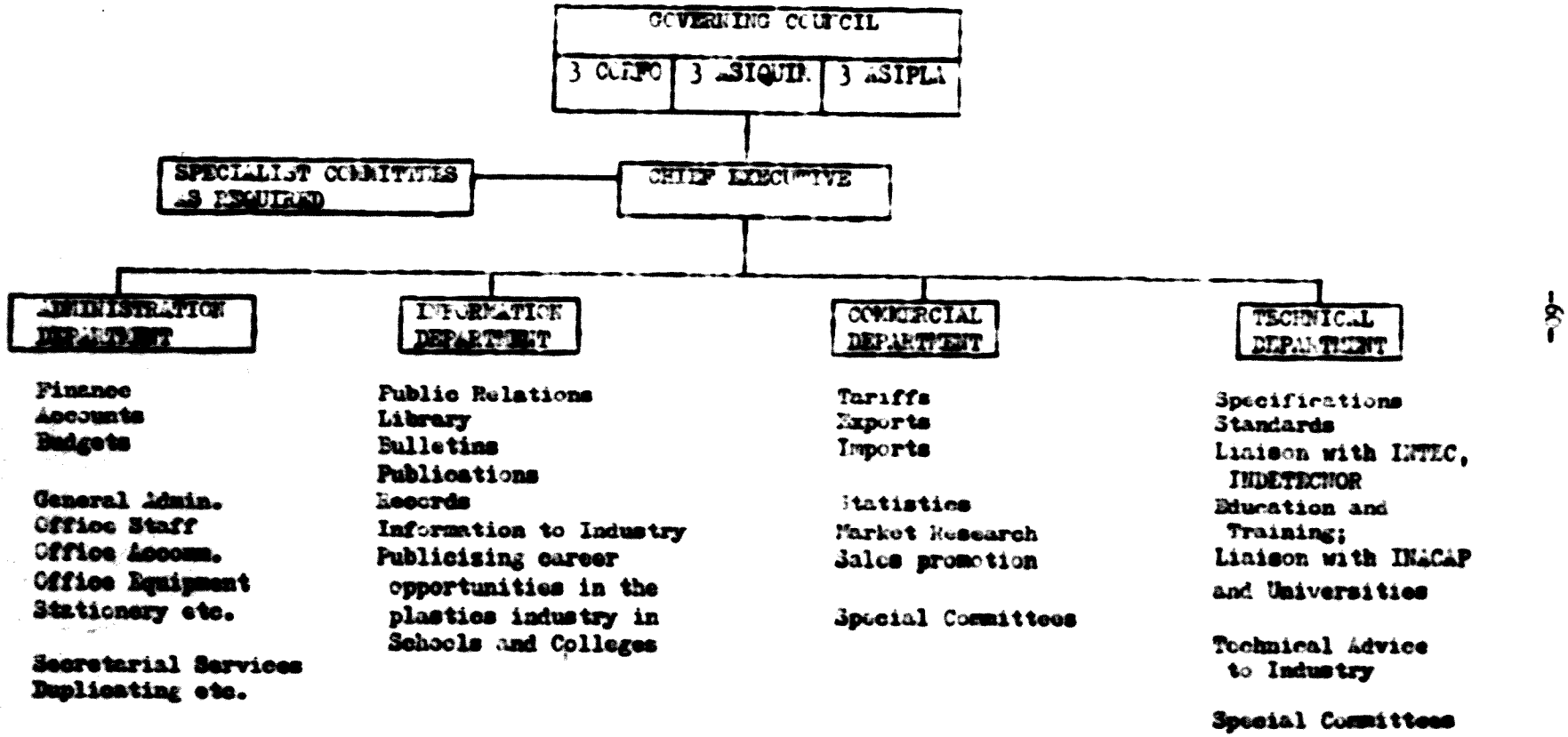
8.3.1.3.5 The Institute will contact and co-operate with similar bodies in other countries, especially within Latin America, and will endeavour to avoid duplication of effort and the laying down of specifications or regulations which will hinder Latin American trade in the future;

8.3.1.3.6 The Institute will set up and maintain a statistical and information department for the benefit of its members which should, in the interest of good public relations, be available to other interested bodies within reasonable limits. This department should also undertake publication of bulletins for members and should promote publication of appropriate information and articles on the plastics industry in other journals.

8.3.1.4 Organization

8.3.1.4.1 Immediately under the Governing Council described on page 56 there should be a full time Chief Executive responsible to the Council for all the functions and organization of the Institute. The Chief Executive should be assisted on complex matters as they arise by advisory committees drawn from the industry and appropriate Government and/or educational institutions. Membership of these committees should be small, expert, part time and unpaid - the members being provided by the industry and appropriate institutions and the secretarial services by the Institute. A tentative organigram is set out below:

TENTATIVE ORGANIZATION CHART OF THE CHILEAN PLASTICS INSTITUTE



8.1.4.4.2 Staffing of the Institute may present some problems both from the financial and personnel standpoint. A potential Chief Executive is already available but two men of high calibre and with a wide knowledge of plastics and the plastics industry are required to head up the commercial and technical departments. The information function is also of great importance and all three departments will have to sell the plastics industry to the Government, educational institutions, the general public and to some extent, to the industry itself since not all of its members will be ready to accept the changes which will be required for growth and progress.

8.1.4.4.3 The Chilean plastics industry is not at present large enough to support an Institute capable of carrying out all the functions listed. It is therefore, of fundamental importance in the early stages to get staff who can improvise and do a good job in promoting the growth and profitability of the industry, thus making it able to pay for the services it needs.

8.1.5 The Chilean Institute of Technology

8.1.5.1 INTEC is, after ICDP, probably the next most important institute for the plastics industry. It is much better established than ICDP as it was set up in 1968. It already has some of its key staff and has recently moved into its headquarters on the outskirts of Santiago. INTEC also differs from ICDP in that it is designed to serve the whole of Chilean industry rather than one section of it. There is however, a special group for the plastics industry and this can be expanded as required. There is also a

group for food technology which has a link with the plastics industry in the food packaging field.

8.3.2.2 It is planned to set up a control group for plastics raw materials, intermediates and finished products to work on analytical and quality controls, strength, heat deformation temperatures, etc. They have been advised by Dr. Levine of MIT on standards and plan to use both standards for packaging. Standards already established in Europe and USA will normally be used and adapted, where necessary, to South American conditions.

8.3.2.3 It is not intended that INTEC will lay down standards but will work to improve standards for enforcement by INDETEC/NOR. It is clearly in this area of quality control, standards and technical assistance to industry that the co-ordinating role of ICDP will be of major importance. While the final definition of a standard may lie with INDETEC/NOR it will be the responsibility of ICDP to ensure that the standard is attainable by the industry, suitable for the purpose for which it is intended and, as far as possible, in accordance with similar standards in South America. ICDP should also assist the industry in putting its problems to INTEC and in getting the answers back.

8.3.2.4 At present INTEC have no plastics processing or testing equipment and badly need such items such as a Banbury mixer, rubber mill, extruders and presses as well as mechanical and physical testing apparatus. Ultimately INTEC will need its own equipment but, at first there may be scope for co-operation with IMACAP which will have a certain amount of such equipment for training purposes.

8.1.2.5 A technical library will be set up to hold patents as well as books and journals and it is planned to set up a group on information storage and retrieval. INTEC have a contract with the Battelle Institute for the provision of information. INTEC does not plan to do general market studies but will do so if required for a specific technical project. The co-ordinating role of ICDP will be important over the whole field covered by this paragraph to ensure that there is the minimum of duplication and that maximum use is made of all the facilities available.

8.1.2.6 For its capital budget INTEC is getting money from CORFO and is using foreign credits. The staff are paid by CORFO. It is planned to charge the full costs of investigations and assistance to industry and thus to recover a part of the costs but it is not thought that the Institute can be self-supporting. It will clearly be of great importance that the Institute's charges should compare favourably with the costs of similar services elsewhere and a rigid cost control system for projects and investigations will be necessary.

8.1.2.7 There is a great shortage of testing and equipment throughout the plastics processing industry in Chile and control testing, especially for the smaller firms, could become an important service to be carried out by INTEC. It must obviously be made cheap enough to discourage firms from setting up their own testing laboratories.

8.3.3 The Chilean Standards Institute

8.3.3.1 INDITECNOR is the organization responsible for final publication and enforcement of standards. It will clearly need much assistance from institutions such as INTEC and ICDF to ensure that its standards are technically satisfactory and administratively enforceable. There may be scope here for the setting up of technical standards committees, on the lines of those set up by the British Standards Institution and ISO, to ensure that the standards meet the needs of all concerned.

8.3.4 The National Institute for Vocational Training

8.3.4.1 INACAP is the official institute for training plant operators, craftsmen and technicians up to medium level. The word technician (tecnico) is reserved by law in Chile for University trained people (see page 54). In this report it is used with its general English meaning of a man whose training, while partly theoretical, has been concentrated on practical applications.

8.3.4.2 The Institute is much larger and longer established than the Institutes previously described. It has a staff of about 800, consisting of 350 instructors, 150 university technicians and engineers and the remainder administrative staff. It has engineers and technical advisers in every zone of the country and there are 23 training centres spread out between Africa in the extreme North and the Magellan Straits in the South. It also has a number of mobile instruction units mounted on trucks and seven more are being purchased for various trades.

8.3.4.1 The Institute is currently training about 28,000 people per year in courses lasting from one week to three years. The total Chilean labour force is about 3,600,000 of which skilled men amount to about 800,000. The ultimate aim of the Institute is the training of school leavers entering industry and the retraining of men moving from one job to another. 85 per cent of their current work, however, is in upgrading men already at work since an extended enquiry showed that 45 per cent of the men in the so-called skilled grades had received no formal training whatever in their specialization.

8.3.4.4 The Institute is already receiving assistance from UNDP Special Funds and a number of projects are also being carried out with the assistance of individual Governments - Belgian, British, Danish, French and Swiss for example - and several others are being negotiated.

8.3.4.5 So far INACAP has not carried out any organised training for the plastics industry in its training institutes but a little work has been done by in-plant training. A special line of die making, developed in the Chilean-Danish Institute, has some application to the plastics industry and it is planned to set up training in mould making for plastics. Plans for training courses for the plastics industry are under discussion but have not yet been finalised. In any case, there is no equipment currently available, although it might be possible to spare a little space for training in plastics.

8.3.4.6 It is clear that the provision of suitable equipment and instructors and the setting up of proper training courses in plastics is a very urgent necessity. ICDP and INTEC should be able to assist in this but ICDP has no staff and INTEC little staff and no equipment. The problem is further dealt with on pages 71 and 72.

8.3.5 The Metallurgical Services Centre

8.3.5.1 CSIR is mainly concerned with metallurgical problems but because of the increasing use of plastics in combination with metals, it has plans to set up a plastics testing laboratory for plastics used in this way. If its work is confined to this rather specialized field there should be no serious duplication but care will be needed to avoid overlapping with INTEC plastics testing work.

9. OBSTACLES TO GROWTH IN THE CHILEAN PLASTICS PROCESSING INDUSTRY

Obstacles to growth are not confined to the processing industry itself but are found also in the areas of raw material supply and finished products markets. Many difficulties foreseen for the industry have been referred to in the earlier sections of this report. In this section they have been brought together and summarized under four broad headings - economic, personnel, mechanical and marketing. There is no sharp dividing line between these classifications - for example a mechanical problem may be economic if the only solution is new plant, or personnel if the solution requires more trained staff.

9.1 Economic Problems

9.1.1 Economic problems start with the economic climate of the country and extend throughout the industry right down to distribution of the end product. The Government of Chile is at present trying to stimulate investment in and expansion of the petrochemicals and plastics industries and, to this extent, the economic climate may be said to be favourable. Nevertheless the existence of a severe inflationary situation may slow up implementation of Government policy by making it more difficult to obtain foreign loans and almost impossible to generate capital for investment internally.

9.1.2 It is doubtful whether the need for capital engendered by the present petrochemical development programme has been fully realised. Factors commonly used are one dollar for monomers requires 2.5 dollars for polymers and 7.5 dollars for processing plants. Sufficient information on the capital costs of the current programme is not available for these factors to be applied in detail but it appears certain that full implementation of the current petrochemical and plastics development programme will call for investment of at least one hundred million dollars in the processing end of the plastics industry.

2.1.3 Some commendable efforts have been made to provide tax incentives both to encourage and broaden the base of private investment in industry and to encourage the development of industry in specific areas. The continued existence of a number of free zones, a relic of past policy, probably now creates more problems than it solves and the whole fiscal and administrative system does not appear to be geared to the implementation of a flexible taxation and investment policy. Recommendations on these problems are outside the scope of this mission but the situation cannot be ignored as a relatively long term impediment to growth in the plastics industry.

2.1.4 A more immediate and ever present economic problem is the price of resins and finished products. A representative selection of resin prices in Chile is shown in Table 7.

TABLE 7: COST OF RESINS IN CHILE — US$ PER METRIC TON

Material	Type	CIF Value	Duties	Other Costs	Total Cost	Local Product
PVC	Suspension Grade Homopolymer	300	325	30	665	-
PVC	Emulsion Grade Homopolymer	360	370	35	765	-
PVC	Copolymer	320	340	30	690	-
PS	General Purpose	320	340	30	690	660
PS	Medium Impact	360	370	35	765	720
PS	High Impact	400	400	40	840	800
ABS	Injection Moulding Grade	320	340	30	690	-
ABS	Extrusion Grade	340	355	35	730	-
SAN	Injection Moulding Grade	380	385	40	805	-
SAN	Extrusion Grade	400	400	40	840	-
PMMA		600	700	80	1380	-
PMMA		500	475	50	1025	-
Urea/ Formaldehyde	Moulding Powder	450	535	45	1030	950
Melamine Formaldehyde	Moulding Powder	750	560	75	1385	-
Methyl Methacrylate	Monomer	600	120	60	780	-

Source: Dow Quimica Chilena.

It will be seen that the ultimate cost to the processor is rather more than double the c.i.f. value. It is probable that the c.i.f. value is somewhat higher than the most advantageous prices obtainable in Western Europe and North America for equivalent material and in general the cost of resins in Chile is about two and a half times the cost of the same material in developed countries.

2.1.5 A direct cost comparison of finished products is not so easy to do since many factors - quality, design etc. - have to be taken into account. A reasonable estimate seems to be that finished articles of plastic cost at least four times as much in Chile as in the highly industrialised countries. This suggests that the costs of conversion are also much higher in Chile. Wages in Chile are low compared with Europe and North America and the increased cost appears to have several components - low plant utilization, high reject rate, below average management and high distribution and selling costs.

2.1.6 Unfortunately the establishment of domestic production of PVC and LDPE does not appear likely to bring about any substantial reduction in cost of these materials to the processor. The ethylene plant is small by today's standards and full credits for propylene and other by-products will not be realised for some years. In consequence the ethylene cost will be high and this will be reflected in the cost of the PVC and LDPE. In this situation the processors will not be encouraged to make

strenuous efforts to reduce costs. Nevertheless it must be realized that a reduction in the real costs of plastics products accompanied by a country-wide rise in real wages would do more than anything else to enlarge the market and promote growth in the industry.

9.1.7 Solutions to many of these problems must be relatively long term but some progress can be made quite quickly. The existence of a number of efficient well managed firms, some of them quite small, is an encouraging sign and aggressive selling of the domestic production of PVC and LDPE, provided it is accompanied by good technical service, will assist these and encourage others to start up. Increased competition can only lead to a general raising of standards, and lowering of costs. Short term measures for the training of operators and technicians should lead to a reduction of the reject rate and improve plant utilisation. This too will be reflected in increased output from the existing plant and lead to a decrease in costs.

9.2 Personnel Problems

9.2.1 The shortage of qualified staff as well as the need for more skilled technicians and operators has been mentioned several times in this report. This means that, of the 16,000 people currently employed in the industry, a substantial number - perhaps half - need some form of training or refresher courses to bring them up to date. If the industry is to treble in size in five years it may require a minimum of 20,000 additional employees of which 200 might be graduates specialising in market research,

product development, quality control, product applications, engineering design and installation and similar fields plus another 400 high and medium grade technicians. Of the remainder probably 10,000 will need to be trained as operators and skilled craftsmen - a grand total of some 4,000 people per year requiring specialized training for the plastics conversion industry. These figures presuppose that improved training and technology will lead to higher output per employee so that the labour force does not increase proportionably with output.

9.2.2 These estimates, which are little more than informed guesses at this stage, must be viewed against the present non-existence of specialized education and training facilities to fit people for the plastics industry and clearly present a major problem. The education and training programmes now being initiated will ultimately provide a solution. This paragraph makes an attempt to estimate the size of the effort necessary.

9.3 Mechanical Problems

9.3.1 No attempt has been made to quantify the mechanical problems. It must be pointed out however, that to process an additional 40,000 MT/a of plastics within five years and, at the same time, to introduce new technology, lay down standards and improve efficiency will require buildings, machinery, laboratories, testing equipment, tools, transport, telephones and many other things to be provided by Chile's already heavily loaded economy. It is therefore, of major importance that maximum output should be obtained from existing equipment, thus minimising the new investment required.

9.4 Marketing Problems

9.4.1 Problems arising in the marketing of plastics in Chile have been indicated at a number of points in this report. They may be summarized as follows:

9.4.1.1 Plastics are not readily accepted in Chile. In consequence users do not specify plastics in applications for which they would be ideal and the drive to increased production and improved quality which comes from a strong demand is lost.

9.4.1.2 The existence of recognized and accepted quality standards provides a sound negotiating basis between producer and user. This basis is absent in Chile.

9.4.1.3 Plastics producers and processors have insufficient accurate information on what products various sections of the market require and what the potential is. The absence until now of any substantial domestic production of basic raw materials and resins has meant that there has been no incentive to acquire this information. Market development in consequence has been fragmented and uncoordinated.

9.4.2 The answers to these problems are easy to state, but difficult and time consuming to implement. They are market research, product development, technical service and sales promotion accompanied by development of standards and quality control and by education and training programmes for the necessary personnel. These things are part of the infra-structure

in which the market rests. They must be accompanied by development of sound production, selling and distribution methods and the whole structure must be held together by good planning and skilled management.

10. RECOMMENDATIONS

10.1 Problems for the Chilean Plastics Industry, either already existing or foreseen for the near future, have been indicated at many points in this report. These problems are neither new nor peculiar to Chile but have been met by processors during the development of the plastics industry of most other countries. They are, however, likely to become especially urgent in Chile during the next two or three years, due to the accelerated rate of growth required by the development of large scale domestic production of thermoplastic resins. Given time, the Chilean industry would solve its problems as the plastics industries in other countries have done. Time for Chile is not really available, however, and help is desperately needed to speed up the process.

10.1.1 UNDP and UNIDO could do much to assist and these recommendations are designed principally to assist both in the development of a request for assistance through a UNDP Special Fund and in the detailed planning of such a project if it is approved. They have been divided for convenience into short and long term measures, although there is no clear dividing line. UNDP/UNIDO assistance can be given in both short and long term but among the short term measures recommended, there

are many things which the Chilean plastics processing industry can and should do to help itself, possibly with limited technical assistance from UNIDO, while the request for Special Fund Assistance is being developed and the detailed plans for the project prepared. The team has concluded that the recommendations should not be addressed to specific individuals or organizations but should state what needs to be done, leaving the questions of how and by whom for decision locally with, if appropriate, assistance from UNIDO experts. It is hoped that suggestions contained in the body of the report will be helpful in making these decisions.

10.2 Short Term Measures

10.2.1 Initiate immediately some measures to improve the public image of plastics products by press advertisements, articles in magazines, lectures and similar means. These measures are a joint responsibility of all parties interested in the growth of the plastics industry. They are relatively long term in their effect and should therefore, be started immediately. They need careful control and co-ordination to ensure that a demand is not created too far ahead of availability.

10.2.2 Take measures as indicated in Section 7 to bring processing equipment technically up to date to increase productivity and decrease scrap rate. This can be done largely by individual manufacturers.

10.2.3 Start immediately on developing standardization of moulds. Here too individual manufacturers can help themselves but wider standardization co-ordinated by an organisation such as IMTEC is highly desirable.

10.2.4 Initiate quality control measures as a matter of great urgency. These should start on the incoming raw materials and go on to finished products. Such measures do not need to wait for development of official standards. At least they will ensure consistent quality even if it is not high enough to meet the eventual standard and the information obtained from them will be of inestimable value for development of the final standards.

10.2.5 Arrange for the creation of a pool of spare parts which may be drawn on by manufacturers when plant breaks down. This will minimize capital investment and greatly decrease the time plant is out of service after breakdowns. It will entail a survey of machine types in use to determine what is required and could be financed on a co-operative basis by those manufacturers wishing to draw on it. It will need control by an organization such as IMTEC or ASIPLA and the work involved in the survey will provide a useful basis for planning maintenance and may lead to some profitable standardization of equipment.

10.2.6 Start immediately on some detailed market research, bringing in outside experts if necessary until Chilean personnel can be trained, especially in the four potentially large consuming areas - packaging, appliances, building and agriculture. This will require careful overall co-ordination, probably by ICDP.

10.2.7 Try to recruit, either internally or externally, some application engineers to improve techniques in existing applications and to develop new ones. Their work would be of great assistance in a comprehensive market survey. These men would normally be employed by individual firms and provide one aspect of technical service, but some co-operative effort co-ordinated by ILTLC or ICDP should be possible.

10.2.8 Encourage the sending of individual technicians and skilled operators for training with companies in Europe or the USA. Co-ordination can be by ICDP or AGIPLA and care will be needed to avoid a "brain drain" since such men are in short supply all over the world.

10.2.9 Complete the formation and preliminary staffing of ICDP on the lines suggested in Section 8. That this will be done is implicit in a number of the preceding recommendations.

10.2.10 Develop and publicise a long term policy for the industry to encourage investment and to serve as a basis for planning.

10.3 Longer Term Measures

10.3.1 Initiate new or redesign existing courses in Universities and other higher education institutions to provide a flow of qualified men with a knowledge of industrial processes and of such techniques as planned maintenance production engineering, applications engineering, market research, industrial economics and planning, and other specialized fields as required. If necessary outside help should be sought in designing the courses and in the teaching.

10.3.2 Arrange industrial fellowships which will permit able men to gain experience of the industry in other countries. Here again care will be needed to avoid a "brain drain".

10.3.3 Extend the measures already initiated for training in industrial design. Good design of consumer products can do much to improve the public image of plastics materials.

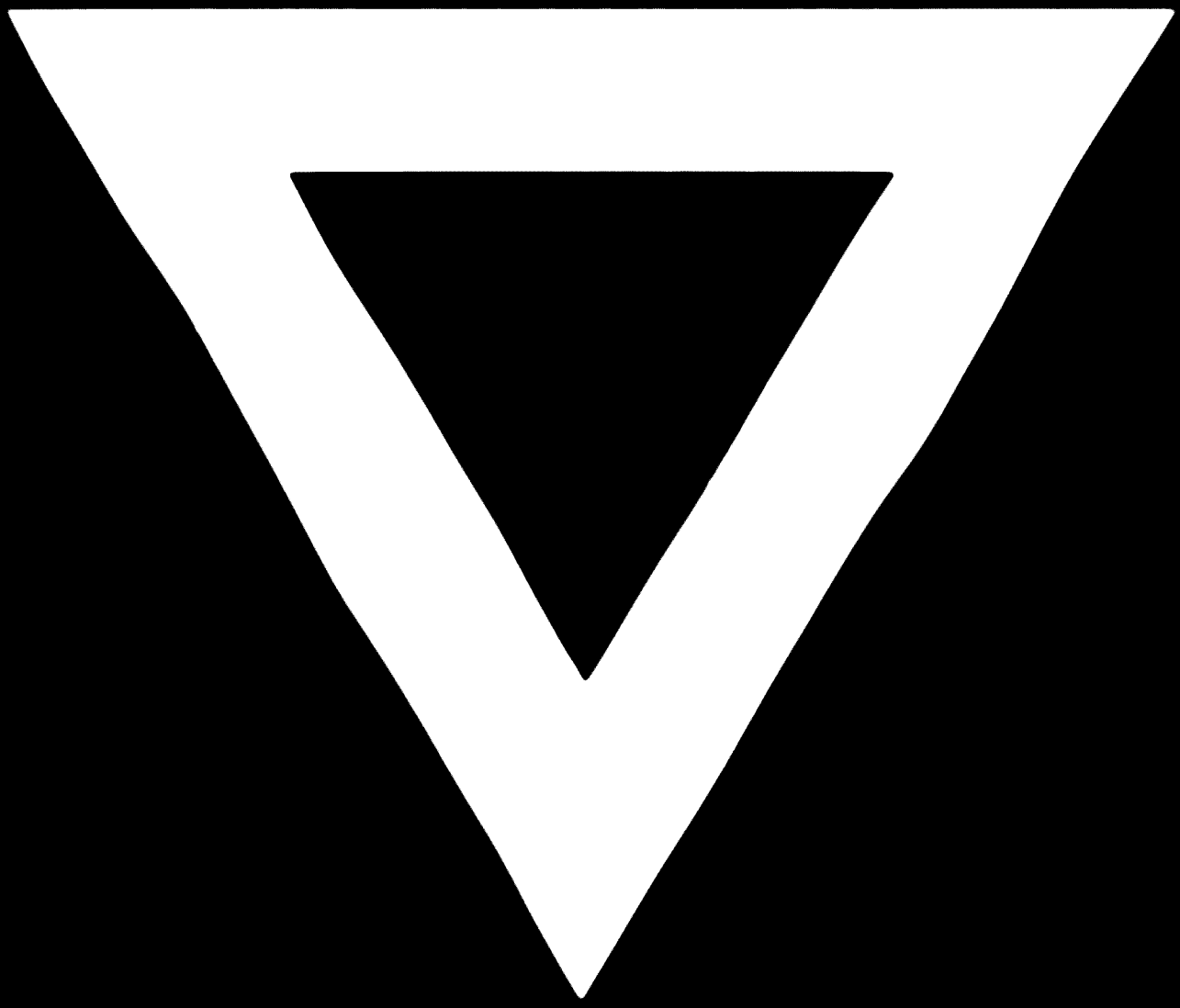
10.3.4 Develop suitable training courses for implementation by such organizations as INCAP for training operators, specialist craftsmen and technicians, again getting outside help in the layout of the courses and in the teaching as required.

10.3.5 Encourage ICDP, INTEC and INCAP to establish and cultivate contacts with similar institutions and with private companies both elsewhere in Latin America and overseas. An important part of this process could be the regular organization of conferences, seminars, symposia and exhibitions in which other countries would participate by sending lecturers and exhibits.

10.3.6 Ensure that, when outside assistance is being used, Chilean counterparts of ability are available so that the expert help may be transmitted and used to the best advantage.

10.4 Conclusion

The team's assessment is that Chile has a vigorous and expanding plastics industry which is doing much to help itself but which badly needs assistance, especially in the field of plastics processing and marketing, to enable it to catch up with and to keep abreast of modern technology. This is the impression that the present report is intended to convey and it is hoped that the suggestions made will be practicable and effective.



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