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ID/WG.78/6

THE DEVELOPMENT OF THE PLASTICS INDUSTRY, ETC.

UNIDO. 1970. 64 p.

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ARGENTINA by O. Quereilhac

1. Technical and economical information collected as reference

Argentina, Brazil, Mexico and Venezuela are from the Latin American countries the ones with better economical level and furthermore are those in which the prospects of reaching a stage of development are really sound. Some contributing factors are as follows:

(a) Balanced international trade on raw materials and semi-finished and finished products (either consumer goods or capital goods);

(b) Good possibilities of multilateral international trade, and chances of being free from monopolistic structures;

(c) Constant growth of a middle class capable of establishing a sound internal economic circuit between manufacturing and consumption of goods.

Still another important factor contributing to development is the slow but firm implementation of LAFTA allowing the set up of large-scale plants supplying basic commodities for the whole or large parts of the area. This will permit in the future a nearly complete source of industrial products within the area.

In our opinion, the factors determining a high level of industrial development are:

(i) availability of raw materials;

(ii) technological level;

(iii) investment capacity, and

(iv) consuming market.

The following is a group of general statistical information on which our opinion is based:

Table I

General information data 1967

	Argentina (%)	Brasil (%)	Mexico (%)	Venesuela (%)	Total
Population (millions)	23.3 (9.5)	90.1 (35)	45.7 (18)	9.4 (4)	245.0
yearly increase%	1.5	3.1	3.5	3.5	
Urban % from total	74.0	47.0	53.0	63.0	
Total area in sq. km	2,808 (14) excl.Antarctis	8,533(45)	1,973(10)	912(4.5)	20,130
Usable for agriculture in % of total	50	15	52	21	
Social data Alphabetes %	95	61	71	77	
Agricultural workers % of working population	22 (*)	52	53	32	
Average life expectancy (years)	67	56	63	66	
Transport and communication lines					
paved roads (km)	22,000 (17)	18,750(14)	37,350(28)	16,440(12.5)	131,000
railroads(km)	43,900 (30)	37,500(25)	25,300(18)	700(5)	144,000
merchand fleet (thousand tons)	1,304 (17)	1,565(17)	380(4)	119(12)	9,392
telephone (thousands)	1,527 (28)	1,432(26)	931(17)	309(5.5)	5,500

Table I (cont'd)

	Argentina (%)	Brasil (%)	Mexico (%)	Venezuela (%)	Total in L.A area
Gross National Product					
total US$ mill.	16,700(17)	27,100(27)	23,320(23)	8,415(8.5)	100,500
per capita US$	724	313	510	900	
yearly increase%	2.8	5.1	7.1	6.0	
Industrial Products					
Products					
steel (thous. tons)	1,326(13)	3,667(36)	3,023(30)	703(7)	9,795
electric power(mill.kWh)	16,508(16.5)	35,300(35)	20,900(21)	9,200(9.2)	100,000
cement (thous.tons)	3,552(15)	6,408(27)	5,500(23)	2,300(9)	24,000
automobiles & trucks (thous)	1,804(5)	1,822(5)	1,343(3.5)	686(2)	36,800
Foreign trade					
balance (mil.$)	+365	+ 20	-565	+1,107	
main export % of total	cereals 26	coffee 44	cotton 3	petroleum 92	

(1) 7 million labour force

2. The Argentine plastics industry

Within the framework of the Argentine industry, the plastics industry has reached a remarkable position due to its high growth rate and also due to its cohesion as an organized group under the industrial association: "Camera Argentina de la Industria Plastica" which groups raw material producers, transformers, machinery manufacturers, tool manufacturers, gross retailers, material and machinery importers altogether surpassing a membership of a thousand firms.

2.1 Its origin and evolution causes

The World War II brought as a consequence important modifications in social and economical structures on many countries which were not directly involved.

Routes and communications traditionally established were interrupted and lack of supply of many commodities resulted in an increased demand exerted upon local industry.

This was the case with the Argentine plastics industry which was born practically in 1940 with thermosetting moulding.

Since 1945, the arrival of imported post war products (some of them war surplus) moulded on thermoplastics led local industrialists to compete with them and the thermoplastic moulding increased.

On the other side, Government policies encouraging light industry and consumer goods production, characterised the 1945-1955 decade as a "boom" for housewares and electrical house appliances (i.e. refrigerators) and of course, toys. Packaging on polyethylene films was another important growing market. From 1955 to 1960, most of the automobile factories actually on the market were established and a third stage, in which "engineering materials" entered, was fulfilled. Quality moulding and tolerances were also incorporated in the trade.

Later, other fields were covered, e.g. plastics parts for the electronic industry (record players, television sets and tape recorders), packaging (household chemicals, cosmetics, pharmaceuticals and foodstuffs) and finally, the building industry in which we can say that plastics are at the very early stage. Furthermore, plastics are steadily introduced in agriculture, putting together one of the most modern national industry with

our traditional farming and agricultural industry, for the benefit of the whole national economy.

A recent congress held in Buenos Aires under the name of "Plastics for Agriculture and Farming" and the presence of an Argentine delegation dealing with this subject on the recent Europlastic Meeting in Paris, prove our actual strong drive toward the application of plastics in agriculture.

2.2 Its present conditions

In the following tables we have grouped data with the purpose of establishing comparisons between the Argentine plastics industry and these of the other countries like United States of America and Federal Republic of Germany which are considered world leaders in this field.

Most of the information belong to 1967 and 1968 (rather "old" for a fast growing industry) but nevertheless are useful to establish comparisons.

Table II

1967 World production of synthetic resins
(in million tons and in % of world total)

	tons	%		tons	%
polyvinyl chloride	3,670	18.7	aminoplastics	1,750	8.7
polyvinyl acetate	810	4.1	phenolics	1,310	6.7
polyvinyl alcohol	186	0.9	alkydes	840	4.3
other vinyl resins	154	0.7	polyesters	790	4.0
[illegible]	4,820	24.4	cellulosics	540	2.7
polyethylene LD	2,710	13.7	acrylics	430	2.2
polyethylene HD	1,180	6.0	polyurethanes	620	3.2
polypropylene	660	2.8	polyamides	120	0.6
[illegible]	4,550	22.5	epoxies	110	0.6
general purpose and high impact polystyrene	2,260	11.5	silicones	50	0.2
			polycarbonate	25	0.1
[illegible]	280	1.4	flouroplastics	15	0.1
[illegible]	2,540	12.9	others & fibres	1,340	6.8
SUBTOTAL	11,910	59.8	SUBTOTAL	7,940	40.2

GRAND TOTAL 19,850 tons 100 %

Table III

Plastics production in 1967, annual growth rate per country and main geographical areas

	1000 tons	%
Federal Republic of Germany	2,635	14
France	890	12
Italy	1,103	14
Belgium	135	14
Netherlands	340	15
European Common Market subtotal	5,103	13.5
Finland	23	16
Sweden	179	14
Norway	90	15
Denmark	41	16
United Kingdom	1,102	12
Switzerland	49	10
Austria	89	14
Portugal	6	20
Spain	162	16
Greece	6	18
Turkey	-	-
subtotal	1,747	15.1
Yugoslavia	80	20
Bulgaria	47	22
Hungary	38	18
Poland	190	17.1
German Democratic Republic	310	14.5
Romania	114	20
USSR	1,112	20
Czechoslovakia	165	14
Eastern Europe subtotal	2,056	17.2
Israel	32	20
Iran	-	-
India	33	27.5
China Rep. of	60	-
China	160	-
South Korea	9	-
Japan	2,434	22
Asia subtotal	2,728	-
Canada	274	9
U.S.A.	6,512	12
Mexico	78	14
Argentina	76	17
Brasil	141	17
Chile	-	-
Peru	11	18
Venezuela	-	-
The Americas	7,092	
South Africa	17	15
Australia	112	16
WORLD TOTAL	19,700	14.2

Table IV

Consumption of plastics in Argentina and USA in 1968
(thousands of tons)

Product	USA	Argentina
polyvinyl chloride }	1,200	18.0
polyvinyl acetate }		4.5
other vinyls	265	-
VINYLS	1,465	22.5
polyethylene LD	1,550	22.4
polyethylene HD	625	1.8
polypropylene	405	2.4
POLYOLEFINES	2,580	26.6

Product	USA	Argentina
POLYSTYRENES	1,400	13.8
aminoplastics	350	8.9
phenolics	500	3.65
alkydes	330	5.8
polyester	300	2.1
cellulosics	100	6.2
epoxies	85	0.5
subtotal	1,665	27.15
GRAND TOTAL	7,110	90.05

Table V

Plastics consumption per capita in 1967

World average	5.5 kg
Federal Republic of Germany	46.5 kg
U.S.A.	33.0 kg
U.S.S.R.	5.0 kg
Spain	10.0 kg
Argentina	3.5 kg
Brasil	1.7 kg
Mexico	1.7 kg

Table VI

Argentine plastics industry - Labour force and salaries 1969

Number of workers	6,700	
Administratives clerks and technicians	5,000	
Total workers man-hours	15,400,000	
Net salaries (without social charges) paid to workers	9,300,000	US$
Net salaries paid to clerks and technicians	12,000,000	US$
Average monthly hours per worker	192	
Average salary per worker per hour	0.83	US$
net collected	0.60	US$
Average montly salary for clerks and technicians	220	US$

Table VII

Argentine consumption of petrochemicals in 1969

Locally produced	140,000,000	US$
Imported	60,000,000	US$
Total	200,000,000	US$

Table VIII

Prices per kg of some widely used plastics materials in U.S.A. and Argentina in 1969 (in US$)

(Rate of exchange US$ 1 = 3.50 $ argentinos nuevos)

Product	USA	Argentina
PVC compound (cable insulation)	0.45	1.00
general purpose polystyrene	0.31	[illegible]
polyethylene LD	0.23	[illegible]
polyethylene HD	[illegible]	[illegible]
polypropylene	[illegible]	[illegible]
moulding acrylics	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]

Table IX

Gross sales in the plastics industry in 1969

raw materials for moulding	100,000,000 US$
finished plastics products	240,000,000 US$
machinery and equipment	7,000,000 US$
tooling	3,000,000 US$

Table X

Economics of a typical Argentine plastics firm

Capital	US$	100,000
Annual sales	US$	240,000
Number of clerks and technicians		5
Salaries for clerks and technicians including social charges	US$	18,000
Number of workers		7
Salaries for workers including social charges	US$	14,000
Cost of raw material	US$	100,000
Machinery and tools (moulds)	US$	10,000
Taxes on sales	US$	20,000
Margin distributed among general expenses, profits; income taxes (on profits) all referred to sales figure		30 %

General comments on 2.2

As can be seen from tables II, III and IV, the 'popular' plastics (PVC, polyolefines, styrenes and phenolics) follow the world pattern.

Per capita consumption is still low for the present development level but there exist very important distorting factors such as local price for transforming materials (table VIII) and the same accounts for some transforming equipment.

2.3 Factors distorting and delaying development

As most of the petrochemicals are produced locally and the ratio between local products and imports is reasonable (table VII) present import duties which automatically increase internal prices and protective tariffs seem not justified.

But a survey on present methods and plant capacity reveals that obsolescency is causing high local production costs. Public investments have been derouted to more important basic industries and services and the plastics industry has been completely left to private investment which is really insufficient, and this is the only retardation factor. Regarding locally produced transformation equipment, the relatively low local demand should be compensated with an aggressive sales and credit policy on the LAFTA zone or others in order to enlarge plants to more economical size.

In this case, external sources of finance should be reached also.

This is the only way in which Argentine machinery producers will be capable to establish costs and technological levels compatible with the international market.

Other problems affecting the plastics industry can be seen in table X.

The margin of 30 per cent deduced can be more than reasonable but all depends on inflation or devaluation rate. Although it has been of nearly 20 per cent per year in the period from 1950 to 1967, in the last three years it has shown a tendency to stabilisation.

That is why during the years from 1950 to 1967 the plastics moulding manufacturers had to fight mainly against capital/erosion and only in the recent past there were signs of improvement.

BULGARIA by T.G. Triphonov

The plastics works in Bulgaria are led by a State Industrial Amalgation which is responsible to the Ministry of Chemistry.

All of the plastics works are based on polyvinyl chlcride, polyethylene and polystyrene.

A plastics plant in the town of Roussa, based on polyvinyl chloride produces calendered products and artificial leathers and floor covering materials which are obtained by spreading methods. Foam separators for storage batteries are also produced.

In a plastics work in the town of Gabrovo based on polyvinyl chloride are concentrated extrusion moulding and extrusion blowing processes.

A plastics work in Sofia is specialised for extrusion blowing and extrusion laminating based on polyvinyl chloride and polystyrene.

Another plastics work in the town of Asenovgrad is based on extrusion of polyethylene on extruder slubbers.

There are twelve enterprises in Bulgaria which work with plastics processing. In addition there are some departments in the machine manufacturing plants specialised for machinery parts from thermosetting and thermoplastic resins.

Our plastics industry will continue its development based on polyvinyl chloride, polyethylene, polystyrene, polypropylene and other plastics.

An interesting product we have the intention of developing, is synthetic upper shoe leathers based on non-woven substrate impregnated with dissolved polyurethane or latex and polyurethane upper layer.

CHILE by M. Abarca

1. Local production of synthetic resins

At present, the Chilean production of synthetic resins is based on imported raw materials. Some compounding ingredients such as plasticisers, stabilisers etc. are produced locally from imported basic chemicals. The following are the production and installed capacity of the Chilean factories:

Product	Production MT/tons	Installed capacity MT/tons
Polystyrene GP	1,500	2,000
Polystyrene HI	500	1,000
Expanded polystyrene	800	1,500
Unsaturated polyesters	1,000	2,000
Phenolic resins	800	2,500
Urea resins	-	1,000
Melamine resins	-	1,000
PVC compounds	600	2,000
Phthalate plasticisers	1,600	12,000
Epoxidised oils	300	1,000
Stabilisers	200	500

Right now, the situation is changing rapidly. Some years ago CORFO (Corporacion de Fomento de la Produccion), a Government institution for development, formed ENAP (Empresa Nacional del Petroleo), which took over the ownership of all the national oil and natural gas resources and which is concerned with all the production and refining of oil in Chile.

Five years ago, the Chilean Government began to promote the development of a petrochemical and plastic industry and it was decided that ENAP would build a cracking plant, adjacent to its refinery near Concepcion (Southern region of Chile) for the production of 60.000 MT/year of ethylene and 30.000 MT/year of propylene and butadiene. The petrochemical development programme will mean an approximate investment of US$ 150,000,000 in the different complexes and plants to be built in the different regions of the country.

Petroquimica Chilena S.A. was formed in 1966 by CORFO and ENAP, (sharing the capital in the same proportion) to implement the petrochemical programme; this programme considers the installation of four complexes:

Ethylene (olefinic) complex,
Aromatic - alcoholic complex,
Acetylic complex, and
Aromatic complex

These four complexes will be the base of an integrated petrochemical system.

The ethylene complex is related with the plastics sector and is constituted by the above mentioned plants of ENAP, a chlorine/caustic plant at Concepcion, built by Petroquimica Chilena with a production capacity of 33.000 MT/year of liquid chlorine, 15,000 MT/year of hydrogen chlorine, and 75,000 MT/year of caustic soda, and a polyethylene plant with a total production capacity of 27,000 MT/year of low density polyethylene and a VCM plant for 18,000 MT/year and 15,000 MT/year of polyvinyl chloride (PVC). These plants were built by Petrodow, a joint company with Dow Chemical Co. of Midland, Petroquimica Chilena S.A. and ENAP.

These plants are already built and in the stage of "starting operation". The total investment of this complex is about US$ 60,000,000.

Petroquimica Chilena S.A. is also making the engineering study for the acetate-alcohols complex which will be constituted by a plant of acetic aldehyde of 12,000 MT/year, and acetic acid plant of 14,000 MT/year, a 15,000 MT/year of vinyl acetate monomer plant and a 25,000 MT/year of high alcohols (butanols and Octanols). This complex will produce the raw material for co-polymers PVC/PVA as well as for the production of plasticisers and other chemicals related to the plastics sector.

Besides this, Dow Quimica Chilena, a subsidiary of Dow Chemical CO. Midland, is going to increase its polystyrene plant capacity up to 10,000 MT/year. In addition, the Chilean subsidiary of BASF is also thinking of increasing its unsaturated polyester plant up to 4,000 MT/year in the near future.

2. The plastics processing industry

There are 280 processing industries in Chile, employing some 20,000 people. The companies range in size from those employing only a few people to those having up to 800 employees. Great difference in management efficiency is observed in general, the largest ones being the most efficient. Most of the synthetic resin used by the processors is imported from Germany, U.S.A., Italy, United Kingdom, Japan etc. and the supplies are sometimes uncertain and of very variable prices.

Anyway, the processing industry has had a big increase during the last ten years. In 1960, there were about 100 enterprises with a total resin consumption of 10,000 MT/year. At present there are 280 enterprises with a total resin

consumption of 29,000 MT/year. Taking into account the local production of the principal thermoplastics resins such as LDPE and PVC suspension grade and the expansion of the polymerization plants mentioned above, it can be estimated that the number of enterprises will increase to at least 500 with a possible resin consumption of 71,000 MT/year. Plastics consumption in Chile for 1963, 1966 and 1968 with an estimate projection for the next five years is shown in table I.

Table I

Consumption of plastics resins in Chile - MT/year

Resins	1963	1966	1968	Projection 1972-1975
Low density polyethylene LDPE	3,250	6,000	7,100	25,000
High density polyethylene HDPE	300	800	900	3,500
Polypropylene PP	420	700	950	3,000
PVC suspension grade	2,750	5,000	4,400	15,000
PVC emulsion grade	550	1,000	1,300	3,500
PVC co-polymers	400	1,000	1,250	2,500
Polystyrene general purpose	1,600	1,900	1,800	6,000
Polystyrene high impact	650	1,000	1,500	3,500
Polystyrene expanded	280	600	800	2,500
Acrylates-methyl methacrylate	200	400	700	1,000
ABS	10	20	80	200
SAN	-	10	100	250
Cellulose derivatives	180	150	150	250
Unsaturated polyesters	350	600	800	1,500
Phenolic resins	600	700	800	1,200
Urea resins	340	450	600	1,000
Melamine resins	150	200	250	500
Polyurethanes	200	350	500	1,500
Total resins	12,248	20,895	24,085	71,150
Plasticisers	2,000	2,000	2,500	10,000

The technology for plastics fabrication in Chile is not so much different from other countries. Our processing industry included all the actual fabrication processes which exist, such as:

Injection moulding,
Compression and transfer moulding,
Blow moulding,
Extrusion,
Sheets,
Laminating,
Foil and film,
Calendering and coating,
Polyesters and epoxies,
Rotocasting,
Foamed plastics,
Vacuum forming, etc.

and also cover a wide range of raw material and finished products. The estimated distribution of plastics consumption in form of finished products in Chile in 1968 is shown in table II (values given in MT).

But the natural development of the processing industry has been limited by the following factors:

- The lack of technical service in the use of resins;
- The lack of technical service on machinery and equipment;
- A serious shortage of spare parts for machinery and equipment;
- The absence of adequate facilities for the training of workers and the absence of facilities to prepare high level professional staff;
- The shortage of skilled production technicians and engineers;
- The absence of standard, quality control facilities and applied research in plastics, and
- The dependency on imported supplies of raw material.

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.

To improve the status of the processing industry and also to incorporate in the plastics markets areas of application which in the past were only slightly

touched i.e. packaging, food packaging, appliances, buildings, agriculture, transports (automobiles) etc., the Government is creating the Chilean Polymer Institute which in its first stage will help to develop the Chilean Plastics Sector by giving the necessary support in the following technical areas:

Production, marketing and management; besides of this the Institute would aid to solve problems of standards, quality control, applied research, training and formation of skilled personnel etc. with the valuable assistance of United Nations Industrial Development Organisation - UNIDO.

TABLE II

ESTIMATED DISTRIBUTION OF CONSUMPTION OF PLASTICS IN CHILE 1968 MT

	LDPE	HDPE	Poly Propylene	PVC Suspension	PVC Emulsion	PVC Container	Polystyrene GP	Polystyrene H.I	Polystyrene Foam	ABS and SAN	Unsaturated Polyesters	Polyurethanes	Acrylics	Cellulose Plastics
	[illegible]			[illegible]										20
	[illegible]	[illegible]		130										100
	[illegible]	[illegible]	[illegible]	[illegible]			1,300	200						
	[illegible]	[illegible]		150										
			[illegible]	150										
				[illegible]										
	[illegible]			[illegible]										
				600										
				450		900								
				150							240			
				100										
				100										
				300	1,000									
						500								
							640							
								1,200						
									800				700	
										205				
														30
											150			
											350			
												500		

CHINA REPUBLIC OF by Chun-I Chang

The plastics industry in Taiwan, Republic of China, has grown dramatically in the last twenty years. During this period, the number of plastics manufacturers has increased to over 20 and that of plastics fabricators over 500. Polyvinyl chloride, polyethylene, polystyrene, polymethyl methacrylate, unsaturated polyesters, phenol-formaldehyde, urea-formaldehyde etc. are produced. A brief report of the individual plastics is as follows:

1. POLYVINYL CHLORIDE

The first polyvinyl chloride plant owned by the Formosa Plastics Corporation was started in opertion in 1957 using calcium carbide and chlorine as raw materials. There are now four private companies producing PVC. The production from 1964 to 1968 is listed as follows:

Year	Production	Remarks
1964	23,189 MT	Formosa Plastics
1965	28,682 MT	Formosa Plastics
1966	44,687 MT	Formosa Plastics, Cathay Chemical China Gulf and Yee Fong
1967	61,775 MT	ditto
1968	68,000 MT	ditto

However, further expansion of the PVC industry in Taiwan would be very difficult if calcium carbide is still used as raw material. The new technology for making PVC using ethylene as raw material has proved to be more economical than the former method. With Government encouragement, a Vinyl Chloride Co. was established in 1969 jointly by the four private PVC companies and the Chinese Petroleum Corporation. The new company is building a vinyl chloride monomer plant using ethylene and chlorine as raw materials by ethylene dichloride route at Kaohsiung, Taiwan, near the petroleum refinery and alkali plant which supply the ethylene and chlorine respectively. The plant with a capacity of 40,000 MT of vinyl chloride monomer per year is scheduled to be completed in 1970. Another vinyl chloride monomer plant will be built in the northwestern part of Taiwan with a capacity of 60,000 MT/year. It is scheduled to be completed in 1971. The feedstock will be ethylene from an ethane cracker. The ethane will be extracted from the natural gas produced in the nearby gas fields.

There are nearly 60 PVC fabricators in which Nan Ya Plastics Corporation is the largest. Its capital grew from US$100,000 in 1958 to US$15,150,000 in 1970. The principal equipments and products are listed below:

Item	Number	Products
Calender	15	PVC film and sheets
Calender	5	Expanded products including imitation leathers, sponge leathers etc.
Foaming oven	6	
Casting machine	1	
Flocking machine	1	
Printing machine	5	Printed sheets
Embossing machine	6	Embossed sheets
Injector	19	Injected products
Hot press	3	Rigid sheets
Vinyl-asbestos tile machine	1	Vinyl asbestos tile
Knitting machine	23	Roll-up blinds
Extruder	36	
Extruder	92	Rigid pipe
Corrugating machine	6	Corrugated and plain sheets
Blender	19	PVC powder
Heat sealer	403	Raincoats, baby pants, hand bags
Sewing machine	674	Mattress cover, garment bags, jackets and shoes
Extruder	62	Window blinds, place mats
Knitting machine	36	Window blinds, place mats

The export of PVC and its products in 1967 is listed below:

PVC resin & compound, Seipper Toy & dolls, shoes, sheets, film Window shade, folding door, raincoat etc.	46,231 MT	US$29,784,309

2. POLYETHYLENE

The largest single foreign investment project in Taiwan is the polyethylene plant. It was put up by the USI Far East Corporation, a subsidiary of National Distillers and Chemicals. The plant produces 34,000 MT/year of polyethylene. The raw material, ethylene is supplied by Kaohsiung Refinery of Chinese Petroleum Corporation, which produces 55,000 MT of ethylene in its naphtha cracking plant. The polyethylene plant started operation in May 1968 to produce low density polyethaylene.

There are nearly 250 polyethylene fabricators of which the most are small size enterprises. The capital of the small size plant is less than US$10,000.

The export of polyethylene products in 1967 is given below:

Polyethylene flowers, bags, hoses, Mattress covers, mats, etc.	US$1,881,404.64

In 1967, the polyethylene used was imported. After 1968, the low density polyethylene is produced locally, therefore an increase of export would be expected.

3. POLYSTYRENE

There are two plants, Taita Chemical and Poly Chemical, producing general purpose polystyrene and expandable polystyrene. The raw material, styrene monomer, is imported. The production statistics are listed as follows:

1956	195 MT
1966	1,456 MT
1967	1,579 MT
1968	1,757 MT

The export statistics in 1967 are:

General purpose polystyrene, sheets Accoustical tiles, lamp shades etc.	US$132,668.03

4. OTHER THERMOPLASTICS

There are a few plants producing polyvinyl acetate, polymethyl methacrylate. The monomer raw materials are imported. The production statistics are:

Polyvinyl acetate

1965	6,000 MT
1968	8,900 MT

Polymethyl methacrylate

1964	726 MT
1965	[illegible]
1966	[illegible]
1967	[illegible]
1968 (est.)	[illegible]

5. THERMOSETTING RESINS

5.1 Phenol-formaldehyde resin

There are two plants, Taita Chemical and Chang Chun Petrochemical, producing the moulding powder and glue. The production from 1964 to 1968 is listed below:

Year	Moulding powder MT	Glue MT
1964	305	66
1965	525	183
1966	915	383
1967	1,202	550
1968 (est.)	1,350	600

The raw material, phenol, is imported. The formaldehyde is produced by Taita and Chang Chun from the oxidation of methanol. Methanol is produced from natural gas by Chang Chun. It started operation of its methanol plant with a capacity of 50 MT/day in 1966. It produced 19,000 MT in 1967. As the demand for formaldehyde is still growing, the said company is now building a new methanol plant with a capacity of 150 MT/day, using the ICI low pressure process. This plant will be completed by the end of 1970.

5.2 Urea formaldehyde resin

There are over ten producers including Taita Chemical and Chang Chun Petrochemical. The production statistics are:

Year	Moulding powder MT	Glue MT
1964	728	22,174
1965	914	23,644
1966	1,122	26,400
1967	1,470	28,862
1968 (est.)	1,600	33,000

The raw material, urea, is produced locally by some fertilizer companies.

5.3 Other thermosetting resins

Other thermosetting resins such as melamine-formaldehyde, alkyd, unsaturated polyester, polyurethane etc. are also produced in Taiwan but a part of the raw material is still imported.

The raw materials for plastics are mostly derived from petrochemicals. Therefore, in 1969 a wholly Government owned company was founded for the development of the petrochemical industry, called the Chinese Petrochemicals Development Corporation. Its main undertaking will be to produce petrochemical intermediates for supply to local manufacturers of plastics and synthetic fibres. After a few years, the plastics industry would be well-developed. During the developing period, testing, standardisation and quality control of plastics as well as the plastics research, basic and applied, must be paid attention in order to make a sound base for the plastics industry.

CUBA by G.L. Mejer

The plastics processing industry until 1959 was formed principally by small and geographically dispersed workshops and only two or three medium size factories. As an undeveloped country at that time, the industry showed the typical one or two injection moulding machines in the garage of a house. No tax regulation or law existed to protect and develop the economically weak national industry against foreign suppliers of semi-finished or finished products with a higher economical development. The total raw materials and equivalent additives used were imported. Around 1964/1965, the national consumption of plastic resins was about 0.53 kg per head.

With the purpose of getting a higher industrial efficiency in the years of 1963/1965, an integration of small workshops and factories into large factories was effected. The integration was accomplished according to the technological similarity of the machinery, thus obtaining factories specialised in injection moulding, extrusion, blow moulding, compression film blowing and others.

Due to the work done concerning the national development of the economy in a balanced and integral way, the application of plastic materials in different industrial sectors and in agriculture started to be studied and evaluated. For this reason, expansion of existing capacities was increased, raising the yearly consumption to approximately 1.5 kg per head in 1968/1969, fundamentally PCV and low-density polyethylene resins, with a total yearly processing in the range of 10,000 to 12,000 tons.

Considering the country's economic accumulation in the decade from 1960 to 1970, and based on the need for increasing the rate of economic growth in the coming years in the following fields:

Food industry,
Building and furniture industries,
Agricultural and irrigation systems, and
Consumer goods

this growth must be fulfilled taking into account

(a) higher industrial efficiency,
(b) lower possible index in initial investment/year producing rate, and
(c) world shortage of traditional materials like paper, cardboard and tin.

All the above must bring the national yearly consumption to an increased range from 3 to 5 kg per head.

To overcome the present main internal difficulties in the plastic processing industry in order to achieve the per head consumption mentioned above, the fundamental needs are:

1. Training of medium level technical staff to operate the new industrial capacities, especially in
   - process technologists
   - quality control technologists
   - mould design technologists.
2. Disponibility of techno-economic indexes specific for our industry to evaluate with the highest accuracy and efficiency the new complete plants and machinery in the shortest possible time.
3. Final products testing plants.

The development of national production of polymers considered in the petrochemical industry is being at present in a more developed stage. This development based on the reference indexes seem to recommend the increase of the national production especially of polyethylene and PVC.

Fundamental plastics materials actually processed in Cuba
(Figures in brackets indicate the process in which the material is used)

Acrylics
- Sheets (13,14)
- Granular (1)

Alkyds (16)

Amines
- Melamine formaldehyde (Alfa cellulose filled) (2)
- Urea formaldehyde (wood filled) (2)
- Urea formaldehyde (17

Cellulosics
- Cellulose acetate (1,13)
- Cellophane (8,11)
- [illegible] (14, 10)

Phenolics

Moulding powder(wood filled) (2)

Polyamides (1)

Polyester resins

Glass reinforced (14)

Polyolefines

High density polyethylene (1, 3, 4, 5, 6, 8, 9, 11)

Low density polyethylene (1, 3, 4, 5, 6, 8, 9, 11, 15)

Polypropylene (1)

Polystyrene and co-polymers

General purpose(1, 6)

High impact (1)

Ultra high impact (1)

SAN (1)

Polyvinyl chloride

Rigid (1, 6, 7)

Plasticised (1, 6, 12, 15)

Plastisol (10)

Polyvinyl acetate (16)

Process identification

1 - Injection moulding
2 - Compression moulding
3 - Blow moulding
4 - Film blow
5 - Pipe and hose extrusion
6 - Profiles extrusion
7 - Monofilament extrusion (only for brooms)
8 - Flexographic film impression
9 - Silk screen impression
10 - Rotational moulding
11 - Heat sealing
12 - HF sealing
13 - Thermoforming
14 - Hand-made pieces
15 - Wire and cable covering
16 - Paint industry
17 - Hand application

Notes: 1. The recipes for PVC compounds are home formulated and plant using imported ingredients.
2. All plastics materials mentioned are at present imported (bags and bins)

INDONESIA by I. Hidajat

The plastic fabrication industry came to Indonesia in the early fifties. At the beginning, only small and simple articles were produced, such as cups, combs, buttons, spoons etc., mostly using thermoplastics material. The equipments were made locally; some used direct flame to heat the mould - at that time electric heating elements were still rare and besides that, electric power was also scarce. The production process was very simple. Raw material in the form of granules, scrapped plastics articles was put into the preheated female-mould followed by male-mold which was pressed manually (compression moulding).

In the mid-fifties, there was a marked growth for the plastics industry, as a result of Government subsidy to industry - through exchange rate regulation and lenient credit policy.

Highest national production output for industrial sector was reached in 1961. A look into the import figure of plastics material will give a picture of fabrication variety in the plastics industry.

Import of plastics material in 1961

1.	Polyethylene (high density)	400 tons
2.	Polyethylene (low density)	400 tons
3.	PVC/PVC compound	350 tons
4.	Urea formaldehyde	150 tons
5.	Phenol formaldehyde	20 tons
6.	Polystyrene	350 tons
	Total	1,670 tons

- From 1961 to 1966, the national industry output was declining. The same trend hit also the plastics fabrication industry. But after 1966, the growth rate for the plastics fabrication sector was so staggering as can be seen from a projected import of plastics material for 1970.

Plastics import estimate for 1970
(data from American Trading Co.)

1.	Polyethylene (high density)	5,000 tons
2.	Polyethylene (low density)	15,000 tons
3.	PVC compound	4,500 tons
4.	PVC resin	3,000 tons
5.	PVC resin (rigid)	500 tons
6.	General purpose polystyrene	2,500 tons
7.	High impact polystyrene	a couple of tons
8.	Polypropylene	500 tons
	Total	31,000 tons

Most of the plastics industry is actually "cottage industry". In an average, 3 to 4 machines are found in every unit (home). Processes used are of single stage i.e.

injection moulding, blow moulding, extrusion moulding (for the production of tubes, blown films), sealing and printing, compression moulding.

These cottage industries usually are not equipped with waste processing equipment such as: granulator/cutting mill, fluidisator. Their machinery is mostly imported from Hongkong and Japan. Some of them use rebuilt machinery i.e. assembled locally from different makers.

Large units which are organised as manufacturing plants, usually work with multiple stage process, i.e.

coloring - mixing/kneading - calendering - embossing,

coloring - extruding - laminating,

coloring - extruding - stretching - weaving.

In general, they are equipped with waste processing equipment. Reclaimed waste is used again for dark colored articles of low strength (impact as well as tensile). Up to a certain percentage, it is also used as raw material mix.

Testing equipment is rarely seen in industry, therefore physical characteristics of the raw material mix are never known. Occasionally poor quality articles reach the market without the knowledge of the maker. This can spoil the quality image of plastics articles to consumers.

Most of the large units are constructed with the help of foreign experts. Local production personnel who are responsible for the continued running of the plant have limited training and knowledge in the plastics field. A need for upgrading their technological know-how is very strong. Many of them want to modernise their processing method but do not have the know-how, - which process is the best, - what machine they should buy etc. They know that to compete with imported plastics articles, means to keep pace with modern fabrication technology developed in industrialised countries. Most of them are eager to learn the latest fabrication techniques and know-how. Training courses abroad sponsored by international agencies through technical assistance programme are always available. But for practical reasons, most of the units can not afford to miss key personnel for 1 to 2 weeks without contact or communication with them. Besides that, only a few of the key-personnel have the ability to

communicate in English, German or another widely used foreign language.

In 1972, Pertamina, a state owned oil company, plans to open a polypropylene plant with a yearly production output of 20,000 tons. Up till now, the only polypropylene consumer in Indonesia is PT Karuna with a yearly consumption of 850 tons.

Most of the plastics industry's machinery is of old type and making. It was mostly imported to Indonesia around 1960. This machinery is intended for processing plastics materials with relatively low working temperature such as PVC, polyethylene, Polypropylene requires a relatively higher working temperature and processing polypropylene-waste needs special equipment with the industry is not yet equipped with.

The supporting industry for plastics fabrication is, at present, not yet able to give satisfactory services to the industry. Locally made moulds and dies are as expensive as the imported ones but the quality is much lower. Usually they have shorter service life compared with the imported ones, and frequently, they give plenty of production problems.

Today, the plastics fabrication industry can supply the domestic market with a variety of articles requiring wide range of processing abilities, i.e.

1. Pail, waste basket, sauser and cup (injection moulding)
2. Jerry-can, cottle, toys (blow moulding)
3. Synthetic leather, coated fabrics
4. Cast film, blown film, tubing, piping (extrusion)
5. Flat yarn, woven fabric, rope
6. Laminate/formica (melamine - phenolic laminates).

IRAQ by R.M. Al-Dujaili

About eight years ago, some companies were building small factories to produce simple articles from many kinds of raw materials to make items like toys, footwear, tooth brushes etc.

But my company, the Electrical Industries Company, had different products and processes of moulded material than the other companies and its production started about four years ago to make products like:

- Electric light fittings,
- Parts for ceiling and table fans,
- Parts for water pumps,
- Shock absorbers and other parts for electric motors,
- Tap-changer switch and other parts for transformers.

The processes of moulded material used in Iraq are mostly injection, compression and extrusion processes. The raw material for the plastics fabrication is imported from overseas.

Raw materials used in Iraq

1. Urea formaldehyde moulding compound
2. Phenolic formaldehyde moulding compound
3. Melamine formaldehyde moulding compound
4. Polystyrene
5. Polyethylene
6. Nylon.

Difficulties in processes of moulded material

Where we use the thermosetting resins to produce moulded material, we come accross some problems in products and processes and we try to overcome some of them by trials. But these trials are not enough to develop the moulded material in a good quality.

Because of these difficulties, UNIDO can help us by giving my Country specifications and demonstrating the various processes for the manufacture of moulding material to overcome problems and difficulties in the processing such as:

1. Warping of flat moulded material
2. Cracks in the surface of moulded material

3. Colour separation in the surface of moulded material

4. Cracks or breaks in the plangor or cavity of some moulds during the processing of moulding material.

It would be of special interest to my country to acquire up-to-date knowledge on the process of moulding material by transfer moulding process for thermosetting resin because we have many kinds of intricate shapes of moulded material and we have some moulds which need metal screws to insert the mould for making threads in the moulded material.

In addition, it would be of great value to see demonstration on the processing of moulded material by rotary moulding techniques for thermosetting resins to get a higher rate of output of moulded material because the conventional compression machines have a lower rate of output.

NIGERIA by E.O. Evuarherhe

The plastics industry in Nigeria is one of the many industries whose growth has been very rapid. Even in less than a decade, Nigerians are participating in this field which formerly was the exclusive province of foreign companies. The industry was started by a few foreign companies which imported the know-how and necessary technology. Today, these foreign companies are still dominating the industry, however, some small indigenous companies have started in this field.

As in most other industries in Nigeria, plastic raw materials are imported from overseas. Plastic conversion takes place mostly by injection, blowing and extrusion processes. The most common materials used are polyethylene, and general purpose styrene. Other materials sometimes used are polypropylene, high impact styrene and polyvinyl chloride, both rigid and plasticized. The latter is primarily used for the production of footwear. Some companies have also started the processing of thermosetting plastics, however, this is mostly restricted to bottle caps.

A great portion of plastic goods are for domestic uses. Industrial requirements, such as radio cabinets and containers for the cosmetics and pharmaceutical industries are slowly gaining in importance. In Nigeria, we are struggling with the fact that industrial users are accustomed to much lower prices for their containers from overseas than we can offer them for locally manufactured products. This is due to a variety of reasons:

1. Markets in developed industrial countries usually allow for much larger production runs than it is possible in Nigeria.
2. We pay a high import duty on our raw materials, in addition to that we pay an excise duty on our production.
3. We are quite removed from the latest technological advances, which makes our operation look quite primitive sometimes to the sophisticated visitor.
4. And last, we do not have the technical assistance at hand to do the necessary repairs when we have a breakdown.

I believe the greatest hope at the moment lies in the dissemination of technical know-how and experience. Seminars such as this one are of great help.

However, a lot of our problems are of a practical nature which can only be solved at the machine on the factory floor. At the moment we get very irregular assistance from machinery manufacturers and raw materials suppliers who send plastics conversion experts to us to discuss and help us to solve our problems. These visits, however, are too short, and the people don't come often enough. This could be one way in which UNIDO could help, namely by sending experts in the practical solution of production problems on a periodic basis, say, once a year.

PAKISTAN by R. S. Karim

In developing countries like Pakistan, which do not have adequate indigenous sources of iron, wood, rubber, glass and aluminium etc. plastics with their diverse and ever increasing applications offer immense possibilities for substitution and augmentation. This would be most marked in fields such as packaging, pipes, containers, household goods, bags and construction materials etc.

The wide range of plastic materials that exist today, their versatility and low cost, the unlimited numbers of ways in which they can be formulated and the almost inexhaustible supply of their raw materials, have contributed to the ever growing demand for them all over the world, to replace traditional materials and fulfil new needs.

At present, about 450 plastic processing industries in East and West Pakistan are engaged in manufacturing plastic goods using imported plastic raw material from the industrialised countries. This implies the expenditure of valuable amounts of foreign exchange on the part of the developing country. As a result, some important industrial and construction applications of plastic have not yet been developed.

At present, only Valika Chemical Industries is manufacturing plastic raw material that is "high pressure low-density polyethylene" using indigenous raw material which is molasses available from sugar cane industries. Converting molasses into ethyl alcohol by fermentation, ethyl alcohol to ethylene by dehydration and finally by polymerisation of ethylene into polyethylene.

In this modern world, it looks odd to convert molasses into polyethylene while others are using cheap raw material like naphtha. At planning time of Valika's polyethylene plant in 1961, molasses was chosen as raw material for the production of ethylene as at that time, molasses of a suitable quality was available in Pakistan as a cheap, surplus commodity. Compared to other indigenous raw material (naphtha from one refinery only), molasses was regarded as an ideal feedstock.

However, in the course of the last few years, considerable changes have taken place as far as the market conditions for molasses are concerned. The disappearance of "Cuba" as the world's largest producer of molasses has resulted in short supply and consequently in a much higher price of molasses in

the short period from 1961 to 1970 the price of molasses has jumped from US$6 to US$25 per ton, which has ultimately affected the cost of production of polyethylene.

Valika Chemical Industries,,besides polyethylene also manufacture the following chemicals using the country's own natural gas as raw material:

- methanol
- formaldehyde
- urea-formaldehyde glue
- hexamine.

Valika Chemical Industries is the only chemical complex in Pakistan of its own type and representative of all modern petrochemical industries of today. It took the initiative for promotion of plastic industries by which foreign exchange is now saved as polyethylene is locally available. It utilises some of the most advanced ideas of science and technology using the country's own resources as raw material. It requires bold planning for the future, large outlays of capital, great construction of projects and the complex co-ordination in movement of its products in the avenues of trade. It brings together in a united effort, large organisations of people representing almost all types and degrees of skill and professional knowledge. Hence the existence of Valika Chemical Industries Ltd. has meant the commingling in close working relations of people of East and West Pakistan.

The writer's firm is planning for the further extension of polyethylene plant using high pressure process to increase its present capacity of 5,000 tons/year to 15,000 tons/year, based on ethylene which will be supplied by the coming petrochemical complex.

The Government of Pakistan has examined the recommendation and approved the setting up of a petrochemical complex in West Pakistan. The starting material for this complex is surplus naphtha which is available from two refineries at Karachi. For further processing the naphtha is cracked in a naphtha cracker yielding ethylene, propylene and other basic materials for plastics industries. Of these, the most important is ethylene which will be utilised by majority of the downstream projects.

Ethylene can also be produced from the country's own natural gas but the source is considered uneconomical in Pakistan. Natural gas available in Pakistan

has a meagre proportion of ethane for possible conversion into ethylene. The final capacities of the down stream project to utilise the intermediates will have a complex which includes the following projects:

- polyethylene
- PVC
- polypropylene
- caustic soda
- chlorine

The complex is being delayed only for want of a good amount of foreign exchange. Now it is hoped that this complex would start its production by 1974.

Only one industry in West Pakistan is manufacturing PVC compounds on imported PVC resin. PVC resin is mostly used in manufacturing water pipes and cable coatings etc.

Two industries in East Pakistan are manufacturing urea-formaldehyde (compounds and glue) which are used for processing of house-hold items and chip boards respectively. The units for urea-formaldehyde in East Pakistan are based on methanol which is supplied from West Pakistan.

The plastic processing industry in Pakistan has expanded manifold during the last decade. The expansion has taken place in almost all the major processes like extrusion, injection, blow and compression moulding. The total existing rated capacity in Pakistan is about 35,000 tons/year of plastic raw materials. The equipment used comprises both foreign as well as locally fabricated.

Most of the plastic processing industries of East and West Pakistan are engaged for the manufacturing of household items, electric goods, toys, packing bags and decorative items etc. Mostly the following types of plastics are used:

- PVC
- polyethylene (high and low density)
- polypropylene
- phenol and urea-formaldehyde
- polystyrene
- cellulose
- acrylic
- melamine

95 per cent of polyethylene is used for packing bags for fertilizer and sugar

etc. as a liner in jute bags. The import of the plastic raw material is restricted due to shortage of foreign exchange and therefore processing of plastic is very low as compared to requirements. Due to this limited source, processors are unable to adopt new ideas and techniques. The time is coming very fast that plastic items would become very important for daily life of the low income people of Pakistan, as it is now very difficult to fulfill the requirements by the expensive items made from glass or steel.

All the factors which have contributed to the astonishing growth of the world plastic industry over the past decade will continue to be of importance in the future. There is every indication that the plastic industry at large will continue its rapid development stimulated in particular by the demand for such materials and will continue to offer economic advantage over many alternative base materials and will thus tend to satisfy the new needs of the country. The plastic processing industry of Pakistan has expanded manifold during the last few years. New processes and machines have been introduced. Processors have installed equipments for producing simple products at initial stage and then expanded for making sophisticated products. The industry is facing a number of problems which are common for the industries based on entirely imported raw materials, equipments, spare parts and borrowed technology. As the industries are developing, the problems are becoming more acute.

The major problems faced by the plastics industries of Pakistan are the following:

- lack of new and advanced technology
- lack of technical know-how
- lack of plastic raw materials
- lack of trained technicians.

The plastic technology is very new for the enterpreneur of Pakistan. Therefore there is a need to develop the knowledge of the technology on the modern line. The utilization of various plastic raw materials entirely depend on the commercial import, the prices for the finished product the consumer would afford. In all parts of the world, plastic is known as cheap material but due to the above reasons, it has resulted in high cost of finished products, therefore substitution has not taken place on any appreciable scale.

When industry started in Pakistan, there was hardly any technician knowing

plastic technology. In course of time a few technicians have come up with foreign training but industry is still short of qualified trained technicians. So the non-availability of trained technicians is responsible for producing substandard products and higher production costs and the reasons why world standard specification cannot be met.

The future market in Pakistan lies in new and sophisiticated items. Pakistan does not have any facilities to make the equipments for making such items nor does it have any research centre to develop new ideas. Development in plastics is going on very fast which cannot be followed because of lack of funds. It should be made possible to fabricate the equipment. Requirements of the plastics should be explored by market surveys which have not so far been done in Pakistan but are common in other parts of the world.

Now it is felt that a petrochemical institute should be established in Pakistan for education and training of personnel in the technology of plastics, synthetic rubber and synthetic fibres etc. The establishment of such an institute is highly desirable. The education and training should be aimed for developing the knowledge of petrochemical industry, handling of material, repairs and maintenance of equipment, research on by-products and new process techniques.

PHILIPPINES by S.G. Ramos

The initial stage of development of the plastic industry in the Philippines might have begun in 1948 with the commercial fabrication of plastic novelties. The next stage was in the early 50's when some processing methods were adopted in commercial production. Injection and compression moulded housewares were introduced in the market. Later, in the mid 50's, the industry's growth had an abrupt change when production was diversified to other fields of plastic processing. Industrial packaging and consumer products were introduced. These were processed by injection moulding, compression moulding, blow moulding, film blowing, film and sheet extrusion, extrusion of profiles, casting, laminating, calendering, monofilament extrusion, rotational moulding, thermo and mechanical forming, etc. It was in the early sixties, however, that plastics in the Philippines achieved full stature and maturity as an industry.

Today, plastic industry in the Philippines may be divided into three major categories, namely:

1. The plastic raw material manufacturer, who produces the basic plastic resins and compounds.

2. The processor who changes the plastic resins or compounds into desired shapes considered as semi-finished or finished products.

3. The fabricator and finisher who further change the shape, or decorate semi-finished products in order to be ready for use.

At present, in the Philippines, there is only one company which produces commercially one kind of plastic resin and compounds. This company is the Mabuhay Vinyl Corporation, the sole manufacturer of polyvinyl chloride resins and compounds. All other plastic resins and compounds needed by local processors and fabricators such as polystyrene, polypropylene, polyethylene, styrene, acrylonitrile, cellulose acetate, cellulose acetate butyrate, methyl methacrylate, high impact polystyrene, acrylonitrile butadiene-styrene, are imported from more developed countries of the world. Because of the country's need for these materials the Board of Investment, under the office of the President, Republic of the Philippines, has encouraged foreign capital to establish pioneer enterprises that would utilize a substantial amount of domestic raw materials, in joint ventures with filipino capital, whenever available. This is so stated in the

Investment Incentives Act otherwise known as Republic Act No. 5186, that prescribes the incentives and guarantees being offered by the Philippine Government to both domestic and foreign enterprises in Preferred Areas of Investment in the Philippines. Among the preferred areas of investment are establishments of polystyrene, polyvinyl acetate, polyvinyl chloride, and polyethylene plants. This is in so far as investments in plastics industry is concerned.

On the second and third categories, it is estimated that close to 400 companies are in operation. Plastic industry in the Philippines, then are concentrated in these two major fields of production. Some of the most common processes and fabrications used are: injection moulding, blow moulding, compression moulding, film blowing, film and sheet extrusion, calendering, coating vacuum forming and press forming; injection and blow moulding being the greatest and still increasing excessively in number.

Some of the major problems confronting the Philippines today in line with plastic production are the following:

1. Lack of a training centre which can adopt programmes to educate the end users and the general public on the nature and uses of plastics. One that can provide a forum for effective training to all persons employed in the plastic industry in the forms of seminars. One that can provide a neutral meeting ground where people from the plastic industry can discuss matters of mutual interest thus fostering a spirit of co-operation and brotherhood within the industry.

2. Lack of any plastic institute in the country which can promote better knowledge and technical know-how. One which should be provided with laboratory equipment and testing machines necessary in the testing of plastic products and materials. One which can carry out research projects or can help in the establishments of standards and specifications comparable to the established standards and specifications of plastics being used by more developed countries of the world.

3. Lack of a comprehensive technical library on plastics for use of the people interested in plastics. One that can also act as a medium for an effective contact with other plastic industry organizations and keep us informed on the latest world development in plastics.

Speaking therefore on behalf of my country, I wish to relay these major problems to help the Philippine Government in the creations of such training centre, plastic institute and plastic technical library through the support and assistance of UNIDO.

POLAND by A. Ruminski

1. Introduction

The beginning of the Polish plastics processing industry falls in the years 1920 - 1930, when some electrical plants started to make moulds from imported phenolic moulding materials. In 1934, the production of Polish phenolic resins and phenolic moulding materials was set up. In 1939, some kinds of phenoplast, galalith, cellulose acetate for injection moulding, cellulose acetate film, cellulose nitrate and synthetic rubbers were locally produced.

This industry was completely destroyed during World War II.

After the war, the Polish plastics industry started in 1946, with the production of phenolic resins.

2. Production of plastics in Poland

The development of the plastics industry in Poland is shown in table I.

The development prognosis of the plastics industry in Poland is shown in table II.

It is estimated that the demand for plastics materials in Poland will amount to about 800,000 tons in 1975. The import of PVC, PS and some other plastics will be indispensable. It will be possible to export some polymers such as polyurethanes, polycarbonates, phenoplasts, aminoplasts.

Table I

Production of plastics in Poland 1950 - 1970
(thousands of tons)

	1950	1955	1960	1965	1970(est.)
Total production	3.5	11.7	55.1	117.2	~ 850
Phenoplasts	1.5	5.9	15.2	25.0	38.3
Aminoplasts	-	1.5	10.3	28.7	46.0
Polyvinyl chloride	-	-	13.4	26.4	94.0
Polystyrene	-	-	3.1	10.2	18.4
Derivatives of cellulose	1.0	1.9	5.7	7.3	7.1
Polyester resins	-	-	0.02	1.3	4.5
Polyamides	-	-	0.2	1.7	2.5
Polyethylene	-	-	-	0.2	15.0
Acrylic polymers	-	0.01	0.1	0.8	1.2
Epoxy resins	-	-	0.12	0.9	1.0

Table II

Prognosis of the production of plastics in Poland
(thousands of tons)

	1975	1980
Total production	500-700	900-1,200
Phenoplasts	51	65
Aminoplasts	82	100
PVC and co-polymers	169	290
Polyolefines	80	260
Polystyrene and co-polymers	42	45
Polyamides	5	10
Acrylic polymers	9	17.5
Polyurethanes	32	55
Polycarbonates	4.5	6
Epoxy resins	9.5	26.5
Polyester resins	24.5	40
Derivatives of cellulose	18.4	19

3. Processing of plastics in Poland

Table 3 gives information on the estimated production of plastics in the years 1970 , 1975 ; 1980 in Poland by different methods.

Table III

Estimated production of plastics in Poland by different methods (per cent/year)

	1970	1975	1980
Injection moulding	11	12	16
Extrusion and blow moulding.	30	36	37
Compression moulding	10	7	6
Calendering process	25	23	19
Miscellaneous	24	22	22
Total	100	100	100

The production of plastics raw material in Poland is centralized in one chemical industry. Processing of plastics materials is however, scattered among many industrial branches, namely:

Ministry of Architecture and Building Materials

Building elements (skylights, panels), wall and floor coverings, plumbing fittings, insulation materials.

Ministry of Heavy Industry

Utilization of materials which do not need to be processed, like adhesives resins for encapsulating and tooling in electrical engineering and electronics and building of machinery. Production of construction elements, electrical goods; automotive, transport and machinery parts, tools and hardware.

Ministry of Light Industry

Fabrics and non-woven materials, coatings with plastics for textile, furniture, automotive and shoes industry; machinery parts technical goods and packaging materials for textiles and leather industry, clothes laminates.(fabrics with foams).

Committee for Small Scale Industry

Consumer products, toys, fancy goods, household ware.

Ministry of Chemical Industry

Utilisation of plastics for protection against corrosion, introduction of new plastics materials in processing, production of materials for thermoforming and production of mass products (films, packaging materials, large containers and tanks, pipes and tubes).

Ministry of Forests and Wood Industry

Production of paper laminated with plastic films, production and wood industry (decorative laminates, foam cushioning, injection moulding and extrusion elements, R.P.).

Ministry of Food Industry

Packaging materials and containers for food products, production and utilisation of plastics materials in equipment of food industry.

Navigation Ministry

Production and utilisation of plastics in ship building; production of boats.

Estimated consumption and processing of plastics in individual branches of the Polish industry are shown in tables IV and V.

Table IV

Estimated consumption of plastics in branches of the Polish industry (per cent/year)

	1970	1975
Architecture	21	23
Heavy Industry	22	22
Packaging materials	7	11
Light Industry	14	8
Paints	19	14
Miscellaneous	17	16
Export	-	6
Total	100	100

Table V

Estimated processing of plastics in branches of the Polish industry (per cent/year)

	1970	1975
Ministry of Chemical Industry	59.9	43
Ministry of Architecture and Building Materials	3.5	20
Ministry of Heavy Industry	10.3	15
Ministry of Light Industry	9.0	7
Committee for Small Scale Industry	12.8	10
Miscellaneous	4.5	5
Total	100	100

3.1 Machinery, equipment and tool requirements for the Polish plastics processing industry

According to our development plans, the demand of plastics industry for ordinary equipment, like injection moulding, extruding and compression moulding machinery will be in future more and more covered by local industry. Special equipment and production lines, requirements for which is very limited, will be imported.

It is a very difficult problem in Poland to supply our processing machinery with moulds, tools and instruments. It is connected with the low growth of this industry and scarcity of production base.

But this situation is also due to other reasons, i.e.:

- Construction of moulds and tools are very often non-repeated;
- There is scarcity in specialized staff;
- Very often, it is not possible to test the moulds in the place of production.

4. The development trends of the Polish plastics industry

Our country is very much retarded in the field of plastics industry. It will be very difficult to reach the proper rate of growth of this industry. The following is needed for that purpose:

Considerable capital investments, import of machinery, equipment, technological methods and licenses. Considerable funds should also be allocated to research work. The aim of research work is to improve technological processes, extend the assortment and improve the quality of raw materials. In the future we may expect certain successes also in the field of new materials, technological processes and products.

5. Problems requiring UNIDO technical assistance to the Polish plastics industry

To reach the fast rate of growth of the Polish plastics industry, assistance from UNIDO in establishment, operation and management of industrial enterprises including the promotion of domestic investment and enlisting of increased external financing for specific industrial projects may be very useful.

In my opinion, completely new manufacturing processes should be introduced, i.e. the production of synthetic "breathing" uppers for shoe leather like and it would be desirable to request for expert services in:

- the selection of process, technologies and machinery and equipment;
- the preparation of invitations for tenders and evaluation of tenders.

In this work, local conditions and the results of research works carried out in Poland must be taken into consideration. The next stage of UNIDO assistance may be establishing an experimental plant designed to demonstrate in practice the production method.

In some other cases, another form of technical assistance may be very useful. Confidential consultations at high policy level can be offered for example on the Polish plans of development of our industry of polyolefines.

Especially useful could be the assistance within special industrial services programmes, namely:

- Ad-hoc assignment of high level experts, to advise on specific questions related to the manufacturing sector. For example: now a short and fast control method of purity of a raw material for our new production of PETP film is needed;
- Fellowships to bring our technicians to the source of specialized knowledge abroad, either to obtain the required assistance or to learn from first-hand observation the solution to technical problems as practised in industrialised areas, could be extremely helpful.

The field in which, in my opinion, fellowships are especially needed are for example:

- Training a design staff in construction of moulds and equipment for plastic processing industry;
- Production of R.P. tubes and tanks with a filament winding method; and
- Production methods of synthetic "breathing" leather.

ROMANIA by V. Mitrofanovici

The production of polymers and synthetic resins

The chemical industry in the Romanian Socialist Republic has known a great development during these last twenty years, the production of plastics representing one of its main branches of activity.

The growth of the plastics industry is a consquence of the availability of natrual sources of raw materials, mainly natural gases and petroleum, which contributed to the development of an important petrochemical industry, represented by the Petrochemical Industrial Groups Ploiesti, Pitesti and Borzesti. These industrial groups process different products supplied by the petroleum industry and provide the plastics industry with the necessary monomers.

The Petrochemical Group Ploiesti possesses two main technological lines: the olefines and the aromatic compounds. The olefine plant uses as raw material the ethane and propane of the natural and refinery gases to produce about 35,000 tons/year ethylene and 20,000 tons/year propylene. Ethylene is used in the polymerisation plant (I.C.I. patent) for high pressure polyethylene, which mixed with the necessary additives and gramulated is sold in different grades. The capacity of the plant, which first began to produce in 1965, is 24,000 tons/year.

Ethylene is also used to obtain ethylene oxide and its derivatives such as glycols, the production being 10,000 tons/year ethylene oxide, 5,000 tons/year monoethylene glycol and 2,000 tons/year diethylene glycol.

The glycols as well as the phthalic anhydride obtained by catalytic oxidation of o-xylene are important for the production of PVC plasticizers. In 1969, the capacity of production for the anhydride, which in 1965 had been 6,000 tons/year, was doubled as a consequence of the increased production of PVC.

Another important section of the Ploiesti Petrochemical Group is the plant for the production of phenol and acetone using as raw materials benzene from the oil distillieries and propylene from the olefine plant. The plant has produced since 1968 its capacity being 25,000 tons/year phenol and 28,000 tons/year acetone.

Phenol is a very interesting product as it represents the raw material for cyclohexanol and cyclohexanone, the basis for E-caprolactam and therefore,

of the polyamide 6 synthetic fibres and plastics which are produced at the Works for Synthetic Fibres Savinesti.

The Petrochemical Industrial Group Pitesti comprises three important units: the pyrolysis complex, the polyethylene plant and the cyan complex.

The pyrolysis complex represents one important part of the production process as it supplies the necessary raw materials ethylene, propylene, butadiene, etc. to the other sections. It processes the petroleum cuts, which result as by-products at the oil distilleries.

The ethylene polymerization plant possesses beside the polymerisation installation the necessary mixing, extrusion and granulating machines. Its output is 60,000 tons/year low-density polyethylene.

The cyan complex comprises besides other sections the acrylonitrile section, based on the Sohio process, involving the ammono-oxidation of propylene. Acrylonitrile constitutes the raw material for a series of acrylic polymers, one of its main uses being in the production of synthetic fibres. The output of the plant is 20,000 tons/year.

Another important monomer is styrene produced at Borzesti Petrochemical Group by catalytic dehydrogenation of ethylbersene, supplied by the catalytic reforming plants of the petroleum industry. The polymerisation section began to produce in 1963 having a capacity of 6,500 tons/year; in 1970 the output will rise to about 12,000 tons/year. Several grades are produced: general purpose, impact and expanded polystyrene. In 1970, the production of ABS and SAN co-polymers will also begin.

Polyvinyl chloride is the most important polymer produced by the Romanian plastic industry, the second being polyethylene. In 1957, the first semi-industrial plant was constructed, followed by a PVC section at the Chemical Works Turda. The plant built at Borzesti, which began to produce in 1963, has a capacity of 36,000 tons/year. In 1969, another plant was added to the already existing ones at the Chemical Group Rimnicu-Vilcea with a capacity of 36,000 tons/year. The monomer vinylchloride is obtained from acetylene and ethylene. Emulsion and suspension PVC are produced in different grades and colours.

The industry of polyamide filaments and fibres based on the production of polyamide 6 obtained by polymerisation of caprolactan has also known a rapid growth in the last ten years. Part of the production of polyamide 6 (Relon)

is used by the plastics processing industry to produce mainly technical parts.

The total production of plastics (not including polymers for filaments and fibres) was: 12,000 tons/1960, 76,000 tons/1965, 210,000 tons (estimated value) 1970, 440,000 tons (estimated value)/1975; that is an increase of 2.76 from 1965 to 1970 and 2.10 per cent from 1970 to 1975.

The estimated values of the production capacities for 1970 and 1975 for the principal polymers are the following:

Material	1970 (thousands of tons)	1975
Polyvinylchloride	78	150
Low-density polyethylene	72	110
Polystyrene	10	30
High-density polyethylene	-	40
Polypropylene	-	10
Polyesters	3	-
Polyacrylates	0.5	3

The trend in the industry of polymers is the developing of new grades with improved qualities of the already produced polymers such as PVC, polypropylene, high-density polyethylene, polyesters. At the same time, research work has been carried out for chlorinated PVC, polycarbonates, polyacetals, vinylchloride/vinylidene chloride and vinylchloride/vinyacetate co-polymers, which production on a small scale will begin in the next years covering at the beginning the home consumption estimated at about 5,000 tons/year.

The construction of plants for the production of polymers and synthetic resins implied the development of two other industries, the plastics processing industry and the industry for the manufacturing of additives, which compounded with the polymers improve their processing and final qualities.

At the beginning of the plastics industry in Romania, these additives (plasticisers, stabilisers, UV absorbers, pigments, etc) were mostly imported. In the last ten years, owing to research work in the laboratories of the chemical institutes and works, many of these additives, e.g. plasticisers such as esters of phthalic acid, sebacates, adipates; stabilisers such as lead, calcium and barium compounds; fillers; pigments, printing inks; lubricating

are produced by the chemical industry.

The processing industry

In a period of about 12 years, the processing industry has known an important growth, the main processing works being used of Bucuresti, Iasi, Buzau Orastie, to which must be added the processing section for phenolic resins and aminoplastics at the works Fagarasi.

Seventy per cent of the processing production is obtained in the works belonging to the Ministry of the Chemical Industry. The Light Industry produces consumer goods such as plastic garments, protection clothing, footwear, bags, suitcases, buttons, table cloths, fancy goods.

The first industrial processing unit for thermoplastics was set up in Bucarest in 1957 with an initial processing capacity of 6,300 tons/year, which by fitting out with new machines and improving the technological process has reached, using the same floor space, 16,000 tons/year and is estimated to increase up to 28,000-30,000 tons in the future. Being the first important plant for the processing of plastics, the works "Bucuresti" had the difficult mission to acquire the most adequate equipment, to get acquainted with various materials and technologies as well as the problem of quality control, to form the necessary technical staff.

From the beginning about all usual technologies were adopted, i.e. extrusion, granulation, blow-moulding, injection, calendering, H.F. welding and printing.

The materials, that were processed, were PVC, polyethylene, polystyrene, to which in time were added polyamides, high-density polyethylene, polypropylene, ABS, polycarbonates, polyacetals, SAN.

The main goods produced by the works are:

- Rigid PVC pipes, heavy, medium and light types for 10.6 and 2.5 kgf/cm^2 nominal pressure (10-110 mm diameter)
- PVC fittings
- Rigid PVC tubes for electrical insulation (Bergmann and Pantser types - 13-39 mm diameter and 16-50 mm diameter)
- Granulated PVC for the cable industry (insulation and sheathing)
- Granulated PVC for shoe soles
- PVC calendered sheeting, embossed sheeting, floor covering
- Polyethylene blown film (0.03-0.15 mm thickness, 160-850 mm width); extruded film (0.2-0.25 mm thickness, 1,400 mm width).

- Polyethylene bags and sacks
- Polyethylene blown bottles
- Injection mouldings:

  Technical components: parts for the automobile industry, gears, casings, gaskets, perforated plates for sewing machines, strainer for water filtering, radio-knobs, etc.

  industrial items: crates for milk bottles, beer bottles, bread, -meat, fruit; instrument cases; refrigerator parts; threaded stoppers, containers, etc.

  consumer goods: buckets, basins, children bath tubs, plates, trays, bowls, cups, etc.

  school supplies; rulers, squares, templet curve; welded articles; wallets, books and copybooks covers; briefcases; inflatable items; toys.

The economic importance of the production of the works "Bucuresti" in the period 1958-1968 results from the data given in Table I.

Table I

Economic efficiency of the plastics production of the works "Bucuresti"

Product	Economic efficiency Substitutes the following materials
PVC - pipes, heavy, medium and light type incl. fittings	65,000 tons steel and irpn pipes
Rigid PVC tubes for electrical networks a. fittings	100,000 km Bergmann tubes amounting to 56,000 tons of lead and cardboard. Important savings at the handling and assembling operations
Rigid PVC - tubes for the electro-technical industry	9,800 km metal tubes amounting to 8,600 tons metal
PVC profiles	670 tons of various wood and metal profiles
Polyethylene bags and sacks	30,000 tons classical packaging material
PVC-granules for electrical insulation	22,900 tons imported granulated PVC

The processing works of Iasi equipped with highly automated lines of production began to produce in 1963 and processes mainly PVC, polyethylene and polystyrene.

The technologies used for the processing of PVC are: extrusion, calendering, granulation and compression. The PVC, supplied by the producers is stored in silos, connected to a pneumatic conveying system, feeding the different processing lines.

The works produce:

- Rigid PVC pipes, heavy, medium and light types (32 - 280 mm diameter). PVC pellets and dry blend can be processed
- Rigid PVC tubes for the electrotechnical industry, Bergmann and Pantser types (13-50 mm diameter)
- Nonrigid PVC tubing "Flexotub" for flexible suction conduits, ventilation equipment, electrical insulation, water supply in greenhouses, etc.
- Extruded corrugated PVC sheet (2m x 1.6m x 1.7 mm).

The output of extruded goods is about 4,000 tons/year, PVC pipes representing the most important part.

- Calendered PVC sheeting, 0.2 - 0.5 mm thickness, 1,200-1,500 mm width, in various colours
- PVC embossed sheeting
- PVC floor covering and tiles obtained by laminating 2 or 3 layers of calendered foils, total thickness 1.5 - 2 mm
- PVC sheets, 2,000 mm long, 1,000 mm wide and 1-20 mm thick, obtained by compression in a multi-stage press of several layers of PVC foils, 0.4 - 0.5 mm thickness
- PVC semi-rigid foils used as substitutes for furniture veneer.

The production of calendered goods is about 6,500 tons/year, the floor covering and tiles representing the greatest production. (Recently, a new technology permits the processing of flooring imitating wood-floors, mosaic or marble).

- Polyethylene blown film, 0.04 - 0.25mm thickness and 150 - 1,000 mm width
- Sacks and bags
- Polyethylene containers, 0.5 to 150 l
- Polystyrene extruded sheet (impact polystyrene)
- PVC pellets for electrical insulation and sheathing.

The production of the works is considered to increase in the following years and to rise to 70,000 tons in 1975, including new products and technologies. Thus the production of pipes will reach 11,000 tons/year in comparison with 3,000 tons/year the present output. The production capacity for polystyrene sheet, electro-technical granulated PVC, polyethylene containers will be doubled. New production lines will be built for PVC profiles - about 3,500 tons/year;reinforced PVC sheets about 1,000 tons/year; PVC extruded film about 3,000 tons/year, and others.

The initial processing capacity of the plastics section at the works Buzau of only 120 tons/year, for Bakelite and amino resins, was developed durin, the last years. It processes at present, beside 700 tons moulding powder, also thermoplastics. In 1961, it began to produce expanded PVC and in 1963, the production of the vaouum-forming section was started prooessing packaging for the food industry, display-articles, instruments. The works also possess since 1965, a section for blown polyethylene film having a capacity of 3,000 tons/year. This section produces over 10 million sacks especially used for fertilizers. A new section has been constructed having a capacity of 17,000 tons/year polyethylene produots, that amounts to about 75 million sacks, 1,000 tons film for the agriculture and other packaging. The total capacity for the processing of plastios materials in this work, of 17,000 tons/year in 1970 will probably reach 65,000 tons/year in 1975.

The plastios processing sections of the Orastie factory process by injection moulding, general purpose and impact polystyrene, low-and high-density polyethylene, PVC and polyamide.

It produces components for the mechanical industry (casings, insulating plates, sleeves, bushings, propellers,etc.); packagings for the drug- and food industry; fittings (transfer moulding); consumer goods.

Mention must be made of the production of methylmethacrylate sheets "Stiplex" at the Chemical Works Copsa Mica, (max. size 1,000 x 1,000 mm).

The total processing capacity of the above mentioned works was 55,000 tons in 1965 and is estimated at 110,000 tons in 1970.

The Light Industry produces consumer goods demanded by the home and foreign trade.

The most important units of this industry for the processing of plastic materials are the following:

- Aradeana-Arad: processes PVC pastes (dolls, toys etc)
- Dermatina-Timisoara: produces mainly laminated goods; (flooring, plasticized PVC foam fabrics) and some injection mouldings.
- Victoria-Timisoara: processes PVC for coatings on textiles, PVC foam, PVC foils, polyurethane foam
- Flamura Rosie: processes by injection moulding thermoplastic and thermosetting materials
- Muntenia-Bucuresti: produces housewares by injection, extrusion , blow moulding, buttons
- Viitorul-Oradea: produces plastic monofilaments, brushes, toys, injection moulded products.

Beside these units the Light Industry possesses the works for the manufacturing of synthetic fabrics.

This branch of activity is also in full development, the rate of production rising steadily. The plants are equipped with new modern lines of production such as equipment for the manufacturing of polyethylene and polypropylene oriented film for synthetic raffia, PVC and polyethylene filaments, tubings, moulded goods. The production in comparison with 1965 taken as 100 per cent was in 1968, 450 per cent.

The rapid growth of the Romanian plastic industry, the beginning of which can be situated after 1955, is mostly due to the general development of the petrochemical industry and chemical industry and the work carried out by the technical staff of the works and the research institutes. The future development is founded on the experience gained during this period. The trend is to adopt new polymers and technologies, to use automated equipment and increase the capacities of production.

SYRIAN ARAB REPUBLIC by F. El Deiri

The plastics industry in S.A.R. started in 1956 with the processing fabrication of

1. PVC water pipes
2. Polyethylene films
3. PVC footwear

The raw materials are imported from Lebanon as granulate.

The processing methods used for producing water pipes and films are the extrusion method and for the footwear the injection moulding method.

The Syrian Government has the intention of setting up a PVC production plant in the years to come 1971/1972 and would like to buy machines for the production of synthetic leather. In this respect, we shall be grateful if UNIDO could give us technical assistance.

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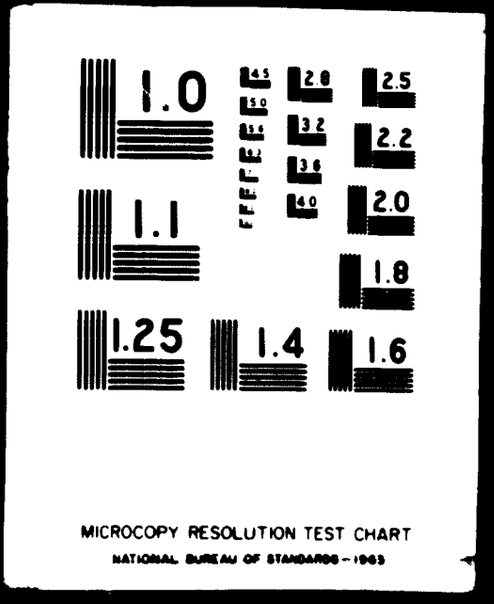
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<u>**THAILAND**</u> by P. Oonsombat

At present, the plastic industry is one of the most important industries in Thailand. All resin raw materials are imported. Most of the plastic industries have been producing consumer articles for daily uses. Only a small fraction of the total amount of resin raw material is used as raw material for other fields of industry. The plastic consumer products are very well known in the market of Thailand and the rate of consumption has a tendency to increase rapidly. Almost all raw materials are imported from Japan by these industries whereas only a small portion is from European and other countries.

<u>Present situation of plastic industry</u>

The plastic industry in Thailand may be said to have started in 1952 when the first factory was registered with the Ministry of Industry for processing plastics articles from imported resin and compound. Today, the total registered plastic plants are about 400 where most of the firms are small-scale industry employing up to ten people or less. Approximately as many as 25 per cent of the plants registered may no longer be in business. Even the growth of the plastic industry has been proceeding over the past 18 years, it was not developd into a stable and dynamic situation. The total employment is limited to some 3,000 to 3,500 people. Total investment in this industry has been estimated at around US$6 million. Primary production equipment is estimated at US$4.2 million at replacement value, while accessory machinery and equipment including dies, moulds, tools, etc. do not exceed US$6 million. Approximately forty of these plants are estimated to be significant in size with employment ranging up to 300 in the largest, they are engaged only in plastic article production. In addition, significant quantities of plastic materials are used as a component by plants producing end products as insulated wire and cables, pipes, [illegible]

There is no production of domestic articles as in the case with primary plastic industry. Consumption is supplied entirely by imports. The total market for plastic materials in Thailand is estimated at 50,000 metric tons (MT) per year. Imported non-cellulosic resin, moulding powder and compounds amount to 40,000 MT/year. Of this total amount, thermoplastic materials account for about 89 per cent. The principal thermoplastics used are polyethylene, polyvinyl chloride (PVC) and polystyrene. Consumption of urea formaldehyde resin, compounds and prepared industrial glues is also significant. A wide variety of consumer products are manufactured from plastic materials in Thailand and recently the industrial use of plastic materials has become important. At present, almost 89 per cent of this consumption is represented by the production of films & bags for packaging, toys, novelties, containers, trays, travel goods, upholstery material, footwear, rope, cord, pipe and hose.

Future consideration

Recently a few industrial enterprises have received permission for producing plastic resins for the supply of local plastic industries. The synthetic resins and compounds produced by these new factories in Thailand are estimated to reach a total of 135,000 MT (± 10%) by 1971. Polyethylene and PVC are estimated to continue to be the principal materials used and to account for about 63 per cent to 73 per cent of the total consumption at that time. This industry has the project to improve and to promote the technical know-how in plastic processing and to produce enough of the resin raw materials for exports.

Economic problems

Since there is no domestic crude oil or natural gas for resin or monomer production, Thailand's new private plant is planned to import crude oil for such purpose. There are also few refineries in the country but the wasted gases are not economical to be processed for plastics industries. This is the reason why the new factories which have received permission to produce plastic resins, will produce the plastic resins from the crude oil. This plant will promote the country's economy as it will be one of the large plants producing enough resin for local and over-sea consumption.

Conclusion:

At present the plastic industry in Thailand is not yet progressed to a stage

that it can play an important role in the economic development. It is required that the study and research in this field will be made available for the necessary development of suitable processes and techniques in order to assist these industries to produce better products and to apply plastic resins in other fields of industries and to look for the new material and process know-how. For this purpose, the establishment of a research institute with the programme to promote the plastic industry is under consideration.

TURKEY by R. Akdeniz

In Turkey there are two main sources of plastics used:

(a) locally produced

(b) imported.

The history of plastics manufacture in Turkey is only 7 years old. A group of engineers came together and built the petrochemical industry in Turkey in 1963. They succeeded in doing so and now we are producing low-density polyethylene at a 12,000 tons/year capacity and polyvinylchloride at a capacity of 26,000 tons/year. A 100 per cent expansion of each is planned, therefore next year the capacity will be doubled.

Among the imported plastics of the thermoplastic group there are polystyrene, polypropylene, polyamid 6 (Nylon), polyester. The plastics include phenolformaldehyde, melamine formaldehyde, urea formaldehyde, epoxy resins, polyesters and polyurethane.

Petkim-Petrokimya A.S. is the company which produces the above polyethylene and polyvinyl chloride. Polyethylene is produced under the licence of ICI by using high pressure method. The 99.85 per cent pure ethylene is compressed to 2,000 kg/cm^2 g. pressure by the aid of primary and secondary reciprocating compressors. The catalyst is added and the polymerisation takes place in a reactor. The unpolymerised gas is recycled, the polymerised product is sold under the name of PETILEN. The process is a continuous one. The masterbatch and compound are also manufactured in this company.

The process applied to PVC is batch process. The raw material for PVC is produced by Petkim-Petrokimya A.S. in the vinylchloride plant. The vinylchloride and the additives are mixed in autoclaves and are let for the polymerisation at 55-60° C and 8-12 kg/cm^{2}g. pressure. The product is sold under the name of PETVINIL.

Petkim-Petrokimya A.S. produces emulsion, suspension type of PVC and the production of the co-polymers will be started soon.

All the above types of plastic are locally produced. In other words, polyethylene and PVC are extensively used in Turkey.

Turkey is an agricultural country. Parallel to agriculture, the industry

is also growing. Polyethylene is used to cover the plants. It also finds its application as hoses in agriculture. Further, it is used in cable insulation. Other fields of application for polyethylene in Turkey are kitchen ware, bottles for drug and perfumes, laboratory equipment, flexible pipes as well as for packaging purposes.

PVC

At present, the consumption of emulsion type PVC in Turkey is around 10,000 tons/year. The demand is increasing every year. Main fields of use of PVC are floor covering (vinilex), sprayed coating, book covering, bags, suitcases, artificial foam leather (skai).

The suspension PVC finds its uses in Turkey in the manufacture of hard materials such as pipes, profiles, plates, flanges, fitting elbows, toys etc. The non-rigid suspension PVC is used mainly for the manufacture of footwear, in flexible floor coverings (trade name Piket), film, hose, etc.

The imported plastics are used for many purposes in Turkey as they are normally used in any other country in Europe or in America.

The machines used for the manufacture of the above articles are of many types, each company uses different machines. Most of the machinery is made in Turkey, its capacity is not very high and we can classify the machines as follows:

1. Extruder
   (a) for tubular film
   (b) for pipe blow off
2. Injection moulding
3. Compression moulding
4. Heat sealing machine
5. Cumberland granulator
6. Calendering machine
7. Foaming etc.

The problems we have to face are as follows:

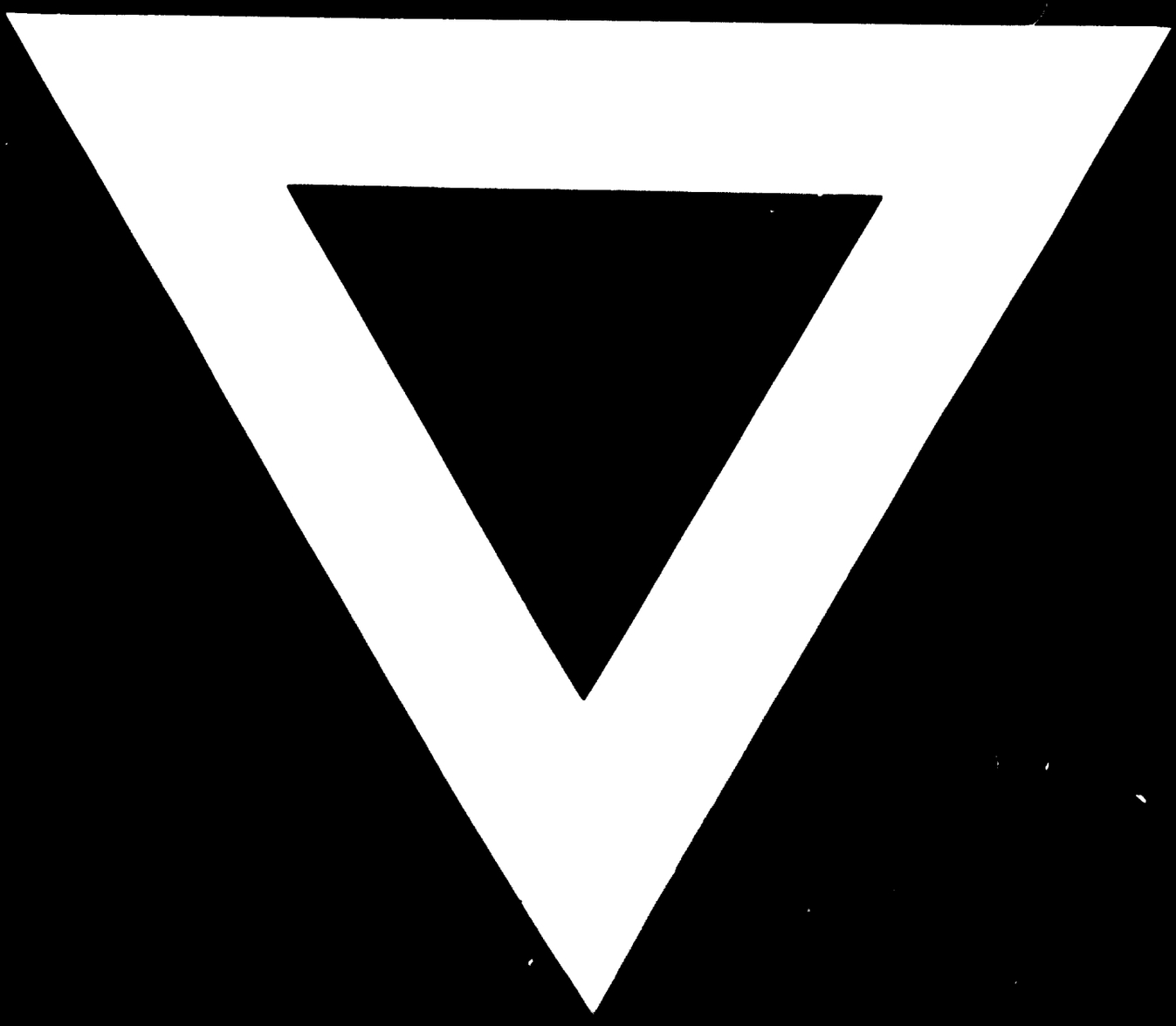
1. Turkey is preparing the standard of every article. For this reason a Turkish Standardization Institute has been established. Up to now, we do not have standards for the plastics materials. Therefore, the quality of the

goods on the market is based upon the experience of the people who are engaged in the plastic manufacture.

2. There exist more than 600 companies working with plastics. Among this number there are about 20 of a larger size which are well organized and use the normal DIN or ASTM standards in order to get exact material. The remainance is not yet able to handle well the problem. Therefore, Petkim-Petrokimya A.S. - a large size company - is now trying to give more technical information on plastics and their treatment and handling e.g. moulding, extrusion, calendering etc.

3. Quality control is almost non-existent. There are not enough plastic testing laboratories to answer the demands.

4. As stated before, machinery for plastic processing is locally produced. These machines do not have high capacities therefore it is not possible to produce big articles.



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