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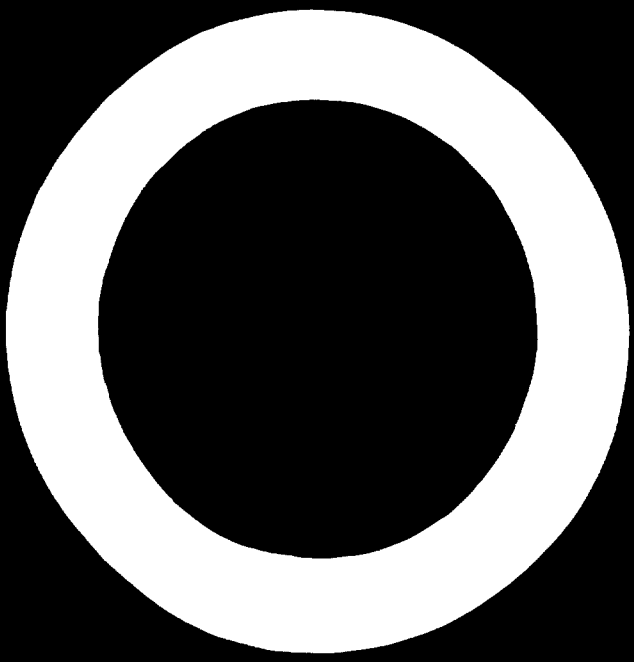
UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
Vienna International Centre, P.O. Box 300, 1400 Vienna, Austria
Tel: (+43-1) 26026-0 · www.unido.org · unido@unido.org

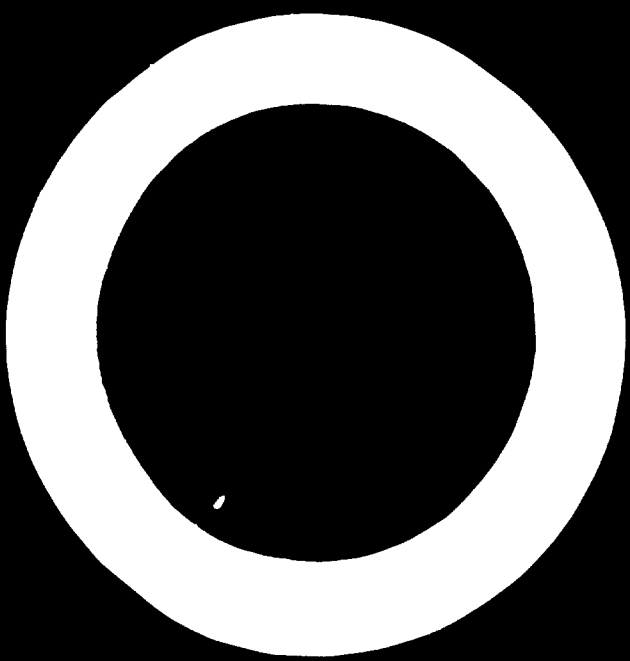
PETROCHEMICAL INDUSTRY SERIES

MONOGRAPH No. 1

THE BRAZILIAN SYNTHETIC POLYMER INDUSTRY

UNITED NATIONS





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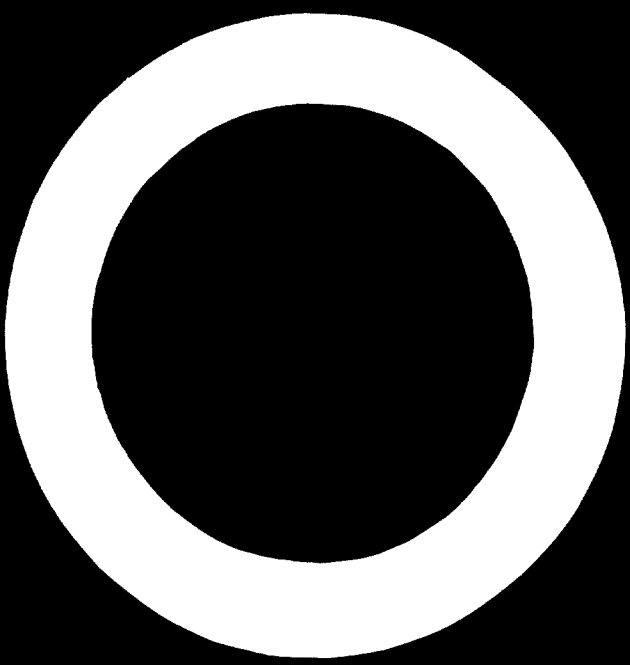

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION, VIENNA

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UNITED NATIONS

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FOREWORD

This publication is the first of a series of monographs in the Petrochemical Industry Series to be published by the United Nations Industrial Development Organization. The titles of other studies in this series will be found on the back cover of this publication.

The world petrochemical industry has shown a high rate of growth during the last ten years. The industry supplies intermediate products for a number of other industries and provides substitutes for traditional materials such as steel, lumber, packaging materials, natural fibres, natural rubber and soap. It is considered to be one of the most strategic sectors of industrial development because most of its products go on to other producing sectors.

This series of monographs is designed to assist the developing countries in dealing with technical and economic problems related to the establishment and development of facilities for the manufacture of petrochemicals and consumer products. The present series is concerned with basic and intermediate petrochemicals and end products, such as plastics, synthetic rubbers and synthetic fibres. Nitrogenous fertilizers[1] and textile production based on synthetic fibres are excluded from the series.

The purpose of this study is to describe the present status of the Brazilian polymer industry. Interviews were carried out with the producers of synthetic polymers and also with the manufacturers of raw materials for these plants. In certain cases, fabricators were also interviewed, but, owing to the limited scope of the study, the author relied primarily on information supplied by the monomer, intermediate and polymer producers in estimating the distribution of various markets. Some of the sections on market distribution are based on recent and more detailed market surveys, altered only where it was necessary to update some of the figures.

The present report was prepared by Mr. Albert V. H. Hahn serving as consultant to UNIDO. The views and opinions expressed in this publication are those of the consultant and do not necessarily reflect the views of the secretariat of UNIDO.

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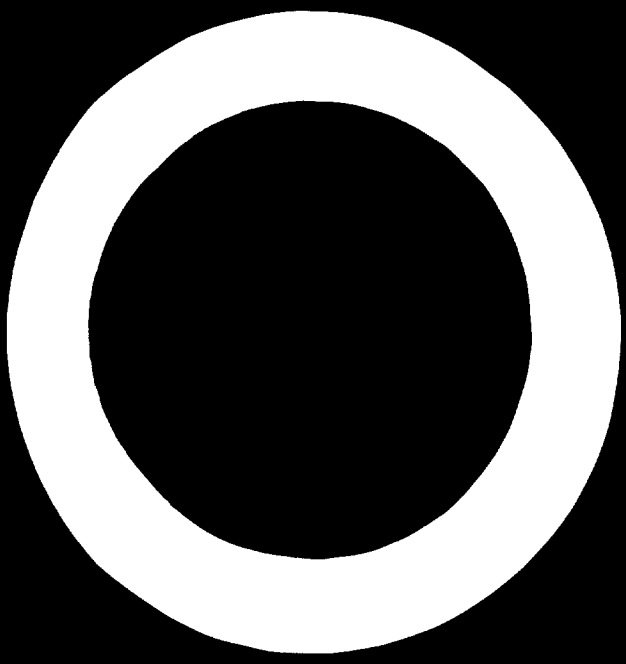
[1] See the Fertilizer Industry Series published by the United Nations Industrial Development Organization (ID/SER.F, Nos. 1, 2, 3, 4 and 5).



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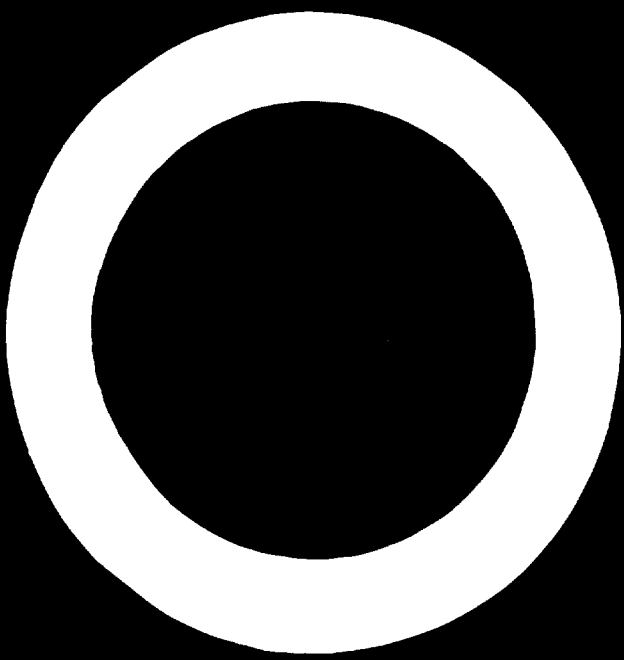


RAW MATERIALS

Olefins

Ethylene

At the present time only Petrobrás produces petroleum-derived ethylene. This amount (30 tons per day) is obtained by recovering the amount present in the off-gases from the thermal cracker at Cubatão, São Paulo. Petrobrás plans to increase this output to 80 tons per day by cracking the ethane and propane contained in these same gases.

All other present ethylene facilities are based on dehydration of ethyl alcohol which is derived from molasses. Present ethylene producers and their output are as follows:

Producer	*Location*	*Output (million lb/year)*	*Raw material*	*Use*
Union Carbide	Cubatão, S. P.	27.0	Ethanol	Low-density polyethylene
Cia. Brasileira de Estireno (Koppers)	Cubatão, S. P.	5.2	Ethanol	Styrene
Ind. Químicas Eletro Cloro (Solvay)	Ribeirão Pires, S. P.	12.0	Ethanol	High-density polyethylene
Petrobrás	Cubatão, S. P.	22.0	Refinery off-gases	Merchant

Two major projects for the production of ethylene have been announced. It is impossible to assert thus far which of the two is more advanced, but both have been approved by the GEIQUIM (Executive Agency for the Chemical Industry). The capacities of the two projects are as shown below.

Project	*Location*	*Capacity (million lb/year)*	*Process*	*Raw material*
Cia. Petroquímica União	Capuava, S. P.	400.0	Tubular furnaces	Naphtha
Union Carbide	Cubatao, S. P.	220.0	Wulff	Naphtha

The Petroquímica União project has a 40 per cent participation by Phillips Petroleum, and is based on the 30,000-barrels-per-day refinery of Refinaria e Exploracão de Petróleo União at Capuava. This will be expanded to 50,000 barrels and the entire increase will be used as petrochemical feedstock.

The proposed plant of Union Carbide, which is not connected to any refinery, will employ the Wulff process, which offers the advantage of producing no pyrolysis gasoline. It has not been made clear what is to be done with the 60 million pounds per year of acetylene that will be produced along with the ethylene, assuming the plant is run for maximum ethylene.

Propylene

Only the Petrobrás plant at Cubatão produces propylene. They sell 8 million pounds per year of a 95 per cent product to Rhodia Indústrias Químicas e Texteis S.A. for transformation into acetone at Campinas, São Paulo.

The Phillips-União project will produce approximately 200 million pounds per year of propylene, most of which will, at least initially, find its way back into the LPG (liquid petroleum gas) pool since Brazil is a net importer.

Acetylene

Although chemically not an olefin, acetylene competes with ethylene in most of its applications and for this reason is included in this section.

All of the acetylene produced in Brazil is derived from calcium carbide. The largest producers are the two PVC (polyvinyl chloride) manufacturers, Eletro Cloro and Matarazzo, followed by Rhodia. Eletro Cloro brings in carbide from Santos Dumont, Minas Gerais, where it has its own source of power and its own limestone quarry. Matarazzo makes carbide on the outskirts of São Paulo alongside the PVC plant, and acquires its power from the main concessionaire, São Paulo Light, at a much higher cost than Eletro Cloro has to pay. Rhodia buys most of its requirements from a small producer in Bragança Paulista, São Paulo. A fourth carbide-acetylene producer is White Martins S.A., a subsidiary of Union Carbide, which produces acetylene for metal-cutting only, and sells carbide to the metal trade and also partially to Rhodia. The production of acetylene is as follows:

Producer	*Location*	*Output (million lb/year)*	*Use*	*Source of carbide*
White Martins	Several	4.5 (est.)	Merchant	Barra Mansa, R. J.
Eletro Cloro	Ribeirão Pires, S. P.	22.0	Vinyl chloride	Santos Dumont, M. G.
Matarazzo	São Caetano, S. P.	11.5	Vinyl chloride	São Caetano, S. P.
Rhodia	Campinas, S. P.	2.5	Vinyl acetylene	Bragança, S. P.

There are two butadiene producers in Brazil. COPERBO Companhia Pernambucana de Borracha Sintética in Recife, Pernambuco, uses alcohol as a raw material and has a capacity of 60 million pounds per year. Petrobrás, whose plant at Duque de Caxias, Rio de Janeiro just went on stream, has a similar capacity and employs the Houdry butane-dehydrogenation process. A summary of the butadiene supply situation is presented below:

Producer	*Location*	*Output (million lb/year)*	*Raw Material*	*Use*
COPERBO	Recife, Pe.	60.0	Alcohol	Polybutadiene
Petrobrás	Caxias, R. J.	60.0	Butane	GRS (general-purpose rubber-styrene)

The C_4 stream from the Petroquímica União naphtha cracker is expected to produce 26,000 tons per year of butadiene at full capacity.

Aromatics

Benzene

Domestic production of benzene from coal is approximately 10,000 tons per year. The major producers are:

Producer	*Location*	*Output (tons/year)*
Cia. Siderúrgica Nacional	Volta Redonda, R. J.	6,000
Cia. Siderúrgica Paulista	Piaçaguera, S. P.	2,000
Usinas Siderúrgicas de Minas Gerais	Ipatinga, M. G.	2,000

There are as yet no producers of aromatics from petroleum, but there are projects planned. Petrobrás is installing a catalytic reformer at Cubatão which will feed a Udex Unit; and both proposed ethylene plants mentioned above will extract aromatics from their liquid pyrolysis products. Capacities of these various projects will be as follows:

Producer	*Capacity (tons/year)*
Petrobrás	18,000
Petroquímica União	58,000
Union Carbide	28,000

Xylenes

The Petroquímica União project is the only one of the three aromatic projects to foresee a xylene separation unit. This will produce a maximum of 30,000 tons per year of *o*-xylene plus *p*-xylene, the exact balance between the two being determined by the incentive to isomerize *m*-xylene into *o*-xylene and *p*-xylene, or even, as is the case at present, to transform *o*-xylene into *p*-xylene by isomerization.

It should be pointed out that no use for pure xylene isomers exists at present, although several projects for the utilization of the isomer in its pure state are under consideration.

Synthesis gas

There is no petrochemical production in Brazil based on natural gas. The minimal production of synthesis gas derivatives that exists is based on the refinery of gases or liquid feedstocks.

The companies in Brazil which generate synthesis gas at present or will do so shortly are:

Company	*Location*	*Raw material*	*Process*	*Product*
(present)				
Alba	Cubatão, S. P.	Fuel oil	Partial oxidation	Methanol
Petrobrás	Cubatão, S. P.	Refinery	Partial oxidation	Ammonia
(future)				
Alba	Cubatão, S. P.	Naphtha	Steam reforming	Methanol
Petrobrás	Camaçari, Ba.	Natural gas	Steam reforming	Ammonia
Rhodia	Campinas, S. P.	Naphtha	Steam reforming	Ammonia
Manguinhos	Rio de Janeiro, G. b.	Refinery off-gases	Steam reforming	Methanol
Ultrafertil	Cubatão, S. P.	Naphtha	Steam reforming	Ammonia

Thus far there is no steam reformer operating in Brazil.

Ammonia

The only producer of ammonia in Brazil is Petrobrás at Cubatão, São Paulo, with a capacity of 100 tons per day. Two of the many projects that have been announced appear serious: Rhodia (40 tons per day) and Ultrafertil (600 tons per day). Rhodia plans to use ammonia primarily for making adiponitrille; some ammonia will also be sold in bottles. Ultrafertil is basically a fertilizer project.

Methanol

Alba (30 tons per day) is the only methanol producer at present. It expects to start work on a 135 tons per day capacity plant shortly and close down the partial-oxidation unit when the new plant is completed. Manguinhos is building a 60 tons per day capacity plant extracting methanol from off-gases from their refinery. Small amounts of methanol find their way onto the market as a by-product of polyester fibre production.

Ethyl alcohol

Under the conditions of the Brazilian economy, 95 per cent pure ethanol can properly be considered a raw material and not an intermediate.

Brazil produces 600 million litres of alcohol annually, a substantial part of which is used as a chemical feedstock. The following companies use alcohol as a chemical feedstock:

Consumer	*Location*	*Present annual consumption (in millions of litres)*	*Product*
Rhodia	Campinas, S. P.	30	Acetaldehyde
Fongra (Hoechst)	Suzano, S. P.	15	Acetaldehyde
COPERBO	Recife, Pe.	25	Butadiene
Union Carbide	Cubatão, S. P.	25	Ethylene
Koppers	Cubatão, S. P.	4	Ethylene
Eletro Cloro (Solvay)	Ribeirão Pires, S. P.	12	Ethylene
	Total	111	

Elekeiroz is building a 2-ethylhexanol plant at Paulista, Pernambuco, which at full capacity will consume 15 million litres per year. COPERBO, it should be pointed out, is running at 25 per cent of capacity. Thus, at full capacity, the chemical industry could consume one third of the entire alcohol output.

The price of alcohol, however, has been rising rapidly, owing partially to the existence of a ready alternate market for exporting molasses. The years of ethanol's use as a chemical feedstock are numbered, as has been the case elsewhere in the world.

MONOMERS AND INTERMEDIATES

Styrene

Companhia Brasileira de Estireno, with a 16,000 tons per year capacity plant in Cubatão, is the only producer of styrene monomer. This plant is being expanded to 32,000 tons per year, with start-up scheduled for 1969.

Petrobras is a large importer of styrene for their SBR (styrene-butadiene rubber) plant near Duque de Caxias, Rio de Janeiro.

The demand for styrene can be categorized as follows:

End use	*Consumption (tons/year)*
SBR	12,000
Polystyrene	14,400
Styrene foam	900
Polyesters	900
Total	28,200

Vinyl chloride

There are two vinyl chloride monomer producers:

Producer	*Location*	*Output (tons/year)*
Matarazzo	São Caetano, S. P.	24,000
Elclor	Ribeirão Pires, S. P.	12,000

Both are fully integrated and start with captive acetylene. Elclor produces calcium carbide in Santos Dumont, Minas Gerais, and Matarazzo in São Paulo. The chlorine plants are located in the cities indicated above. The present production is 32,000 tons per year, all of which is polymerized by these two companies; there are no independent PVC producers.

There is a project for a 120,000 tons per year vinyl chloride monomer plant in the greater São Paulo area to be based on ethylene from the Petroquímica União naphth cracker. The two present producers would close down their present units and participate in the new plant.

Vinyl acetate

Rhodia is the only producer of vinyl acetate. The 5,000 tons per year capacity unit is located at Campinas, São Paulo. It produces its own acetic acid, and generates acetylene from carbide, which is bought mainly from an independent plant located at Bragança, São Paulo, which is said to have been sold recently to the Air Reduction Company.

The current market for vinyl acetate is approximately 5,000 tons per year, of which Rhodia itself uses 25 per cent. The rest is sold to numerous coating or merchant emulsion manufacturers. Approximately 5 per cent of the total is used with vinyl chloride for copolymers.

Hoechst (Fongra) is considering building a plant based on ethylene using the Bayer process disclosed at the Seventh World Petroleum Congress.

Phenol

The only producer of phenol is Quimbrasil with a 7,000 tons per year capacity sulphonation plant at São Caetano, São Paulo. Apart from sporadic purchases by Rhodia for use in converting phenol to cyclohexanol, the only market for phenol is the production of phenolic resins. The consumers of phenol are listed below:

Consumer	*Consumption (tons/year)*
Alba	2,160
Resana	600
Formiplac	720
Formica	420
Plásticos do Brasil	480
Madeirit	180
Plastiresina	420
Resinbra	240
General Electric	300
Ambalit	180
Marco	360
Perstorp	240
Others	240
Total	6,540

Rhodia is considering basing its nylon 6/6 production on phenol and building a large plant (probably close to 50,000 tons per year) based on cumene.

Urea

There is no production of urea in Brazil. Petrobrás has signed a contract with Toyo Koatsu for a 50,000 tons per year capacity plant, but the start-up date is still indefinite.

Formaldehyde

There are five formaldehyde plants in Brazil:

Producer	*Location*	*Capacity (37 per cent basis) (tons/year)*
Alba	Cubatão, S. P.	20,000
Alba	Curitiba, Pa.	10,000
Eletroquímica Rio Cotia	Osasco, S. P.	6,000
Resimpla	Guaiba, R. G. S.	5,000
Plásticos do Brasil	São Paulo, S. P.	5,000

Several other plants are under consideration, the most serious project being a 5,000 tons per year capacity plant that Alba plans to build in Recife, Pernambuco.

The market for formaldehyde is currently approximately 38,000 tons per year, distributed as follows:

Applications	*Total market (per cent)*
Urea-formaldehyde resins (including textile treatment)	71
Phenol-formaldehyde resins (including resorcinol-formaldehyde)	29

No formaldehyde is used as a chemical intermediate.

Methyl methacrylate

There is no local production of methyl methacrylate, but a project exists for a 5,000 tons per year capacity plant in Aratú, Bahia. It is to be an integrated project

with captive HCN (hydrogen cyanide), acetone and sulphuric acid production. Raw materials will be ammonia, natural gas, isopropanol and sulphur. Sponsor of the project is Paskin S.A., a producer of acrylic sheet. The present market for methyl methacrylate is as follows:

Applications	*Consumption (tons/year)*
Acrylic sheet	1,600
Acrylic emulsions	
surface coatings	250
leather and textiles	100
Moulding powders (including dental uses)	50
Total	2,000

Phthalic anhydride

There are two producers of phthalic anhydride in Brazil:

Producer	*Location*	*Raw material*	*Output (tons/year)*
Vulcan	Suzano, S. P.	Naphthalene	10,000
Plasbaté	Taubaté, S. P.	Naphthalene	1,500

A 5,000 tons per year capacity plant is under construction in Camaçarí, Bahia. Sponsors of the project are CIQUINE (Cia. de Indústrias Químicas do Nordeste). The plant is to be based on the use of *o*-xylene and was engineered by Chemibau.

The present market for phthalic anhydride is approximately 7,000 tons per year, distributed as follows:

Applications	*Consumption (tons/year)*
Plasticizers	4,000
Alkyd resins	2,500
Polyesters	500
Total	7,000

Maleic anhydride

There is very little production of maleic anhydride in Brazil. Elekeiroz in Jundiaí, São Paulo produces 250 tons per year using the Union Chimique Belge process.

The total market for maleic anhydride is approximately 500 tons per year, most of which goes into polyester resins. Small amounts go into plasticizers (dibutyl maleate) and surface-active agents of the sulphosuccinate type, which are made by Imbra in Diadema, São Paulo.

Nylon intermediates

Rhodia is presently producing all the intermediates for nylon 6/6 at their Campinas, São Paulo complex. The raw material used is imported cyclohexanol.

With the exception of small amounts of adipic acid, these intermediates are not sold on the market. Current nylon 6/6 production is approximately 12,000 tons per year, expressed as N-salt, of which 99 per cent goes into fibres and the rest into resins. There is local production of caprolactam.

Polyfunctional alcohols

There is no local production of olefin oxides; therefore, ethylene and propylene glycols are not manufactured. The producers of polyester fibres and resins must rely on imports.

All of the glycerine produced in Brazil is natural. Lever (Valinhos, São Paulo) and Matarazzo (São Paulo) are the largest soap manufacturers, but there are numerous small soap makers and fat splitters who account for a large part of the market. Approximately 1,800 tons per year of glycerine are used by the alkyd resin industry. There is no local production of pentaerythritol or other polyfunctional alcohols.

Cellulose acetate

Rhodia is a completely integrated producer of cellulose acetate, starting with cotton linters and ethyl alcohol. Present production is approximately 10,000 tons per year, distributed as follows:

Applications	*Consumption (tons/year)*
Fibres	6,000
Cigarette filters	3,400
Resins (moulding, extrusion)	600
Total	10,000

Other monomers and intermediates

It can be assumed that all other monomers and intermediates mentioned or implied in the rest of this study are imported rather than produced in Brazil.

POLYMERS

Plastics

Low-density polyethylene

Union Carbide, with a 19,500 tons per year capacity plant at Cubatão, São Paulo, is the only producer of low-density polyethylene. A project to expand the capacity to 62,500 tons per year has been authorized and a portion of the additional low-density polyethylene is intended for export to other parts of South America.

The present demand is approximately 15,000 tons per year, of which 4,000 tons per year is being met by imports as a result of the high prices charged by Union Carbide. This demand can be described as follows:

End use	*Consumption (tons/year)*
Extrusion	4,000
Extrusion coating	2,500
Injection moulding	4,500
Blow moulding	2,300
Cable covering	1,500
Wax fortification Monofilament	200
Total	15,000

Film is the main extrusion product and is used chiefly for packaging. Pipe is of secondary importance. Extrusion coating is applied to paper, aluminium and cellophane, in that order. Household products, flexible packaging and toys are the main outlets for injection moulding. Blow moulding is the fastest growing application of all. In many of these applications, converters utilize mixtures of low- and high-density polyethylene.

High-density polyethylene

The only plant for high-density polyethylene in Brazil is Eletro Cloro (Solvay) at Ribeirão Pires, São Paulo. The capacity of this plant is 5,000 to 5,500 tons per

year, the lower end of the range applying to the production of low-melting-index polymers. An expansion to 7,500 tons per year and later to 10,000 tons per year has been authorized.

The present market for high-density polyethylene is approximately 4,800 tons per year:

Application	*Consumption (tons/year)*	
Injection moulding		
household products	1,600	
containers	900	
others	1,000	
Total		3,500
Monofilament		600
Blow moulding		500
Film, sheet etc.		200
	Total	4,800

Blow moulding is reportedly the process showing the fastest growth. This coincides with the opinion of Union Carbide that low-density polyethylene is not a suitable raw material for blow moulding. This also seems to verify the observation that most processes use mixtures of low-density and high-density polyethylene.

Polystyrene

There are three producers of polystyrene in Brazil:

Producer	*Location*	*Output (tons/year)*
Idrongal (BASF)	Guaratinguetá, S. P.	900
Bakol	São Caetano, S. P.	5,400
Plásticos Koppers	Cubatão, S. P.	9,000

Idrongal produces expanded polystyrene beads for making foam; the other manufacturers make conventional polystyrene.

The demand for polystyrene resins is approximately 14,000 tons per year. High-impact resins account for 45 per cent of the market and their share is growing at the expense of general-purpose materials. The polystyrene market is as follows:

Application	*Consumption (tons/year)*
High-impact	
extrusion followed by vacuum forming	3,500
injection moulding	2,800
General-purpose	
injection moulding	7,700

Vacuum forming is primarily used for making refrigerator doors and shelves. Another less important application is lighting fixtures. Among the high-impact injection applications are spools for sewing thread, bobbins for the textile industry, washing machine agitators (some of these are made of phenolics, however), parts for the automobile industry, and radio and telephone set housings.

Applications for general-purpose injection moulded products include toys, packaging (margarine containers alone account for 1,000 tons per year), combs (500 tons per year, made primarily of reprocessed material), closures and so on.

As elsewhere, polystyrene is the preferred plastic in Brazil for numerous rigid injection moulded objects. Of the total demand for polystyrene, 3,000 tons per year of the product are crystal clear and the rest are coloured.

Unsaturated polyesters

The total production of unsaturated polyesters is approximately 1,700 tons per year, distributed among producers as follows:

Producer	*Output (tons/year)*
Alba	240
Propol	900
Resana	560
Total	1,700

Of this total, 53 per cent goes into reinforced polyester applications, which are distributed as follows:

Application	*Consumption (tons/year)*
Civil construction roofing and shower doors	350
Automobile bodies	120
Boat hulls	170
Corrosion-resistant process equipment	110
Furniture	120
Others	30
Total	900

The remaining 800 tons per year are used without glass fibre reinforcement primarily for buttons and automobile putty.

Reinforced polyester is expensive in Brazil because the specially treated glass fibres required for this application are imported. There are rumours, however, that they may soon be manufactured in Brazil.

Polyvinyl chloride

The current market for PVC is 32,000 tons per year. Matarazzo (Geon) has 37 per cent of the market and Elclor (Solvay) claims the remaining 63 per cent. The main difference between the markets served by these two companies is that Elclor has a virtual monopoly of the calendering business in view of its close connections with Vulcan and Plavinil, the two largest producers of vinyl cloth (supported and unsupported). Plavinil is controlled by Elclor, while Vulcan now belongs to Grace. Elclor also supplies most of the flooring market, since Vulcan is also the largest producer of PVC flooring materials.

The major producer of rigid tubing is Cia. Hansen Industrial in Joinville, Santa Catarina. Another major producer is Plastar, also recently acquired by Grace. Pirelli in Santo André, São Paulo and Ficap in Rio de Janeiro, Guanabara, are the two largest producers of coated cables. The main producer of injection moulded shoes is Alpargatas in São José dos Campos, São Paulo. There are several producers of knife-coated textiles, but the most important is Kalson in Rio de Janeiro, which makes vinyl leather for upholstery and luggage.

The market for polyvinyl chloride is distributed as follows:

Applications		*Consumption (tons/year)*
Calendering		10,600
Rigid tubing		6,700
Injection moulding		
rigid (fittings)	600	
plasticized (shoes etc.)	2,200	
Total		2,800
Wire and cable coating		2,900
General-purpose extrusion (refrigerator gaskets etc.)		2,000
Phonograph records		1,500
Vinyl-asbestos flooring		500
Textile coating		1,700
All other uses		3,300
	Total	32,000

Cellulose acetate

The market for cellulose acetate moulding powders is approximately 900 tons per year, consisting of 650 tons per year of acetate and 250 tons per year of plasticizers and additives. Rhodia is the only producer of cellulose acetate.

The largest single use of cellulose acetate is film, consuming 300 tons per year. Numerous injection moulding outlets (combs, ball-point pens etc.) make up the rest of the demand.

Methyl methacrylate

Approximately 1,600 tons per year of acrylic sheet are consumed in Brazil from imported monomer. Paskin, Naufal and Plasticos do Brasil are the only producers.

Polyamides

Rhodia produces approximately 120 tons per year of nylon 6/6 moulding powders. Its main customers are the injection moulders (gears etc.) and bristle manufacturers. Rhodia also makes some nylon 6/10 resins from sebacic acid made by Resana.

Irmãoe Mazzaferro, under licence from the Swiss company, produces 120 tons per year of "Crilon" moulding powders from imported caprolactam. It is used captively for making bristles and fishing nets.

Rilsan sells 60 tons per year of their nylon 11 polymer to the plastics sector. This company is on the verge of expansion into nylon 11 film for meat packing exports. The assets of the Rilsan company have been bought by the Klabin group, the largest pulp and paper producer in Brazil.

There are a considerable number of nylon resins imported, especially by Dupont ("Zytel"). The total market for all polyamides is approximately 450 tons per year.

Resins

Phenolic resins

The producers of phenolic resins in Brazil are listed below with their approximate output.

Producer	*Output (tons/year)*	*Main uses*
Alba	2,450	Merchant (general)
Formiplac	500	Laminates
Resana	700	Merchant (general)
Formica	800	Laminates
Plásticos do Brasil	550	Moulding powders, binding agents
Madeirit	250	Adhesives
Plastiresina	500	Moulding powders
Resimbra	250	Moulding powders
General Electric	350	Shell-moulding resins, moulding powders
Ambalit	200	Moulding powders, industrial laminates
Marco	400	Brake lining binders
Perstorp	300	Laminates
Others	250	
Total	7,500	

The demand for phenolic resins in Brazil is approximately 7,500 tons per year.

Applications	*Consumption (tons/year)*	
Moulding powders (resin content)		3,250
Laminates		
decorative	1,150	
industrial	400	
Total		1,550
Brake linings		720
Abrasive-wheel bonding		250
Shell-moulding resins		900
Plywood (exterior-grade)		250
Insulation binder		300
Others		280
Total		7,500

The main outlets for phenolic moulding powders are buttons and handles for household appliances, washing machine agitators, distributor caps and other automobile components, electrical parts and battery housings. Telephone sets, toys and closures are on the decline as outlets for phenolics, since consumers prefer coloured or less breakable products.

The various producers of phenolic moulding powders are listed below with their productions. The quantities given represent the total moulding powder produced, of which the resin itself represents approximately 45 per cent; the remainder is mainly sawdust.

Producer	*Output (tons/year)*
Plastiresina	1,200
Ambelit	500
Plásticos do Brasil	850
Resinbra	650
General Electric	600
All others	3,400

There are three producers of shell-moulding resins: Alba, General Electric and Resana. The shell-moulding process is used by a large number of foundries.

The following companies make phenolic laminates:

Producer	*Share of market (per cent)*	*End use*	
		Decorative	*Industrial*
Formiplac	50	x	x
Fórmica	28	x	–
Perstorp	16	x	x
Ambalit	4	–	x
Fanapla	2	–	x

Very little exterior-grade plywood is used in Brazil. Production totals 40,000 cubic metres per year, of which 90 per cent is used for concrete forms. This represents less than 5 per cent of the total Brazilian output. There are three producers of exterior-grade plywood:

Producer	*Location*	*Share of market (per cent)*
Madeirit	São Paulo	70
Wagner	Paraná	20
Getal	Rio Grande do Sul	10

Getal also produces a special exterior plywood primarily for use in naval construction; Madeirit and Wagner sell almost entirely to the construction industry.

There are five producers of brake linings in Brazil:

Producer	*Share of market (per cent)*
Plásticos Marco	40
Plásticos do Brasil	30
Ferodo (Turner-Newell)	20
Lonaflex	5
D. L. R. Plásticos do Brazil (Bendix)	5

Plásticos Marcos, Plásticos do Brasil and D.L.R. make their own resins; Ferodo and Lonaflex purchase resins from Alba and Resana.

The three producers of grinding wheels are Carborundum, Norton and Reboloe do Brasil. All three purchase their resins from Alba and Resana.

Amino resins

There are numerous producers of amino resins in Brazil. Alba (Borden) plays a major role in the market, controlling approximately 75 per cent of the merchant business.

The demand for urea-formaldehyde resins is currently 20,000 tons per year, distributed as follows:

End use	*Consumption (tons/year)*
Plywood	6,000
Furniture	1,400
Other adhesives	360
Floor polish	2,500
Moulding powders (resin content)	1,200
Particle-board	2,140
Textile treatment	5,500
Others	900
Total	20,000

The largest manufacturers of adhesives for plywood and furniture are Alba and Resana. Alba has formaldehyde and resin plants in Curitiba, Parana, in the heart of one of the richest timber regions in Brazil. This is an excellent position for this company considering its product. The two largest producers of adhesives, after Alba, are Coldemar and Ircec.

Alba also produces floor-polish resins. Its main competitor is Synteko in Rio Grande do Sul, an associate of Resimpla. Synteko is under licence from Kasko A. B. in Sweden.

Besides Alba, the largest producers of urea-formaldehyde moulding powders are Mapomel and Plásticos do Brasil. Sacra and Aliberti are less important.

The most dynamic sector of this market is the production of particle-board. The first two plants (Madequímica, an associate of Resimpla, and Placas Paraná) are less than two years old. With several large projects under way (Novopan in Bahia, Satipel in Rio Grande do Sul, and Alplan in São Paulo), the demand in this field may rise to ten times the present level within two or three years. This alone would double the total demand for urea-formaldehyde resins.

Between 50 per cent and 60 per cent of the low-molecular-weight resins used in textile treatment are made by the same companies that use them. The merchant producers are usually companies that specialize in textile chemicals; that indicates that it is a market-oriented product. The major suppliers are Brasitex, Ircec, Sandoz, Bayer and Idrongal (BASF), all of which show outputs of approximately 400 tons per year.

The demand for melamine-formaldehyde resins is 800 tons per year, of which all but 25 per cent are made by the three producers of decorative laminates. Goiana, the largest manufacturer of melamine dinnerware, imports its resin from American Cyanamid. The producers of melamine-formaldehyde resins include:

Producer	*Output (tons/year)*
Formiplac	300
Formica	180
Perstorp	120
Sacra	150
Others	50
Total	800

Alkyd resins

Over 75 per cent of all alkyd resins are made for captive use by the various paint manufacturers. Only four companies make alkyd resins for sale. They include the small paint manufacturers, as well as those making specialty resins, such as amino-resin modified alkyds for baking finishes etc. The production data on alkyd resins is as follows:

Merchant producers	*Output (tons/year)*
Resana	1,200
Propol	420
Poliquímica	240
Adrizyl	240
Total	2,100

The paint manufacturers producing alkyd resins are listed below. The output figures were not obtained directly, but were calculated from the respective phthalic anhydride purchases which were accurately determined.

Captive producers	*Output (tons/year)*
Ypiranga	2,520
Supercor	1,020
Polidura	420
Coral	840

(continued)

Captive producers	*Output (tons/year)*
Ideal	600
Adriano	600
American Marietta	480
Sherwin Williams	420
Montesano	300
Horst	200
Urania	200
International	200
Total	7,800

The prospects for alkyd coatings seem favourable. On the one hand, emulsion coatings are on the rise in Brazil as elsewhere in the world, but there is still a large section of the industrial coatings market that employs nitrocellulose lacquers. It is possible to replace these lacquers with modified alkyd resins.

Vinyl emulsions

The total demand for vinyl emulsions is 9,500 tons per year, which corresponds to 4,750 tons per year on a contained solids basis. Rhodia, the only monomer producer, follows a policy of selling monomer not only to captive emulsion producers, but also to merchant resin manufacturers who compete with Rhodia in the emulsion business.

Fongra and Alba are the two largest merchant producers of vinyl emulsions. Brasitex claims over 75 per cent of the textile emulsion business. The total demand for vinyl emulsions is:

End use	*Consumption (tons/year– total weight)*
Surface coatings	4,150
Adhesives	3,800
Textile treatment	950
Other uses	600
Total	9,500

There is also a small production of solid vinyl acetate homopolymer, used mainly as a base for chewing gum.

Acrylic emulsions

A total of 400 tons per year of acrylates and methacrylates goes into emulsions of various types. It is difficult to separate acrylate-vinyl acetate copolymers from straight acrylic emulsion. The former, used for interior surface coatings, are known to have better properties than straight vinyl emulsions and are being manufactured by such firms as I.Q.T. (Indústrias Químicas Taubaté) and Fongra. The largest producer of acrylic emulsions, used mainly in the leather industry, is Filibra (Rohm & Haas).

Elastomers

The approximate consumption of all new elastomers in Brazil is:

Types of elastomers	*Consumption (tons/year)*
Natural rubber	
imported	21,600
domestic	9,700
Synthetic rubber—GRS	
domestic	35,000
imported	1,700
Polybutadiene	
domestic	8,400
Butylrubber	
imported	2,800
Styrene-butadiene latices	600
Other elastomers	600
Total	80,400

The production of natural rubber has remained constant at 22,000 tons per year for many years. Over 90 per cent of this is extracted from the jungle in the Amazon valley. There has, however, been a great surge of hevea planting in the region around Ilheus (Bahia), and it is expected that by 1975, the amount of plantation rubber available will be equal to that of wild rubber.

There are two synthetic rubber plants in Brazil:

Producer	*Location*	*Production*	*Output (tons/year)*
COPERBO	Recife, Pe.	Polybutadiene	25,000
Petrobrás	Caxias, R. J.	GRS	40,000

The Petrobrás plant uses technology supplied jointly by Firestone and Goodyear. Butadiene is being produced from butane (Houdry process) obtained from the nearby Duque de Caxias refinery. Styrene is still imported, as was butadiene until a few months ago.

The COPERBO plant uses the Firestone polybutadiene process, which employs an alkyl lithium catalyst. Butadiene is obtained from alcohol in a second-hand plant imported from the United States of America, which was last in operation in that country during the Korean conflict. At the time of purchase, the plant belonged to Rohm & Haas; operating know-how was supplied by Union Carbide. Technically the plant is a success, but demand is well below the original predictions and the maintenance costs are high. Continued prospects for the plant are not very favourable, since alcohol prices continue to rise under pressure from the increasing demand for molasses as feed for cattle.

The demand for GRS and polybutadiene can be broken down as follows:

Product	*End use (per cent)*	
	Tires	*Mechanical goods*
GRS	72	28
Polybutadiene	92	8

This breakdown reflects the fact that COPERBO has not been able to support the kind of staff required to introduce a new elastomer into the less-concentrated mechanical goods industry.

Phillips Petroleum has announced its intention to use the butadiene contained in the C_4 stream from their proposed naphtha cracker to make "Solprene", a polybutadiene elastomer obtained by polymerization in the C_4 stream itself, that is, without the need for extraction.

Foams

The relative importance of the three types of foam made in Brazil can be seen from the figures of total production:

Type	*Output (tons/year)*
Rubber	750
Polyurethanes	4,100
Polystyrene	900
Total	5,750

Rubber foams

Rubber foam, used in bedding, furniture and garments, is on the decline in the face of a rising demand for polyurethanes. The largest manufacturers are Trorion and Irmãos Lantieri.

Polystyrene foams

Expandable polystyrene is made by Idrongal (BASF) and is foamed by several fabricators, of which the most important are:

Fabricator	*Location*
Conterma	São Paulo
Isopor	São Paulo
M. Hamers	Guanabara
Madef	Rio Grande do Sul
Isonor	Pernambuco

Polyurethane foams

There are five manufacturers of polyurethane foams in Brazil with a total output of 4,100 tons per year. However, this figure is expected to rise; at the same time, the demand for rubber latex foam will decrease.

The raw materials for urethanes are still imported. Bayer is the main supplier of isocyanates. Polyethers are also imported since there is no production of propylene oxide. Some polyesters, however, are produced by Trorion for their own use from adipic acid and imported diethylene glycol.

The demand for polyurethanes can be analysed in several ways. The distribution according to the type of polyal is:

Type	*Consumption (tons/year)*
Polyether-based	3,350
Polyester-based	750
Total	4,100

Each of these two types of foam can be analysed further with respect to the manufacturer:

Manufacturer	*Share of market (per cent)*	
	Polyester	*Polyether*
Trorion	60	50
Vulcan	40	22
Piramide	–	25
Tufy Habib	–	2
Irmãos Lantieri	–	1

This breakdown allows an estimate of the total production of each manufacturer as follows:

Manufacturer	*Output (tons/year)*
Trorion	2,120
Vulcan	1,040
Piramide	840
Tufy Habib	70
Irmãos Lantieri	30
Total	4,100

All manufacturers employ slab-moulding techniques with the exception of Lantieri, which has specialized in form moulding. It is generally admitted that these five manufacturers operate at approximately 20 per cent of capacity.

Rigid and semi-rigid foams account for 5 per cent and 2 per cent respectively of the market, a fact which indicates that practically the entire output is in the form of flexible foam. The more expensive polyester foams are only used in applications where their better appearance is an advantage. The combined market for polyurethane foams is:

Applications	*Consumption (tons/year)*
Automobile industry	600
Furniture	1,300
Bedding	600
Textile lining	200
Industrial uses (vibration control)	80
Carpet underlay	130
Packaging	50
Novelties, toys, household products	1,140
Total	4,100

Synthetic fibres

The Brazilian synthetic fibre industry is in a state of agitation. For several years this industry has been dominated by one producer, Rhodia, a subsidiary of Rhône-Poulenc. Rhodia has become more integrated than any other producer. It produces viscose, acetate, nylon and polyester, and has a plant for spinning acrylics under construction. Rhodia has enjoyed its leading position. Recently a large number of new projects have invaded the industry, but this has happened just at the time when it is evident that the age of abnormally high profits in the synthetic fibre industry has come to an end. Price erosion has been so rapid that many of the projects submitted to the various Government authorities contain sales prices that might have been reasonable six months earlier, but are no longer realistic as a result of the invervening price collapse.

The production of synthetic fibres is presently as follows:

Producer	*Production (tons/year)*		
	Acrylics	*Polyester*	*Nylon*
Rhodia	–	6,600	13,200
Sudamtex	–	2,000	–
Matarazzo	–	100	1,200
Nailonsix	–	–	300
Others	400	–	–
Total	400	8,700	14,700

Acrylics

There is thus far no production of acrylic fibres in Brazil. The 400 tons per year referred to in the table above consist of imported tops that are spun and dyed *à façon* for DuPont and Bayer. Practically the entire output of acrylics goes into knitwear, with about 10 per cent of the total already being used in carpets on an experimental basis.

The only concrete project under way for the production of acrylic fibres in Brazil is that of Rhodosa (an affiliate of Rhodia), which is building a 1,500 tons per year capacity plant at São José dos Campos, São Paulo. Rhodosa plans to import the resins in the first stage, and to import acrylonitrile monomer in the second stage, which would include an expansion to 3,000 tons per year. There are no plans to produce the monomer.

Techint, an Italian company active mainly in the steel and contracting industries, plans to build a 4,000 tons per year capacity plant using technology developed by Sabrin, a Swiss company. The project is to be located in Bahia, and doubling the

plant to 8,000 tons per year in the second stage would be accompanied by the development of a monomer plant using propylene from the Mataripe refinery and ammonia from Camaçarí. This project is not very far advanced, although a pilot company has been established.

Polyester

Rhodia, the largest producer of polyester filament and cut fibres, has its plant in Santo André, São Paulo. It operates under licence from ICI (Imperial Chemical Industries).

Most of Rhodia's efforts have been directed towards polyester-worsted mixtures, which have been very successful almost to the point of displacing pure woollen materials. Rhodia uses a discontinuous process (that is, via chips) starting with imported dimethylterephthalate and ethylene glycol.

Sudamtex (an affiliate of United Merchants) makes a fabric called "Nycron", originally a mixture of nylon, polyester and viscose, but apparently no longer containing any nylon. Unlike Rhodia, Sudamtex is completely integrated, and the final products are finished textiles that are sold to the garment industry or to the public through wholesalers. Rhodia has also started polymerizing recently; the raw materials employed are a mixture of dimethylterephthalate and dimethylisophthalate, and ethylene glycol.

Matarazzo makes small quantities of polyester on an almost experimental basis and entirely for captive use. The nylon 6 plant is located in São José dos Campos. Rhodia has plans for a 2,000 tons per year capacity installation in northeast Brazil scheduled to go on stream in 1970. Safron, a company formed by a group of levantine bankers, intends to make 5,000 tons per year of polyester fibres in Bahia.

Polyamides (nylon 6/6, nylon 6, nylon 11)

The only producer of nylon 6/6 at present is Rhodia, with a current output of 1,100 tons per month at its plant in Santo André, São Paulo. The output varies considerably with the product being manufactured, and thinner gauges evidently means a smaller output. Rhodia makes its own raw materials at Campinas, São Paulo. The N-salt is transported from there to Santo André in tank trucks.

Of all the new nylon fibre projects under study, the only one involving nylon 6/6 is that of Celfibras (Celanese) at São Bernardo do Campo, São Paulo. The initial capacity will be 200 tons per month with an eventual expansion to 700 tons per month. The N-salt will presumably be imported.

Both the Matarazzo (São José dos Campos, São Paulo) and Nailonsix (São Paulo) plants make nylon 6. Matarazzo polymerizes imported caprolactam, whereas Nailonsix imports the resin itself.

There are several projects for nylon 6 under discussion and one is under construction. The Manela group is building a 120 tons per month capacity plant in Rio de Janeiro, Guanabara. The nylon 6 is primarily for use in their own garment factories (De Millus etc.). This plant should go on stream early next year. A firm that calls itself Celanese do Brazil, but has nothing whatever to do with Celanese itself, has had a project for spinning nylon 6 approved by SUDENE. The group has very solid international banking support, and the project may well succeed. The plant is to have a capacity of 90 tons per month and will be located in Bahia. Both Matarazzo and Nailonsix plan to expand the capacity of their plants to 200 tons per month.

There are two additional projects involving nylon 6 about which not much is known. A São Paulo group, connected to a texturizing plant, plans to manufacture 50 tons per month. Rilsan (see below) intends to convert its plant to spin both nylon 11 and nylon 6. Rilsan Brasileira, under licence from Organico (France), makes α-aminoundecylenic acid and its polymer (nylon 11) starting from castor oil. This firm has just been taken over by the Klabin group after having operated precariously for many years. Klabin is a large pulp and paper manufacturer and also has other interests. Since it is one of the most dynamic industrial groups in Brazil, it is felt in the trade that its new acquisition of Rilsan may mean that Rilsan will recover.

Two changes are to be introduced in the Rilsan plant. First, caprolactam will be spun in addition to nylon 11; alterations on the continuous polymerization section of the plant are under way. Second, a larger portion of the nylon 11 output will be devoted to non-fibre applications, including packaging film for meat (primarily for export, in paperboard containers already made by Klabin). The plant, located in Osasco, São Paulo, has a capacity of 120 tons per month. However, this capacity has never been reached. The output before a recent shutdown for major repairs and alterations was 60 tons per month.

Prices

The following are representative prices for various elastomers, fibres, plastics, resins and raw materials produced in Brazil:

	Current price (US cents/lb)
Elastomers	
SBR	23.5
Polybutadiene	31.0
Fibres	
Nylon 66	
30/10, 0 torsion, tubes	286.0
70/23, 0 torsion, tubes	221.0

(continued)

	Current price (US cents/lb)
Tire-cord	129.5
Polyester (3 d., semi-opaque)	122.2
Plastics and resins	
PVC	
natural	26.2
coloured	41.0
High-density polyethylene	
injection	45.4
extrusion	35.8
Low-density polyethylene	28.3
Polystyrene	
high-impact	30.8
general-purpose	27.9
Urea-formaldehyde moulding powders	35.5
Nylon 6 moulding powders	119.0
Phenol-formaldehyde moulding powders	18.6
Cellulose acetate:	
injection	69.0
extrusion	83.0
Vinyl acetate emulsions (5 per cent solids)	27.0
Raw materials	
Ethyl alcohol	3.7
Styrene monomer	17.7
Vinyl acetate monomer	16.8
Calcium carbide	5.9
Propylene	6.8
Benzene	5.1
Naphtha	1.13
Urea	5.3
Formaldehyde (37 per cent)	5.9
Phenol	21.8

Some of these raw material prices decline in the face of surging imports, but they seldom last long. Generally prices are 50 to 150 per cent higher than in the United States and even more in comparison with less protected markets.

Prospects for the Brazilian polymer industry

In 1966, the Brazilian Government made sectoral studies of the economy, including the industry of petrochemicals. A forecast of demand was made, and the investments necessary in order to meet the predictions were indicated.

These studies were based on the correlations published by the Economic Commission for Latin America (CEPAL) between *per capita* income and *per capita* consumption of various groups of end products, fibres, plastics, paints, detergents and elastomers. Data used were the predicted *per capita* income and population figures for 1976, as provided by the Ministry of Planning. The total potential demand for these groups of commodities was then broken down into individual chemicals and polymers, taking into account the relative position each particular one holds within the total market for the respective commodity in Japan, Europe and the United States. The results of this study, the estimated potential demand for polymers in Brazil in 1976, are presented below:

	Estimated demand in 1976 (tons)
Plastics	
Low-density polyethylene	98,500
Polyvinyl chloride	123,700
Polystyrene	68,900
High-density polyethylene	35,970
Polypropylene	21,900
Unsaturated polyesters	16,900
Polyurethanes	13,450
Methacrylates	10,200
ABS resins	9,800
Polyamides	2,510
Cellulose acetate	2,170
Polyacetals	1,480
Polytetrafluoroethylene	1,030
Polycarbonates	570
Resins	
Urea-formaldehyde	55,500
Phenol	30,050
Alkyds	24,700
Polyvinyl acetate	18,800
Petroleum resins	7,300

(continued)

	Estimated demand in 1976 (tons)
Epoxi resins	4,900
Melamine-formaldehyde	4,450
Silicones	1,480
Elastomers	
SBR	67,600
Stereospecific rubbers	49,600
Neoprene	9,180
Butyl rubber	3,550
Nitrile rubber	3,830
Others	1,240
Synthetic fibres	
Polyamides	49,500
Polyesters	49,500
Acrylics	6,700
Polypropylene	5,000

Investment requirements

The investment requirements to meet the entire demand for petrochemicals for the period of 1967–1976 in Brazil are presented below. They represent the capital needs for raising production in the various fields from present to projected levels. The following should be noted:

(a) All figures are on an ISBL (Inside Battery Limits) basis. Since many of these products will require fundamental units or complexes, a multiplication factor of 1.7 should be used in converting ISBL to total investments.

(b) These investment figures include provisions for manufacturing petrochemicals other than polymers: solvents, surface-active agents, pesticides, artificial fibres and so on. It would be impossible to separate out that part of investment in the intermediates applicable only to the polymer industry, but the author estimates that 70 per cent of the petrochemical output of a given economy goes into polymeric materials.

End products	*Investment requirements 1967 to 1976 (millions of US dollars)*
Elastomers	34.8
Fibres	118.9
Plastics	
polymerization	96.7
transformation	46.7
Paint and detergents	17.3
Intermediates and raw materials	216.0
Total	530.4

CONCLUSIONS

The comparatively low demand for plastics in Brazil is a consequence of several factors. First, plastics consumption *per capita* is quite elastic with respect to income. It must be remembered that Brazil still has a *per capita* income estimated at US$285. It is expected to reach US$402 by 1976. The income elasticity of demand for plastics is such that a rise in *per capita* income of 41 per cent is expected to produce a rise of 300 per cent in plastics consumption over the next ten years. Conversely, however, if the projected 5 to 6 per cent annual rise in GNP (gross national product) is not realized, a correspondingly large downward adjustment for these estimates will be necessary.

Second, the prices of all resins in Brazil are still much higher than they are in the developed countries.

Third, reinforcing the preceding remarks on the developed countries, plastics now replace primarily those products from which developing countries derive most of their export earnings. There are certain fundamental objections to the replacement of domestic raw materials by plastics of petrochemical origin, especially since two thirds of all requirements are being met by imports.

Fourth, in many of the applications that plastics have won away from other traditional raw materials in the developed countries, the deciding winning factor has been that lower costs of fabrication and installation offset the higher costs of petrochemical raw materials. In Brazil, labour costs are much lower, and the price ratio between plastics and metals is higher than in the developed countries. Therefore, there is often little economic incentive to switch to plastics.

All these factors, it is admitted, are not of a kind that allow any immediate corrective action. There are areas, however, in which the United Nations Industrial Development Organization could be of assistance to the Brazilian polymer industry. These possibilities are enumerated below:

(a) Brazilian companies have little incentive and even less resources to carry out research. In the plastics industry, research is usually simple from a chemical standpoint but complicated and also costly from a technological point of view. UNIDO could therefore be of considerable assistance in financing applied research which could be carried out either locally, or, probably at much lower cost, in already existing technical service centres, pilot plants, experimental production lines and so forth.

(b) Research in developed countries tends to be oriented towards the substitution of the natural resources being imported from less developed countries. UNIDO could help mitigate the effects of this substitution process by:

(i) Advising government agencies in the less developed countries of research being carried out in the industrialized part of the world that is directed towards the replacement of traditional commodities;

(ii) Attempting to make early technical and economic assessments of potential qualitative and quantitative effects on the market for these traditional commodities that such research might have if successful;

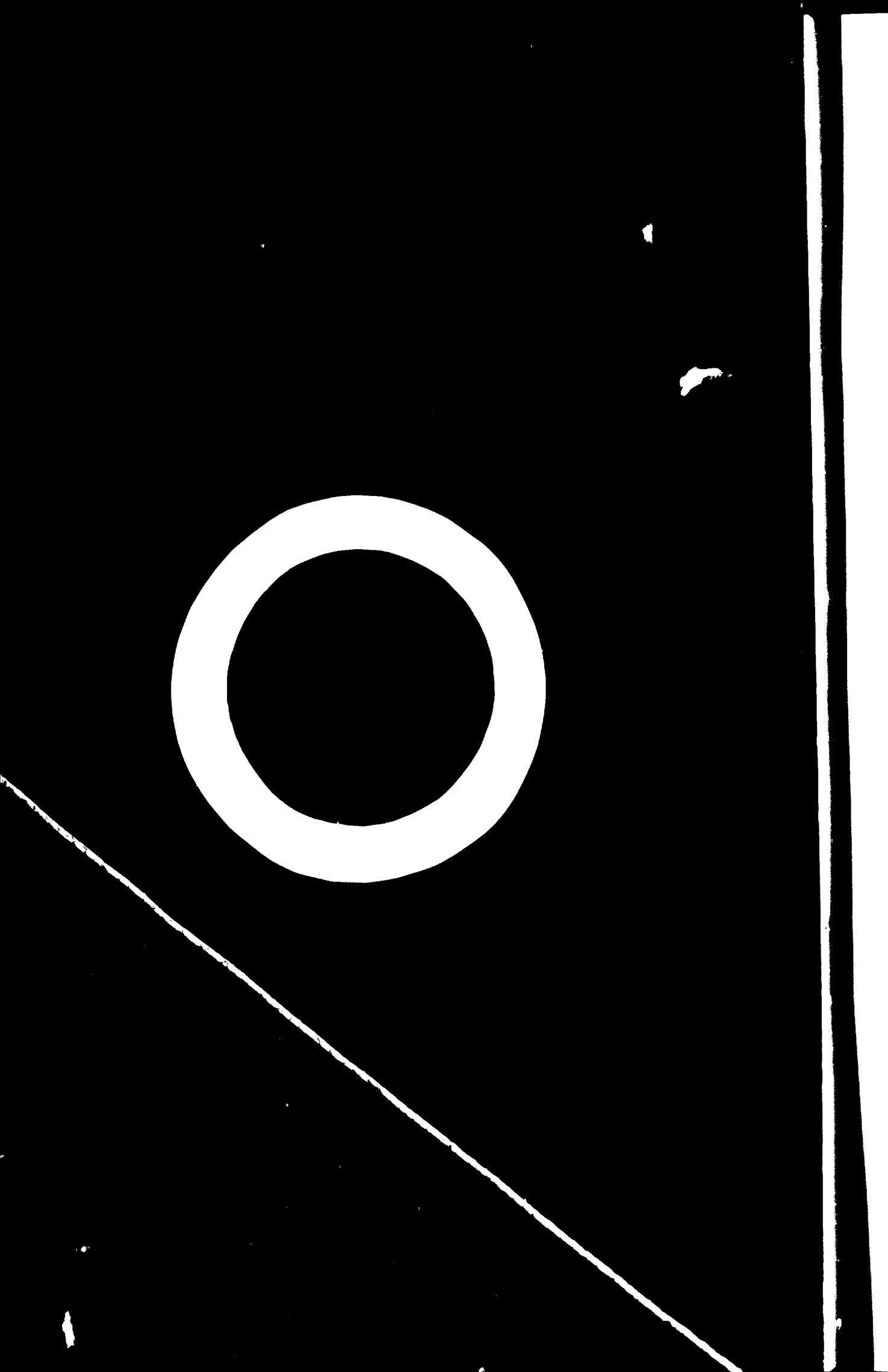
(iii) Lending its technical support to the attempts of developing countries to upgrade those export commodities that seem most threatened by plastics competition. This implies reducion of the pertinent tariff barriers, readaptation of existing marketing factors and marketing research facilities, feasibility studies for the projects involved, and so on.

(c) There are opportunities for upgrading natural products with the help of synthetic polymers. UNIDO could advise government or private agencies on these opportunities, help direct research in these fields with respect to the commodities in the most immediate danger of losing their accustomed markets, sponsor marketing research for the upgraded products, all with a view towards a gradual transition to plastics in certain fields.

(d) UNIDO could conduct "know-how searches" on behalf of private enterprises (polymer and additive manufacturers, converters and fabricators) in new fields that may be judged of interest. Although independent firms of all sizes often have excellent connexions in the industrialized countries within their own field, diversification usually involves investigations that such companies can often not afford. UNIDO could collaborate by carrying out or financing such searches.

(e) UNIDO could sponsor economic research concerning the price and income elasticities of demand for plastics in Brazil. With prices as high as they are, any significant decrease could bring about large rises in demand that would be impossible to predict without previous research of this sort.

The scope of action open to UNIDO is quite wide and its influence on the Brazilian polymer industry may be very significant.



ANNEX

SELECTED LIST OF SYNTHETIC POLYMER FIRMS IN BRAZIL

ADRIZYL RESINAS SINTETICAS S/A Rua Mar. Badóglic 286 km 16 Via. Anchieta	São Paulo, S. P.
ALBA S/A - ADESIVOS E LACTICINIOS BRASIL - AMERICA Rua Cons. Néibas 14 - 13° andar	São Paulo, S. P.
ALIBERTI S/A, INDUSTRIAS Rua Cav. Basilio Jafet 38 2° andar	São Paulo, S. P.
ALPLAN - ALMEIDA PORTO and CIA LTDA Rua Alvaro de Carvalho 48 - cj. 42	São Paulo, S. P.
ALPARGATAS SAO PAULO S/A Rua Dr. A. Alima 1130	São Paulo, S. P.
AMBALIT LTDA, SOCIEDADE Rua Dr. Plácido Oliveira 652	Joinville, S. C.
AMERICAN MARIETTA S/A TINTAS E LACAS Av. Paulista 2073 - 21° andar	São Paulo, S. P.
BAKOL S/A INDUSTRIA E COMERCIO Rua Gois Raposo 4625	São Paulo, S. P.
BAYER DO BRASIL INDUSTRIAS QUIMICAS S/A Rua Dom Gerardo 52/64	Rio de Janeiro, Gb.
BRASIL S/A, PLASTICOS DO Rua Cons. Crispiniano 58 - 9° andar	São Paulo, S. P.
BRASIL S/A, REBOLOS DO Rua Dr. Rodrigo Barros 261	São Paulo, S. P.
BRASITEX - POLIMER INDUSTRIAS QUIMICAS S/A Pça. Dom José Gaspar 134 - 4° andar	São Paulo, S. P.
CARBORUNDUM S/A INDUSTRIA BRASILEIRA DE ABRASIVOS Av. 9 de Julho 6058	São Paulo, S. P.
CEFILBRAS (Celanese)	São Bernardo do Campo São Paulo,
CELANESE DO BRASIL C/O SAFRA S/A CREDITO, FINANCIAMENTO E INVESTIMENTOS Rua Libero Badaró 293 - 30° andar	São Paulo, S. P.

COLDEMAR S/A INDUSTRIA E COMERCIO Rua Tito, 1653	São Paulo, S. P.
CONTERMA CONSTRUTORA INDUSTRIAL E TERMOTECNICA LTDA. Rua Capote Valente 1316/1350	São Paulo, S. P.
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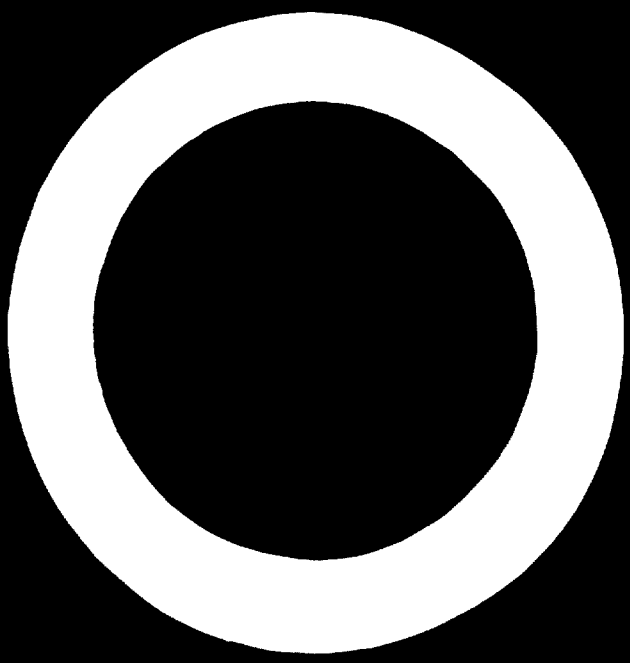

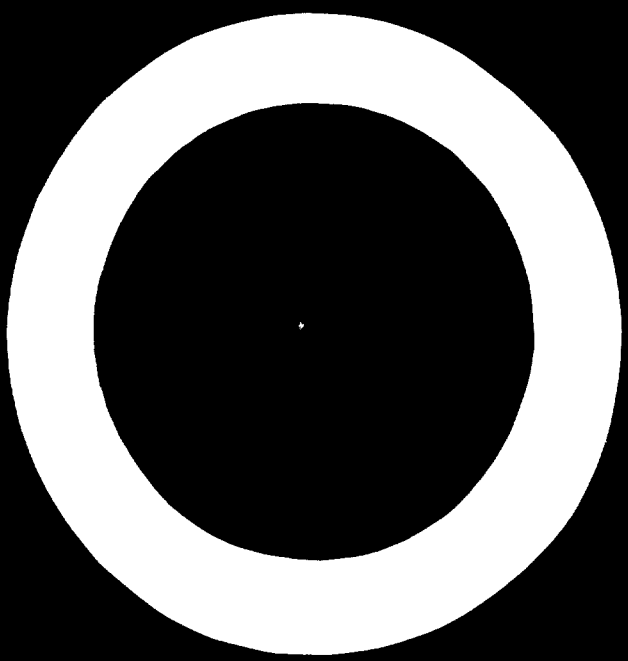

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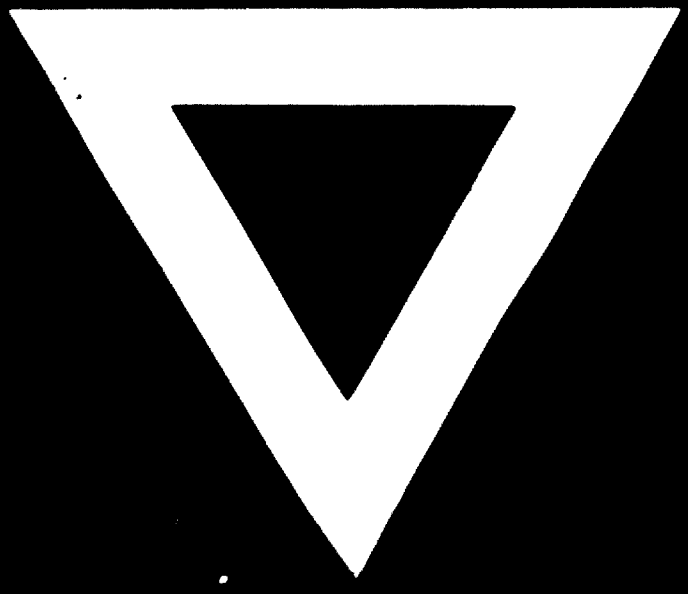

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