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**Expert Group Meeting on Future Trends in,
and Competition between Natural and
Synthetic Rubber**

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**PRESENT AND FUTURE TRENDS IN UTILIZATION
OF NATURAL AND SYNTHETIC RUBBERS IN EGYPT ✓**

by

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I. INTRODUCTION

1. General:

The rubber industry in the world is more than a century old. It has been growing during this period and is capable of continuing its growth. This growth is governed by several technical, commercial, and marketing factors. But the main factor deciding its growth rate is the ever increasing demand of the public all over the world for better quality, durable, safer, and less expensive rubber products.

To achieve these objectives, the rubber industry as well as the chemical and petroleum industries have spent and will continue to spend considerable money and efforts on research and development to introduce new materials, improved technologies, increased productivity and expanded marketing services.

The period of accelerated expansion of the rubber industry indeed started in the years following the second world war. Consumption as well as production have since increased by an annual average of 6 to 7 per cent. In 1970 the world rubber demand was about 8.7 million tons, and is expected by 1980 to exceed 17 million tons. Section II of the study of "Future trends in and competition between Natural and Synthetic Rubbers" by C.W. Robinson & Co. Inc. - UNIDO Contract 71/20, contains extremely interesting statistics and forecasts for demand, production and trends in consumption of natural and synthetic rubbers, which we ask the participants of this meeting to read and study carefully.

2. Natural vis synthetic rubber:

Natural rubber was used for making all rubber articles, till synthetic rubber became known and available on an industrial scale. Today nearly every rubber product can be satisfactorily manufactured with synthetic rubber as a partial or total replacement for natural rubber. There are no applications where natural rubber must necessarily be used for technical reasons, except in truck tires where the replacement of natural rubber is restricted to the stereo specific rubbers (Polybutadiene and Polyisoprene) and only up to a certain percentage of total rubber hydrocarbon used in carcass and tread compounds of these tires.

Since synthetic rubber emerged as an important raw material during world war II, it has kept increasing in importance, more particularly from 1950, and in the course of the years from 1950-1970 production rose by an annual average of 10 per cent for synthetic rubber as compared with hardly 3 per cent for natural rubber. It was not until 1962 that synthetic rubber outclassed natural rubber in importance. At present synthetic rubber represents about 63 per cent of overall world rubber consumption. Expectations for 1980-1985 indicate that synthetic rubber consumption will reach up to 72-75 per cent while natural rubber will represent 25-27 per cent of total new rubber.

Behind this basic structural change were more particularly the specific qualities of synthetic rubbers and the wider fields of application which were derived therefrom. But most important also, was the relatively restricted character of natural rubber production and the fairly large price fluctuations resulting from the varying sizes of supply and demand.

In other words, natural rubber production could not be turned on or off to meet market variations as it was possible with synthetic rubber. This means that within the total new rubber market supplied by natural and synthetic rubbers, natural rubber is by far the less flexible in ability to quickly adjust to bring supply and demand into balance.

It is certain that the market will continue during the present decade to depend on synthetic rubber to fill the gap between total natural rubber sales and total market demand. With total new rubber sales going up at the rate of almost 5 per cent yearly, and natural rubber production moving ahead at a relatively slower pace, as far as absolute tonnage is concerned, synthetic rubber sales are going to be very much on the rise. But, within its capacity to produce, natural rubber sales will continue upwards too.

From the technical point of view, natural rubber continues to hold a major position, namely in carcass and tread compounds of truck tires. This is due to its unsurpassed properties of high resilience, low hysteresis and low heat build-up, besides natural rubber's well known property of excellent "green tack" which is very important in assembling or building the tire.

The pattern of utilization of natural vis synthetic rubber expressed as a percentage of total new rubber consumed differs widely from market to market. It is not the same in India as it is in the USA. If SBR is the general purpose rubber in Europe and Japan, it is not in India or Egypt.

In the next part of the paper we shall attempt to demonstrate and clarify this statement as well as throw some light on what we think the rubber industry in Egypt will attain during the next ten years.

II. THE RUBBER INDUSTRY IN EGYPT

1. General

Examination of the rubber industry in Egypt shows that the main rubber products manufacturers in Egypt fall within the following classifications:

- (1) Tire products manufacturers (public sector)
- (2) Non tire products manufacturers (public sector)
- (3) Non tire products manufacturers (private sector)

The first rubber products facility in Egypt dates back to 1908 while the first tire production is as recent as 1956. The private sector of the non tire products branch is relatively small in size because of the difficulty of importing raw materials such as raw rubbers and chemicals, also limitations on importation of machinery and equipment. But this sector is expanding rapidly and is expected to expand at a faster rate during the present decade. This sector is mainly specialized in footwear and diversified moulded household articles as well as some automotive parts for the replacement market.

The public sector in non tire products takes care of the entire local market as far as footwear, rubber hose, rubber flooring and mats, latex products, transmission and conveyor belting etc. are concerned. Besides that, still large quantities of rubber products are imported especially medical rubber goods, special hosing, V belts, as well as several other speciality products. It is estimated that total imports of rubber products amount to 2,000 tons annually.

2. Tire products:

Table 1 shows the output of different tire products during the last 4 years (1967/68 to 1970/71)

Table 1 - Output of tire Products
(1968-1971)

Production Type	67/68	68/69	69/70	70/71
	No.	No.	No.	No.
1. Passenger Tires	194,935	230,786	252,863	268,505
2. Truck Tires	133,795	134,504	155,504	160,482
3. Inner Tubes	234,152	276,375	409,147	390,656
4. Biocycle Tires	453,315	453,304	286,896	342,506
5. Biocycle Inner Tubes	449,935	567,170	298,030	481,111
6. Motorocycle Tires	5,482	5,402	16,194	6,286
7. Motorocycle Inner T.	18,822	16,448	35,359	24,682

Table 2 shows the exports of automotive tires and tubes during the same period (1967-1970)

Table 2 - Exports of automotive tires and tubes
(1967-1970)

Product Type	67/68	68/69	69/70	70/71
	No.	No.	No.	No.
1. Passenger Tires	16,091	51,677	63,768	53,104
2. Truck Tires	407	9,985	14,576	11,423
3. Inner Tubes	3,892	39,419	63,227	64,890

By a quick look at these figures it is quite evident that quite a good chunk of the production of passenger car tires was for years devoted to export while exports of truck tires was limited. But examination of the actual local consumption of tires and tubes based on vehicle population shows the following:

(a) Passenger tires:

Passenger car density in Egypt is one of the lowest in the world - 4.4 cars per 1,000 inhabitants were in use in 1970. Although passenger tires production was always below 300,000 units yearly, yet exports of passenger tires were always 20-25 per cent of production.

This situation is changing rapidly due to the rapid growth in private car ownership during the last three years. Exports of passenger car tires will drop in the year 1971/72 to about 20,000 tires while the local market is suffering from shortage of tires. This is due to the increase in number of imported cars, as well as the upgoing production of the local motorcars manufacturing company.

If a forecast is to be made for the next ten years, passenger car population is expected to grow at a rate of 10 per cent annually. Passenger car requirements will be about 900,000 units yearly including a share of 10 per cent only for exports. Any export potentials or objectives beyond this share should be added to these requirements.

(b) Truck tires:

During the last few years Egypt has seen a rapid growth of truck and bus transportation. Encouraged by a rapidly increasing local production of trucks, tractors, and buses as well as importation of trucks both by the public and private sectors, the vehicle population has increased rapidly during the last few years. While it was possible in 1961 till 1965 to export large quantities of truck tires, local production has been always less than total requirements starting from 1967. Imports of truck tires amount now to 80-90,000 units yearly (while about 10,000 units of local production are being exported yearly to keep relations with traditional export markets).

To forecast what total market requirements of truck and tractor tires in 1980 will be, consideration will have to be given to the expansion plans of the automotive industry as this will be the main source of vehicle population increase over the decade. An average growth rate of 10 per cent can be reckoned with, thus meaning that total truck tires requirements in 1980, including a 10 per cent share for export would reach 650,000 units per year.

To summarize this,

Total tire requirements in 1980/81 will be:

Passenger Tires: 900,000 units yearly

Truck Tires: 650,000 units yearly

3. Non tire products:

The public sectors' share of this class of products represents the main share in output or production capacity. However, no accurate figures are available for production and import of rubber goods. A good estimate is available for the last three years, and from that a forecast for the next decade can be drawn up as will be shown hereafter:

	<u>Average of 1969/71</u>	<u>1975</u>	<u>1980</u>
El Nasr Rubber Co.	4,000 tons	7,000	10,000
Other Public Sectors and Private Sectors	2,000 tons	3,000	4,000
Imports	2,800 tons	2,000	1,000

Therefore total consumption of industrial rubber goods in 1980 will amount to 15,000 tons. If we add up the total weight of tires and related products which will be produced in 1980, (about 35,000 tons yearly) therefore total rubber goods consumption will be about 50,000 tons in 1980. At that time Egypt's population will be 42 million people. Per capita consumption of rubber goods calculated for 1980 would therefore amount to 1.2 kgs. Later on, we shall refer to per capita consumption of raw rubber and compare present and forecasted consumption with figures available for other countries of the world.

III. UTILIZATION OF NATURAL AND SYNTHETIC RUBBER

1. Present situation:

Natural rubber is by far the main general purpose rubber used in Egypt. Since a large share of the country's rubber consumption goes to the tire sector and still a large share therefrom goes into truck tire production, therefore natural rubber is the

main new raw rubber used. Besides that, the footwear industry as well as the private sector producers of moulded household and automotive parts are more oriented towards the utilisation of natural rubber.

A close estimation of 1970/1971 consumption of new rubber is as follows:

Natural rubber	5,000 tons
Polybutadiene	1,200 tons
SBR	3,000 tons (including oil extended types)
Butyl	600 tons
	<hr/>
	9,800 tons
	<hr/> <hr/>

This shows that natural rubber represents more than 50 per cent of total new rubber; whereas this percentage in USA does not exceed 25 per cent and in Europe 35 per cent.

It is believed that this situation will change gradually in favour of synthetics. Along with the expected growth of total new rubber consumption during the present decade, another accelerated growth in the utilization of synthetic rubber is to be expected also.

2. Forecast for 1980

A forecast of total new rubber requirements in 1980 based on growth expectations outlined before in the tire sector and plans for expansion in the industrial goods sector and expectations of increased activities and effectiveness of the private sector, shows that total new rubber requirements could go up to 30,000 tons yearly as shown in table 3.

Table 3 - New Rubber Requirements in 1980

	<u>Tire products</u>	<u>Non tire products</u>		<u>Total</u>
		<u>Public Sector</u>	<u>Private Sector</u>	
Natural rubber	8,000	3,500	1,000	12,500
Polybutadiene	5,000	-	-	5,000
SBR	5,000	2,500	2,000	9,500
Butyl	2,000	-	-	2,000
Other synthetic types	-	500	-	500
	<u>20,000</u>	<u>6,500</u>	<u>3,000</u>	<u>29,500</u>

This means that total natural rubber requirements will be about 12,500 tons representing 42 per cent of total new rubber. The rest, 58 per cent will be synthetic rubbers including butyl and other special types.

3. Per capita consumption of new rubbers

If above estimates and forecasts for new rubber requirements are correct and taking into consideration that Egypt's present population is about 34 million inhabitants, and assuming that population will continue to grow at the same rate as during the last decade, i.e. at 2.5 per cent annually, therefore Egypt's population in 1980 will reach about 42 million inhabitants.

Therefore per capita consumption of new rubber in 1970 was about 0.28 kgs, whereas in 1980 with an estimated total new rubber consumption of 30,000 tons per capita consumption will reach about 0.7 kgs.

If compared against present standards in other countries, the conclusion could be made that even in 1980 after more than doubling per capita consumption from 1970 to 1980, the 1980 figure is still considerably lower than average per capita consumption of developed countries in 1970. Table 4 shows per capita consumption of new rubber in some western countries in 1960 vis 1970.

**Table 4 - Per Capita consumption of Rubber
in Western world**

Country	Per Capita consumption (Kgs)	
	1960	1970
USA	8.8	11.9
Canada	5.2	8.6
Australia	6.1	7.1
UK	5.7	8.2
France	4.9	8.1
W. Germany	4.6	9.2
Italy	2.6	5.6
Japan	2.5	7.5
Netherlands	2.8	3.3
Brazil	0.9	1.3
India	0.1	0.2

If compared against Brazil which is a developing country the present per capita consumption figure for Egypt (0.25 Kgs) is only very humble. The predicted per capita consumption for 1980 (0.70 Kgs) can still be considered a humble figure when Brazil and other developing countries should have reached consumption levels of about 2 Kgs./person in 1980.

To reach 1 Kg per person in 1980 would not be much of a dream, but should be a goal in front of the rubber processing industries which could and should be reached in 1980.

The main incentive to help reach that goal is the starting of a synthetic rubber plant in Egypt. Plans do exist already and are shaping up towards final realisation. Details of these plans will be outlined later.

If the 1 Kg per person goal is achieved in 1980, therefore total new rubber consumption should reach 42,000 tons. If natural rubber's share continues to be 42 per cent as already concluded before, therefore total synthetic rubber required will be about 25,000 tons. Such requirements are enough to justify a moderate scale local synthetic rubber production. Experts are however to be considered, especially if they

are based on marginal costs to keep their prices competitive on the international market. Egypt is favourable situated in the centre of an area with large trade potentials. The following countries rank first among possible markets for synthetic rubber:

- the countries bordering on the Mediterranean Southern Europe and North Africa.
- countries of the Near and Middle East.
- West and Central Africa.
- East Africa.

Size of exports could be estimated at 5,000-10,000 tons, thus bringing the capacity of the synthetic rubber facility up to 30,000-35,000 tons yearly.

IV. PLANS FOR SYNTHETIC RUBBER MANUFACTURE IN EGYPT

Egypt is planning and is actually in process of establish the first petrochemical complex in the Middle East. In the first stage of the project, production of polyethylene and polyvinyl chloride is planned. Before completion of the first stage, a second stage will be started in which synthetic rubber will be manufactured, based on butadiene which will be available from the naphtha cracking process.

1. Size of plant:

Being in the planning stage, discussion and investigations still go on to choose the type of polymer and polymerisation process which meets the country's needs and fulfils the basic economic requirements to justify investment involved.

Among several factors which are being considered is the minimum size plant. It is known that a single line 20,000 tons plant is about the minimum economically feasible operation for a general purpose rubber. A 40,000 tons plant is certainly more realistic and what an investor in a developed economy would insist upon before making an investment therein. First of all a smaller size plant requires specially built equipment, thus increasing capital investment per ton of output. Secondly, since labour and most overhead items are relatively fixed, the proportional cost/Kg produced decreases as the quantity produced increases.

2. Type of Rubber:

If we still remember our forecast for new raw rubber requirements in 1980, which again are:

Natural Rubber	12,500 tons
Polybutadiene	5,000 tons
SBR	9,500 tons
Butyl	2,000 tons
Other special types of synthetic	500 tons

It is quite evident that butyl and speciality synthetic rubbers cannot be considered. Polybutadiene and SBR only should be considered with a possibility of giving some consideration to polyisoprene, although it is not on the list.

If the minimum economically feasible plant size is 20,000 tons, therefore none of the above-mentioned rubbers comes near to that figure. The nearest one however is SBR. If the production of a raw material is in itself a great incentive to develop its use, and initiate the production of new products and expand existing facilities, we might hope to boost consumption of SBR in 1980 up to 11,000-12,000 tons, which means that 8,000-9,000 tons yearly will have to be exported. This might not be a problem if quality and price are competitive. But we should not forget that quality competition is stiff, and for small size plants, the margin of profit is low. Besides the problem of excess SBR production, the country will still have to import polybutadiene which is solely used by the tire industry.

It is the writers opinion that in a case like this, which is most probably representative of many other developing countries, a multi-purpose plant capable of production of two or more types of rubbers is the ideal solution, although these plants are more expensive to operate.

3. Possibility of using the solution polymerisation process:

In our case the possibility of establish a solution polymerisation process should be investigated. Such a unit would be capable of producing solution SBR and Polybutadiene (38 Cis content). If the output of the plant is chosen to be 20,000 tons, which is undoubtedly economically sound, this means that about 75 per cent of the output will be consumed locally. The rest 25 per cent or about 5,000 tons yearly will have to be exported. This will not present any serious problem to the economics of the project. We should not forget what we mentioned before about export potentials to neighbouring countries. To that we can only add that some Middle East countries are seriously considering or are already planning their own national tire plants. This will certainly create markets for excess rubber production.

V. SOLUTION POLYMERS FROM THE TECHNICAL POINT OF VIEW

1. General:

An extremely important development in the elastomers field was the discovery that some organometallic catalysts could help produce rubbers with a controlled molecular configuration. This development made it possible to "tailor make" rubbers with specific combinations of properties.

This new class of elastomers is called "Solution" rubbers. Polymerization is achieved in a homogeneous solution of monomers and polymers in a hydrocarbon medium rather than in a hydrocarbon water emulsion. Among the first rubbers to be produced by the solution process were CIS polyisoprenes and CIS polybutadiene. A new family of solution polymerized styrene-butadiene and polybutadiene rubber is being widely used now by the rubber industry. Solution polymerization has the advantages of regulation of the butadiene-styrene ratio, distribution of these monomers along the polymer chain, together with the chemical configuration of monomers and control of long chain branching. The process results in high purity rubber with the following properties.

- Low odour and light colour; rubbers are ideally suited for making whits, transparent or coloured rubber articles.
- Low ash content with low water absorption.
- High rubber hydrocarbon content.

2. Characteristics of solution polymers

Technical literature available on some of the known solution polymers report that the following characteristics are to be expected from these rubbers:

- Fast cure rates, thus allowing a reduction of acceleration level in many instances.
- High tolerance for fillers and oils, thus allowing great extension of compounds and possibility of producing quality products at lower cost.
- Excellent moulding properties.
- Fast injection at low pressures, together with good temperature resistance make them especially suited for injection moulding.
- Low die swell and fast extrusion rates.

- Outstanding ageing resistance.
- Excellent aged adhesion properties.
- High resilience and low heat build up.
- Low compression set.
- Good tear resistance.
- High abrasion resistance.
- High resistance to crack growth.

Whatever the extent to which these properties are really attainable, there is no doubt that solution rubbers will be used much more during the coming years, and that they opened up an extensive field of research and investigation for the rubber chemistry and industry.

3. Future of solution polymers:

According to H.L.H. Krol of Shell International Chemical Co. in a paper presented at the conference of the UK Institution of the Rubber Industry in March 1971, a growth in consumption of emulsion SBR of 4.5 per cent yearly is forecast for West Europe in the present decade, compared with a figure of 3 per cent yearly for natural rubber.

Meanwhile solution polybutadienes of the 40.92 and 96 CIS per cent are now fully commercially stabilised and the growth of their consumption in West Europe in the 70's is expected to be of the order of 9 per cent a year. The consumption of polyisoprene rubber is gradually picking up by replacing natural rubber to significant levels in tire compounds, up to a maximum of 40 per cent in carcass compounds and in truck tread stocks up to 20 per cent. Figure 1 shows the consumption of the general purpose rubbers in Europe over the last decade as well as what is now reasonably expected during the present decade.

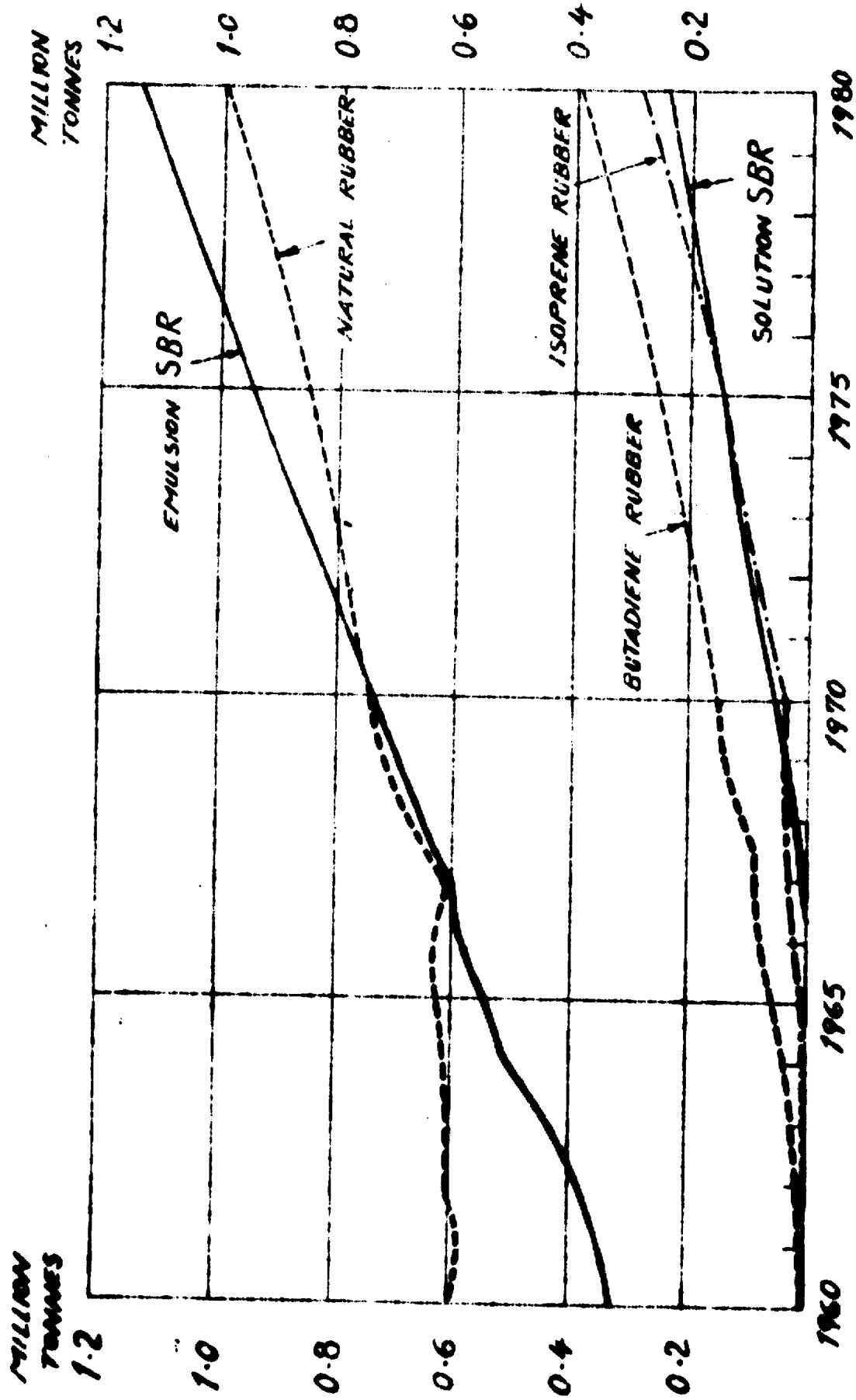


FIG.1 - WEST EUROPEAN (SOLID) GENERAL PURPOSE RUBBER CONSUMPTION.

VI. CONCLUSIONS AND RECOMMENDATIONS

There is no doubt that controlled solution polymerization has opened up a new era in the rubber industry. To cope with the future demand for styrene butadiene copolymers, there are strong indications that expansion of world's production capacity will, to a great extent, be based on solution polymers. These polymers have great promise for further improvements, largely because of the possibility of controlling such polymer parameters as monomer sequence, steric configuration, molecular weight distribution, branching etc.

It seems that for developing countries looking forward to the introduction of synthetic rubber manufacture, the solution polymerization process should extend more flexibility and less probability of having to market excess capacity if emulsion SBR or any other type of rubber produced.

It is believed that UNIDO can extend its help to developing countries in two ways:

- (1) Complete the investigation of potentials of growth of solution polymers from the production and utilization point of view.
- (2) Investigate the patent and license situation and extend help to developing countries in making the know how for this process available since it is believed that only a very limited number of synthetic rubber producers possess the know how.



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SUMMARY

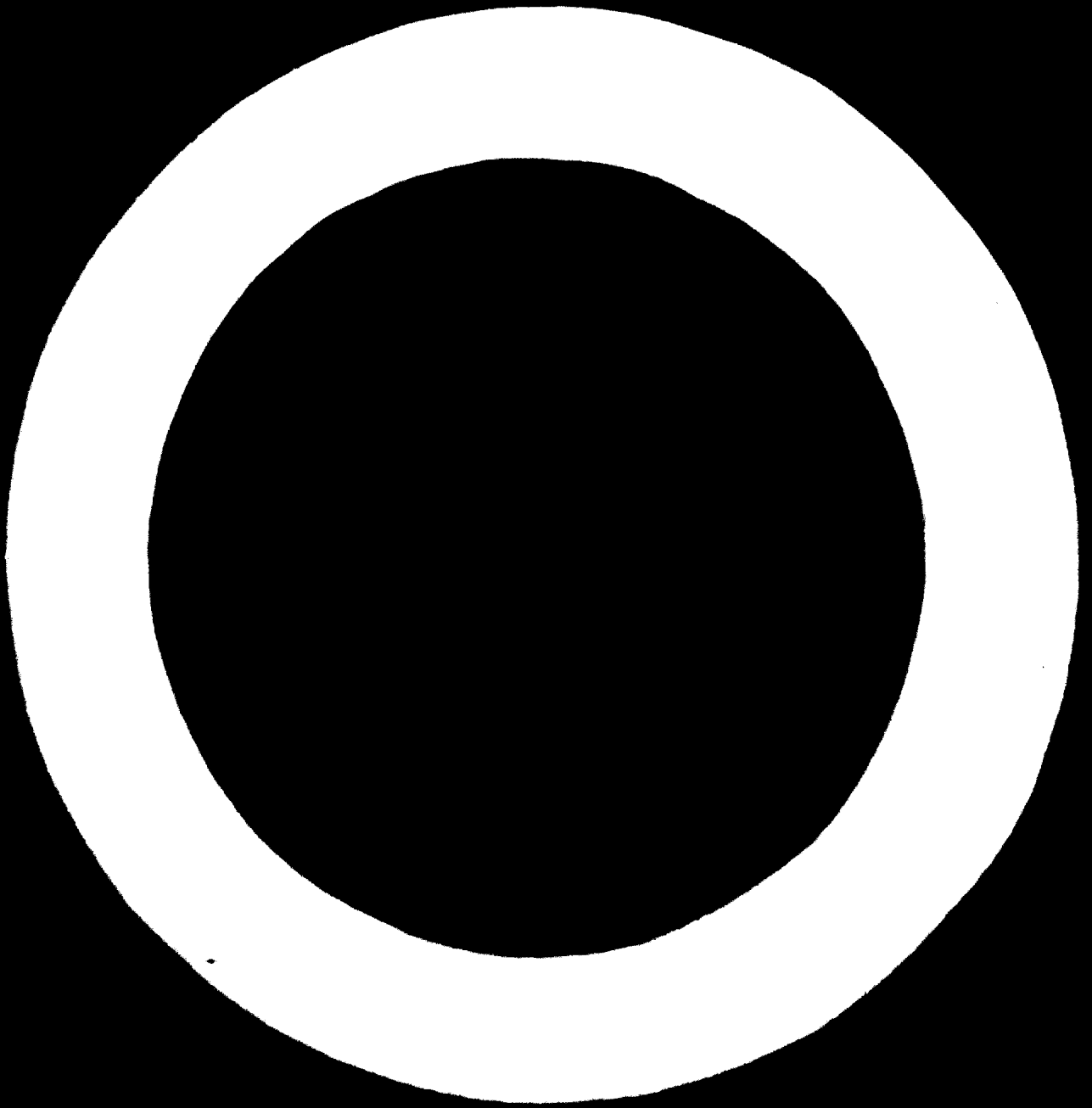
**PRESENT AND FUTURE TRENDS IN UTILIZATION
OF NATURAL AND SYNTHETIC RUBBERS IN EGYPT 1/**

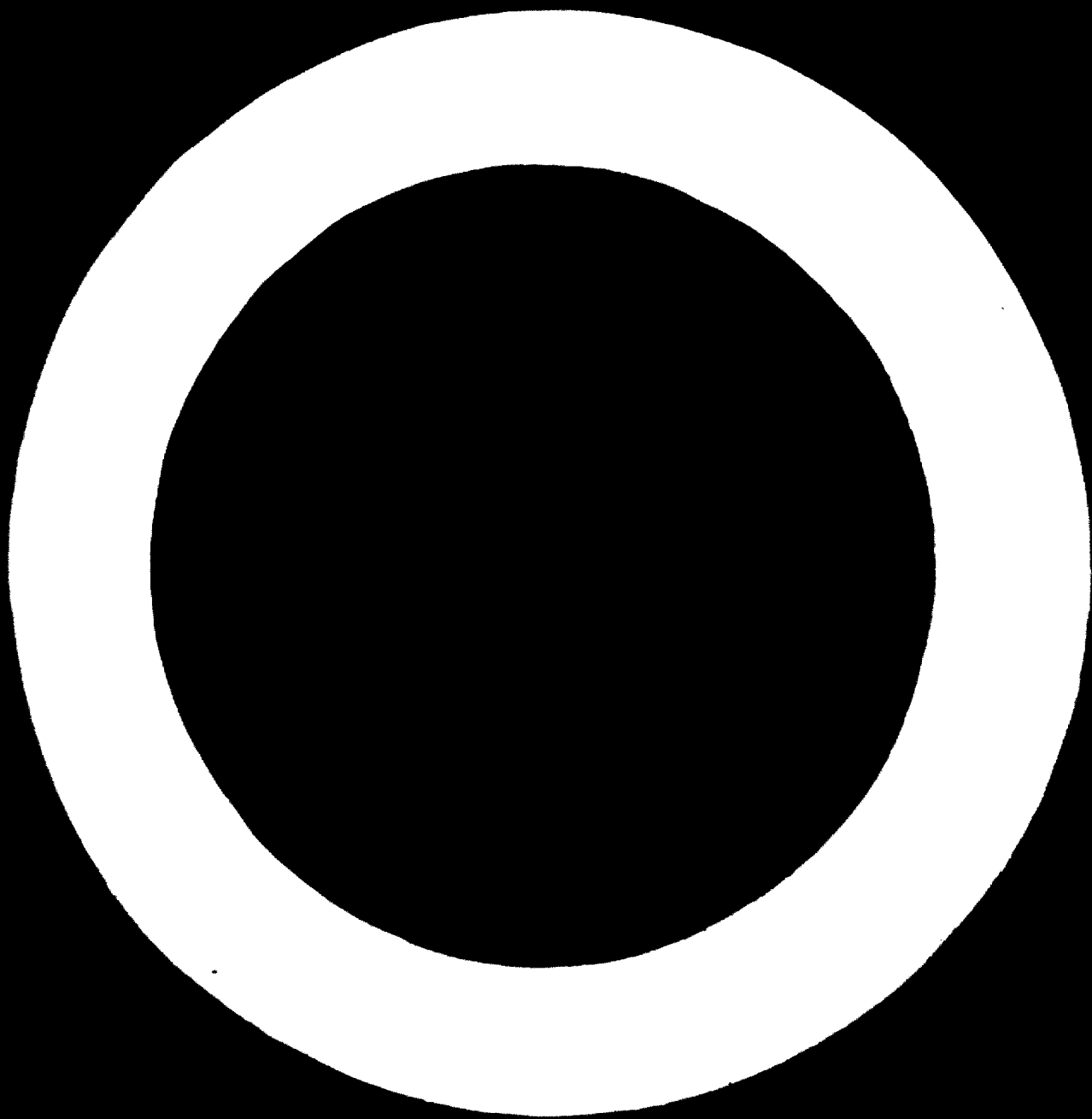
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A review of the tire and non-tire sectors of the Egyptian rubber industry is presented. The non-tire rubber industry in Egypt is almost 40 years old, while the first tire produced in Egypt was made only in 1956.

An assessment of activities in both sectors is presented, showing latest production figures as well as imports of different rubber articles from 1968 to 1970. A forecast for 1975 and 1980 consumption is also presented based on trends and estimated growth rates during that period. It is shown that quite a large size of import of non-tire rubber products still exists, while imports of tires was very limited till 1966 when requirements of truck tires surpassed production. Imports of truck tires have increased gradually since then and reached almost 80 - 90,000 tires in 1970. Passenger car density in Egypt is one of the lowest in the world (4.4 cars per 1,000 inhabitants in 1970), but the last three years have seen a rapid growth in private car ownership due to increasing car imports and the rapidly growing local automotive industry. A growth rate of 15-20% is recorded for the last three years, while a growth rate of at least 10% can be reckoned with till 1980.

Based on these assumptions, forecasts for tires and tube requirements in 1975 and 1980 show that about 1,5 million units will be required by 1980, (900,000 passenger tires and 600,000

truck tires). If this is translated into raw rubber requirements, therefore, total rubber consumption in Egypt in 1980 will certainly reach about 30,000 tons yearly.

The main rubber types and their predicted consumption by different sectors in 1980 will be:


<u>(Unit metric tons)</u>	<u>Tire Products</u>	<u>Non-Tire Products</u>	
		<u>Public sector</u>	<u>Private sector</u>
Natural Rubber	8,000	3,500	1,000
Polybutadiene	5,000	-	-
SBR	5,000	2,500	2,000
Butyle	2,000	-	-
Total:	20,000	6,000	3,000

Total Natural Rubber Requirements will be about 12,500 ton i.e. 47% of total rubber requirements, while total Polybutadiene requirements will be about 5,000 tons i.e. 17% of total requirements and total SBR requirements about 9,500 tons i.e. 32% of total requirements.

Since Egypt has ambitious plans for introducing petrochemical industries, including a synthetic rubber plant, extensive studies are being made to forecast requirements, and to choose the type of synthetic rubber which can be most economically produced. If production capacity is to be based on local consumption only and a slight share of production for export, it is obvious that the consumption of any of these synthetic types does not justify the cost of a plant, or in other words it is by all standards far much lower than the smallest economic size plant.

It is the writer's opinion that a solution polymerization unit to produce stereospecific SBR and polybutadiene by solution polymerization, should be the most adequate solution in such a case. A yearly production capacity of 15,000 - 20,000 tons could be considered, which should cover the country's estimated requirements by 1980 and leave a reasonable share for marketing to neighbouring Arab countries.

It is believed that the technology of solution polymerized rubbers as well as their use in tires and non-tire products, is becoming well established and will certainly not before long, be widely accepted throughout the rubber industry.





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