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STUDY ON SYNTHETIC VERSUS NATURAL PRODUCTS
PILOT PROJECT ON THE RUBBER INDUSTRY
AND ITS IMPACT ON THE ENVIRONMENT 1/

by

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C O N T E N T S

INTRODUCTION

This paper will deal with some aspects of the rubber industry in Egypt and its influence on the environment, with particular stress on two important aspects: Namely the planned manufacture of synthetic rubber, and the disposal of waste rubber products, the most important of which being tires.

I should like first to describe briefly and in some figures the geography of the country :

Egypt occupies the northeastern corner of Africa. Its territory covers about 390,000 Sq. miles, but only about 3 - 4 % is inhabited cultivated land. The rest is desert. The Nile like an elongated oasis, cuts Egypt south to north for a distance of 800 Miles till Cairo where it divides into two main branches each about 150 Miles long, forming the Nile Delta.

The land mass west of the Nile is a vast desert with a few fertile oasis, while the land east of it is a desert stretching to the red sea. The Suez canal links the red sea at Suez, with the Mediterranean at port Said.

The population of Egypt in 1973 was about 35 millions, 95 % of which live along the fertile banks of the Nile. The density of population (over 2000 persons per square mile in the Delta area) is probably one of the highest in the world.

ECONOMY AND THE ENVIRONMENT :

It is natural that most economical, and industrial activities are concentrated in the heavily populated areas. Pollution has not so far become a problem that could attract public opinion or governmental intervention. It seems that most industries existing in the country were able to foresee what their pollution or waste disposal problems could be, and were able to a great extent to get over such problems successfully. The location or site selection of particular industries like petroleum refineries, cement factories, steel mills, paper mills etc... seems to be ideal from the point of view of their effect on the environment and population especially in the heavily populated towns and cities.

We need not mention however that Egypt is a developping country with a relatively good size of industrial activity, which is nevertheless far less significant than that of developped countries or even some of the developping countries which had more favourable conditions for industrial progress like Spain. It is going to be some time before pollution resulting from industry become a problem, but it is certainly essential that Egypt, as well as all developping countries, plan from now to avoid pollution and environmental damage that have been concomitants of industrial development in developped countries.

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THE RUBBER INDUSTRY OF EGYPT :

Egypt still does not have a rubber producing or manufacturing industry. The only rubber industries in the country are rubber products manufacturing industries. Since the country is on the threshold of an economical boom which will involve a large industrial, agricultural, construction, and transportation expansion, the outcome should be an increase of the consumption of rubber goods from the present low per capita consumption of 0.75 Kg. yearly to an estimated 1.20 kg. yearly in 1980.

Although the rubber industry has not so far given any threats to the environment, yet it is essential to examine the effects or impact of these products in their entire life cycle on the environment with a view to avoid or minimize environmental damage which has been associated with the rubber industry in developped countries.

In this connection consideration should be given to the environmental factors or pollution threats which could be expected from the rapid growth rates expected for the Egyptian rubber industry, with its two branches :

a) Rubber manufacturing industry.

b) Rubber products manufacturing industries.

A- RUBBER MANUFACTURING INDUSTRY :

There is no point in trying to make choices between natural and synthetic rubbers, since Egypt cannot be natural rubber growing country. On the other hand, Egypt like many other mideast countries, is contemplating an ambitious plan for the production of a wide variety of petro-chemical products, including olefins, aromatics, fertilizers and other petrochemical derivatives,

This plan, as it stands now, and as being negotiated between responsible government organizations and several consulting, construction, contracting and manufacturing firms is as follows:

Product	Capacity (MT Yearly)
A. Aromatics Complex :	
DMT	100,000
Plasticizers	50,000
Cyclohexane	165,000
Phthallic Anhydride	50,000
B. Olefins Complex	
L D P E (Low density polyethylene)	170,000
PVC (Poly Vinyl Chloride)	100,000
PP (Polypropylene)	100,000
PS (Polystyrene)	75,000
SBR (Styrene Butadiene Rubber)	80,000
Ethylene Glycol	50,000
Oxo-Alcohols	55,000

In considering the environmental effects of the synthetic rubber manufacturing unit, we should consider the complex as a whole.

As a matter of fact the problems of waste disposal, air and water pollution are already handled in the pre-feasibility studies of the project. The call for tender will specify waste disposal systems according to the local regulations, while the preliminary project includes such provisions as :

1- Maximum use of in- plant pretreatment for highly contaminated aqueous wastes before they are routed to the main waste water system.

2- These treatments will include :
   - Stripping of aqueous streams containing light organic compounds, sulfides, and ammonia.
   - Neutralization of chemical wastes.
   - Removal of polymers, latex, crumbs....

3- Other treatments should also be included if necessary, such as:
   - Oil removal
   - Biological treatment
   - Aeration.

   Appendix (I) shows the proposed specification of effluent.

4- A flares system is to be installed wherever necessary in the complex units and at the storage of light hydrocarbons.

5- The local regulations concerning maximum allowed concentration of vapours, gases, dust and suspended particles in air in external and internal atmospheres will be specified and have to be adhered to in the final design of the project.

Appendix (II) gives the maximum allowable limits as specified by local regulations.

6- The site location:

As should be expected, the complex will be located not far away from Egypt's second large city and largest sea Port-Alexandria, and close to a fresh water canal - The Nubariah canal. This location is ideal from the point of view of its environmental effects on such a heavily populated city as Alexandria.

B- RUBBER PRODUCTS MANUFACTURING INDUSTRIES :

The two known categories of rubber products are represented in Egypt, namely tire and non-tire products. The average production output and imports of the two categoris over the last few years were as follows :

	Out put in tons	Imports in tons	Total
Tire products	11,000	4000	15,000
Non-Tire Products	7,000	3000	10,000
	18,000	7000	25,000

Due to the expected rapid economical growth over the next five years, the total output of the rubber manufacturing industries could go up to 50,000 tons yearly together with an insignificant size of imports.

In its present size and output, the rubber products manufacturing industry has not presented any threats or damage to the environment in Egypt. The main product, which is tires, has found many uses after they have given all their useful life as tires. Old scrap tires have the following uses :

1- As dock bumpers

2- Tires which are not serviceable for motor vehicles are used for horse drawn vehicles.

3- Peeled tire treads are used to cover wooden wheels used on horse drawn carts and carriages.

4- Peeled treads are buffed and cut to make cheap shoe heels.

5- Carcass plies are cut to make cheap shoe soles as well as straps for wooden house shoes, and for making gaskets.

6- Carcasses are also used to make link matting.

7- There is a small size reclaiming activity with a total output of about 1000 tons yearly.

It is certain that these uses will continue but without any remarkable increase in quantity, except reclaim. As a matter of fact, some of these uses such as shoe heels and soles, are declining because of the tendency to use better qualities as the standard of living continues to rise.

There is no doubt however that the present size of the reclaiming industry is very insignificant and does not reflect the relative importance of this material which is attributed to the economy it imparts to the production of a large variety of articles, and its desired technical properties when added to certain rubber compounds. As to its importance with respect to the problem of waste disposal, We should not forget that even in developped countries. only a small fraction of old scrap tires are used to make reclaimed rubber. The demand for reclaim in relation to new rubber has declined gradually after the end of 2nd. world war because of the vast quantities of relatively cheap synthetic rubbers that have been available. Oil extended rubbers in particular have limited the expansion in using rubber reclaim quite severely.

This situation was not expected to change till the end of 1973. Since that date, the prices of synthetic rubbers, in fact of all petrochemical products, increased considerably. The traditionally low prices of synthetic rubbers do not exist any more, and the price difference between reclaimed rubber and the cheapest grade of SBR, could start to work favouring an increase in demand for reclaimed rubber.

We believe that a modern well equipped reclaiming facility should go along with other rubber goods manufacturing projects in developping contries like Egypt.

Since the quality of reclaim and hence the fields and percentages of reclaim to new rubber used depend on the quality and method of manufacture, the selection of process is therefore of utmost importance to ensure high quality levels at minimum cost, enabloing the export of reasonable quantities to other developping or even developped countries. Egypt could very well have a 5000 tons yearly production of reclaim, the end uses of which would be in hard rubber battery boxes, tires, shoe heels and soles, matting and flooroing, etc... A reclaiming plant of the mentioned size would absorb quite reasonable quantities of scrap tires. What is left will not represent any problem or cause any harm to the environment.

But the future for Egypt might look differently when more and more tires are produced and used, and the disposal of scrap tires starts to become a problem as it is today in developped countries.

In the united Kingdom, there are more than 400,000 tons of scrap rubber annually. The reclaiming industry does not absorb sufficient quantity to become a solution to the problem. Dumping is not a satisfactory answer, and burning is an offense against the clean air act.

Controlled burning is now thought ... to be the only satisfactory way to get rid of large quantities of rubber waste. Besides, the British Rubber and Plastics Research Association (RAPRA) considers that the terrific heat generated when rubber is burnt should be employed so that the process returns a profit rather than being an expense. Tires, after debeading are essentially a mixture of solid hydrocarbons and pure carbon with less than 2 % of non-combustible matter, and should naturally have a high calorific value.

There has been a lot of dispute in Great Britain after RAPRA has adopted burning or inceneration as the most feasible way of disposal of waste tires. The controversy which took place there was quite interesting. Some people maintained that the reclaim industry should find means of making reclaim cheaper and better in quality by using more modern manufacturing methods, in which case it would compete favourably with synthetics.

RAPRA maintained that smokeless inceneration was perfectly feasible and was the only effective method of large-scale disposal. RAPRA has actually performed a more positive role than just expressing their ideas about the problem. They have sponsored the development of suitable equipment for burning scrap tires. Heenan & Froude of Worcester, England were able to develop an incenerator, coupled with a boiler to use the calorific value of waste to produce steam for industrial use. The first incenerator came into service in 1965 at Watts Tire & Rubber Co., in Gloucestershire. It run into difficulties because of the tremendous heat generated by the waste rubber fuel. Modifications were made which resulted in a satisfactory rate of burning, smokeless inceneration, and adequate steam for a retreading plant. The incenerator disposes of approximately 350 Kgs. of scrap per hour and raises about 3500 Lbs. of steam. Operating 24 Hrs. per day, five days a week, it will consume about 2300 tons of scrap yearly.

OTHER FIELDS FOR USES OF SCRAP RUBBER :

Another field which has not been explored extensively yet for using scrap rubber advantageously is the dry distillation of vulcanised rubber scrap. Results of experimental work carried out in this field were published, but so far it is believed that no applied industrial scale results are available or published. The value of dry distillation as an outlet for disposing of some quantities of scrap rubber might not be great, but we thought we should point it out to direct the attention of research and development efforts towards a complete investigation and evaluation of its technological and economical feasibility.

According to published information, the dry distillation of vulcanized rubber under reduced pressure and at temperatures around 350°C results in decomposition of the material giving a gas, an oil, and a residue. By fractional destillation of the oil part, a light fraction obtained at 70 - 140°C proved to be an excellent solvent for raw rubber with no poisoning effect or irritating action to the skin. When mixed with normal gasoline the mixture showed good anti-knock characteristics. This light fraction proved also to be a good cleansing solvent for clothes, preferred to benzine or benzol as it does not affect the fibres as much.

Results of work carried out by Dr. Hans Schmidt in 1944 indicated that the dry distillation of natural rubber vulcanizate at 1 mm Hg pressure and at a temp of 320°C resulted in a brown distillate which amounted to 35 % of the rubber vulcanizate used. By fractional distillation of this liquid under 5 mm.Hg. pressure several fractions were obtained at different temperature ranges, and only 15 % of the liquid remained as a thick viscous fluid.

In another work described by an Italian patent the resulting liquid after dry distillation of synthetic rubber vulcanizate was further heat treated to give a liquid which when mixed with drying oils made high quality lacquers.

As pointed out before, the technical and economical feasibility of the process should be explored before it could even be thought of as a way for the disposal of scrap rubber.

CONCLUSIONS

1- Owing to its size and capacity, the rubber industry in Egypt has not created any environmental problems yet. But with the expected rapid growth of the economy and the introduction of synthetic rubber production, consideration should be given to pollution dangers and environmental damages that are associated with petrochemical industries. The outcome of this Group Meeting and the action plant which will result from its discussions, willcertainly be helpful to Egypt and other developping countries contemplating plans for petrochemical industries, in taking proper measures to avoid environmental problems and minimise pollution and damage of the environment.

2- To minimise the effect of scrap rubber products on the environment, the following recommendations could be made:

a) Encourage the manufacture of rubber reclaim, by finding methods to improve its quality and cut down the cost of production.

b) To encourage the use of scrap tires in such diversified uses, as dock bumpers, matting, gaskets, shoes heels and soles, etc...

c) Investigate the technical and economical feasibilities of controlled burning of scrap tires to produce process steam in industrial locations.

APPENDIX 1

BOD	30 ppm.max.
COD	40 - 100 ppm.
Oxygen,	More than 3 mg/l.
Chromium (total)	0.05 to 0.25 ppm.
Dissolved solids	750 ppm above ambient concentration
Ammonia as N	2. - 5 - 10
Lead	0.1
Zinc	1
Fluorine	5.
Iron (Total)	0.5 to 2.5
Copper	0.2
Oil and grease	5 - 15
pH	6 - 8.5
Temperature	3°C above ambient
Phenols	0.5 ppm. max. (0.02 after dilution)
Chloride	150 ppm. after dilution
Sulphates	250 ppm. after dilution

APPENDIX II

Max. Allowable in the Ext. and Int. Atmosphere

- Vapours and Gasses :

Substance	Internal atmosphere 8 hours exposure		External atmosphere 24 hours exposure	
	Mol. air per M.P.	M.GM./M³ Air	Mol. per M.P. air	M.GM./M³ Air
Acetildhyde	200	350	7	12
Acetone	1000	2500	33	80
Acroline	0.5	1.18	0.07	0.15
Ammonia	100	70	3.25	2.5
Ethylene	5	1.9	0.165	0.065
Arsine	0.05	0.165	-	-
Benzol	25	80	1	3
Bromine	1	6	-	-
Carbon Monoxide	50	60	2.5	2.3
Chlorine	1	2.9	0.03	0.09
Chlorobenzine	75	350	3	14
Chloroform	50	250	107	8
Cresol	5	22	0.2	0.9
Cyclohexane	400	1400	13	46
Cyclohexanol	100	400	3	15
Cyclohexanon	50	200	1.5	6
Ethyl Alcohol	1000	1900	40	75
Ethyl Ether	400	1200	15	50
Formalhyde	5	6	0.2	0.25
Florine	0.5	1	0.002	0.01
Gasoline	500	-	20	-
Heptine	500	2000	20	85
Hexane	500	1800	20	70
Iodine	0.1	1	0.003	0.04
Nitrobenzene	1	5	0.03	0.15
Nitroglycerine	0.5	5	0.015	0.15
Octine	500	-	20	-
Ozone	0.1	0.2	0.003	0.01
Pentine	1000	3000	33	100
Phenol	5	20	0.01	0.04
Phosgene	1	4	0.03	15
Phosphene	0.3	0.5	0.01	0.02
Satabene	0.1	0.55	-	-
Asterrine	100	590	-	-
Sulpher Monochloride	1	5.5	-	-
Toluene	200	800	6	25

B- Dust and suspended toxic particles in air

Substance	8 hours exposure Avg. during 24 hours	
	M.GM./M^3 air	M.GM/M^3 Air
Fume (Soot)	-	0.15
Antimony	0.5	0.005
Cyanide	5	0.17
O.Nitrocresol	0.2	0.006
Flerides	2.5	0.08
Iron Oxide	15	0.5
Lead	0.2	0.014
Magnesium Oxide	15	0.5
Manganese	6	0.2
Mercury	0.1	0.003
Phosphorus	0.1	0.005
Selenium	0.1	0.005
Telerium	0.1	0.005
Zinc Oxide	15	0.5
Barium	0.5	0.005
T.N.T.	1.5	-
Dinitetroluene	1.5	0.05
Trichloronaphtalene	5	0.17
Trinitrotoluene	1.5	0.05
Chromic acid and chromates as CrO_3	0.1	0.005
Sulfuric Acid	1	0.1
Phosphorus Pentachloride	1	0.03
Phosphorus Pentasulfide	1	0.03
Naphtalene Pentachloride	0.5	0.02
Phenol Pentacecloride	0.5	0.02
D.D.T.	1	-
Lead Tetraethyl as Pb.	0.075	-
Arsenic	0.5	0.005
Cadmium	0.1	0.005
Diphenyl Chloride	1	0.03

C- Suspended Natural Dust

Substance	8 hours exposure Av. During 24 hours	
	M.C.M/M^3 air	M.CF/M^3 air
Asbestos	180	-
Non silica dust	1800	60
Mica (50 % Silica)	700	-
Portland Cement	1800	60
Talcum Powder	700	-
Dilicas		
a- Contenuing 50 % Silica	180	6
b- Contenuing 5-50 % "	700	35
c- Contenuing less than 5 % Silica	1800	60
Cleansing dusts	700	-

N.B. : Quantities enlisted above for particles do not exceed 10 Micron in diamter.

Substance	Internal atmosphere 8 hours exposure		External atmosphere 24 hours exposure	
	Mol. air per M.P.	M.GM./M^3 Air	Mol. per M.P. air	M.GM./M^3 Air
Orthoteluedine	5	22	0.17	0.75
Terpentine	100	-	4	-
Xylene	200	900	6	2.9
Methyl Alcohol	200	250	2	2.5
Carbon Dioxide	5000	9000	500	900
Carbon Dicsulfide	20	60	0.02	0.06
Ethane Dichloride	50	200	5	25
Nitrogen Dioxide	5	10	0.1	0.2
Sulfur Dioxide	5	13	0.075	0.2
Aceyic acid	10	25	0.35	0.85
Phosphorus Trichloride	0.5	2.5	0.02	0.1
Nitric Acid	10	25	0.2	0.5
Ethyl Acetate	400	1500	15	60
Hydrogen Cyanide	10	11	00.35	0.4
Sulfo Cyanide	0.05	0.2	0.002	0.005
Carbon Tetra Chloride	25	160	1	6
Hydrogen Floride	5	2.5	0.1	0.09
Petroleum Nephta	500	-	15	-
Gaal Nephtha	200	-	7	-
Hydrogen Sulfide	20	28	0.02	0.003
Hydrogen Chloride	5	7	0.008	0.02

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