STUDY OF THE HEALTH HAZARDS IN
GLASS-FIBER REINFORCED PLASTIC
(GRP) INDUSTRY.

THESIS

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بسم الله الرحمن الرحيم

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THE CANDIDATE

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INTRODUCTION

INTRODUCTION

Glass-fiber reinforced plastic(GRP)industry is a very fast growing industry, which yields pipes, tanks and fittings intended for under-ground and above-ground installations and pressure applications. These products are used for municipal and industrial purposes, such as sewers, water distribution, turbine piping and industrial pressure pipes.

These tubings will have evry advantage over metals because of the hazards of corrosion by oxidation and by electrolysis. Moreover, they are electrical non-conductors and they provide great protection to the elctrical and telephome cables. They, in addition, need not be maintained, while metallic pipes should be sandblasted and painted at regular intervals. Also, a metal storage tank is very limited as to the liquids that may be stored in it, where a polyester pipe has a much wider range of resistance to fuels and chemicals.

The GRP industry is one of the recently introduced industries in Egypt, and uptill now no study for the health hazards of such an industry has taken place.

In this industry, simply, polyesters are reinforced with glass-fiber strands which are held together by adhesive resin binders. The polymers formed are cured rapidly by the intervention of a small quantity of catalyst.

The polyesters are supplied as solution in styrene which provides cross-links; fillers and reinforcements are added.

A general purpose formulation for polyester may be described briefly as an unsaturated polyester dissolved in styrene.

The styrene crosslinks the polyester, though it is equally logical to say that the polyester crosslinks the styrene.

The structure of the cured polyester is suggested by figure(I) (Doyle E.N., 1969).

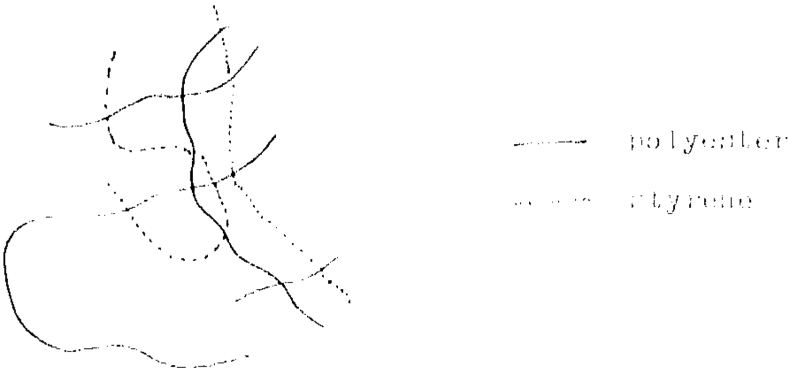


Fig.-I- Typical cross-linked structure of a polyester.

The GRP industry entails the use of many chemicals which may be toxic eg. styrene, polyester resins, glass-fibers, organic peroxides, cobalt and methyl ethyl ketone, etc.
Styrene was chosen as our target chemical of study, for it is the most significant exposure in the factory and the most serious at the same time.

This study took place in the Arabic Company for Development Materials which is located 14 kilometers from El-Maadi district.

Objectives of the Study

OBJECTIVES OF THE STUDY

Many chemicals which might be toxic are used in the glass - fiber reinforced plastic industry. Amongst these chemicals is styrene which is the most toxic, and it forms the [illegible] most significant exposure in the factory.

The objectives of this study are to:

1. study the health hazards of exposure to styrene, and to
2. find out a practical, specific and simple method for monitoring exposure to styrene in the plant.

It is well known that workers allover the world dislike the use of personal protective measures. This is true for all types of industries, and this decreases the value of these measures in prevention . Thus, the most reliable preventive measures are those which do not depend on workers co - operation. This could be easily achieved through determination of styrene or its metabolites in the biological fluids, and in the work environment.

REVIEW OF LITERATURE

LITERATURE REVIEW

History

Styrene (phenylethylene, vinylbenzene, styrol, cinnamene) is the simplest and by far the most important member of a series of unsaturated aromatic monomers. Styrene is used extensively for the manufacture of plastics , including polystyrene, rubber - modified impact polystyrene, acrylonitrile - butadiene - styrene terpolymer(ABS), styrene acrylonitrile copolymer (SAN), and for the production of SBR-type synthetic rubber (styrene butadiene).

Commercial manufacture of the monomer began on a small scale shortly before the World War II. Since that time the production of the monomer has shown enormous growth and is expected to reach five billion Ib annually by I970 (encyclopedia of plastic technology, Vol.I9 , 55, I972).

Styrene was first isolated in the nineteenth century from the distillation of storax (a natural balsam).

Although styrene was known to polymerize, no commercial applications were attempted for many years because the polymers were brittl and cracked easily. The simultaneous development of a process for the manufacture of styrene by the dehydrogenetion of ethyl benzene by the Daw Chemical Company and Badische Anilin-and Soda Fabrik AG (BASF) represented the first real breakthrough in styrene technology.

In I937 both of these companies were manufacturing a high purity monomer which would be polymerized to a stable, clear, colorless plastic.

During World War II, styrene became very important in the manufacture of synthetic rubber and large-scale plants were built .Later, peacetime uses of styrene-based plastics have accounted for the continuing rapid growth of the industry.

Production of styrene:-

Higher yields of styrene are obtained by cracking iso-propyl benzene. Styrene is also produced by cracking crudeoil (Laurance T., Fairhall, 1957).

Commercially, styrene is produced from ethylbenzene, for which latter substance a variety of commercial processes of production exist. Ethylbenzene is catalytically dehydrogenated to styrene at high temperatures, yields of 50-80 % are thus obtained.

Styrene in nature:-

Styrene occurs naturally in the sap of styraceous trees and can further be obtained from various pyrolytic oxidation products of organic substances, in particular hydrocarbons, for certain by-products of petroleum cracking and petroleum derivative pyrolysis; from coal tar and from shale oil.

Physical properties of styrene

Pure styrene is a colorless or yellowish oily liquid, with a pungent penetrating aromatic odor. It polymerizes [illegible] glass-like solid which also has the characteristic odor (L[illegible] T.F., 1957).

The physical properties of styrene monomer are given below in the following table .

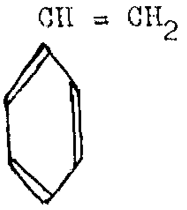
Physical Properties of Styrene Monomer

(encyclopedia of plastic technology, Vol. 19, 56, 1972)

Property	Value
Molecular weight(M.W)	104.14
Specific gravity(S.G.)	0.[illegible]
Boiling point(B.P), at 760mmHg, °C	145.0
Melting point (M.P), °C	[illegible]
Fire point, °C	[illegible]
Flash point, °F	[illegible]
Vapour pressure(V.P)	[illegible]
	10mmHg(30.[illegible]°)

Chemical properties of styrene

Styrene (also known as monomeric styrene, phenylethylene, vinylbenzene or cinnamene; cinnamol)is one of the vinyl monomers having the following formula [C_6H_5-CH-CH_2 or C_8H_8]



From the hygienic point of view, styrene might be considered a solvent, although it is used as starting material for polystyrene and as a modifier of polyester plastic.

The existence of the double bond in the vinyl group gives styrene great reactive potential. Styrene polymerizes to a glass mass of a "metastyrene" on standing & it is a common practice to add 3% hydroquinone to styrene to inhibit polymerization during storage or transport. In addition to polymerization, styrene also undergoes readily all of the normal reactions of a typical unsaturated compound eg. hydration, oxidation, halogenation, etc., especially in the presence of heat or light. Thus, on oxidation with chromic acid, it yields benzoic acid and on hydrogenation with platinun-block catalyst,it yields ethyl cyclohexane (Laurance T.F, 1975).

Also,the presence of the double bond in the side chain of styrene significantly increases the irritant properties of benzene ring; however, the general toxic action of styrene is less pronounced than that of benzene.