



CHAPTER I

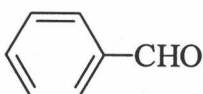
INTRODUCTION

Industrial wastes are the dangerous materials. They take form in solid, gas, liquid or sludge. When not appropriately disposed of, such wastes pose substantial dangers both now and in the future. In the world, the disposal of industrial wastes is a major environmental problem. Recycling and reusing of wastes have been a topic of interest in the fields of science and technology.

In Thailand, the polystyrene plant of Thai Petrochemical Industry (TPI) Co., Ltd. in Rayong alone generates at least 150 metric tons per month of styrene waste. This waste left from distillation of styrene for manufacturing of polystyrene. It placed in sealed container and lay down at the plant. Utilization of this waste is restricted due to large amount of ethyl benzene and the percent of styrene oligomer which increases rapidly upon storage.

Polkit Sangwanich [1] found that 2-phenyl ethanol could be synthesized from styrene waste via styrene oxide in 67% yield. This product is used as fragrance in perfumery, cosmetics, and toiletry. In this study, we would like to convert styrene waste to benzaldehyde, benzoic acid and benzyl alcohol.

Benzaldehyde, C_6H_5CHO is colorless liquid with an odor of bitter almonds. It is the simplest and industrially the most importance aromatic aldehyde.



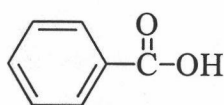
Mr 106.13

m.p. $-56^{\circ}C$

b.p. $179^{\circ}C$

The best known natural source of benzaldehyde is amygdalin, which exists in combined form as a glycoside and presents in bitter almonds. It is an importance starting material for the manufacture of odorants and flavors. The compound is responsible for the odor of natural bitter almond oil and is incorporated directly in perfumes, soaps, foods, drinks and other products. Substantial amounts are used in the production of derivatives, that are also employed in the perfume and flavor industries. In the pharmaceutical industry, benzaldehyde is used as an intermediate in the manufacture of chloramphenicol, ampicillin, and other products. Benzaldehyde is used in photochemistry, as a corrosion inhibitor and drying auxiliary, in the electroplating industry, and in the production of agricultural chemicals.

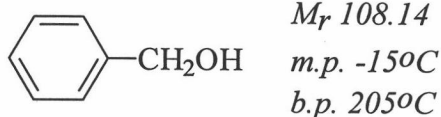
Benzoic acid, C_6H_5COOH is white monoclinic crystals. Benzoic acid and its derivatives are widely distributed in nature. Gum benzoin contains from 12-18% benzoic acid in free and esterified form. Other natural products containing benzoic acid are the bark, foliage, fruits, and seed of various plants, including cherries and prunes.



M_r 122.12
 $m.p.$ 122°C
 $b.p.$ 250°C

More than half of the benzoic acid produced is utilized captivity to produce phenol and caprolactam. Glycol esters of benzoic acid are used as plasticizer for vinyl resins. Benzoic acid is added to alkyd resins used for surface coating; it acts as a regulator controlling the extent of polymerization and improving the surface properties. Other uses of benzoic acid include intermediates for dyes, herbicides, pharmaceuticals, food additive, and perfumes [2].

Benzyl alcohol, $C_6H_5CH_2OH$ is a colorless liquid with a faint aromatic odor and mildly irritating effect on the mucous membranes. It is the simplest and also the industrially most important aromatic alcohol.



Benzyl alcohol occurs in nature both free and in combined forms. In the latter case it exists as esters of acetic, benzoic, salicylic, and cinnamic acids. It is known to occur in the balsams of Peru and Tolu, in the flower oils of hyacinths and wallflower, in ylang-ylang oil, and in other essential oils. Benzyl alcohol is an important solvent for surface coating materials and resins. In the textile industry, it is used as an auxiliary in the dyeing of wool, polyamide, and polyester. Because it has only a relatively faint odor, it is used as a solvent and diluting agent in the manufacture of perfume and flavors. In color photography it is increasingly important as a development accelerator. In pharmacy, it is used as a local anesthetic and, because of its microbicidal effect, as an ingredient of ointments and other preparations. Benzyl alcohol is a starting material for the preparation of numerous benzyl esters that are used as odorants, flavors, stabilizers for volatile perfume and plasticizers [3].

Objective and scope of study

The objective of this study was to add value of styrene waste by conversion to useful products. The study was performed via ozonolysis of styrene waste to benzaldehyde, benzoic acid, and benzyl alcohol.

Benzaldehyde was prepared by ozonolysis of styrene waste and followed by reduction of ozonolysis products with Zn-acetic acid mixture. The oxidation of ozonolysis products with hydrogen peroxide and acetic acid was used for preparation of benzoic acid. Benzyl alcohol was obtained by catalytic reduction of ozonolysis products, platinum on charcoal was used as catalyst. The optimum conditions were studied.