Epoxy Formulation for Industrial Floor Coating

Chanchai Thongpin[1,2], Vithaya Pengjam[1], Veerasak Arun[1], Siri Bumpeum[1] and Narongrit Sombatsompop[3]

[1] Materials Science and Engineering Department, Faculty of Engineering and Industrial Technology, Silpakorn University, Sanamchandra Palace Campus, Nakon Pathom, 73000. Thailand.
[2]National Center of Excellence for Petroleum, Petrochemicals and Advanced Materials, Bangkok, Thailand.
[3] Polymer PROcessing and Flow (P-PROF) Research Group
School of Energy, Environment and Materials
King Mongkut's University of Technology Thonburi (KMUTT)
Bangkok, 10140, Thailand.
**corresponding author;chanchai@su.ac.th*

Abstract: Although the ready to use epoxy resin for industrial floor coating is available in the market, many companies have tried to formulate their own qualified epoxy formulae for floor protection and an easiness to clean floor, in some specific industries. The two grades of epoxy, i.e. R-7040 and R-7035 are generally available. This study was aimed to formulate the epoxy coating for the industrial floor, using cheap grade of epoxy resin. YD-515 epoxy was used as the matrix. Silica powder and calcium carbonate ($CaCO_3$) were used as reinforcement fillers. The silica powder contents were varied from 5, 10, 15, 20, 25 and 30% by weight of epoxy, giving the composites of epoxy reinforced with silica powder. The mechanical properties of the prepared composite; i.e. impact strength, compressive strength and hardness were then determined. The distribution and dispersion of the filler in the composites were also evaluated. The compressive strength of the composites were found to be 99.42, 108.66, 97.34, 92.50, 79.24 and 74.24 MPa, and the impact strength were found to be 3.32, 2.73, 2.30, 1.62, 1.55 and 1.61 kJ/m^2 respective to the silica powder contents mentioned earlier. Comparing with the reference resin in terms of their cost and properties, composites with the silica content at 15 % was chosen to use as R-7040 supplement. Then the composite with the silica content of 20 % by weight was chosen for further study. The impact strength of the composite was then to be improved by the addition of calcium carbonate. The various amount of $CaCO_3$, i.e. 5, 10, and 15% by weight were added. It was found that the composite containing $CaCO_3$ 15% by weight could be used in supplement of R-7035 for their best properties and economic reasons. From this research, it was found that the formulated epoxy resins were better than the commercially available resin, in terms of properties and cost.

Keywords: Epoxy Floor coating, SiO_2, $CaCO_3$, Compressive strength, Impact Strength.

1. INTRODUCTION

Concrete floor for an industry is a system with the function of sealing the industry building for a long time. Not only that, the industry floor also functions as loading and unloading area, stand working area. Floor surface must function against a series of factors like light, water, temperature, corrosion, abrasion, etc. The floor coating in concrete structures are used in order to improve the several durability, suc as scuff resistance, slip resistance, chemical resistance and abrasion resistance. The chemical resistance and cracking are important properties that would be needed for the heavy duty floor, loading and unloading product are the most cases. Epoxy is one of the most coating which is resistant to chemical and cracking where the microorganism can infect the concrete surface. The infection with microorganism should be avoided fot the food and related industries.

Epoxy resin is one of the most important surface coating resin that has been widely used due to its excellent strength, good acid and base resistance and great adhesion with substrate. Yaping Zhang [1] mixed SiO_2 nano-particles into epoxy resin and dispersed the particle using ultrasonic. It was found that impact strength of epoxy resin increased 56 % with the content of SiO_2 nano particle at 3 % wt content. Tensile strength and modulus of the epoxy also enhanced for 114 % and 12.6 % respectively. The effect of nano-size and micro-size TiO_2 on epoxy were also studied by Ng [2]. The TiO_2 particles are also simply dispersed in matrix resin by ultrasonic. It was found that at the 10% wt content of nano-TiO_2 improved Young's modulus, strain at break, whereas, the present of micro-TiO_2 particles in epoxy matrix decreased the values. It was also reported that abrasion resistance of the composites could be improved for both fillers. Yu and Wang [3] researched nano-calcium carbonate modified epoxy for coating. They found that $CaCO_3$ was very well dispersed in epoxy matrix during coating process leading to good tensile properties and corrosion resistance.

In Thailand, the ready to use epoxy resin for industrial floor coating is available in the market, many companies have tried to formulate their own qualified epoxy formulae for floor protection and an easiness to clean floor, in some specific industries. The two grades of epoxy, i.e. R-7040 and R-7035 are generally available. This study was aimed to formulate the epoxy coating for the industrial floor, using cheap grade of epoxy resin and enhance the properties by SiO_2 and $CaCO_3$.

2. METHODOLOGY

2.1 Materials

2.1 Materials: Epoxy resin, part A, grade 7040 and 7035 were kindly provided by Zos's Engineering. Co. Limited (Thailand), together with hardeners, part B, grade 7040 and 7035. These resin systems were used as reference. The epoxy resin, grade YD 515 and polyamide hardener, provided from Thai Epoxy group were use to formulated epoxy coating. Nano-SiO_2 was provided from Siam Silica Company, CaCO3 and bis-(3-triethoxysilylpropyl) tetrasulfane (Si69) were kindly provided by Innovation Group Co. Limited.

2.2 The Preparation of Epoxy Composites: The various amount of Si-69 treated SiO2, i.e. 5, 10, 15, 20, 25 and 30 % by weight, were mixed into epoxy resin, grade YD515, using mechanical stirrer until the silica was totally dispersed. The mixture was degassed in vacuum oven at room temperature. The hardener, with the ratio of 1:1 to the epoxy resin, was then mixed into the