CHAPTER 1
INTRODUCTION

Properties of the fiber/matrix interface are related to the behavior of fiber reinforced cement-based composites. There are several surface modification techniques to increase the fiber/matrix bonds such as chemical modification, corona treatment, grafting polymerization and plasma treatment. All of these techniques will improve interfacial strength directly because the processes generate polar or functional chemical groups on the fiber surface. The presences of polar groups enhance the surface reactivity with the matrix in order to promote excellent adhesion. However, these techniques require special equipment and gas phase processing that is difficult to control. Therefore, admicellar polymerization (polymerization of monomer solubilized in adsorbed surfactant aggregates) is a potentially useful process for improving the polymer surface hydrophilic property, especially in the composite material strength. Also, the polymerization is carried out in the liquid phase with no special equipment need.

Admicallar polymerjzation can be devided into four steps: admicellar formation, monomer adsolubilization, polymer formation, and surfactant removal as illustrated in Fig. 1.1.

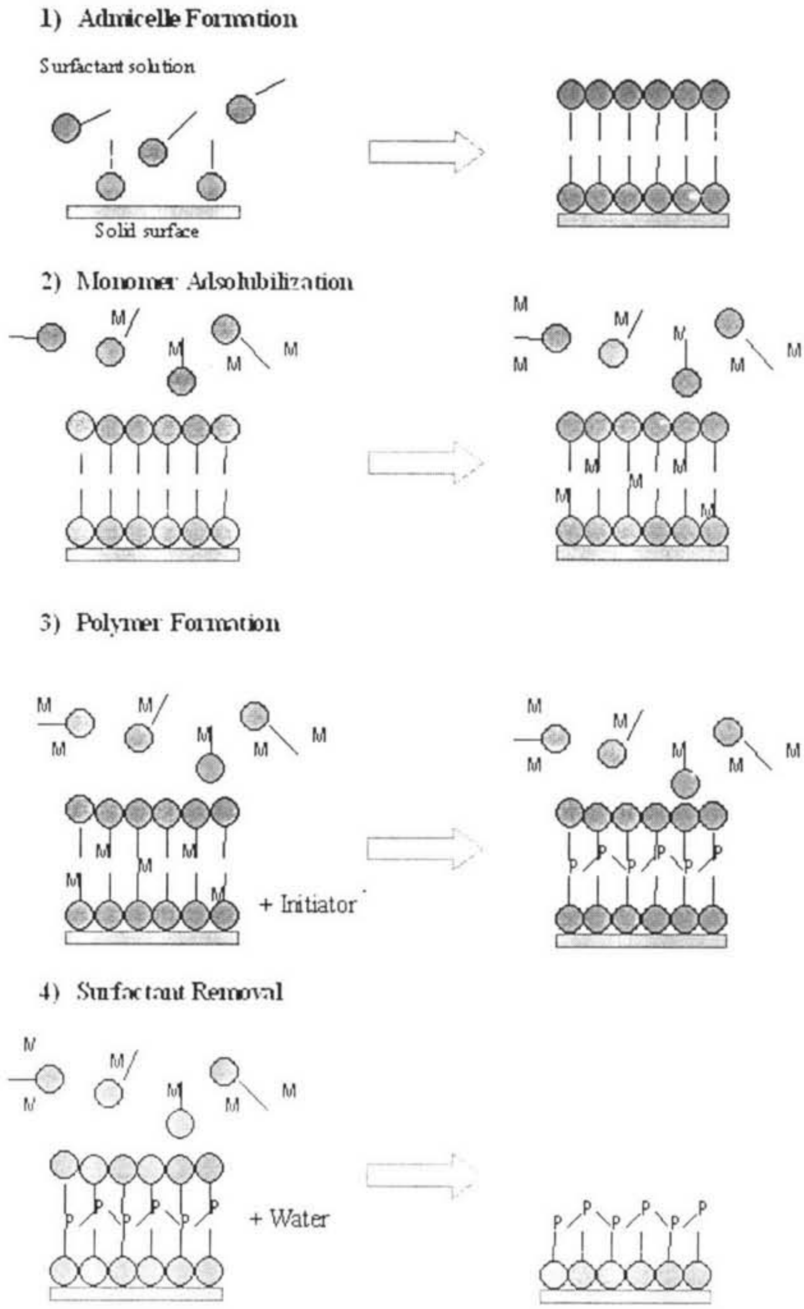

Figure 1.1 Admicellar polymerization process.

Step 1: Admicellar Formation

The adsorption of surfactant at the solid/liquid interface which forms admicelles (bilayer) is controlled by solution conditions and surfactant concentration. The adsorption isotherm of ionic surfactants onto a substrate surface can be divided into four regions as shown in Figure 1.2.

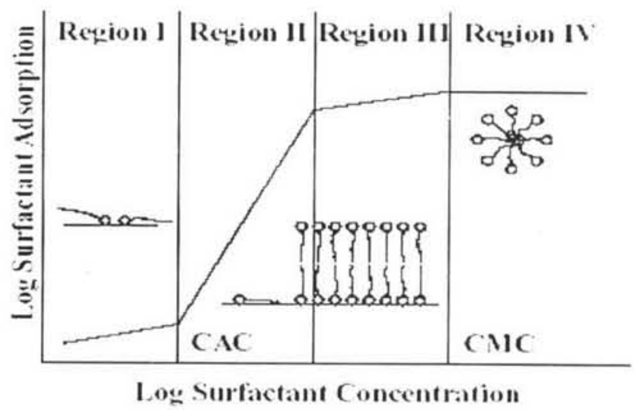

Figure 1.2 Adsorption isotherm of surfactants on a solid surface.

This curve is a plot between log of adsorbed surfactant versus log of equilibrium surfactant concentration which can be used to obtain the appropriate concentration of surfactant for admicellar polymerization process. In order to prevent emulsion polymerization, equilibrium surfactant concentrations that are below the critical micelle concentration (CMC) are required.

The electro chemical nature of the substrate, the type of surfactant molecule, pH of solution, and added counterion control the adsorption of the surfactant on the substrate surface. At pH values below the PZC (point of zero charge), surface of the substrate is positively charged; above the PZC, surface of the substrate will be negatively charged. Consequently, anionic surfactants will adsorb well at pH of the solution below the PZC and cationic surfactants will adsorb well at pH of the solution above the PZC. An electrolyte can also be added to reduce the charge on the surface, which may affect the adsorption of ionic surfactants. The important parameters that need to be manipulated are pH value and counterion concentration. Counterions help to reduce the electrostatic repulsion between the incoming ions and the like-charged head groups of surfactants on the surface to promote the dense adsorption of surfactants.

Step 2: Monomer Adsolubilization

When organic monomer which sparingly soluble in water is added to the system, it will preferentially partition into the organic interior of the admicelle. Adsolubilization can be done simultaneously with admicelle formation, or subsequent to it.

Step 3: Polymer Formation

For free-radical polymerization, an initiator capable of generating radicals is added to the system. Water soluble or water insoluble initiators can be used.

Step 4: Surfactant removal

After completing polymerization, accessible surfactant is removed in order to expose the polymer-modified surface.

Polyester fabric is widely used to as a reinforcing material. However, polyester fabrics have several serious drawbacks in reinforcement applications because of poor adhesion to the polar matrix. To overcome these problems, thin films of polar polymer can be introduced onto polyester fabric using admicellar polymerization technique can increase the adhesion between surface substrate and cement matrix. The surface modification is expected to provide a good wetability and low contact angle (high surface energy) and thus better adhesion between the fiber matrix and continuous concrete phase in order to enhance toughness, the energy absorption capacity of composites. It should also help to reduce the cracking sensitivity of the composite.

In this research work, a thin film of poly(acrylic acid) (PAA) was introduced onto the hydrophobic polyester fabric surface. After the polymerization reaction, the PAA-coated polyester fabric introduces carboxylic groups to the surface of the fabric to improve the hydrophilicity of the polyester fabric. The study will be focused on the optimum solution conditions and surfactant concentration, adsorption isotherm, morphology of surface, and interaction between the thin film surface on the polyester fabric and cement matrix.