CHAPTER II
LITERATURE REVIEW

Poly(ethylene terephthalate) is a linear, hydrophobic polymer commonly used for geotextile application. It has excellent toughness and dimensional stability. However, Its hydrophobic nature can be disadvantage for adhesion between the fiber and matrix. Insufficient adhesion between hydrophobic fiber and hydrophilic matrix results in poor mechanical properties of the composites.

Adhesion Mechanism

Adhesion between fiber and matrix can be attributed to some combination of the following mechanisms.

1.) *Adsorption and wetting:* it is essential that the fibers be wet by the resin during the manufacturing process.

2.) *Chemical bonding*: the strength of the final bond will reflect any chemical reaction that has occurred between fiber, fiber coating, and resin during processing.

3.) *Mechanical adhesion:* bonding of the matrix to the irregular surfaces characteristic of some carbon and organic fibers can occur via mechanical interlocking.

4.) *Inter diffusion:* it is possible for the molecules of one surface to diffuse into the other, resulting in the formation of a bond.

5.) *Electrostatic attraction:* adhesion between fiber and resin may be promoted, at least initially, by a difference in electrostatic charge between the two materials.

Synthetic Fiber Reinforced Cementitious Composites

Wang, Backer, and Victor (1987) conducted an experimental program on the properties of various synthetic fiber reinforced cementitious composites and the properties of the reinforcing fibers. Acrylic, polyester and aramid fibers were tested

in uniaxial tension, both in their original state as well as after ageing in cement. The properties of concrete, apparent ductility, were found to be greatly improved by the inclusion of such fiber reinforcement.

Long Paul, and Lampo report on the bond strength between geotextile and concrete(1989). Concrete and geotextile were bonded by placing fresh concrete on a geotextile and allowing it to cure. The influences of construction, geotextile, concrete, and load on bond strength were examined using peel test. Concrete penetration into the textile was the major factor affecting bond strength. Penetration was dependent on fiber geometry, and was increased by vibration during curing. Woven geotextiles bonded least strongly unless geometric projections were provided.

Kanda and Li (1998) studied the characterization of fiber-matrix interfacial properties and the apparent strength of hydrophilic fibers. Single-fiber pullout test showed that these fibers had surprisingly high chemical and frictional bond strength. The chemical bond strength was relatively stable independent of a water-to-cement ratio of matrix and the fiber type tested, contrary to the friction bond strength. The pull-to-rupture strength tests revealed that the apparent of the PVA fibers in the cementitious composites was considerably lower than that in standard fiber strength tests. The apparent was further reduce with inclining angle of fiber alignment. This effect was captured by a single phenomenalogical model in this study, which introduce the apparent strength reduction factor. The combined effects of high bond strength and degraded fiber strength would likely contribute to composite performance less than would be expect from a high-performance fiber.

Surface Modification

The effect of plasma treatment on the interface bond properties of polyethylene fibers in cement based on both single fiber pull-out test and uniaxial tensile test of composite was studied by Li, Wu, and Chan (1996). The presence of polar groups on the fiber surface enhance reactivity and thus improves the adhesion between fiber and cement. Also, wettability of fiber surface by cement were

enhanced, leading to increased contact between fiber and the surrounding cementious matrix.

Simor, Rahel (2003) investigated atmospheric-pressure plasma treatment of polyester non woven fabric hydrophilic and facilitate absorption of palladium catalyst in order to provide a catalytic surface for the deposition of electroless nickel. The result obtained show that an extremely short 1-s plasma treatment was sufficient to hydrophilize the fabric fibers surface and to obtain a clear improvement in the nickel plating uniformity and adhesion.

The surface chemical and physical modifications of PET fibers induce by radio frequency air plasma treatment (Riccardi, Barni 2003), RF air plasma treatment of PET fibers led to an increase in their hydrophilicity. Best and more durable wettability results were obtained under high RF power and under negative polarization of treated samples, i.e. under condition in which the implantation polar groups on the PET surface, evidenced by XPS analysis, was accompanied by extensive surface etching and possibly cross-linking between activated species.

The adhesion strength between PET fibers and styrene-butadiene rubber (SBR) was studied Krump, Simor, Hudec Jaso, Luyt (2005). When washed and treated in plasma, a substantial improvement in adhesion strength was observed. This confirmed that the plasma streamers caused the creation of a new, relatively stable chemical species on the polymer surface. Results suggested that the surface modification of PET fibers by plasma treatment at atmospheric gas pressure was a suitable and technologically applicable method for the improvement of adhesion strength of polyester reinforcing material to rubber.

Xu, Liu (2003) investigated the surface modification of polyester fabric by corona discharge irradiation. Good hydrophilic property was observed around 10 kV when the fabric was treated at speed of 5cm/min. The hydrophilic property could be preserved for a long time. After the treatment, dye-uptake ratio and dying speed were also improved, these results showed that the polyester yarn could be sized with modified starch effectively, thus it could take the place of PVA which is widely used in the textile industry.

Ibrahim, Salmawi (2005) studied electron-beam modification of textile fabrics for hydrophilic finishing. This study were carried out to modify different

textile fabrics such as cotton, cotton/polyester blend nylon-6 fabrics by surface coating with a constant thickness layer of 25mm of aqueous solution of polyvinyl alcohol (PVA) and acrylic acid (AAc). Radiation curing of surface coating was accomplished by electron beam irradiation with a constant dose of 50 kGy. An attempt was made to prepare different coated textile fabrics in order to increase their water uptake. Also, this study led to obtain modified types of textile fabrics that would acquire a good hydrophilic property after being coated with different formulations. The durability of the coated layer to washing cycle was also studied. From the results, it was found that durability of the coated formulation was improved toward washing cycle. Moreover, the color strength of all fabrics toward basic and reactive dye was increased and SEM micrographs confirmed the complete adhesion between the coating formulation and all treated fabrics.