Chapter 1

Introduction

Cellulose is the most abundant natural polymer and one of renewable materials, which have diversified applications. For many centuries it has served mankind as a polymer construction material, mainly in the form of intact wood. Paper is also produced from wood pulp, a short cellulosic fiber. Cotton and flex are the main source of long cellulosic fibers used in textile industry. Moreover, cellulose is a versatile starting material for subsequent chemical conversion, aiming at the production of artificial cellulose–based threads and films as well as of a variety of stable soluble cellulose derivatives to be used in many areas of industry and domestic life.

Cellulosic fibers have many important properties: physical properties, such as moisture uptake, tensile strength, elasticity and luster. Chemical properties include their resistance to various chemicals commonly employed in bleaching and other processes and their dyeability. Currently, many dyes have been employed for dyeing cellulosic fibers such as direct, vat, sulphur, and reactive dyes. Each dye has both advantages and disadvantages, for example, an ease to dyeing but poor wet fastness in case of direct dyes on cellulosic fiber, using a reactive dyeing usually consumes large amount of salt and high concentration of unfixed dyes and salt in the effluent.

Many researchers have been trying to find the best methods for the best results in dyeing of cellulosic fibers, such as dyeing with a heterofunctional reactive dye, improving of machinery and modification of cellulose. As for the modification of cellulose there are several approaches in producing modified dyeability of cotton itself. For example, Ueda and Tokino [(1)] introduced physico-chemical modifications of fibers, such as plasma treatment and UV-irradiation for altering surface properties, such as the handle, water repellency and the colour depth of fabrics.

To be presented here is the alternative approach in incorporating high molecular weight polymer into cellulose structure without requirement of chemical bond. In-situ polymerization of carboxylic acid containing monomers in amorphous region of cellulose fiber using oil-in-water microemulsion technique will be investigated. Carboxylic acid containing monomers such as acrylic acid or methacrylic acid is preferable since their polymeric forms could alter the original cellulose properties, for example, water retention capacity and dyeability with basic dyestuffs. Particularily the dyeability with basic dyes could not be satisfactorily achieved in typical cellulosic fibers. The use of oil-in-water microemulsion is aimed at carrying the water-insoluble initiator such as AIBN or BPO into amorphous region of cellulose. Oil-in-water microemulsion could be prepared by high speed stirring of benzene, cetyltrimetylammium bromide (CTAB), and water with the additional propanol as a co-surfactant. Microemulsion droplets are so small, normally less than 100 nm in size. The CTAB is cationic surfactant chosen in this experiment for the reason that its cationic characteristic could promote the adsorption of microemulsion droplets into cellulose due to the opposite attraction force between cationic surfactant and negative charged fiber surface. Once cotton fiber is immersed in microemulsion solution it is expected that microemulsion would diffuse inside the fiber and bring the water-insoluble initiator into the amorphous region. Then a carboxylic acid containing monomer is added into the system and heat is applied to the certain temperature to initiate the radical polymerization. As the result, the entangled high molecular weight polymer produced inside the fiber could be retained firmly with in cellulosic structure without requirement of any chemical bond.

The scope of this experiment comprises three parts. Firstly, oil-in-water microemulsion will be prepared and its particle sizes are measured by light scattering technique. In-situ polymerization of methacrylic acid is carried out. Graft polymerization of methacrylic acid using potassium persulfate is also performed for comparison purpose. Characterization of in-situ polymerization inside cellulose is done by FTIR. Secondly, the treated cotton is dyed with basic dyes by exhaustion method in the absence of any auxiliaries. The percentage of dye exhaustion and the degree of dye fixation will be determined spectrophotometrically. Finally, the properties of modified cotton such as moisture regain, basic dyeability and fastness properties including washing fastness and light fastness and distribution of dyes inside cotton will be discussed.