ABSTRACT

The advent of synthetic yarns dawned a new era in the textile world. Poly(ethylene terephthalate) or PET or polyester is one of the most important synthetic fibres due to its high strength, elasticity, abrasion resistance, durability, crease recovery and good resistance to chemical, biological and environmental degradations. They have scored over natural fibres as regards their light weight and ease of care properties. A significant drawback of polyester material is its hydrophobic nature. The PET fibres do not absorb water as do natural fibres like cotton. The fabric worn next to skin should absorb perspiration and facilitate heat exchange with the surroundings. Hence there is a need for extensive investigation in improving hydrophilicity of PET fabric.

It is rather difficult to modify the surface properties of polyester material due to its crystalline structure and deficiency of reactive groups. Of the various methods suggested, alkali treatment is commercially viable. In this study an attempt is made to improve hydrophilicity of polyester fabric by employing concomitant effect of sodium hydroxide and poly(vinyl alcohol) on PET fabric by two methods. Poly(vinyl alcohol) or PVA, is a non-toxic synthetic polymer with good physical and chemical properties and film-forming ability with relatively a simple structure of pendant hydroxyl groups. Modification of the PET fabric surface without involving hazardous organic solvents and achieving permanent hydrophilic character is the advantage of the chosen method.

In the first method a single stage treatment of PET fabric with PVA in alkaline medium was carried out. The PET fabric was treated with a solution of Poly(vinyl alcohol) in alkaline medium at boiling temperature. The treated fabric was washed with hot water to remove physically held PVA. The moisture related properties of the fabric, tensile strength, spectral analysis, thermal studies, dyeability of fabric with disperse dyes, basic dyes and reactive dyes were assessed. The PET fabrics treated with sodium hydroxide alone, under similar experimental conditions, were taken as control fabrics with which the performance of PVA treated PET fabrics were compared. Experiments were carried out using ten different concentrations of PVA and sodium hydroxide. Based on the performance of treated fabrics, the treatment of PET fabric with 1.5% (w/v) PVA solution in 1 N sodium hydroxide at boil were considered as the optimum condition.

The permanency of the presence of PVA on PET was confirmed by spot test after successive washings. The PVA treated PET fabric tested with a drop of boric acid and a drop of iodine solution developed a blue colour, confirming the presence of PVA. The PVA treated fabric showed improved wettability, moisture regain, water retention and wickability. The water contact angle of the PVA treated, control and untreated PET fabrics were found to be 67.31º, 116.75º and 124.24º, respectively. The dyeability of the fabric showed improvement with both disperse and reactive dyes. The SEM photograph and ATR-FTIR spectra of the fabric revealed the presence of PVA. Melting temperature and heat of fusion of the treated fabric decreased as indicated in the DSC traces. Analysis of moisture related properties and

reactive dyeing of the fabric revealed that high molecular weight PVA was giving better results compared to low molecular weight PVA.

In the second method, application of PVA on PET fabric using a two stage process was carried out. PET fabric was first treated with 1 N sodium hydroxide at boil for one hour. The sodium hydroxide treated fabrics were padded with PVA solution along with glutaraldehyde, magnesium chloride and acetic acid by a 3-dip/3-nip process, dried at 100^{o}C, cured at 150° C for 3 minutes. The treated samples were soaped to remove physically held PVA.

To assess the effect of glutaraldehyde on polyvinyl alcohol fixation, PET fabrics were padded with different concentrations of glutaraldehyde, magnesium chloride(10gpl) and acetic acid (0.1%), dried at 100^{o}C, cured at 150° C for 3 minutes and washed. The treated PET fabric showed improved wettability, water retention and wickability. The dyeability of PET fabric with reactive dye showed considerable improvement. This observation substantiates the presence of polar hydroxyl functional groups on the treated fabric surface. The dyeability of fabric with disperse dye was hindered by this treatment as indicated by a low K/S value. The tensile strength of the fabric was found to increase after PVA treatment.

The SEM photograph of treated fabric revealed the presence of PVA. The ATR-FTIR spectra of the PVA treated PET fabric showed a broad band in the region 3435 cm^{-1} which revealed the presence of hydroxyl groups. Study of moisture related properties, dyeability and spectral analysis showed

that high molecular weight PVA showed better binding with PET fabric compared to low molecular weight PVA.

The pre-treatment conditions were varied and the PET fabrics were treated with varying concentrations of NaOH solutions. PVA was applied on these control fabrics by pad dry cure method. Based on the performance of treated fabrics it is clear that the optimum pre-treatment condition for applying PVA on PET fabric is treatment with 1 N NaOH giving a weight loss of about 5.77 %.

The PET fabric was given a commercial hydrophilic finish, Hydroperm RPU using pad dry cure method. The moisture related properties and dyeability of the finished fabric were assessed and compared with PVA treated fabric. PVA treatment is giving improved hydrophilic character to PET fabric comparable to the commercial finish. One added advantage of PVA treatment is that the treated PET fabric can be dyed using a reactive dye.

A similar study was carried out on cotton and polyester/cotton blend fabrics using PVA and glutaraldehyde for investigating the possibility of dyeing of polyester/cotton fabric using reactive dye in a single bath. It was observed that PVA treatment improves the dye uptake of polyester/cotton blend fabric.

From the work carried out it could be concluded that treatment of polyester fabric with poly(vinyl alcohol) promises a new method to improve its hydrophilicity.