ABSTRACT

The main aim of the current research work is to study the effect of plasma pretreatment on multifunctional finishes and the influence of a bio culture of Lactobacillus acidophilus on effluent. The raw materials of cotton, viscose and polyester fabrics were selected on the basis of non-toxic, non-allergic and non-carcinogenic effect which is suitable for the current research study. Many functional fabrics for different applications having different yarn counts in warp and weft vary from 29.5 to 7.4 Tex. Hence for this research work, an attempt has been made with nominal count of 14.76 Tex. Based on the sustainable product point of view cotton, viscose and polyester fabrics were selected for the plasma pretreated multifunctional finished fabrics. Also, it is noticed that the plain structured fabric has many advantages such as simple and tightest woven structure which is more suitable for multifunctional finish treatments. Chitosan, TiO2 and ZnO are commonly used to impart multifunctional finishes as they have eco-friendly properties.

The effect of air and oxygen plasma pretreatment was imparted to cotton, viscose and polyester fabrics and their results were observed in this research work. In this regard, their characterization was also compared with the conventional pretreatments. Evaluation of both conventional pretreated and plasma pretreated fabrics were assessed for wettability, wickability, weight loss, surface modification, drape and air permeability. The evaluated results of wettability of plasma pretreated cotton, wickability of plasma pretreated viscose and polyester fabrics show 93 %, 91.1% and 95.6 % improvements over the conventional pretreated cotton, viscose and polyester fabric respectively. Similarly, the evaluated results of weight loss of plasma pretreated cotton, viscose and polyester fabrics show 71.5 %, 73.6 % and 83% lower, the evaluated

results of drape percentage of plasma pretreated cotton, viscose and polyester fabrics show 16.44 %, 18.9% and 14.1% improvement, the evaluated results of air permeability of plasma pretreated cotton, viscose and polyester fabrics show 45.83 %, 56.5% and 203% improvement over conventional pretreated method respectively. Optical microscope was used to observe the surface modifications between the conventional pretreated and plasma pretreated method of cotton, viscose and polyester fabrics. All the evaluated plasma pretreated fabrics improvements of cotton, viscose and polyester was due to (i) removal of contaminants by the surface etching, (ii) the power and pressure parameter that contribute for the improvement in the wettability, and (iii) the surface modifications in the fibres.

Synthesis of Chitosan nano-particles and TiO_2 and ZnO nano-particles was carried out using ionic - gelation technique and the ball milling technique respectively. The characterization of nano particles from the XRD spectra pattern peak and using Debye- Scherrer's equation Chitosan, TiO_2 and ZnO nano-particles sizes are inferred as 7.4 nm, 21.12nm and 3.11 nm respectively. The nano particles on the fabrics have high durability because of smaller nano-particle size. Thus, nano finishes have new and highly improved functions when compared to conventional pretreated fabrics. Application of nano particles on both conventional pretreated and plasma pretreated cotton, viscose and polyester fabrics were carried out. The conventional pretreated fabrics were imparted with multifunctional finishes by the synthesized nano particles of Chitosan, TiO_2 and ZnO.

The air and oxygen plasma pretreated optimized fabrics out of fifty four samples such as CA9, CA18, CA27 and CO9, CO18, CO27 and VA9, VA18, VA27 and VO9, VO18, VO27 were selected to impart multifunctional finished

for cotton and viscose fabrics respectively. Also in air plasma pretreatment polyester optimized fabric PA4 out of eight samples and in oxygen plasma pretreatment the optimized fabric PO6 out of eight samples were selected to impart multifunctional finished using nano particles of Chitosan, TiO_2 and ZnO.

The assessment of both conventional pretreated and plasma pretreated multifunctional finished fabrics of cotton, viscose and polyester were assessed in terms of antimicrobial activity, Ultra Violet (UV) Protection, thermal resistance, physical characteristics and presence of proscribed toxic substances. The assessment of antimicrobial wash durability was found to be above 90% on plasma pretreated cotton, viscose and polyester fabrics. This antimicrobial wash durability remains up to 20 wash cycles in conventional pretreated multifunctional finished cotton and viscose fabrics and 25 wash cycles in plasma pretreated multifunctional finished cotton and viscose when using Chitosan nano particles. In the case of plasma pretreated polyester antimicrobial wash durability remains up to 16 wash cycles in conventional pretreated multifunctional finished polyester fabrics and 20 wash cycles in plasma pretreated multifunctional finished polyester when using Chitosan nano particles. This result shows that 25 % improvement on antimicrobial wash durability of plasma pretreated cotton, viscose and polyester fabrics when compared with antimicrobial wash durability of conventional pretreated multifunctional finished cotton, viscose and polyester fabrics. Similarly, the same antimicrobial wash durability of plasma pretreated multifunctional finished cotton, viscose and polyester fabrics using TiO_2 and ZnO nano particles show 100- 300 % improvement up to 5-15 wash cycles' when compared with antimicrobial wash durability of conventional pretreated multifunctional finished cotton, viscose and polyester fabrics. When compared with the conventional pretreated multifunctional finish, the plasma pretreated

multifunctional finish shows the improvements of cotton, viscose and polyester fabrics 28.4 %, 32.5 % 17.3% and 24.3 %, 24.9 % and 29.1%, in the assessment of UV Protection factor and thermal resistance respectively. The results show that assessment of physical properties such as tensile strength, elongation percentage, wicking, drape and air permeability of plasma pretreated multifunctional finished cotton show marginal improvement of 1.62 to 5.27 %, viscose show marginal improvement of 1.5 to 4.28 %, and polyester show marginal improvement of 1.4 % to 7.06% respectively over the conventional pretreated multifunctional finished viscose and polyester fabrics.

Lactobacillus acidophilus culture was developed and its influence on effluents has been studied. The test results show that Total Suspended Solids (TSS) was reduced to the extent of 91%. Also Total Dissolved Solids (TDS) were reduced to the extent of 74.2 % after the treatment. The Chemical Oxygen Demand (COD) and Biological Oxygen Demand (BOD) of treated effluents were reduced to the extent of 96.3% and 93.3 % respectively. The colors of the effluent in Platinum- Cobalt Scale were reduced to the extent of 70% after the treatment. This is may be due to adsorption and reaction of culture. The characteristics of effluents after treatment were compared with general standards for discharged environmental pollutants recommended by the Central Pollution and Control Board (CPCB), INDIA. All the characteristics of effluents after treatment are highly commendable value when compared to the norms recommended by the Central Pollution and Control Board (CPCB), INDIA. So, it indicates the research work on the influence of *Lactobacillus acidophilus* culture is fit for treatment of effluents. Hence, this is an Eco-friendly treatment and safe guards the environment.