White Cotton Bio-bleaching Saves Costs and Nature

Finest cotton fabric with high water absorption is achieved with chemo-enzymatic pre-treatment

For best dyeing results, high quality white cotton with superior ability to absorb moisture is ideal for enzyme and chemical companies. However, industry standards do not currently offer mild pre-treatment of cotton textile allowing maximum bleaching, whitening, and water absorption. Due to the chemically complex and highly hydrophobic nature of cotton surface, technical improvements are not adequate.

VTT has developed an innovative bio-based bleaching process to remove impurities from the surface of cotton fabric. To achieve better-quality results, different enzymatic treatments with esterases, proteases, and pectinases were performed. Whiteness and wetting properties of raw cotton fabric are affected especially with enzyme mixtures. The chemo-enzymatic pre-treatment method, which involves a chemical bleaching step, guarantees excellent results. Compared with industrial bleaching process, VTT's combined treatment generates equal lightness and wetting properties while enhancing tensile properties. Textile and chemical companies will find this significant breakthrough suitable to their customers' stringent quality standards.

CHALLENGE
Sustainable means to improve the processing and quality of cotton textile

Aside from cellulose, raw cotton contains impurities such as complex organic compounds and complex substances. The purpose of cotton preparation is to remove the non-cellulosic impurities from the cellulosic fibers and increase the wettability and whiteness of the fabric. This improves dyeing performance and subsequent processing steps such as printing and finishing.

Conventional time consuming methods used in scouring and bleaching of cellulose-based textile material use large amounts of chemicals, energy, and water. To avoid environmental damages, the effluents require neutralization or dilution prior to discharge.

The greatest problem occurring during bleaching with peroxide is in the radical reactions of the bleaching compounds with the fiber. This can
lead to a decline of polymerization and eventually to a decrease in tensile strength, especially in the presence of metal ions that act as activators for hydrogen peroxide.

As a remedy, the use of enzymes for bioscouring has been suggested. However, the current enzymatic scouring processes are not effective enough to prepare the fabric for dyeing in batch and especially in continuous processes. The whiteness of the bioscouring material has remained lower than the whiteness obtained by using the traditional processes including alkaline wash. Accordingly, the attempts to combine the bioscouring and bleaching steps are not fully satisfactory, because they still involve alkaline conditions, thus causing strength losses and environmental damages.

SOLUTION

Environmentally safe and commercially feasible pre-treatment

Mild pre-treatment and combined scouring and bleaching composition for cellulose-based textile material developed by VTT answers current industry needs. This efficient method comprises a sequential or simultaneous scouring step with an enzyme composition acting on outer layers of cellulosic fibers and bleaching step with a chemical bleaching agent. The process is environmentally friendly because no causticizing and oxidizing agents are required to achieve the desired lightness and wettability.

Due to the mild pre-treatment conditions, tensile strength of the fabric is better than that achieved with traditional pre-treatment. The new process can be carried out in an environment friendly manner with in neutral and slightly acidic conditions with mild reagents. This effectively results to low concentration, leading to lower chemical, water, and energy consumption than regular pretreatment process involving separate scouring and bleaching steps and using causticizing and oxidizing agents. By using the process of the present invention, production costs are significantly reduced.

KEY INNOVATIONS

The chemo-enzymatic pre-treatment process of cotton is developed as a function of suitable enzyme–bleaching chemical combination, treatment conditions, and others. By combining the processes, precious time, water and energy is saved, dramatically reducing production costs.

The effect of the novel system on ability of cotton for dyeing purposes is very valuable to enzyme and chemical industries. Manufacturing sectors looking for alternative solutions to reduce cost in cotton processing while improving cotton quality at the same time will definitely gain competitive advantage.