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Sodium hypophosphite and nano TiO_2 inorganic catalysts along with citric acid on textile producing multi-functional properties

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ABSTRACT

Nowadays, introducing a textile with multi-functional properties is in a central point of research also application of nano particles can be helpful to reach this goal. Here, nano TiO_2, citric acid and sodium hypophosphite applied on the cotton/polyester knitted fabric to obtain divers features on the fabric. The results revealed an excellent performance of the treatment on diverse properties of the fabric including flame retardancy, anti-pilling, hydrophilicity, self-cleaning, antibacterial and UV protection properties. Increasing the concentration of CA enhanced both the photoactive properties and washing fastness of the TiO_2 treated fabrics. Thermal behaviors of the treated fabrics displayed flame retardant characteristics with high char residue. Also the treated fabrics indicated the higher bioactivity and hydrophilicity with considerable lower pilling rate. This paper revealed a simple method on application of inorganic catalysts with friendly cross-linking agent to introduce multi-functional properties in the blended fiber yarns with knitted structure.

1. Introduction

In the global competition, textile manufacturing companies always try to obtain the significant market share. They are trying to improve the quality of their products by developing new technologies or new products. Also the consumers are demanding textile products with higher performances, even in the usual clothing and home textiles. Therefore, researchers have made attempts to give more functional characteristics to fabrics introducing multi-functional textiles [1].

Nano technology has been used to improve the textile properties and made them with multi-functional characteristics. Thus, application of nano particles on textile materials has been the object of several researches produced finished fabrics with different functional performances [2–14].

Metal oxide nano particles such as TiO_2 are more desirable because of cost considerations. In fact, titanium dioxides are non-toxic and chemically stable under exposure to high temperatures with photo catalytic property [1,12]. Many researches display the application of nano TiO_2 particles for UV blocking, antibacterial and photo catalytic properties [2–18].

The most important properties of textile treatments are durability and washing fastness. Although the nano particles can provide high durability for treated fabrics [16] with respect to conventional materials, but many researchers have tried to improve wash fastness by means of some binders and spacers or other methods [4,19]. Some researchers displayed the attachment of nano TiO_2 on fabric by means of poly carboxylic acids [20–22].

In this study, nano TiO_2 with different concentrations of citric acid as a cross-linking agent applied on the cotton/polyester (35/65) knitted fabric through exhaustion in a simple ultra sonic bath followed by drying and curing. Various features of the treated fabrics including flame retardancy, anti-pilling performance, hydrophilicity, self-cleaning properties, antibacterial, UV protection and washing durability evaluated and thoroughly discussed.

2. Experimental

2.1. Material

Citric acid (CA) and sodium hypophosphite (SHP) purchased from Merck Chemical Co., Germany. Nano titanium dioxide (NTO) applied as a photo-catalyst with the anatase crystalline structure and average particle size of 21 nm from Degussa Chemie Co., Duisburg, Germany. C.I. Reactive Black 5 provided from ex.Ciba Co. (Switzerland). The cotton/polyester (35/65) knitted fabric used with the fabric weight of 195 g/m^2. Ultravon GPN based on sodium alkyl aryl sulphonate and ethoxylated fatty alcohol gifted from ex-Ciba Co. (Switzerland).

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