RESEARCH PAPER | Home Science | Volume : 4 | Issue : 12 | Dec 2014 | ISSN - 2249-555X

Synthesis of Zno Nano Particles for Reactive Dyed Cotton Fabric

KEYWORDS: Cotton, ZnO Nanoparticles, Reactive dye, UV, UPF

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ABSTRACT *The primary requirement of human begins to live comfortably without harm from UV rays. This study reports the UV protection of nano finishing dyed cotton fabric. Zinc oxide nanoparticles are the prototype for non toxic. Nanoparticles were syntheses by zinc acetate dehydrate and sodium hydroxide as a surrogate using wet chemical method. The structure and presence of ZnO were investigated using (SEM) Scanning Electron Microscopy; (FTIR) Fourier transformed infrared spectroscopy and (EDAX) Energy Dispersive X-ray analysis. Reactive dyed cotton fabrics effectiveness of UV blocking treatment measured by the standardized test UV-V is spectrophotometry and the Ultraviolet Protective Factor (UPF) were calculated before and after the treatment of ZnO nanoparticles.*

INTRODUCTION:

Ultraviolet radiation (UVR) is one of the radiations among the electromagnetic spectrum and the major source in the sun. Williams says the UV radiation are cannot see and it feel through human skin and their eyes, It emitted natural or artificial source the radiation with different wave lengths UVA (400-315 nm), UVB (315-280 nm), UVC (280-100 nm) [1]. Generally ultraviolet (UV) radiation affect the human begin and it cause sun burn, wrinkles, lower immunity, premature ageing and cancer. Textile clothing has the ability to protect the skin from these harmful rays. The UV protection levels of fabrics are including weave, colour, weight, stretch and wetness. ZnO nanoparticle (NPs) has UV blocking properties, non toxic nature and Photo catalytic degradation materials. Essentially Zinc Oxide and Titanium di Oxide are chemically stable under exposure in high temperature. Nanoparticles coating application in textiles have large surface area-to-volume ratios that increase the effectiveness of photo catalytic oxidation when compared to bulk material [2]. The analysis of molecules in reactive dye can increase its UV-protection properties. The coloration of cellulose fabrics are specially tailored dyes. UV-absorber auxiliaries could eliminate the necessity of using additional and decrease the number of chemicals used in the dye house [3]. This paper focussed on reactive dyed cotton with ZnO nanoparticles treated fabric. The fibre, fabric structure, color and finishes are very important to fulfil UV property requirements. The measurements of UV transmittance through a fabric were used to determine the UV protection ability by the ratio of Ultraviolet protection factor (UPF).

MATERIALS AND METHODS:

***Synthesis chemical Method of Nano particle preparation*:** Zinc acetate dehydrate (99% purity) 20gm was dissolved in 1000ml of distilled water under vigorous stirring at room temperature. Magnetic stirrer was used for continuous stirring at 60 ˚C high speed rate. Aqueous 2M NaOH was added drop by drop to reach until pH 12 for 2hrs stirring. After finishing point of reaction, the white precipitate formed. The pale white precipitate taken out and washed over and over again with distilled water followed by get free of the impurities. ZnO synthesis nanoparticle precipitate was dried in a hot air oven for about 48 hrs 60 ˚C. Complete conversion of Zn $(OH)_2$ into ZnO NPs get position for the duration of drying.

Fabric Coating with Nanoparticles: ZnO nanoparticles apply the reactive dyed fabric in pad-dry-cure method. Immersed solution containing nanoparticles 2%, citric acid binder 1% for 5min, pass through the fabric running speed pressure 2 Kg f/cm^2, in 15 m/min 2 g/1 of sodium lauryl sulphate used for remove un bound nanoparticles.

UV absorption properties:

$$UPF = \frac{\sum_{280}^{400} E(\lambda)\cdot S(\lambda)\cdot \Delta\lambda}{\sum_{280}^{400} E(\lambda)\cdot T(\lambda)\cdot S(\lambda)\cdot \Delta\lambda} \quad \text{---------- (Eq 1)}$$

$E(\lambda)$ = The relative erythemal spectral effectiveness

$S(\lambda)$ = Solar spectral irradiance (wm^{-2}nm^{-1})

$\Delta(\lambda)$ = The measurement wavelength interval (nm)

$T(\lambda)$ = The average spectral transmittance of the specimen [4]

The ultraviolet protection factor indicates how much longer the person can stay in the sun with the fabric covering the skin as compared with uncovered skin to, obtain the same erythemal response. The UPF is UV-A and UV-B transmission, $_{UVA+UVB}$were measured on a Lamda 35 UV/Vis spectrometer according to the AATCC Test method 183-2000 [5] Transmittance for blocking of erythemaly weighted ultraviolet radiation through fabrics.

RESULT AND DISCUSSION:

Fig.1 shows the Perkin Elmer Spectrum BX system FT-IR model operating at a resolution of 4000 - 400cm^{-1} for as prepared ZnO samples by chemical method. The broad and intense band at 3237 - 3565 cm^{-1} is due to OH stretching. Band at 417, 450, 540 cm^{-1} indicate the presence of ZnO nanoparticles.

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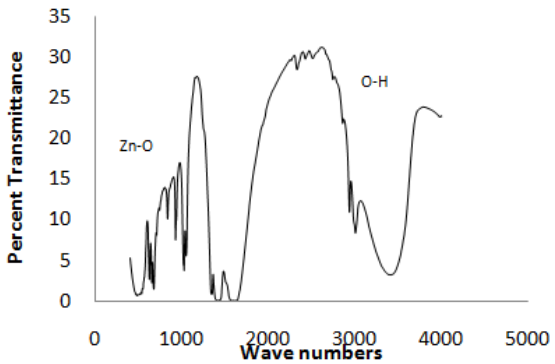

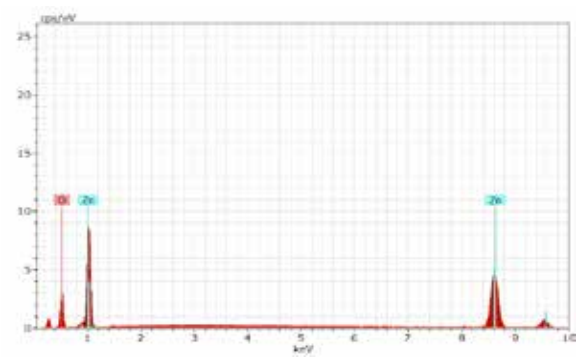

Fig.1 FT-IR spectra of ZnO nanoparticles

Fig.2 EDAX spectra of ZnO nanoparticles

Fig.2 EDAX spectrum peaks of as prepared zinc nanoparticles. It shows the 66.37 atomic wt% of oxygen and 30 atomic wt% of zinc

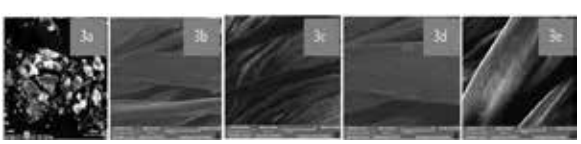

Fig.3 SEM Tescan VEGA-3 LMU model image (a) ZnO nanoparticle size and external morphology ranges from 100-190 nm. Figure 3 represents that the obtained products are composed the shape morphology with the average size in the range of 100µm. Fig 3(b,c) shows nano coated dyed sample before washing and (d,e) nano coated dyed sample after washing. The SEM images are in various magnifications. Fig 3(b and d) shown 10 µm and 20 µm for fig 3(c and e). Nano particles are covered the cotton fiber systematically. Fig 3(d and e) shows the diminish of nanoparticles.

Table 1

Samples Cotton	Bleached	Reactive Dyed	Nano treated	After washed
UV transmission	0.08	0.051	0.046	0.049
UPF (AATCC)	12.5	20	21.9	20.7

Table 1, represent UV transmission value for the different samples for UVR (280nm - 400nm) Nano treated cotton samples UPF 21.9 (Eq.1) than reactive dyed sample.

CONCLUSION:

The UV transmission indicates a significant increment of UPF in ZnO treated reactive dyed cotton fabric. This result suggest for the protection of the body against UV and for other technological textile applications.

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