

**UNIVERSITI TEKNOLOGI MARA**

**EFFECTS OF CROSSLINKERS  
ON MORPHOLOGICAL  
STRUCTURE, WASHFASTNESS  
AND SELF-CLEANING  
PROPERTIES ON TITANIUM  
DIOXIDE COATED COTTON  
YARN**

**MIRRA EDREENA BINTI SALLEHUDIN**

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## ABSTRACT

Titanium dioxide has an extraordinary photocatalytic activity and it effectively provides self-cleaning properties. However, the incorporation of TiO<sub>2</sub> nanoparticles into cotton faces a low surface area of the support and weak interactions between the fibre and nanoparticles. This makes the adherence of TiO<sub>2</sub> nanoparticles on cotton weak and they eventually come off, especially after washing. Therefore, this study aimed to identify an optimal crosslinkers to coat TiO<sub>2</sub> on cotton to improve its durability after washing and at the same time provide the self-cleaning properties. In this study, cotton yarn samples were treated with four different types of crosslinkers, which were 1,2,3,4 butane tetracarboxylic acid (BTCA), polydimethylsiloxane (PS), succinic acid (SA), and polyacrylic acid (PAA) and were then dipped in 1% concentration of TiO<sub>2</sub> nanoparticles suspension. A scanning electron microscope (SEM) was applied for the analysis of surface morphology of coated samples and also the distribution of the TiO<sub>2</sub> nanoparticles in the cotton yarn. An energy dispersive X-ray (EDX) analysis was conducted to confirm the presence of TiO<sub>2</sub> on the cotton yarn surface, while the X-ray diffraction method (XRD) was used to determine the crystallinity. The optimal crosslinker was determined by observing the durability of TiO<sub>2</sub> nanoparticles on cotton yarn after washing up to 20<sup>th</sup> cycles and self-cleaning property. The results from the SEM and EDX analyses confirmed the presence of TiO<sub>2</sub> nanoparticles on cotton yarn. The crystallographic structure of TiO<sub>2</sub> taken from XRD analysis showed that all coated samples are in anatase form at  $2\theta=25.2^\circ$ , except for crosslinker PS, where the particles were hindered by the crosslinker. As for the durability of TiO<sub>2</sub> on cotton yarn after washing or also known as washfastness test, the crosslinker PS was found to provide an optimal adhesion of TiO<sub>2</sub> on cotton yarn based on the lowest weight loss after washing with approximately 1.15 %, and also provide a good self-cleaning property due to the hydrophobicity of the silicone oil in the sample. In addition, the C-TiO/SA sample exhibited good photocatalytic activity for self-cleaning properties based on the result through a visual discoloration and K/S value. Thus, it can be concluded that the presence of PS and SA crosslinkers improves the durability of TiO<sub>2</sub> on the cotton yarn surfaces and gives good self-cleaning properties. Nonetheless, if a permanent self-cleaning cotton with a life cycle of up to 20 washings was developed, it could meet the textile industry's requirement in the outline of a new product classified as smart textiles.

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