UNIVERSITI TEKNOLOGI MARA

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

MIRRA EDREENA BINTI SALLEHUDIN

Thesis submitted in fulfilment
of the requirements for the degree of
Master of Sciences
(Textiles Science and Technology)

Faculty of Applied Sciences

June 2023

ABSTRACT

Titanium dioxide has an extraordinary photocatalytic activity and it effectively provides self-cleaning properties. However, the incorporation of HO2 nanoparticles into cotton faces a low surface area of the support and weak interactions between the fibre and nanoparticles. This makes the adherence of Ti02 nanoparticles on cotton weak and they eventually come off, especially after washing. Therefore, this study aimed to identify an optimal crosslinkers to coat Ti02 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 Ti02 nanoparticles suspension. A scanning electron microscope (SEM) was applied for the analysis of surface morphology of coated samples and also the distribution of the Ti02 nanoparticles in the cotton yarn. An energy dispersive X-ray (EDX) analysis was conducted to confirm the presence of Ti02 on the cotton yarn surface, while the X-ray diffraction method (XRD) was used to determine the crystallinity. The optimal cross-linker was determined by observing the durability of Ti02 nanoparticles on cotton yarn after washing up to 20^{th} cycles and self-cleaning property. The results from the SEM and EDX analyses confirmed the presence of Ti02 nanoparticles on cotton yarn. The crystallographic structure of Ti02 taken from XRD analysis showed that all coated samples are in anatese form at 29=25.2°, except for crosshnker PS, where the particles were hindered by the crosshnker. As for the durability of Ti02 on cotton yarn after washing or also known as washfastness test, the crosshnker PS was found to provide an optimal adhesion of Ti02 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 Ti02 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.

ACKNOWLEDGEMENT

First and foremost, I'd like to thank Allah SWT for allowing me to embark on my Master's journey and for successfully completing this long and difficult journey. Ts. Dr. Nor Dalila binti Nor Affandi, my supervisor, deserves my appreciation and thanks. She has always opened the door for me whenever I have had a problem or a question about my research. She not only consistently allowed this thesis to be my own work, but she also pointed me in the right direction whenever I needed it.

I would like to thank my co-supervisor, Assoc. Prof. Ts. ChM. Dr Lim Ying Chin and Ir. Dr. Ahmad Mukifza Harun from Universiti Malaysia Sabah, as well as the staff and upper management of the Faculty of Applied Sciences for providing facilities and assistance throughout the project. Special thanks to my colleagues for their assistance with this project.

Following that, I dedicate this thesis to my beloved and supportive father, and mother, for having the vision and determination to educate me. This triumph is dedicated to both of you. An abundance of gratitude and love are also dedicated to my life partner, who always believes in me and provides moral support. Not to mention my sibling, extended family, and closest friends.

As a result, I would like to express my heartfelt gratitude to each of them for their moral support and continuous encouragement throughout my years of study and research while writing this thesis. This achievement would not have been possible without their assistance.

Thank you.

Alhamdulillah

TABLE OF CONTENT