EXTRACTION AND CHARACTERIZATION OF MICRO FIBRILLATED CELLULOSE FROM TEXTILE COTTON WASTE

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Degree of Master of Science

Department of Materials Science and Engineering

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This Dissertation submitted in partial fulfillment of the requirements for the Degree of Master of Science in Material Science.

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Declaration

I do herewith declare that the reported work in this entire thesis and the experiment was carried out by myself under the supervision of Mr. A. M. P. B. Samarasekara and Dr. D.A.S. Amarasinghe. This thesis describes the results of my own independent experimental work except where I have mentioned due references made in the text. There was no part in this thesis submitted elsewhere as a part of an any other or the same degree program.

....

Date J.M.R Jayasinghe

I endorse the declaration by the candidate.

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Mr. A. M. P. B. Samarasekara.

Supervisor.

Date: ....

....

Dr. D.A.S. Amarasinghe

Supervisor.

Date: ....

Abstract

Cotton is a natural staple fiber that almost consist with cellulose compared to wood. The major economic value of the cotton is in Textile Industry. In the past recent years, cotton consumption demand was increased than the production. In textile industry cotton are blending with various other synthetic fibers such as polyester, nylon and lycra to obtained desirable properties. Therefore, the fabric recycling methods are quite complicated although it is highly available as pre-consumer garment waste. In this work a method was developed to identify the amount of cotton present in the cotton/polyester blended fabric by using Fourier transformed infrared (FTIR) second-order derivative spectrum. Then the cotton waste composition was determined and used to extract cellulose. Then purify cellulose was subjected to extract Micro Fibrillated Cellulose (MFC) by using acid hydrolysis method. MFC has very high economic value compared to cotton fabric waste in various applications such as bio-composites, medicine, cosmetic, pharmaceutical, tissue engineering, bio-sensors, paints and coating, flexible electronics, air filters and high tech applications including aviation and automobile.

However, the major challenge of extracting MFC is the low amount of yield in acid hydrolysis, although it considered to be as most cost effective method of MFC extraction. Laboratory extracted small quantities are not sufficient in industrial applications such as in reinforcing composites. Three experimental factors including; acid concentration, hydrolysis time and temperature show the highest effect in yield and quality of MFC. Therefor this experiment was designed to optimize the three independent factors effect on two responses of yield (%) and Width (nm) of MFC. Response surface methodology was employed to design the experiment and ANOVA statistical test results were used to determine the significance of the parameter effect on acid hydrolysis. Further extracted MFCs physical and structural properties were discussed. Morphological features and size of the fibers were examined by scanning electron microscopy (SEM), structural features and chemical functionality was determined by Fourier transformed infrared (FTIR) spectroscopy, degree of crystallinity was obtained by X-ray diffraction (XRD) spectroscopy and thermal properties were determined by Thermo gravimetric analysis (TGA).

Keywords: Micro Fibrillated Cellulose, chemical purification, acid-hydrolysis, second-order derivative spectroscopic method.

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