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Journal of Analytical Science and Technology

Volume 23, Issue 5, October 2019, Pages 901-913

Extraction and characterization of microfibrillated and nanofibrillated cellulose from office paper waste (Article)

[Pengekstrakan dan pencirian mikrofibril dan nanofibril selulosa daripada sisa kertas pejabat]

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Abstract

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The tremendous increase in papermaking and cellulose production, both of which are sourced from wood pulp, has resulted in the severe exploitation of trees, thereby leading to environmental problems, including deforestation. Besides, the reduction of paper usage is not on the horizon. Thus, when it comes to the environmental issue, the extraction of cellulose from paper waste can be an alternative initiative to mitigate the negative impact of deforestation via the reuse of paper waste. In this study, the extraction of cellulose microfibrils and nanofibrils was achieved through the use of office paper waste as the source material. Alkali and bleaching treatments were employed for the extraction of cellulose fibres, followed by acid hydrolysis under controlled conditions for the isolation of the cellulose nanofibrils. The alkali treatment was carried out using various concentrations of 2%, 4%, 8% and 16% of sodium hydroxide (NaOH) solution, while the bleaching treatment was carried out using sodium hypochlorite (NaClO) solution. The extraction of nano-fibrillated cellulose was achieved by means of acid hydrolysis with various concentrations of 5%, 15%, 30% and 60% sulphuric acid (H₂SO₄) under controlled conditions. The structural and functional groups were analysed using attenuated total reflection Fourier transform infra-red (ATR-FTIR) imaging, while a morphological analysis was performed using optical microscopy and transmission electron microscopy (TEM). The FTIR analysis indicated that the lignin, ink, fillers and other components had been removed after the alkali and bleaching treatments. The imaging analysis using an optical microscope showed that the extracted cellulose had a fibrous and rod-like structure, while the TEM images showed that the extracted cellulose ranged from micro to nano size down to ~20-30 nm depending on the concentration of acid used. The extraction of either micro-fibrillated or nano-fibrillated cellulose from office paper waste in this work might pave the way towards the alternative reuse of office paper waste for the production and application of cellulose materials. © 2019, Malaysian Society of Analytical Sciences. All rights reserved.

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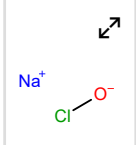
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Funding details

Funding sponsor	Funding number	Acronym
International Islamic University Malaysia		IIUM
Foundation for Fundamental Research on Matter	FRGS19-015-0623	FOM

Funding text

This study was supported by the Fundamental Research Grant Scheme (FRGS19-015-0623), Ministry of Education, Malaysia and International Islamic University Malaysia.

ISSN: 13942506

Source Type: Journal

Original language: English

DOI: 10.17576/mjas-2019-2305-15

Document Type: Article

Publisher: Malaysian Society of Analytical Sciences

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