Materials Today: Proceedings xxx (xxxx) xxx

Contents lists available at ScienceDirect

Materials Today: Proceedings

journal homepage: www.elsevier.com/locate/matpr

# Synthesis and characterisation of microcrystalline cellulose-g-poly (Acrylamide) superporous absorbent composite using graft polymerisation methods

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A R T I C L E  I N F O

*Article history:*
Available online xxxx

*Keywords:*
Cellulose
Biodegradable
Highly Porous
Superabsorbent Polymer

A B S T R A C T

Superabsorbent polymer was synthesised by using graft polymerisation method incorporated with micro crystalline cellulose (MCC) as a filler and sodium bicarbonate ($NaHCO_3$) as the foaming agent. The addition of organic filler and porosity generator produced a highly porous biodegradable superabsorbent polymer composite (HP-PAM-g-MCC), which improved the characteristics of the acquired products, in comparison with the conventional SAP. Determination of water absorbency was tested by using the tea bag method after immersing in distilled water. The effects on amount of MCC and sodium bicarbonate addition towards water absorbency were studied to determine the optimum condition of PAM-g-MCC SAPs composite. The maximum water absorbency of PAM-g-MCC composite was achieved at 1.0 wt% of MCC and 1 wt% $NaHCO_3$, resulting in 74.01 g/g and 93.96 g/g of water absorbency, respectively. The Fourier transform infrared (FTIR) and scanning electron microscope (SEM) analyses data revealed the presence of chemical bonding and morphological characteristics corresponding to the water absorption capacity of HP-PAM-g-MCC.

Selection and peer-review under responsibility of the scientific committee of the 6th National Conference for Postgraduate Research.

## 1. Introduction

Interest towards superabsorbent polymer (SAP) potential applications is growing constantly due to its characteristic of high-water absorption capacity over the traditional water-absorbent materials. In general, SAP is defined as hydrophilic three-dimensional polymer networks with a corresponding absorption capacity of up to 10 g/g, which usually obtained in non-biodegradable form [1,2]. Most of the SAP materials are based on synthetic petroleum-based materials that provide implication towards environment and high production cost [3]. SAP materials have a wide application in various fields, such as agriculture, incontinence products, water purification, tissue engineering, drug-delivery and sensors [1]. Approximately 90% of superabsorbent was used as disposable products, and then disposed of to landfills or incinerator that caused an environmental problem [4]. Therefore, biodegradability and materials cost are significant issues of research due to the renewed attention towards environmental protection issues. Since the last decade, the attention focused on synthesising biodegradable hydrogel polymer by introducing organic material in the polymer networks [4]. Several organic materials, such as biomass [5], starch [6], cellulose [7], protein, chitosan [8] are well known with hydrophilic behaviour, were incorporated with inorganic monomers to produce a biodegradable SAP [3]. In this study, cellulose that is the most abundant natural polymer with biodegradable and biocompatible polymer was used to promote biodegradability of the prepared SAP. The development of biodegradable SAPs strengthened the usage of this product, especially in agricultural field.

Superporous hydrogel (SPH) was categorised as a different group of water-absorbent polymer system in 1998. In the next generation of SPH, higher mechanical strength and elastic properties were developed in comparison with the original SPH. In general, SPH has a highly porous structure with a pore size of between 100 μm and 1000 μm [9]. This highly porous structure of SPH possesses hundreds of times more surface area and shorter diffusion time than conventional SAPs. These features allow dried SPH to have a tendency for rapid and extensive swelling when in contact with aqueous medium [10]. The SPH can be classified into three

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https://doi.org/10.1016/j.matpr.2023.04.284
2214-7853/
Selection and peer-review under responsibility of the scientific committee of the 6th National Conference for Postgraduate Research.