Iran Polym J (2014) 23:671–678
DOI 10.1007/s13726-014-0261-8

ORIGINAL PAPER

Oil absorbency of cellulose/butylmethacrylate graft polymer fibers

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Received: 14 January 2014 / Accepted: 22 June 2014 / Published online: 17 July 2014
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Abstract Cotton pulp cellulose and butyl methacrylate were used as the main raw materials to synthesize cellulose/butylmethacrylate graft polymer (Cell-*g*-PBMA) via homogeneous ATRP method, after which the graft polymer was dissolved in *N*,*N*-dimethylacetamide to prepare a spinning solution, and the novel oil-absorbent Cell-*g*-PBMA graft polymer fibers were spun by wet-spinning method. The morphology of the polymer fibers before and after oil absorption was analyzed using a high-powered microscope and scanning electron microscope and the saturated oil absorption rate as well as buoyancy recovery of the fiber products were also studied. The results showed that Cell-*g*-PBMA polymer fibers had a rough surface and exhibited a void network structure that was specific to oil-absorbent materials. The saturated absorption rates of the Cell-*g*-PBMA polymer fibers for crude oil, vegetable oil, dichloromethane and diesel were 96.5, 78.7, 38.4, and 27.2 g/g, respectively, which were about 3–6 times that of a commercial polypropylene sorbent. The Cell-*g*-PBMA fibers also displayed excellent oil/water selectivity and high buoyancy recovery in the clean-up of oil over water. Its excellent oil absorbency demonstrated oil absorbent characteristics of both traditional oil-absorbing materials and synthetic oil-absorbing resins, rendering it an excellent fibrous oil-absorbent material.

Keywords Cellulose · Butyl methacrylate · Homogeneous ATRP · Oil-absorbent fibers · Oil absorbency

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Introduction

With the development of industries, the increasing emission of waste oil poses serious threats to rivers, oceans, and our environment. According to statistics, at least 5–10 million tons of oil are poured into the water every year by various ways, making oil a major pollutant of water bodies and thus, arousing great concern [1].

In many oil processing methods, the oil-absorbent materials are widely used due to their characteristics of efficiency, economical, and generalized use [2–4]. Researchers have developed a variety of oil-absorbing materials such as inorganic clay, silica, iron pearls, lime; organic pulp, kapok, peat; composite polystyrene fabric, polypropylene(PP) non-woven fabric, polyacrylic ester series of high oil-absorption resins, etc. [5–7]. Among them, the high oil-absorption resin composed of oil-wet monomers by moderate cross-linking is a kind of granular functional polymer material with three-dimensional network structures [8, 9]. Compared with other oil-absorbing materials, it has the advantages of absorption of various oils, high absorption speed, good selectivity of oil/water absorption, heat resistance and cold resistance, etc. However, many applications of the high oil-absorption resin have been curbed due to the following two reasons. First, most high oil-absorption resins are currently available in a single shape as granular materials. In contrast, the specific surface area of the oil-absorbent fiber is larger and it can be processed into various forms of products which according to the needs and application fields can be greatly broadened. At the same time, the three-dimensional network structure of oil-absorption resins results in their insolubility and non-melting characteristics. It is difficult to use traditional spinning method to make oil absorption fibers with good performance from an oil-absorption resin [10].

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