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ORIGINAL PAPER

Synthesis and characterization of (poly (N-vinyl formamide)—pregelled starch—graft copolymer

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Abstract Bromate / cyclohexanone redox system was investigated as a novel initiator for graft copolymerization of N-vinyl formamide onto pregelled starch. A number of variables in the grafting reaction were investigated including N-vinyl formamide, cyclohexanone, bromate ion, sulphuric acid and pregelled starch concentrations, material to liquor ratio along with polymerization time and temperature. The graft copolymers were evaluated in terms of graft yield, graft reaction efficiency and homopolymer formation (%). The optimum conditions for grafting of N-vinyl formamide onto pregelled starch are: N-vinyl formamide 50% based on weight of substrate, cyclohexanone 15 mmol / l, bromate ion, 30 mmol / l, liquor ratio 10, pH 6, time 120 min., and temperature 40°C. On the other hand, characterizations of the resultant copolymers with respect to swelling capacity, solubility %, metal ion up-take and suitability as a sizing agent for cotton textiles were investigated. The results obtained reflect that, the resultant copolymer shows better results for the aforementioned properties in comparison with that obtained from native pregelled starch as a starting substrate.

Keywords Pregelled starch · N-vinyl formamide · Potassium bromate / cyclohexanone · Swelling capacity · Solubility % · Heavy metal removal

Introduction

Starch as one of the most abundant, renewable, low cost and biodegradable carbohydrate polymers world wide, suffers from some drawbacks the most outstanding is a deficient of properties of synthetic polymers [1]. The latter can be improved by modification through grafting of vinyl monomers on it, thus graft copolymerization will enhance the properties like swelling, solubility and metal ion uptake [2]. For the last few decades, modification of starch by one of the most fascinating, universal, effective and accessible methods i.e. graft co polymerization, that provides a substantial modification route to alter physical and chemical properties of starch, thereby enlarging the range of its utilization by attaching a flexible synthetic polymers onto the rigid natural polysaccharides backbone without greatly changing the latter [3–12]. In addition, the properties of the resulting copolymers may be widely controlled by the characteristics of synthetic side chains, including molecular structure, length and number. In the past, starches have been graft co polymerized by different techniques, most of them are based on free radicals technique that are formed along the backbone of the polymer either by chemical initiators [13–17] or by irradiation [18, 19]. The main disadvantageous of the above methods especially that based on chemical method are the heterogeneous distribution of

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