

DEVELOPMENT OF ENVIRONMENTALLY DEGRADABLE POLYMERIC MATERIAL (PLASTICS) FROM SAGO STARCH FOR AGRICULTURAL AND MEDICAL INDUSTRIES

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Introduction

Majority of synthetic polymers prepared from petrochemical-based monomers are usually tough and not easily degradable, which give rise to environmental problems. Sago starch is one of the biobased materials suitable for the production of environmentally degradable polymers (plastics). In order to increase the desirable qualities of the form polymers, starch can be modified lightly by crosslinking and grafting with other monomers. These types of biodegradable polymers could be used as polymeric hydrogels for possible application as matrices in the controlled release of agrochemicals and drugs, and as supersorbents in healthcare industry.

Materials and Methods

Sago starch was purchased from a Malaysian Company. Methyl methacrylate of Fluka was stored at -10°C after being freed from its stabiliser by passing through a proper column of activated aluminium oxide. Ceric ammonium nitrate (CAN) was obtained from Ajax Chemical (Univar). Potassium persulfate ($\text{K}_2\text{S}_2\text{O}_8$) was obtained from Mallinckrodt. All solvents used were of analytical grade and obtained from Hamburg Chemicals. The commercial alpha-amylase enzyme produced from malt (type V-A, 2.7 units / mg solid at pH 6.9 at 20°C) was obtained from Sigma USA. Other chemicals were obtained from Merck Germany. Graft copolymerisation reactions of poly (methyl methacrylate) on sago starch were carried out using CAN initiator at different temperatures in a

round bottom flask equipped with reflux condenser and nitrogen gas inlet. The grafted copolymer product was precipitated using methanol, filtered using sintered glass and then dried at 60°C . Grafting levels of the samples were calculated and then were subjected to FTIR, DSC, TGA and viscosity analysis. Quantitative analysis of glucose content was carried out by using the phenol sulphuric acid method.

Results and Discussion

FTIR analysis has indicated the occurrence of grafting reactions of poly (methyl methacrylate) on sago starch. The following bands of FTIR spectra were used to distinguish between fresh sago starch and poly (methyl methacrylate) with theirs grafted one. The stretching of ($-\text{C}=\text{O}$) group at 2997 cm^{-1} , ($-\text{CH}_2-\text{CH}_2-$) groups at 842.3 cm^{-1} and 751 cm^{-1} for poly (methyl methacrylate) and the stretching of ($-\text{OH}$) group at 3409 cm^{-1} for sago starch. TGA shows thermal stability of the samples. Starch was decomposed at 330°C and of grafted sample decomposed at 375°C . The presence of separated thermal transitions in the DSC curves of the grafted sago starch at 382°C and 316°C may be considered as an indicative of incompatibility between the poly (methyl methacrylate) and sago starch. The study also observed the dependence of the initiator, nitric acid and monomer concentrations on the grafting percentage. Viscosity study has shown that the increasing in $[\eta]$ (intrinsic viscosity) values is proportional to the degree of grafting. Biodegradation study on the glucose production shows that the rate of degradation for sago starch was higher (maximum at the 3rd day) than the grafted methyl methacrylate onto sago starch (maximum at the 7th day)

Conclusions

Sago starch could be grafted with methyl methacrylate using ceric ammonium nitrate and potassium persulfate initiators. At the optimum conditions, the maximum percentage of grafting was 246. % and 91 % using CAN and ($\text{K}_2\text{S}_2\text{O}_8$) systems respectively. In addition, graft copolymer was found to be more stable compared to sago starch alone.