STUDIES ON BROMINATION OF ATACTIC POLYPROPYLENE

by

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CERTIFICATE

This is to certify that the thesis entitled "STUDIES ON BROMINATION OF ATACTIC POLYPROPYLENE" being submitted by Ms. Anita Mohan, to the Indian Institute of Technology,Delhi, for the award of the degree of Doctor of Philosophy in the Department of Textile Technology, is a record of bonafide research work carried out by her. Ms. Anita Mohan has worked under my guidance and supervision and has fulfilled the requirements for the submission of the thesis.

The results contained in this thesis have not been submitted, in part or in full, to any other Institute or University for the award of a degree or diploma.

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A Mohan

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ABSTRACT

The present study deals with bromination of atactic polypropylene (APP) followed by characterization and evaluation of properties of brominated product. Bromination was carried out by thermal initiation without adding any other catalyst. The effects of various parameters on bromination such as time, APP concentration, bromine concentration and temperature have been studied. The order of reaction with respect to APP concentration and activation energy involved for the process have been determined. A mechanism for the process has been suggested.

The presence of bromine in the polymer chain was ascertained by quantitative estimation of bromine and infra-red spectroscopy. IR results indicate appearance of new absorption bands at 500-800 cm^{-1}, which may be assigned to the presence of bromine in the derivative polymer. ^{13}C-NMR study shows the presence of bromine atoms in all the three possible positions namely tertiary, secondary and primary carbon atoms. Density of brominated APP (BAPP) shows a continuous increase with increase in bromine content due to decrease in free volume. Molecular weight and molecular weight distribution (MWD) studies by gel permeation chromatography and dilute solution viscosity show that molecular weight decreases with increase in bromine content, in general. During bromination, chain scission takes place and hence the reaction conditions influence the molecular weight of the brominated product. Dilute solution viscosity values show a continuous decrease with increase in bromine content and are not dependent on the reaction conditions. The decrease in viscosity can be attributed to increased polar interaction leading to a decrease in hydrodynamic volume.

Thermal behaviour of brominated APP has been evaluated by thermogravimetric analysis (TGA) and differential thermal analysis (DTA). TGA study shows that initial decomposition temperature (IDT) and char yield of BAPP samples increase with increase in Br-content while integral procedural decomposition temperature (IPDT) decrease. Similarly, Tg as measured by DTA, continuously increases with the increase in bromine content and reaches a value of 105 °C at 70% Br.

Flammability characteristics of brominated APP, as evaluated in terms of limiting oxygen index (LOI), show a marked increase with increase in bromine content of BAPP and reach a value of 77.3 at 70% Br.

Experiments have been conducted using BAPP as a flame-retardant coating onto cotton fabrics. With increasing amount of coating onto the fabric, the LOI values increase. This is because of the retarding effect of HBr by reducing the oxygen concentration in the combustible mixture and also by directly participating in the flame reactions. However, BAPP coated fabrics showed lower breaking load as compared to original cotton fabric. TG analysis shows that BAPP coated samples are thermally less-stable than cotton but are of high flame resistant type as compared to cotton. Finally, surface morphology of the coated fabric samples was studied by scanning electron microscope.

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