PROCESSING AND PROPERTIES OF POLYPROPYLENE CLAY NANOCOMPOSITE BLOWN FILMS

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PROCESSING AND PROPERTIES OF POLYPROPYLENE CLAY NANOCOMPOSITE BLOWN FILMS

By

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Submitted

in fulfillment of the requirements of the degree of Doctor of Philosophy

to the

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Dedicated to

My Loving and Caring Parents

CERTIFICATE

This is to certify that the thesis entitled, **"Processing and Properties of Polypropylene Clay Nanocomposite Blown Films**" submitted by **Mr. Manash Jyoti Kashyap** to the Indian Institute of Technology Delhi, for the fulfillment of award of the degree, Doctor of Philosophy, is a record of bonafide research work carried out by him under my supervision and guidance. This thesis has been prepared in conformity with the rules and regulations of the Indian Institute of Technology Delhi, New Delhi.

The thesis, in my opinion, is worthy of consideration for award of the degree of Doctor of Philosophy in accordance with the regulations of the Institute. To the best of my knowledge, the results embodied in the thesis have not been submitted to any other University or Institute for the award of any other Degree or Diploma.

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Manash Jyoti Kashyap

Abstract

Polymer nanocomposites has been an area of immense interest since the last couple of decades. The possibility of a quantum increase in the polymer matrix properties has led to efforts towards application in areas from aerospace application to the possibility of substitution of polymer nanocomposite in monolayer films for packaging applications. The present study aims to make a detailed investigation on the processing, rheology and properties of polypropylene (PP) clay nanocomposites and their applications in blown films. The studies on rheology involved detailed analyses of the shear and extensional rheology of polypropylene clay nanocomposites with correlations between the material characteristics and blown film processing of the nanocomposites. The thermal studies involved both isothermal and non-isothermal crystallization kinetics studies. These studies revealed the nucleating effect of nanoclay especially at the highest rates of cooling and the highest crystallisation temperature in non-isothermal and isothermal crystallisation studies respectively. Further, these studies also indicated the formation of predominantly one-dimensional fibrillar morphology bordering on two-dimensional disc like crystalline structures. The PP clay nanocomposite blown films were analysed for their thickness variation, tensile, oxygen barrier, haze/transmittance and crystalline properties and correlations were made with the structure and compositions of these films. The studies on blown film morphology indicated distinct alignment of nanoclay platelets parallel to machine directional stretching (in the blown film process). Further, the polypropylene blown film surface morphology was observed to be altered on addition of nanoclay with smoother morphology for the PP clay nanocomposites compared to those of PP. Further, addition of nanoclay also led to lower average spherulite diameters of PP thus confirming the nucleating effect of nanoclay.

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