

**STUDIES ON POLYCARBONATE /ACRYLONITRILE
BUTADIENE STYRENE BLENDS AND CLAY
NANOCOMPOSITES**

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**CENTRE FOR POLYMER SCIENCE AND ENGINEERING
INDIAN INSTITUTE OF TECHNOLOGY DELHI**

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BUTADIENE STYRENE BLENDS AND CLAY
NANOCOMPOSITES**

by

PRIYANKA SINGH

Centre for Polymer Science and Engineering

Submitted

in fulfillment of the requirements of the degree of

Doctor of Philosophy

to the



INDIAN INSTITUTE OF TECHNOLOGY DELHI

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Dedicated

To My

Mother “**Padma Singh**”

&

Father “**Shri H. N. Singh**”

CERTIFICATE

*This is to certify that the thesis entitled, “**Studies on Polycarbonate /Acrylonitrile Butadiene Styrene Blends and Clay Nanocomposites**” submitted by **Ms. Priyanka Singh** 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 her 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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ABSTRACT

The goal of this research is to develop Polycarbonate/Acrylonitrile Butadiene Styrene (PC/ABS) blends and its clay nanocomposites with preferential distribution on nanoclay in polycarbonate phase and investigate the effect of clay and ABS on viscoelastic behavior, torsional behavior, and notch sensitivity and fracture behavior to check the sustainability of material under torsion and tension load. For the systematic study of the PC/ABS/Clay nanocomposites, study has been carried in four steps; 1) effect of nanoclay on polycarbonate and ABS separately in terms of mechanical properties, thermal, viscoelastic behavior and morphology; 2) PC/ABS blends has been investigated and optimized in terms of ductility, notch sensitivity, viscoelastic behavior and developed morphology; 3) PC/ABS Clay nanocomposites is developed to established the preferential clay distribution and investigated the morphology, notch sensitivity, ductility and viscoelastic behavior; 4) PC/ABS blends and its Clay nanocomposites is studied for its fracture behavior and response under torsional load. Effect of clay on reinforcement of PC and ABS is compared. PC/ABS blend is optimized with 30 wt. % of ABS on the basis of mechanical property, notch sensitivity and its morphological state. PC/ABS/Clay nanocomposites are prepared with idea of selective distribution of nanoclay in PC phase. To achieve that, nanocomposites is prepared is two step; in first step, clay is added to PC to form master batch; in second step, ABS is added to prepare respective composition. Preferential distribution is established by measuring wetting coefficient which is further supported by DSC and morphological observations. Ductility behavior is retained up to 2 wt% of nanoclay which is evaluated in terms of ductility index. Addition of ABS reduces the notch sensitivity for impact load but nanoclay increase the notch sensitivity. Time temperature superposition principle is applied to PC/ABS blends and PC/ABS nanocomposites to assess the structural complexity. Relaxation behavior of blends

and nanocomposites is established along with viscoelastic behavior. Torsional behavior of PC/ABS blends and PC/ABS/Clay nanocomposites is evaluated, considering torsion as one of the critical load during application. Addition of ABS improves the torsional resistance and torsion rigidity while clay reduces the same. Fracture behavior of blend and nanocomposites is evaluated by essential work of fracture approach. Addition of ABS improves the resistance to crack propagation with decrease in resistance for crack initiation. Addition of higher nanoclay loading does not validate the essential work of fracture (EWF) principle while PC/ABS/Clay nanocomposites with 2 % loading validates the principle; decreases the EWF with marginal decrease in non-EWF.

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