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# Influence of Carbon Black (CB) on Mechanical Behaviour and Microscopic Analysis of Poly-propylene (PP)/ Acrylonitrile-butadiene- styrene (ABS) Nanocomposites

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**Abstract**

Composite materials allow designing materials that may combination of mechanical properties similar to those high load bearing materials. For advance mechanical properties of material polypropylene (PP) as a polymer, acrylonitrile-butadiene styrene (ABS) as rubber phase copolymer and filler material as carbon black (CB) are used to prepare blending of PP/ABS and formation of nanocomposites . Nanocomposite is prepared using twin screw extruder via injection molding. For characterization of polymer nanocomposites, microscopic analysis and mechanical properties are studied. For microscopic analysis to understand the morphology, the scanning electron microscopy (SEM) is used. Further, for mechanical behaviour, tensile test and impact test are carried out. As carbon black has comparatively unique structure and properties became an important group of filler material which offered improvement mechanical properties. The existing polymer blend is modified with the nano filler material; which exhibits improved morphological and mechanical properties having cost efficient application. These mechanical and morphological results depicts PP/ABS (80/20) blends in presence of CB improves the results. It is found that 2.5 wt % of CB gives better tensile properties and 5wt % CB showing better improvement in Impact strength.

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## 1. Introduction

Polymer composites show alternative better properties than the basic original polymer material. The distribution of particle in the homogeneity and the individual properties of each polymer can affect the overall composite. Forming composite is a current alternative of basic polymer for improving morphology and obtained improved overall properties. Polymer composite properties depend upon the properties of mixed/blend polymers. As per the basic polymer composites mechanical properties can be enhanced. Forming a composites also results into cost efficient polymer blending which is helpful for replacing the basic polymeric material [1-2]. Advantage of polypropylene (PP) is high heat alteration in temperature, better processibility and low cost. Among various polymers, PP is an important commodity plastic extensively used to manufacture products by various industries [11–13]. One of the shortcomings of PP is its lower impact properties. This shortcoming can be overcome by an addition of rubbery polymeric phase in PP matrix. Various rubber toughened polymers were added to the PP matrix, which includes, polyethylene octane (PEO) copolymer, ethylene-propylene random copolymer (EPR), styrene-butadiene-styrene rubber (SBR), ethylene propylene diene monomer rubber (EPDM) and acrylonitrile butadiene styrene (ABS) [14–19]. Among the various rubbery polymers, ABS is an attractive polymeric material because the rubbery butadiene contributes towards enhancement in impact properties, while styrene-acrylonitrile contributes towards enhancement in tensile properties. Thus, in this work it is planned to use PP and ABS blending materials [1,3,4,8] .

The filler materials are applied for improvement of properties such as mechanical, morphological and others of the polymer composite. Many filler materials like carbon black [9], carbon nanotubes (CNTs) [2], graphene [5], Multi walled carbon nanotubes (MWCNT) [6], clay, glass fibers, etc. [7] are used as filler in nano size. The filler materials can enhance thermal, electrical and mechanical properties of polymer blends. Currently, carbon black (CB) proves as effective filler material for polymer matrix. CB have low electrical interfaces between more than two atoms molecules which are very close to each other and due to which it can be dispersed in PP matrix. Also carbon black has very low cost as compare to other filler materials.

The applications of polymer nanocomposite are for automobile parts, packaging, films, fibers, moldings, and many more. The improved mechanical properties give toughness increment of the existing polymeric material applicable for automobile purpose which replaces automobile spares like outer body made of polymer, clutches, staring, bonnet, engine housing, engine fans, etc. Also polymer nanocomposites have medical and commercial application in many field of polymer industries which required improved mechanical properties [10].

## 2. Experimental work

### *2.1. Materials and Specimen preparation*

Polypropylene (PP) was supplied by the VIT, Vellore having grade REPOL homopolymer110MA. It has melting Index of 11 g per 10 min up to 230 °C. The quantity should be 2.16 kg in weight. Acrylonitrile-butadiene styrene was purchase from Strylotion, India having grade GP-22 with melt flow index of 19 g per10 min up to 230 °C. The quantity should be 2.16 kg in weight. PP/ABS blend and their composites were manufactured using twin screw extruder rotating in counter direction which is provided by S. C. Dey Co., Kolkata, India having length to diameter ratio is 14 and screw diameter 25 mm, at temperature range of 155–210–240 °C. The rotational speed of screw was 10 rpm with various CB concentrations (0–10 wt.%). Through injection molding machine, the samples were pressed molded at 220 ºC for 3 min. Before preparation of the samples, all the samples were dried through vacuum at 80 ºC for a day. The compositional sample details are given in Table 1.

### *2.2 Mechanical Properties and Scanning and Transmission Electron Microscopy (SEM)*

The mechanical properties of the PP/ABS/CB prepared with twin screw excluder composite were examined using a UTM machine make Instron 4467. Tensile test was performed according to the ASTM D 638. [11] The speed of crosshead reciprocating movement for tensile test was 50 mm/min. Izod Impact test was performed according to the ASTM 256 [12]. For tensile and Impact test, 12 specimens were prepared and comparative study should be carried out.

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