Effect of reinforcement on tensile behaviour of MWCNT Filled Thermoplastic Composites

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Abstract**—***Polypropylene (PP) is one of the most widely used engineering polymers. In this study, multiwalled carbon nanotube (MWCNT) has been melt blended into PP using twin screw extrusion process, indifferent ratios for two different set of composites. For first set, 2.5, 5 and 10 wt.%of MWCNT was used whereas for another set 1.25, 3.75 and 7.5% were the values. The extruded pellets were then injection moulded using a 50 Ton machine to produce PP+MWCNT composite flattest specimens according to ASTM standards and were used to carry out the tensile tests. While there is a huge reduction in failure strain and a marginal increase in ultimate tensile strength, there was nearly 65 % increase in young's modulus with MWCNT as reinforcement. These experimental values were compared with the theoretical values calculated using Halpin-Tsai model for randomly oriented fibres.There was significant deviationof the theoretical data from the experimental data. The comparison and analysis of theoretical and experimental results are carried out in the present work. A mathematical model equation has been fit for the variation of young's modulus in both the sets of composites. The variation has been found to be constant in terms of the parameters of the equation. This shows the variation of the tensile properties are proportional to the degree of reinforcement.*

Keywords**—**Polypropylene, carbon-nanotubes, twin-screw extruder, nano-composites, Halpin-Tsai.

I. INTRODUCTION

Owing to their broad range of properties and manufacturability, both synthetic and natural polymers play an essential and useful role in everyday life. Inspite of their attractive properties, they have low toughness due to their tendancy to be string and brittle but still they are highly deformable. This results in low energy absorption capacity during failure. The combination of the existing usage with specific improvement targets for expanded use makes polymers a prime candidate for composite matrices. Existing research also indicates that polymer composites with nanofillers show superior performance versus microfillers [1].

Polypropylenes, polyamide (Nylon) belong to the family of crystalline polymers. Polypropylene (PP) has a wide spectrum of applications including packaging and labeling, textiles (e.g., ropes, thermal underwear and carpets), stationery, plastic parts and reusable containers of various types, laboratory equipment, loudspeakers, automotive components, and polymer banknotes due to its processability, good balance of physical properties and price. The structure of PP is chemically simple. This makes it good choice as matrix material in understanding the properties of composites.

A Carbon Nano Tube (CNT) is an allotrope of carbon with a cylindrical form and subdivided into single-walled (SWCNT) and multi-walled CNTs (MWCNTs). They are formed by rolling the one-atom-thick grapheme sheet into cylinders at a specified angle, variation in which will lead to different CNT structures. CNTs have sp^2 bond between carbon atoms which is responsible for its high tensile strength and elasticity modulus [5]. MWCNT will have multiples layers of graphene sheets (concentric cylinders) which make them incredibly strong fibers. SWCNT are well suited for electrical and thermal conduction. The strength of a MWNT is ten times higher than any other known fiber.