# DESIGN AND DEVELOPMENT OF LOAD BEARING COMPONENTS FOR A BICYCLE FROM GLASS FIBRE REINFORCED NYLONS

BY

ASHOK GUPTA

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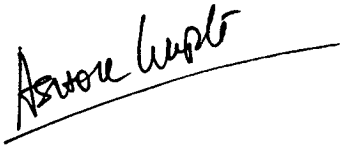

# CERTIFICATE

This is to certify that the thesis entitled '**Design and Development of Load Bearing Components for a Bicycle from Glass Fibre Reinforced Nylons**' being submitted by **Mr. Ashok Gupta** to the Indian Institute of Technology, Delhi for the award of degree of Doctor of Philosophy, is a record of bonafide research work carried out by him. Mr. Ashok Gupta has worked under our guidance and supervision and has fulfilled the requirements for the submission of this thesis.

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


PROF. ASHOK MISRA

Professor and Head

Centre for Polymer Science and Engineering

Indian Institute of Technology, Delhi

Hauz Khas, New Delhi 110 016

PROF.R.K. MITTAL

Professor and Head

Department of Applied Mechanics

Indian Institute of Technology, Delhi

Hauz Khas, New Delhi 110 016

DEDICATED

TO

MY FAMILY

AND

FRIENDS

# Abstract

The use of reinforced grades of engineering components have been justified for the design and manufacture of several load bearing engineering components used in ground transport. For bicycles, the introduction of polymeric component started in early eighties with the development of components such as crank, chain wheel and frames. This introduction was primarily to develop light weight components with reduction in manufacturing operations. This study also deals with the design and development of selected bicycle components such as crank chain wheel, and handle bar assembly. The prime objective of this development was to design/develop light weight, single piece injection moulding of these two components in short glass fibre reinforced composites of nylons. An attempt is also made in reducing the number of manufacturing operations for these components.

The effect of processing parameters on the mechanical properties of short glass fibre reinforced thermoplastic composite have been well illustrated in literature (8,9,17), hence, samples of short glass fibre reinforced nylons and acetal resin were developed on a single screw extruder. The compounded material was then used for the fabrication of standard test specimens by varying processing parameters such as mould temperature, injection speed and injection pressure, on a Windsors SP-1 reciprocating screw type injection moulding machine. Tensile, flexural and impact properties were evaluated for these standard test specimens and correlated with the processing conditions. The cryogenically fractured surface of the flexural test specimen were examined for fibre distribution using Scanning Electron Microscope (SEM), while the fibre length distribution was determined by projectina microscope. An attempt was made to correlate these with mechanical properties of the moulded test specimens and optimum processing parameters for each short glass fibre reinforced composite were thus obtained. Parallel to this exercise, conceptual designs for both the components were proposed. In designing both these components, an estimation of rider induced load on these two components were obtained for a commercial 21 inch model of a bicycle (28). Conceptual designs were proposed for both using Uni-graphics (series-9000) HP-work station. For the crank and chain wheel, photoelastic models were prepared and after the stresses were frozen in the models they were partially sliced to separate the crank from the chain wheel. These partially sliced sections were then examined for a maximum shear stress distribution following which maximum shear stress in the crank part of the prototype was estimated. Based on the results and practicability in fabrication, a design was selected, which was then developed into actual operatable component for a bicycle, using HP-work station. A mould was

designed which was subsequently manufactured. The performance of this component was evaluated by putting it on a bicycle based on this evaluation suitable modifications were carried out in the product design. The handle bar design was developed for manufacture using short glass fibre reinforced composite. A mould was also designed for this component.

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