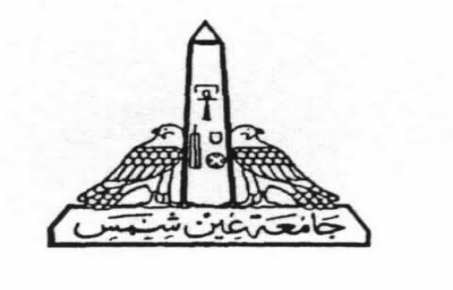

Ain Shams University

Faculty of Engineering

Mechanical Behavior of Composite Materials from Natural Fibers

A Thesis

By

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M.Sc. in Mechanical Engineering, 2006.

Design and Production Engineering Dept.

Submitted in Partial Fulfillment of the Requirements for the Degree of Doctor of Philosophy in Mechanical Engineering

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Statement

This thesis is submitted in partial fulfillment of the requirements of PhD degree in Mechanical Engineering to the Faculty of Engineering -Ain Shams University.

The author carried out the work included in this thesis, and no part of this thesis has been submitted for a degree or qualification at any other University.

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Chapter 7 ***Conclusions and future work……..***

Summary

The objective of the research work in this thesis is to implement the use of natural fibers of agriculture residuals in the production of polymeric matrix composites materials. Improving the mechanical properties in order to expand their domain of applications. The mechanical properties of low and high density polyethylene (LDPE&HDPE) reinforced with three different types of natural fibers (cotton stalk, rice straw and sugarcane) were investigated. Treatments were made to improve the mechanical properties of the polymeric composite by improving the interface between the natural fibers and low and high density polyethylene matrices. Fibers treatment was carried out by using sodium hydroxide (NaOH) with different concentrations 1, 2, 5 and 10 % for different holding times 6, 12, 24 and 48 hours at room temperature. Matrix treatment was carried out by adding MAPE to the polymeric matrices with 1, 2, 5, 10 and 20 wt% of fibers weight content to improve the interface between the natural fibers and polymeric matrices. The effect of treatment methods on wetting between fibers and low and high density polyethylene matrices were also analyzed. The effect of fiber content on the mechanical properties of the polymeric composite was studied at different fiber contents of 5%, 10%, 20%, and 30% weight percentage. The composite materials were produced in two steps. First matrix and fiber were mixed in a thermal mixer, second step the mixed matrix and fibers were pressed in square die by using a hydraulic press. The effect of fiber mesh size on the mechanical properties of the composite was also studied. The fracture surfaces were observed and studied by using SEM in order to study the wetting between natural fibers and matrices. Matrix treatment has high effect on the mechanical tensile properties while, fibers treatments has limited effect. Matrix and fibers treatment improve the interface between matrix and fiber which leads to better mechanical properties.

NOMENCLATURE.

ABS	……Acrylonitrile Butadiene-Styrene
AGR	……Agricultural Residues
CMC	……Ceramic Matrix Composites
E	……Young's Modulus
E_c	……Young's Modulus For Composites
E_m	……Young's Modulus For Matrix
E_f	……Young's Modulus For Fiber
V_f	……Fiber Volume Fraction
C%	……NaOH Concentration
C_1	……Factor for Fibers Treatment
C_2	……Factor for Matrix Treatment
HCL	……Hydrochloric Acid
HDPE	……High Density Poly Ethylene
HIP	……High Impact Polystyrene
HT	……Halpin-Tsai
IROM	……Inverse Rule Of Mixtures
K	……Krenchel
K_1	……Fibers Orientation Factor
K_2	……Fibers Length Factor
L	……Fibers Length
L_c	……Critical Fiber Length
MA	……Maleic Anhydride
MAPE	……Maleic Anhydride grafted Poly Ethylene
MAPP	……Maleic Anhydride grafted Poly Propylene
MK	……Modified Krenchel
MHT	……Modified Halpin-Tsai
MMC	……Metal Matrix Composites
NaOH	……Sodium Hydroxide
NF	……..…Natural Fibers
NFRPC	……...Natural Fibers Reinforced Polymer Composites

PE	……Poly Ethylene
P_{ff}	……Packing Factor of the Fibers
P_f	……property of the fibers
PP	……Poly Propylene
PMC	……Polymeric Natural Composites
PS	……Poly Styrene
PVC	……Poly Vinyl Chloride
ROM	……Rule of mixtures
SEM	……Scanning Electron Microscope
SF	……Synthetic Fibers
TGA	……Thermo Gravimetric Analysis
UTS	……Ultimate Tensile Strength
V	……Volume Fraction
V_m	……Matrix Volume Fraction
X	……NaOH Mass in gm.
Y	……Water mass in gm.
Σ	……Maximum Tensile Strength
σ_c	……Composites Strength
σ_m	……Matrix Strength
σ_f	……Fibers Strength
N	……Poisson's Ratio
ν_m	……Matrix Poisson's Ratio
ν_f	……Fiber Poisson's Ratio
η_{LE}	……Fiber Length Efficiency Factor
η_o	……Fiber Orientation Factor
Φ_n	……Orientation Angle
Φ_{max}	……Maximum Fibers Packing Fraction
Ξ	……Shape Fitting Parameter

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