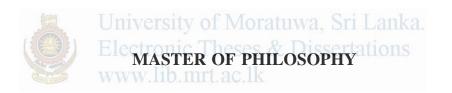
PREPARATION AND CHARACTERIZATION OF LOW DENSITY POLYETHYLENE/MODIFIED CHITOSAN/PAPAIN COMPOSITE

By

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January 2010

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This thesis was submitted to the Department of Materials Science and Engineering of the University of Moratuwa, Sri Lanka, in partial fulfillment of the requirements for the Degree of Master of Philosophy

> Department of Materials Science and Engineering Faculty of Engineering University of Moratuwa Sri Lanka

> > January 2010

DECLARATION

"I hereby certify that this thesis does not incorporate any material previously submitted for a degree or diploma in any university and to the best of my knowledge and belief, it does not contain any material previously published, written or orally communicated by another person except where due reference is made in the text"

(Signature of the Candidate) A.M.P.B. Samarasekara

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(Supervisor) Dr. S. U. Adikary, Head/Senior Lecturer, Department of Materials Science and Engineering, University of Moratuwa. January 2010

ABSTRACT

The objective of this research was to impart biodegradability to a polyethylene blend using Chitosan as the main additive which was extracted from fishery waste. Papain, a natural enzyme derived from papaya plant, was also used to enhance the biodegradability. The biodegradability of this Polyethylene blend was studied using low molecular weight chitosan both in the presence and absence of papain.

The influence of concentration and type of alkali on the chitin yield and chitosan obtained from deacetylation process were investigated. Low molecular weight chitosan was prepared by different depolymerization methods. This study investigated the time dependent weight loss using soil burial test, stress – strain properties and water absorption properties of the developed polymer, to evaluate the degree of biodegradability. The Fourier transform infrared spectroscopy (FTIR), Differential thermal analysis (DTA), Thermogravimetric analysis (TGA) and optical and Scanning electron microscopic investigation (SEM) were used to determine the properties of LDPE – Chitosan – Papain composite.

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The optimum composition for the industrial trial production was selected by considering the tensile strength, elongation, optimum degradability as well as good processability. Industrial trial production was done using composition containing of LDPE with 5% chitosan and 3% papain by weight.

Soil burial test results showed that specimens degraded by 60% in a six month period, while complete degradation occurred after one year. Since experimental analysis did not indicate formation of new bonds, it could be concluded that Chitosan, LDPE and Papain are present in the final product as a physical mixture without any detectable chemical reactions among different constitutes. Products manufactured in industrial scale also showed appreciable biodegradable properties. The biodegradation mechanism proposed for LDPE – Chitosan – Papain composite is based on the hydrolysis followed by actions of microorganisms.

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LDPE	Low Density Polyethylene
IR	Infrared
FTIR	Fourier Transform Infrared
ASTM	American Society for Testing and Materials
BS	British Standards
ISO	International Standards Organization
MFI	Melt Flow Index
DTA	Differential Thermal Analysis
TGA	Thermogravimetric Analysis
NaOH	Sodium Hydroxide Electronic Theses & Dissertations
кон	Potassium Hydroxide
LiOH	Lithium Hydroxide
H_2O_2	Hydrogen Peroxide
FAO	United Nations Agency of Food and Agriculture Organization
PLA	Polylactic Acid

PHA Polyhydroxyalkanoate