

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

By

A.M.P.B. SAMARASEKARA



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MASTER OF PHILOSOPHY

**Department of Materials Science and Engineering
University of Moratuwa
Sri Lanka**

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A.M.P.B. SAMARASEKARA

Supervised By

Dr. S. U. Adikary



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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

“The above particulars are correct to the best of my knowledge”



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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.

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 constituents. 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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Title	Page
Abstract	I
Acknowledgements	II
Contents	IV
List of Figures	VIII
List of Tables	XI
List of Abbreviations, Terms and Symbols	XII
CHAPTER 1	1
INTRODUCTION	1
CHAPTER 2	4
LITERATURE REVIEW	4
2.1. Management of Polymer Waste	4
2.1.1. Recycling	5
2.1.2. Incineration	6
2.1.3. Biodegradation	6
2.2. Biodegradable Polymers	8
2.3. Modes of Biological Degradation	11
2.4. Natural Biodegradable Polymers	13
2.4.1. Shrimps	14
2.4.2. Chitin	14
2.4.3. Chitosan	15
2.5. Enzymes	22
2.6. Papaya	23
2.6.1. General Introduction	23
2.6.2. Papaya Industry in Sri Lanka	24
2.6.3. General Applications of Papain	24

Title	Page
2.6.4. Papain Extraction	25
CHAPTER 3	27
METHODOLOGY	27
3. 1. Summarized Process Flow Chart	27
3.1.1. Shrimp Shell Powder Preparation	28
2. Extraction Process of Chitin	28
Extraction of Chitosan	30
Measurement of Particle Size of Chitosan	31
Fourier Transform Infrared Spectroscopy Test	31
Methods Used to Control the Molecular Weight of Chitosan	31
Use of Papain	31
Use of Hydrogen Peroxide	32
Irradiation	32
Response Surface Methodology (RSM)	32
3. 4. Papain Extraction	33
3. 5. Mixing Process	34
3. 6. Sample Preparation	34
3. 7. Testing of Samples	34
3. 7. 1. Biodegradation Tests	35
3. 7. 2. Experimental Data	35
3. 8. Industrial Trial Production	36

Title	Page
CHAPTER 4	37
RESULTS AND DISCUSSION	37
Processing of Shrimp Shells	37
Determination of Particle Size and Particle Size Distribution of Shrimp Shell Powder	37
Extraction Process of Chitin and Chitosan	38
Chitin Extraction	38
Chitosan Extraction	39
Reducing Molecular Weight of Chitosan	42
Method Based on Use of Papain	42
Method Based on Use of Hydrogen Peroxide	43
Irradiation Method	44
Response Surface Methodology (RSM)	44
Testing of LDPE – Chitosan – Papain Blended Polymer Sheets	46
Soil Burial Degradation	46
Effect of Papain	49
Measurements of Melt Flow Index (MFI)	51
Industrial Trial Film	52
Degradability of Industrial Trial Film	52
Tensile Properties of Industrial Trial Film	52
Strain Properties of Industrial Trial Film	53
Water Absorption Test Results of Industrial Trial Film	54
Micro Structural Changes	55
.Proposed Mechanism Taken Place During The Biodegradation	56
Fourier Transform Infrared Spectroscopy (FTIR) Test Results	56
Thermogravimetric Analysis (TGA) Results	59
Differential Thermal Analysis (DTA) Results	60
The Proposed Mechanism of Biodegradation	62

Contents (Contd.)

Title	Page
CHAPTER 5	68
CONCLUSION	68
CHAPTER 6	70
REFERENCES	70



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Figure No.	Figure Name	Page
	Biodegradation Mechanism of Synthetic Polymers	13
	Structure of Chitin	15
	Structure of Chitosan	16
	Process Flow chart for development of LDPE – Chitosan – Papain polymer composite	27
	Process Flow Chart of Chitin Extraction	28
	Flow Chart of Chitosan Extraction	30
	Particle Size Distribution of Shrimp Shell Powder	37
	FTIR Spectrum of Chitosan (Extraction from LiOH used as Deacetylation media)	40
	Standard FTIR Spectrum of Chitosan	41
	Particle Size Distribution of Extracted Chitosan	41
	Variation of Molecular Weight of Chitosan Vs Reaction Time (Method Based on Use of Papain)	42
	Variation of Molecular Weight of chitosan Vs Hydrogen Peroxide volume (Method Based on Hydrogen Peroxide)	43
	Variation of Molecular Weight of Chitosan Vs Irradiation Doses	44



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 www.lib.mrt.ac.lk

Figure No.	Figure Name	Page
	Variation of Molecular Weight of chitosan Vs reaction time in the Response Surface Methodology	45
	Variation of Molecular Weight of chitosan Vs deacetylation temperature in the Response Surface Methodology	45
	Percentage Weight Loss of Chitosan – LDPE Polymer Blends With Different Chitosan Concentrations	46
	Tensile Strength Vs Chitosan Concentration in Chitosan – LDPE Polymer Blends	47
	Percentage Elongation Vs Chitosan Concentration in Chitosan – LDPE Polymer Blends	48
	Tensile Strength Vs Papain Concentration in 5% Chitosan – LDPE Polymer Blends	49
	Percentage Elongation Vs Papain Concentration in 5% Chitosan – LDPE Polymer Blends	49
	Percentage Weight Loss of 5% Chitosan – LDPE – Papain Blends With Different Papain Concentrations	50
	Melt Flow Index of 5% Chitosan Blends With Different Papain Concentrations	51
	Weight Loss Vs Time of The Chitosan – LDPE – Papain Blended Industrial Trial Film	52
	Tensile Properties of Industrial Trial Film	53
	Strain Properties of Industrial Trial Film	53
	Percentage Water Absorption of Industrial Trial Film	54
	Surface of Sample (Before burial)	55

List of Figures (Contd.)

Figure No.	Figure Name	Page
4.22	Surface of Buried Sample after 4 weeks	55
4.23	Surface of Buried Sample after 12 weeks	55
4.24	Surface of Buried Sample after 24 weeks	55
4.25	FTIR Spectrum of Pure LDPE and LDPE + Chitosan + Papain (Final Product)	56
4.26	FTIR Spectrum of Pure Chitosan and LDPE + Chitosan + Papain (Final Product)	57
4.27	FTIR Spectrum of Pure Papain and LDPE + Chitosan + Papain (Final Product)	58
4.28	TGA Curves	59
4.29	DTA Curves	60
4.30	Mechanism of (a). Radical and (b). Polysaccharide depolymerisation	64
4.31	Deacetylation of chitin to form chitosan and hydrolysis to form oligosaccharide	65
4.32	FTIR Spectra of Final Product (Before and After the Degradation)	66

List of Tables

Table No.	Table Name	Page
2.1	The major properties of Low Density Polyethylene	05
2.2	Global consumption of biodegradable polymers by polymer type for years 2000 and 2005	10
3.1	Chitin Extraction Methods by varying Deproteinization Conditions	29
3.2	Chitin Extraction Methods by varying Papain Concentration	29
3.3	Chitosan Extraction Methods by varying Deacetylation Media	31
3.4	Response Surface Methodology (RSM)	33
4.1	Chitin Yield and Remaining Protein Content	38
4.2	Effect of Deacetylation Media on Chitosan Yield	39

List of Abbreviations, Terms and Symbols

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
KOH	Potassium Hydroxide
LiOH	Lithium Hydroxide
H ₂ O ₂	Hydrogen Peroxide
FAO	United Nations Agency of Food and Agriculture Organization
PLA	Polylactic Acid
PHA	Polyhydroxyalkanoate