

DEVELOPMENT OF EXTRUSION TECHNOLOGY OF BREATHABLE FILM FOR INDUSTRIAL APPLICATIONS.

BY

Samantha Sisira Kumara Perera Illangarathne.

LIBRARY
UNIVERSITY OF MORATUWA, SRI LANKA
MORATUWA

A dissertation submitted as practical fulfillment of the requirements for the award of degree of **MASTER OF SCIENCE** in polymer



Technology, University of Moratuwa, Sri Lanka
Electronic Theses & Dissertations
www.lib.mrt.ac.lk

Department of Chemical & Process Engineering
University of Moratuwa

June 2008

University of Moratuwa



93942

93942

66 "08"

678 (043)

TH

Supervisor: Dr. Olga Gunapala

University of Moratuwa

93942

Department of Chemical and Process
Engineering.
University of Moratuwa.
Sri Lanka,
December 2008.

“ I certify that this thesis does not incorporate without acknowledgment 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.

UOM Verified Signature

Signature of candidate

Mr. S.S.K.P. Illangarathne

“To the best of my knowledge, the above particulars are correct”



University of Moratuwa, Sri Lanka.
Electronic Theses & Dissertations
www.lib.mrt.ac.lk

Supervisors:

UOM Verified Signature

Dr (Mrs.) *G.* Gunapala
Chemical and Process
Engineering Department.

UOM Verified Signature

P.V.
Dr P.V. Gunapala
Materials
Engineering Department.



ACKNOWLEDGEMENT

I record my most sincere appreciation and gratitude to my supervisors Dr. (Mrs.) O. Gunapala Department of Chemical and Process Engineering and Dr P.Y .Gunapala Department of Materials Engineering Moratuwa for valuable guidance, encouragement, help and advice during the course of this work. I value best the assistance given by Dr. Santha Walpolage and Dr.Jagath Premachandra , Department of Chemical and Process Engineering, University of Moratuwa. I am grateful to the academic staff of the Department of Chemical and Process Engineering and all non-academic staff members of the Departments of Chemical and Process Engineering and Materials Engineering for their unhesitating corporations.

I wish to express my special thanks to Mr.Anuradha Jayasinghe (C.E.O Tuffline), and Management of Tuffline ltd. My thanks further extended to my mother Mrs. M.T.Illangarathne, my father Mr. M.P.Illangarathne, my brothers and sisters also. This makes me up in thanking of the Dean of the PGS University of Moratuwa.



University of Moratuwa, Sri Lanka.
Electronic Theses & Dissertations
www.lib.mrt.ac.lk



ABSTRACT.

The present research was pursued to develop breathable plastic packaging suited for desired level of moisture permeable application. The monolayer plastic films differed by resin composition were extruded by blown film equipment and two types of packaging with different architecture were prepared from the films extruded. To evaluate the package quality, the shelf life of fresh mushrooms packed in the packages was studied. Water vapour transmission rate and other performance properties of plastic films were determined. Results demonstrated good breathability of the developed packaging. Preference was given to the filled polyolefin compounds. Importance of filler particle size, treatment and processing conditions, including biaxial orientation were shown. Use of local filler and traditional single layer extrusion equipment did not contribute to the cost significantly, making packaging affordable easily by local consumer.



University of Moratuwa, Sri Lanka.
Electronic Theses & Dissertations
www.lib.mrt.ac.lk

CONTENTS

Chapter 1	pages
1.1 Introduction	01
1.2 Objectives	02
Chapter 2	
Literature review	
2.1 Historical background of polyethylene technology	03
2.2 Ethylene molecules and polyethylene	05
2.2.1 Low-density polyethylene (LDPE)	06
2.2.2 Special characteristic of LDPE	06
2.3 Application of LDPE	06
2.4 High-density polyethylene (HDPE)	07
2.4.1 Characteristic of HDPE	07
2.5 Linear low-density polyethylene (LLDPE)	08
2.6 Structure of LLDPE	09
2.7 Fillers and its characteristics	09
2.8 Permeability in packaging	11
2.8.1 New development in plastic packaging	13
2.8.2 Barrier Properties	19
2.8.3 Application of breathable film	19
2.9 Blown film extrusion	21
Chapter 3	
Material and Experimental methods	
3.1 Resources required	32
3.2 Materials	32
3.3 Mixing procedure for surface treated CaCO ₃ and Polyolefin materials	37
3.4 Film extrusion process	38
3.5 Film forming	40
3.5.1 Stretching and heat setting.	41

3.6 Characterization of mechanical properties	42
3.6.1 Measurement of sample thickness and width	42
3.6.2 Tensile strength test of plastic film	42
3.6.3 Testing for friction	43
3.6.4 Vicat softening temperature determination	45
3.7 Procedure for measurement of the water vapor transmission rate	47
3.8 Pouch sample preparation to check the shelf life of the Fresh items	48

Chapter 4

Results

4.1 Results obtained from the thickness and width of films	51
4.2 Results obtained from the digital force gauge meter	53
4.3 Results obtained from the friction proofing test	53
4.4 Results obtained from the Vicat softening point test	54
4.5 Results obtained from the water vapour transmission test	54
4.6 Results on observations of the shelf life of the fresh packed product.	56

Chapter 5

Analysis and discussions

5.1 Analysis and discussions	63
5.1.1 Effect of filler on process parameters	63
5.2 Effect of filler concentration on properties of plastic film	64
5.2 .1Effect of filler concentration on tensile strength of plastic films	64
5.2 .2 Effect of filler concentration on the appearance of plastic film	67
5.3 Effect of filler concentration on thermal stability of plastic films	70

5.4 Water vapor Transmission rate	71
5.5 Study on the shelf live of packed mushrooms	73
Chapter 6	
Conclusion	77



University of Moratuwa, Sri Lanka.
Electronic Theses & Dissertations
www.lib.mrt.ac.lk