

Table of Contents

CHAPTER	PAGE
Title Page	i
Abstract (in English)	ii
Abstract (in Thai)	iii
Acknowledgements	iv
Table of Contents	v
List of Scheme	ix
List of Tables	x
List of Figures	xi
I INTRODUCTION	1
1.1 Introduction	1
1.2 Objective	2
1.3 Scope of Research	2
1.4 Theoretical Background and Literature Reviews	2
1.4.1 Multi-layered Films	2
1.4.2 Biodegradable Polymers	3
1.4.3 Poly(lactic acid) (PLA)	5
1.4.4 Poly(butylene succinate) (PBS)	7

CHAPTER	PAGE
1.4.5 Thermoplastic Starch (TPS)	8
1.4.6 Bioplastic Multi-layered Films	8
1.4.7 Points of the work	8
II EXPERIMENTAL	9
2.1 Materials	9
2.1.1 Polymers	9
2.1.2 Chemical Reagents	9
2.1.3 Solvents	9
2.2 Instruments and Equipment	10
2.2.1 Structural Characterization	10
2.2.1.1 Fourier-transform Infrared Spectroscopy (FTIR)	10
2.2.1.2 Nuclear Magnetic Resonance Spectroscopy (NMR)	10
2.2.2 Thermal Analysis	10
2.2.3 Mechanical Testing	11
2.2.4 Compatibility Study	11
2.2.5 Water Absorption	11
2.2.6 Barrier Properties	12
2.2.7 X-ray Diffraction	12
2.3 Methodology	12
2.3.1 PLA-based Multi-layered Films with PBS	12

CHAPTER	PAGE
2.3.1.1 Poly(Lactic Acid) Prepolymer	12
2.3.1.2 Poly(Butylene Succinate) (PBS) Prepolymer	13
2.3.1.3 Poly(Lactic Acid- <i>b</i> -Butylene Succinate) (PLA- <i>b</i> -PBS)	14
2.3.1.4 PLA/PBS/PLA Multi-layered Film	15
2.3.2 PLA-based Multi-layered Films with TPS	16
2.3.2.1 TPS Preparation	16
2.3.2.2 TPS Blend Preparation	17
2.3.2.3 PLA/TPS/PLA Multi-layered Films	17
III RESULTS AND DISCUSSION	18
3.1 PLA-based Multi-layered Films with PBS	18
3.1.1 PLA- <i>b</i> -PBS Copolymer Characterizations	18
3.1.1.1 Structural Analysis	18
3.1.1.2 Thermal Analysis	23
3.1.1.3 Spherulite Study	24
3.1.2 Characterizations of PLA/PBS/PLA Multi-layered Films	26
3.1.2.1 Compatibility Study	26
3.1.2.2 Thermal Properties and Crystallization Behavior	30
3.1.2.3 Mechanical Properties	31
3.1.3 Vacuum Applications	34
3.1.4 Conclusions	35

CHAPTER	PAGE
3.2 PLA-based Multi-layered Films with TPS	36
3.2.1 TPS Characterizations	36
3.2.1.1 Structural Analysis	36
3.2.1.2 Thermal Analysis	37
3.2.1.3 Spherulite Study	37
3.2.2 Characterizations of PLA/TPS/PLA Multi-layered Films	38
3.2.2.1 Thermal Properties	38
3.2.2.2 Mechanical Properties	39
3.2.2.3 Water Absorption	41
3.2.2.4 Oxygen Permeability	43
3.2.3 Conclusions	44
IV CONCLUSIONS	45
REFERENCES	46
CURRICULUM VITAE	51