

**STUDIES ON RHEOLOGY AND MICROSTRUCTURE OF  
STARCH-BASED HDPE BLENDS**

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## ABSTRACT

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Thipa Naiyawat : Studies on Rheology and Microstructure of Starch-Based HDPE Blends. Thesis Advisors : Assoc. Prof. David C. Martin, Dr. Ratana Rujiravanit, and Mr. John W. Ellis, 53 pp. ISBN 974-638-480-5

The rheological properties of starch/high density polyethylene (HDPE) blends have been studied. Starch contents were varied from 0-40 wt %. Two different types of starch were used in this work, viz. tapioca and rice starch. Blend rheological properties studied were the viscous, elastic, and viscoelastic behaviors. Both types of starch made the blends more viscous and stiffer. Tapioca and rice starch gave almost the same viscous behavior, but they exhibited different elastic and viscoelastic behaviors. Rice starch-HDPE blends were stiffer than tapioca starch-HDPE blends. In addition, storage modulus and loss modulus of the blends containing rice starch were higher than those of the blends containing tapioca starch.

From scanning electron micrographs, both types of starch showed poor adhesion between starch particles and the HDPE matrix. In addition, the rice starch particles exhibited agglomeration while tapioca starch particles were discrete and well distributed in the HDPE matrix.

## บทคัดย่อ

ทิวา นัยวัฒน์ : การศึกษาสมบัติการไหลและโครงสร้างจุลภาคของพอลิเมอร์ผสมระหว่างพอลิเอทิลีนความหนาแน่นสูงกับแป้ง (Studies on Rheology and Microstructure of Starch-Based HDPE Blends) อ.ที่ปรึกษา : รศ. ดร. เดวิด ซี มาร์ติน (Assoc. Prof. David C. Martin) ดร. รัตนา รุจิรวนิช และ มร. จอห์น ดับบลิว เอลลิส (Mr. John W. Ellis) 53 หน้า ISBN 974-638-480-5

งานวิจัยนี้ศึกษาสมบัติการไหลของพอลิเมอร์ผสมระหว่างพอลิเอทิลีนความหนาแน่นสูง (HDPE) กับแป้ง ปริมาณแป้งที่ศึกษาอยู่ระหว่าง 0 ถึง 40 เปอร์เซ็นต์โดยน้ำหนัก แป้งที่ศึกษามี 2 ชนิด คือ แป้งมันสำปะหลังและแป้งข้าวเจ้า สมบัติการไหลของพอลิเมอร์ผสมที่ศึกษาได้แก่ ความหนืด ความยืดหยุ่น และความเป็นวิสโคอีลาสติก (viscoelastic) การเติมแป้งทั้งสองชนิดมีผลทำให้พอลิเมอร์ผสมมีความหนืดมากขึ้นและแข็งตึง (stiff) ขึ้น แป้งมันสำปะหลังและแป้งข้าวเจ้าส่งผลต่อความหนืดของพอลิเมอร์ผสมเหมือนกัน แต่ให้ผลต่างกันสำหรับความยืดหยุ่นและความเป็นวิสโคอีลาสติก พอลิเมอร์ผสมระหว่างแป้งข้าวเจ้ากับพอลิเอทิลีนความหนาแน่นสูงมีความแข็งตึงกว่าพอลิเมอร์ผสมระหว่างแป้งมันสำปะหลังกับพอลิเอทิลีนความหนาแน่นสูง นอกจากนี้สตอเรจมอดูลัส (storage modulus) และลอสสมอดูลัส (loss modulus) ของพอลิเมอร์ผสมที่มีแป้งข้าวเจ้ามีค่าสูงกว่าพอลิเมอร์ผสมที่มีแป้งมันสำปะหลัง

จากภาพถ่ายของโครงสร้างจุลภาค พบว่าไม่มีการยึดเกาะระหว่างอนุภาคของแป้งทั้งสองชนิดกับเนื้อพอลิเอทิลีนความหนาแน่นสูง นอกจากนี้ยังพบว่าอนุภาคของแป้งข้าวเจ้าในพอลิเมอร์ผสมเกิดการเกาะกันเป็นกลุ่มก้อน ส่วนอนุภาคของแป้งมันสำปะหลังสามารถกระจายตัวได้ดีในเนื้อพอลิเอทิลีนความหนาแน่นสูง

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## TABLE OF CONTENTS

	<b>PAGE</b>
Title Page	i
Abstract	iii
Acknowledgments	v
List of Tables	ix
List of Figures	x
<b>CHAPTER</b>	
<b>I INTRODUCTION</b>	
1.1 Background	1
1.1.1 Starch	1
1.1.2 Rheology	3
1.1.3 Microstructure	11
1.2 Literature Survey	11
1.3 Objectives of Research	17
<b>II EXPERIMENTAL SECTION</b>	
2.1 Materials	18
2.1.1 High Density Polyethylene	18
2.1.2 Starch	18
2.1.3 Calcium Oxide	18
2.1.4 Natural Rubber	18
2.1.5 Zinc Stearate	18

<b>CHAPTER</b>	<b>PAGE</b>
2.2 Instruments	19
2.2.1 Two-roll Mill	19
2.2.2 Twin-screw Extruder	19
2.2.3 Compression Molding Machine	19
2.2.4 Capillary Rheometer	19
2.2.5 Dynamic Mechanical Spectrometer	20
2.2.6 Scanning Electron Microscope	20
2.3 Procedure	20
2.3.1 Sample Preparation	20
2.3.2 Rheological Measurements	22
2.3.3 Microstructure Characterization	25
<b>III RESULTS AND DISCUSSION</b>	
3.1 Rheological Studies	26
3.1.1 Viscous Behavior	26
3.1.2 Elastic Behavior	32
3.1.3 Viscoelastic Behavior	35
3.2 Microstructure Characterization	43
3.2.1 Starch	43
3.2.2 HDPE	44
3.2.3 Tapioca Starch-based HDPE Blends	45
3.2.4 Rice Starch-based HDPE Blends	46
3.2.5 Comparison Between Tapioca and Rice Starch-based HDPE Blends	47

<b>CHAPTER</b>		<b>PAGE</b>
<b>IV</b>	<b>CONCLUSIONS</b>	48
	4.1 Rheological Studies	48
	4.2 Microstructure Characterization	49
	<b>REFERENCES</b>	50
	<b>CURRICULUM VITAE</b>	53



**LIST OF TABLES**

<b>TABLE</b>		<b>PAGE</b>
2.1	Conditions for compounding materials in twin screw extruder	21
3.1	Power law index (n) for the starch-HDPE blends at 180°C	28

## LIST OF FIGURES

FIGURE	PAGE
1.1 Types of flow curves : (a) arithmetic, (b) logarithmic. N = Newtonian, P = Pseudoplastic, D =Dilatant	5
1.2 Stress-strain relationship for elastic solids	8
1.3 Deformational and recovery behavior of a Hookean solid, a Newtonian fluid, and a viscoelastic material	9
1.4 The schematic stress response of an elastic, a viscous, and a viscoelastic material to a sinusoidally applied strain	10
2.1 Shear stress-strain curve of a solid	24
3.1 Effect of tapioca starch content on viscosity of blends containing 0, 10, 20, 30, and 40 wt % of starch at 180°C at various apparent shear rates	27
3.2 Effect of rice starch content on viscosity of blends containing 0, 10, 20, 30, and 40 wt % of starch at 180°C at various apparent shear rates	27
3.3 Effect of starch type on viscosity of blends at 180°C : (a) 10 wt % of starch, (b) 20 wt % of starch, (c) 30 wt % of starch, and (d) 40 wt % of starch	29
3.4 Effect of temperature on viscosity of HDPE	30
3.5 Effect of temperature on viscosity of blends containing 20 wt % of tapioca starch	31
3.6 Effect of temperature on viscosity of blends containing 20 wt % of rice starch	31

<b>FIGURE</b>	<b>PAGE</b>
3.7 Shear stress-strain curves for blends containing different tapioca starch contents analyzed at 30°C	32
3.8 Effect of starch type on shear yield stress of blends at 30°C	33
3.9 Effect of starch type on shear yield strain of blends at 30°C	34
3.10 Effect of starch type on shear modulus of blends at 30°C	35
3.11 Effect of tapioca starch content on storage modulus of blends containing 0, 10, 20, 30, and 40 wt % of starch at 30°C	36
3.12 Effect of tapioca starch content on loss modulus of blends containing 0, 10, 20, 30, and 40 wt % of starch at 30°C	37
3.13 Effect of tapioca starch content on loss tangent of blends containing 0, 10, 20, 30, and 40 wt % of starch at 30°C	37
3.14 Effect of rice starch content on storage modulus of blends containing 0, 10, 20, 30, and 40 wt % of starch at 30°C	38
3.15 Effect of rice starch content on loss modulus of blends containing 0, 10, 20, 30, and 40 wt % of starch at 30°C	39
3.16 Effect of rice starch content on loss tangent of blends containing 0, 10, 20, 30, and 40 wt % of starch at 30°C	39
3.17 Effect of starch type on storage modulus of blends at 30°C: (a) 10 wt % of starch, (b) 20 wt % of starch, (b) 30 wt % of starch, and (d) 40 wt % of starch	40
3.18 Effect of starch type on storage modulus in the glassy state of blends at 30°C	41
3.19 Effect of starch type on loss modulus of blends at 30°C: (a) 10 wt % of starch, (b) 20 wt % of starch, (c) 30 wt % of starch, and (d) 40 wt % of starch	42

<b>FIGURE</b>	<b>PAGE</b>
3.20 Effect of starch type on loss tangent of blends at 30°C: (a) 10 wt % of starch, (b) 20 wt % of starch, (c) 30 wt % of starch, and (d) 40 wt % of starch	43
3.21 Scanning electron micrographs of starches : (a) tapioca starch, and (b) rice starch	44
3.22 Scanning electron micrographs of fractured surfaces of HDPE : (a) at 35X magnification, and (b) at 1000X magnification	44
3.23 Scanning electron micrographs of fractured surfaces of tapioca starch-based HDPE blends : (a) 10 wt % of starch, (b) 20 wt % of starch, (c) 30 wt % of starch, and (d) 40 wt % of starch	45
3.24 Scanning electron micrographs of fractured surfaces of rice starch-based HDPE blends : (a) 10 wt % of starch, (b) 20 wt % of starch, (c) 30 wt % of starch, and (d) 40 wt % of starch	46
3.25 Scanning electron micrographs of fractured surfaces of blends containing 20 wt % of starch : (a) tapioca starch-based HDPE blend, and (b) rice starch-based HDPE blend	47