

การเตรียมฟิล์มไบโอบีโคมพอลิเมอร์ของแป้งมันสำปะหลังเสริมแรงด้วยคริสตัลลีนเซลลูโลส



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PREPARATION OF BIOCOMPOSITE FILMS FROM CASSAVA STARCH REINFORCED WITH  
CRYSTALLINE CELLULOSE

Miss Voravadee Suchaiya

A Thesis Submitted in Partial Fulfillment of the Requirements  
for the Degree of Master of Science Program in Applied Polymer Science and Textile Technology

Department of Materials Science

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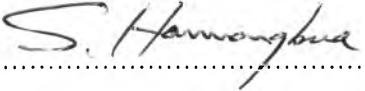
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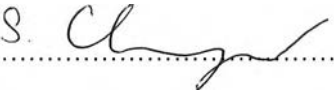
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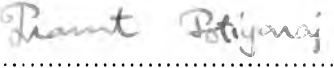
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งานวิจัยนี้ศึกษาการเตรียมฟิล์มไบโอคอมพอสิตของแป้งมันสำปะหลังที่เสริมแรงด้วยคริสตัลลีนเซลลูโลสที่เตรียมจากวัตถุดิบทางการเกษตรคือ ชานอ้อย และกากบดด้วยวิธีการไฮโดรไลซิสด้วยกรดซัลฟิวริกและกรดไฮโดรคลอริก โดยทำการศึกษา วิธีการ ขั้นตอน และภาวะที่เหมาะสมในการเตรียมคริสตัลลีนเซลลูโลสจากชานอ้อยและกากบด ผลการวิจัยพบว่า ความเข้มข้นของสารละลายไฮดรอกไซด์ที่เหมาะสมในการกำจัดลิกนินของชานอ้อยและกากบดคือ 0.5 และ 1 โมลาร์ ตามลำดับ สำหรับภาวะที่เหมาะสมในการฟอกขาวเส้นใยที่ได้จากชานอ้อยและกากบดคือที่ความเข้มข้นร้อยละ 6 ของไฮโดรเจนเปอร์ออกไซด์ในสารละลายเบส กรดไฮโดรคลอริกและกรดซัลฟิวริกที่ความเข้มข้น 2.5 นอร์มัล ถูกใช้สำหรับไฮโดรไลซิสที่เวลาต่าง ๆ เพื่อเตรียมไมโครคริสตัลลีนเซลลูโลสด้วยการวัดค่าเฉลี่ยขนาดอนุภาค พบว่าเวลาที่เหมาะสมสำหรับไฮโดรไลซิสเยื่ออ้อยและเยื่อกากบดที่ได้คือ 60 และ 30 นาที ตามลำดับ ไมโครคริสตัลลีนเซลลูโลสที่เตรียมได้ และไมโครคริสตัลลีนเซลลูโลสทางการค้าถูกผสมลงในฟิล์มแป้งในปริมาณร้อยละ 0-40 โดยน้ำหนักของแป้ง พบว่าฟิล์มที่เสริมแรงด้วยไมโครคริสตัลลีนเซลลูโลสจะมีความใสน้อยกว่าฟิล์มที่ไม่ถูกเสริมแรงด้วยไมโครคริสตัลลีนเซลลูโลส ความขุ่นของฟิล์มไบโอคอมพอสิตเพิ่มขึ้นเมื่อปริมาณของไมโครคริสตัลลีนเซลลูโลสเพิ่มขึ้น นอกจากนี้การเติมไมโครคริสตัลลีนเซลลูโลสลงในฟิล์มแป้ง สามารถปรับปรุงค่าความทนต่อแรงดึงและค่า Young's Modulus ของฟิล์มแป้งที่เติมพลาสติกไซเซออร์ ค่าความทนต่อแรงดึง และ ค่า Young's Modulus สูงสุดของฟิล์มไบโอคอมพอสิตที่เตรียมได้มีค่าในช่วง 10-15 เมกะปาสคาล และ 600 -800 เมกะปาสคาล ตามลำดับ ฟิล์มไบโอคอมพอสิตมีความสามารถในการย่อยสลายมากกว่าฟิล์มแป้งที่เติมพลาสติกไซเซออร์ อีกทั้งความสามารถในการย่อยสลายของฟิล์มเพิ่มมากขึ้นเมื่อขนาดและปริมาณของไมโครคริสตัลลีนเซลลูโลสเพิ่มมากขึ้น ซึ่งผลที่ได้สอดคล้องกับผลของการดูดซึมน้ำของฟิล์มไบโอคอมพอสิต ฟิล์มไบโอคอมพอสิตที่เสริมแรงด้วยไมโครคริสตัลลีนเซลลูโลสของชานอ้อยที่เตรียมจากกรดไฮโดรคลอริก มีเสถียรภาพทางความร้อน สมบัติเชิงกล และความสามารถในการย่อยสลายที่ดีกว่าฟิล์มไบโอคอมพอสิตอื่น ๆ ที่เตรียมได้รวมทั้งฟิล์มแป้งที่เติมพลาสติกไซเซออร์

ภาควิชา วัสดุศาสตร์

สาขาวิชา วิทยาศาสตร์พอลิเมอร์ประยุกต์และเทคโนโลยีสิ่งทอ  
ปีการศึกษา 2551

ลายมือชื่อนิสิต..... ๑๕๑๕..... ผู้ช่วย ๒๒

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# # 4972469523 : MAJOR APPLIED POLYMER SCIENCE AND TEXTILE TECHNOLOGY

KEY WORD: BIODEGRADABLE POLYMER / CASSAVA STARCH / CRYSTALLINE CELLULOSE

VORAVADEE SUCHAIYA : PREPARATION OF BIOCOMPOSITE FILMS FROM CASSAVA STARCH REINFORCED WITH CRYSTALLINE CELLULOSE. THESIS PRINCIPAL ADVISOR : ASSOC. PROF. DUANGDAO AHT-ONG, Ph.D., THESIS COADVISOR : ASSOC. PROF. PRANUT POTIYARAJ, Ph.D., 211 pp.

An environmentally friendly biodegradable composite films between plasticized cassava starch and crystalline cellulose from agricultural wastes were successfully prepared. Two types of agricultural wastes, bagasse and banana stem, were made into crystalline cellulose by acid hydrolysis using HCl and H<sub>2</sub>SO<sub>4</sub>. The suitable condition for preparing crystalline cellulose from each agricultural waste was investigated. From the results, the suitable NaOH concentrations for delignification of bagasse and banana stem fiber were 0.5 M and 1 M, respectively. For bleaching, 6% H<sub>2</sub>O<sub>2</sub> in alkali solution was the most appropriated condition for both pulps. HCl and H<sub>2</sub>SO<sub>4</sub> at 2.5 N concentrations were used for hydrolysis at varied reaction time in order to obtain microcrystalline cellulose (MCC) with determined average particle size. The suitable reaction times for hydrolysis bagasse and banana stem were 60 and 30 min, respectively. The prepared crystalline cellulose as well as a commercial MCC were mixed, at 0-40 wt% (based on starch), with plasticized starch. The films containing MCC were less transparent than the one without MCC. The haze of biocomposite films readily increased with the increasing amount of MCC. The incorporation of MCC improved the tensile strength and Young's modulus of plasticized starch. In general, the maximum tensile strength and Young's modulus of the prepared film were as high as 10-15 MPa and 600-800 MPa, respectively. The biocomposite films showed higher degree of biodegradability comparing with the plasticized starch film. The biodegradability increased when the amount and the average particle size of MCC increased. These results are in agreement with the water absorption behavior of the films. Biocomposite film reinforcing with bagasse MCC prepared using HCl had better thermal stability, mechanical properties, and biodegradability than other prepared biocomposite and plasticized starch films.

Department: Materials Science

Field of study: Applied Polymer Science and Textile Technology

Academic year: 2008

Student's signature.....*๒๖๓๑ ๒๖๖๕๕๕*.....

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## ABBREVIATIONS

HCl-BG	:	Hydrolyzed bagasse from HCl
H <sub>2</sub> SO <sub>4</sub> -BG	:	Hydrolyzed bagasse from H <sub>2</sub> SO <sub>4</sub>
HCl-BS	:	Hydrolyzed banana stem from HCl
H <sub>2</sub> SO <sub>4</sub> -BS	:	Hydrolyzed banana stem from H <sub>2</sub> SO <sub>4</sub>
CM	:	Commercial microcrystalline cellulose
MCC	:	Microcrystalline cellulose
XRD	:	X-Ray diffractometer
SEM	:	Scanning electron microscope