

ผลของการเปลี่ยนอัญรูปเซลล์โลสต่อสมบัติของเส้นใยเซลล์โลส

นางสาว วิไลพร ไสตถิธรรมรักษ์



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ลิขสิทธิ์ของจุฬาลงกรณ์มหาวิทยาลัย

Effect of Cellulose Polymorph Transformations on Cellulosic Fiber Properties

Miss Wilairom Sottithumaruk

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

Department of Materials Science

Faculty of Science

Chulalongkorn University

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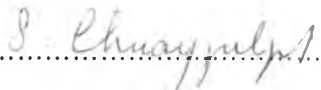
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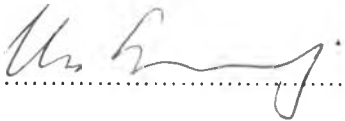
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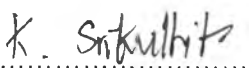
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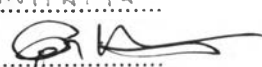
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งานวิจัยนี้เป็นการศึกษาถึงกระบวนการเปลี่ยนอัญรูปของเซลลูโลสในผ้าฝ้ายดักและผ้าฝ้ายทอ โดยอาศัยสารเคมีพื้นฐานและกระบวนการเปลี่ยนอัญรูปที่ไม่ซับซ้อน ตลอดจนตรวจสอบสมบัติบางประการอันได้แก่ ระดับของการพอลิเมอไรเซชัน ความแข็งแรงของผ้า และความสามารถในการดูดซึมน้ำของผ้าฝ้าย ณ อัญรูปต่างๆ ของเซลลูโลส

จากผลการทดลองพบว่าสามารถเปลี่ยนอัญรูปเซลลูโลสไปมาระหว่าง cellulose I, cellulose II และ cellulose III ได้โดยการชุบมันด้วยสารละลายโซเดียมไฮดรอกไซด์ หรือการทรีทเมนต์ด้วยแอมโมเนียเหลว ซึ่งอัญรูปเซลลูโลสที่ได้รับจากการเปลี่ยนจะค่อนข้างสมบูรณ์เมื่อเซลลูโลสนั้นได้ผ่านการเปลี่ยนอัญรูปมาแล้วหลายครั้งโดยการชุบมันด้วยสารละลายโซเดียมไฮดรอกไซด์สลับกับการทรีทเมนต์ด้วยแอมโมเนียเหลว และทั้งสองกระบวนการนี้สามารถเปลี่ยนอัญรูปเซลลูโลสไปมาได้หลายครั้งโดยไม่ทำลายเส้นใย ตรงกันข้ามกลับส่งผลให้ผ้าฝ้ายที่ได้มีความแข็งแรงมากขึ้น มีความยืดหยุ่น และความสามารถในการดูดซึมน้ำที่ดีขึ้น สำหรับผ้าฝ้ายที่ถูกเปลี่ยนอัญรูปเป็น cellulose II หรือเคยผ่านการเป็น cellulose II มาก่อนจะมีความสามารถในการดูดซึมน้ำที่ใกล้เคียงกันแต่สามารถดูดซึมน้ำได้ดีกว่าผ้าฝ้ายในอัญรูปเซลลูโลสอื่นๆ และเมื่อพิจารณาถึงความสะดวกในการใช้งานพบว่ากระบวนการเปลี่ยนอัญรูปเซลลูโลสจาก cellulose I เป็น cellulose II นั้นเป็นกระบวนการที่เหมาะสมที่สุดที่จะช่วยปรับปรุงสมบัติด้านความแข็งแรง และความสามารถในการดูดซึมน้ำของผ้าฝ้าย

ภาควิชาวัสดุศาสตร์
สาขาวิชาวิทยาศาสตร์พอลิเมอร์ประยุกต์ ๔
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ลายมือชื่อนิสิต.....วิไลพร โสทธิธรรมรักษ์.....
ลายมือชื่ออาจารย์ที่ปรึกษา.....

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KEY WORD: cellulose polymorph / transformations / cotton fabric / X-ray / properties

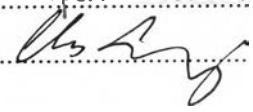
WILAIORN SOTTITHUMARUK : EFFECT OF CELLULOSE POLYMORPH TRANSFORMATIONS ON CELLULOSIC FIBER PROPERTIES. THESIS ADVISOR : DR. USA SANGWATANAROJ. 95 pp. ISBN 974-13-0510-9.

This research are focusing on studying the transformations among cellulose polymorphs of cotton woven and knitted fabrics using basic chemicals and the simplest treatments, and to determine some properties of the fabrics at each stage of cellulose polymorphs. All untreated and treated fabric samples were tested for the stage of cellulose polymorphs, degree of polymerization, the fabric strength and the dye absorption.

Results showed that the transformations among cellulose polymorphs I, II and III were possible by caustic soda mercerization or liquid ammonia treatment. To obtain a completion of cellulose polymorph transformation, cellulose must pass several transformations by the uses of caustic soda mercerization altering with the liquid ammonia treatment. With these two treatments, cellulose was able to transform its polymorph to other polymorphs as many times as possible without damaging cellulosic fiber. In addition, these transformations improved the strength, flexibility and dyeability of the cellulosic fabrics. Samples of cellulose II or samples that have passed the transformation to cellulose II obtained the same dyeability but they were capable of absorbing more dyes than other samples. For application and economical reasons, the process of transformation of cellulose I to cellulose II is the most appropriate process to improve dyeability and strength of cotton fabrics.

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Student's signature Wilaiporn Sottithumaruk

Advisor's signature 



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ABBREVIATIONS

Cellulose I	Original native cellulose.
Cellulose II _I	Cellulose I was mercerized with caustic soda to form cellulose II.
Cellulose III _I	Cellulose I was treated with liquid ammonia followed by an air evaporation to form cellulose III.
Cellulose III _{II}	Cellulose I was mercerized with caustic soda to form cellulose II, then was treated with liquid ammonia followed by an air evaporation to form cellulose III.
Cellulose I from cellulose III _I	Cellulose I was treated with liquid ammonia followed by an ammonia removal in water to form cellulose I
Cellulose I from cellulose III _{II}	Cellulose I was mercerized with caustic soda to form cellulose II, then was treated with liquid ammonia followed by an ammonia removal in water to form cellulose I.
Cellulose II from cellulose III _{II}	Cellulose I was mercerized with caustic soda to form cellulose II, then was treated with liquid ammonia followed by an air evaporation to form cellulose III and finally was mercerized with caustic soda to form cellulose II.
η_{rel}	Relative viscosity
$[\eta]$	Intrinsic viscosity
c	Cellulose solution concentration
DP	Degree of polymerization