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PREPARATION OF ACRYLIC ACID-CASSAVA STARCH GRAFT
COPOLYMER AS A THICKENER FOR COTTON FABRICS PRINTING



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จุฬาลงกรณ์มหาวิทยาลัย
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พิมพ์ต้นฉบับบทคัดย่อวิทยานิพนธ์ภายในกรอบสี่เหลี่ยมนี้เพียงแผ่นเดียว

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แป้งมันสำปะหลังธรรมชาติได้รับการดัดแปรทางเคมีให้เป็นแป้งที่กราฟต์ด้วยโพลิกรดอะคริลิก ด้วยการทำ
ปฏิกิริยากราฟต์โคโพลิเมอร์ของกรดอะคริลิกในโครงสร้างหลักของโพลิแซคคาไรด์ โดยผ่านกลไกการริเริ่มปฏิกิริยาด้วย
ไฮโดรเจนเปอร์ออกไซด์และกรดแอสคอร์บิก ด้วยการทำให้แป้งมีลักษณะเป็นเจลที่ 80°C เป็นเวลา 1 ชั่วโมงก่อนเริ่ม
ปฏิกิริยาการกราฟต์ตัวแปรทางปฏิกิริยาที่สำคัญประกอบด้วยความเข้มข้นของกรดอะคริลิก ไฮโดรเจนเปอร์ออกไซด์
กรดแอสคอร์บิก และแป้ง อุณหภูมิของการทำโพลิเมอร์ไรเซชัน เวลาในการทำโพลิเมอร์ไรเซชัน อัตราการหยุดของสารผสม
ระหว่างกรดอะคริลิก และไฮโดรเจนเปอร์ออกไซด์ นำผลิตภัณฑ์แป้งที่กราฟต์ด้วยโพลิกรดอะคริลิกมาทำปฏิกิริยาสะพอนิไฟ
ด้วยสารละลายของโซเดียมไฮดรอกไซด์ที่มีความเข้มข้นอยู่ 25 ที่อุณหภูมิห้องซึ่งเป็นผลให้หมู่คาร์บอกซิลิกได้รับการเปลี่ยน
เป็นหมู่คาร์บอเนต นำผลิตภัณฑ์โคโพลิเมอร์ที่ได้มาพิสูจน์ลักษณะโดยใช้อินฟราเรดสเปกโตรสโคปีและนิวเคลียร์แมกเน
ติกเรโซแนนซ์สเปกโตรสโคปี ใช้ GPC เป็นเครื่องมือในการหาน้ำหนักโมเลกุลเฉลี่ยของแป้งและกราฟต์โพลิเมอร์ของกรด
อะคริลิกที่ผ่านการไฮโดรไลซ์ด้วยกรดเกลืออะซิติกและกรดเปอร์คลอริก วัดความหนืดของกราฟต์โคโพลิเมอร์โดยการแปร
ปริมาณความเข้มข้น (6, 8, 10, และ 12% น้ำหนัก/น้ำหนัก) น้ำหนักโมเลกุลเฉลี่ยที่สูงของไฮโดรไลซ์(เกลือโซเดียม) กราฟต์
โคโพลิเมอร์ของแป้งมันสำปะหลังและกรดอะคริลิกละลายในน้ำกลั่นได้ดีกว่า เป็นผลมาจากอิทธิพลของเกลือและความมีขั้วของ
โมเลกุล การกระจายของน้ำหนักโมเลกุลของสายโซ่โพลิอะคริลิกที่กราฟต์อยู่ในช่วง 9,599-77,459 และ 101,246-651,967
และน้ำหนักโมเลกุลเฉลี่ยของแป้งที่ผ่านการไฮโดรไลซ์ด้วยกรดอยู่ในช่วง 190,302,1,005 ได้ทดสอบการดูดซึมน้ำของสารชั้น
ใหม่ในน้ำกลั่น งานวิจัยนี้ยังได้อธิบายอิทธิพลของตัวแปรดังกล่าวต่อการเกิดปฏิกิริยาและการดูดซึมน้ำ ได้ศึกษาความหนืด
ของสารชั้นด้วยการแปรปริมาณความเข้มข้น (น้ำหนัก/น้ำหนัก) ซึ่งแสดงให้เห็นว่าปริมาณความเข้มข้นของสารชั้นมีผลให้
ความหนืดของสารชั้นเปลี่ยนแปลงไป และมีสมบัติด้านการไหลแบบเชียร์ทีนนิ่งหรือซูโดพลาสติก

จุฬาลงกรณ์มหาวิทยาลัย
CHULALONGKORN UNIVERSITY

ภาควิชา สหสาขาปิโตรเคมี-โพลิเมอร์.....
สาขาวิชา วิทยาศาสตร์โพลิเมอร์.....
ปีการศึกษา 2539.....

ลายมือชื่อนิสิต สรุ๊ก อารยเมธาเลิศ.....
ลายมือชื่ออาจารย์ที่ปรึกษา สุตา เกียรติกำจรวงศ์.....
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SURUCK ARAYAMAYTHALERT : PREPARATION OF ACRYLIC ACID-CASSAVA

STARCH GRAFT COPOLYMER AS A THICKENER FOR COTTON FABRICS PRINTING.

THESIS ADVISOR : ASSOC. PROF. SUDA KIATKAMJORNWONG, Ph.D. 181 PP. ISBN 974-633-757-2

Native cassava starch was chemically modified into starch graft poly(acrylic acid) under a grafting copolymerization of acrylic acid onto the polysaccharide backbone via a hydrogen peroxide-ascorbic acid initiation method. Prior to the grafting reaction, starch was gelatinized at 80°C for 1 h. Reaction variables of importance included concentrations of acrylic acid, hydrogen peroxide, ascorbic acid, and starch; polymerization temperature; polymerization time; and the addition rate of acrylic acid-hydrogen peroxide mixture. The poly(acrylic acid) grafted starch was subsequently saponified with a 25% aqueous solution of NaOH at room temperature to convert carboxylic groups into carboxylate groups. The copolymers were characterized by infrared spectroscopy and nuclear magnetic resonance spectroscopy. GPC was used as a tool to determine the average molecular weights of the starch and grafted poly(acrylic acid), which had been hydrolyzed by glacial acetic acid and perchloric acid. Viscosity measurements of the graft copolymers were carried out at various concentrations (6, 8, 10, 12% w/w) of the thickeners. The high molecular weights of the hydrolyzed (Na salt) cassava starch-acrylic acid copolymer dissolve better in distilled water resulting from the salt and polarity of the molecules. The distribution of molecular weights is in the ranges of 9,599-77,459 and 101,246-651,967 for the grafted poly(acrylic acid) chains and 190, 302, 1,005 for the acid hydrolyzed starch. Water absorption of the new thickener was carried out in distilled water. Discussion of the effects of the parameters on the reactions and water absorption was also given in this research. The viscosity of thickener was also studied as a function of concentration (w/w). It is evident that the concentrations of the thickener alter the viscosity and their rheological behavior known as shear thinning or pseudoplasticity.

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ABBREVIATIONS

°ซ.	องศาเซลเซียส
AA	acrylic acid
AGU	anhydroglucose unit
AN	acrylonitrile
AH ₂	L(+)-ascorbic acid
Ce ⁴⁺	cerium (IV) ion
Ce ³⁺	cerium (III) ion
cm ³	cubic centimetre
cm ⁻¹	unit of wavenumber
CMC	carboxy methyl cellulose
Co-60	cobalt 60
Cs-137	cesium-137
C=O	carbonyl group
Co ²⁺	cobalt (II) ion
Cr ²⁺	chromium (II) ion
Cu ²⁺	copper (II) ion
D	rate of shear
DHA	dehydroascorbic acid
D.P.	degree of polymerization
D.S.	degree of substitution
EMA	ethylene maleic anhydride copolymer
f	initiator efficiency
Fe ³⁺	iron (III) ion
Fe ²⁺	iron (II) ion

FT-IR	Fourier Transform Infrared
FT-NMR	Fourier Transform Nuclear Magnetic Resonance
g	gram
-g-	graft
GFC	gel filtration chromatography
GPC	gel permeation chromatography
G.E.	grafting efficiency
GG	guar gum
h	hour
HSPAA	hydrolyzed starch-g- poly(acrylic acid)
HSPAN	hydrolyzed starch-g- polyacrylonitrile
i	position of carbon atom
[I]	initiator concentration
J	joule
K	degrees Kelvin
k_d	initiator dissociation rate constant
k_p	propagation rate constant
k_t	termination rate constant
kJ	kilojoule
kg	kilogram
l	liquid
m^3	cubic metre
M	molarity
MA	methacrylic acid



MEHQ	monomethyl ether of hydroquinone
min	minute
\bar{M}_w	weight average molecular weights
\bar{M}_n	number average molecular weights
\bar{M}_v	viscosity average molecular weights
\bar{M}_z	z-average molecular weights
MMA	methyl methacrylic acid
P	polymer
PAA	poly(acrylic acid)
PAN	polyacrylonitrile
PEO	poly(ethylene oxide)
ppm	part per million
PS	polysaccharide
PS $^\bullet$	polysaccharide radical
R $^\bullet$	radical
r.m.m	relative molecular mass
R _p	rate of polymerization
s ⁻¹	per second
S	shear stress
S-g-PAA	starch graft poly(acrylic acid)
S-g-PAM	starch graft polyacrylamide
S-g-PAN	starch graft polyacrylonitrile
S-OH	starch molecule
S-O $^\bullet$	starch macroradical
Ti ²⁺	titanium (II) ion
t _R	retention time
V ²⁺	vanadium (II) ion

w/v	weight by volume
w/w	weight by weight
°C	degrees Celsius
%	percent
<	less than
>	more than
α	alpha
β	beta
γ	gamma
η	viscosity
μm	micrometre
Eur. Polym. J.	European Polymer Journal
J. Appl. Polym. Sci.	Journal of Applied Polymer Science
J. Chromatogr.	Journal of Chromatography
J. Macromol. Sci. Chem.	Journal of Macromolecular Science Chemistry
J. Polym. Sci. A.	Journal of Polymer Science, Part A
J. Polym. Sci. Polym. Chem. Ed.	Journal of Polymer Science, Polymer Chemistry Edition