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การเริ่มปฏิกิริยาด้วยไฮโดรเจนเปอร์ออกไซด์และกรดแอสคอร์บิก

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Graft Polymerization of Acrylic Acid onto Cassava Starch  
By Hydrogen Peroxide-Ascorbic Acid Initiation



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CHAIRAT WIWATWARRAPAN: GRAFT POLYMERIZATION OF ACRYLIC ACID ONTO  
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Native cassava starch was chemically modified into starch-g-PAA's under a grafting copolymerization of AA onto the polysaccharide backbone via  $H_2O_2$ -ascorbic acid initiation method. Prior to the grafting reaction, starch was gelatinized at  $80^\circ C$ . The parameters studied were  $[AA]=1.47-4.42 M$ ,  $[H_2O_2]=0.0553-0.3322 M$ , and the reaction temperatures in range of  $35-65^\circ C$ . The starch-g-PAA copolymer was subsequently saponified with a 25% aqueous solution of KOH at room temperature to convert the carboxylic groups into carboxylate groups. Infrared spectrophotometer was used as a tool to follow up the extent of grafting and saponification. The saponified starch-g-PAA copolymer was then characterized in terms of weight average molecular weight of grafted PAA by GPC.

Water absorption of the newly synthesized saponified starch-g-PAA copolymer was carried out in deionized distilled water, and the solutions of NaCl,  $MgCl_2$ , KCl,  $K_3PO_4 \cdot 3H_2O$ ,  $NH_4Cl$ , and  $(NH_4)_2HPO_4$  at various ionic strength. The water absorption capacity in deionized distilled water ranged from 19 to 234 times their original dried weight. The hydrolyzed starch-g-PAA prepared with 2.95 M AA, 0.2217 M  $H_2O_2$ , and  $35^\circ C$  gave the maximum water absorption. Water absorption capacity in saline solutions decreased dramatically with increasing the salt concentrations (or ionic strength). Water retention in sand by mixing it with the grafted copolymer at concentrations of 0.5, 1.0, 2.0, and 3.0% showed a linear relationship in which water retention increased with increasing the amount of absorbent added.

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พิมพ์ต้นฉบับบทคัดย่อวิทยานิพนธ์ภายในกรอบสี่เหลี่ยมนี้เพียงแผ่นเดียว

ชัยรัตน์ วิวัฒน์พันธ์: การเกิดโพลิเมอร์แบบต่อของกรดอะคริลิกบนแป้งมันสำปะหลัง โดยการเริ่มปฏิกิริยาด้วยไฮโดรเจนเปอร์ออกไซด์และกรดแอสคอร์บิก (GRAFT POLYMERIZATION OF ACRYLIC ACID ONTO CASSAVA STARCH BY HYDROGEN PEROXIDE-ASCORBIC ACID INITIATION) อ.ที่ปรึกษา : รศ.ดร. สุดา เกียรติอำรุงศ์, 197 หน้า. ISBN 974-581-560-8

แป้งมันสำปะหลังได้รับการดัดแปลงทางเคมีให้เป็นแป้งที่กราฟต์ด้วยโพลิอะคริลิกโดยทำปฏิกิริยากราฟต์โคโพลิเมอร์เชนซ์ของกรดอะคริลิกในโครงสร้างหลักของโพลิแซคคาไรด์ โดยผ่านกลไกการเริ่มปฏิกิริยาด้วยไฮโดรเจนเปอร์ออกไซด์และกรดแอสคอร์บิก โดยทำให้แป้งมีสภาพคล้ายแป้งเปียกที่ 80 ° ซ. ก่อนที่จะทำปฏิกิริยากราฟท์ ตัวแปรที่ศึกษาคือความเข้มข้นกรดอะคริลิก, ไฮโดรเจนเปอร์ออกไซด์ ระหว่าง 1.47-4.42, 0.0553-0.3322 โมลต่อลิตรตามลำดับ และอุณหภูมิในการกราฟท์ 35-65 ° ซ. นำผลิตภัณฑ์โคโพลิเมอร์ที่ได้มาทำปฏิกิริยาสะพอนิไฟต์ด้วยสารละลายที่มีโพแทสเซียมไฮดรอกไซด์อยู่ร้อยละ 25 ที่อุณหภูมิห้อง ซึ่งเป็นผลให้หมู่คาร์บอกซิลิกเปลี่ยนเป็นหมู่คาร์บอซิเลต ปริมาณการเกิดปฏิกิริยากราฟต์โคโพลิเมอร์ และสะพอนิไฟต์ติดตามโดยใช้เครื่องอินฟราเรดสเปกโตรโฟโตมิเตอร์ การพิสูจน์เอกลักษณ์ของโคโพลิเมอร์ได้กระทำในรูปของการหาน้ำหนักโมเลกุลเฉลี่ยเชิงน้ำหนักโดยเครื่อง GPC.

ได้ทำการทดสอบการดูดน้ำของสารนี้ในน้ำกลั่น สารละลายของ NaCl, MgCl<sub>2</sub>, K<sub>3</sub>PO<sub>4</sub>·3H<sub>2</sub>O, KCl, NH<sub>4</sub>Cl และ (NH<sub>4</sub>)<sub>2</sub>HPO<sub>4</sub> พบว่าการดูดน้ำในน้ำบริสุทธิ์มีค่าอยู่ในช่วง 19 ถึง 234 กรัมต่อกรัมของน้ำหนักแห้งสารนี้ สารดูดน้ำที่เตรียมจากกรดอะคริลิกและไฮโดรเจนเปอร์ออกไซด์ 2.95 และ 0.2217 โมลต่อลิตรตามลำดับ และอุณหภูมิในการกราฟท์ที่ 35 ° ซ. มีการดูดน้ำมากที่สุด ความสามารถในการดูดน้ำลดลงอย่างมากในสารละลายเกลือ ความสามารถในการอมน้ำของสารนี้ในทรายทำได้โดยผสมสารนี้ความเข้มข้นร้อยละ 0.5, 1.0, 2.0 และ 3.0 โดยน้ำหนักกับทราย ความสามารถในการอมน้ำมีความสัมพันธ์เชิงเส้นและเพิ่มขึ้นเมื่อปริมาณของสารดูดน้ำมากขึ้น

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ศูนย์วิทยทรัพยากร  
จุฬาลงกรณ์มหาวิทยาลัย

## ABBREVIATIONS

AA	acrylic acid
AGU	anhydroglucose unit
AN	acrylonitrile
BU	bushel unit
CAN	ceric ammonium nitrate
$Ce^{+4}$	cerium (IV) ion
Ce(IV)	cerium ion
$Cl^{-}$	chloride ion
$cm^3$	centimetre cubic
$cm^{-1}$	unit of wavenumber
Co-60	cobalt-60
Cs-137	cesium-137
$Cu^{+2}$	copper (II) ion
C=N	nitrile group
C=O	carbonyl group
DHA	dehydroascorbic acid
DMF	N,N-dimethylformamide
$dm^3$	decimetre cubic
D.P.	degree of polymerization
eV	electrovolt
f	initiator efficiency
$Fe^{+3}$	iron (III) ion
$Fe^{+2}$	iron (II) ion
FT-IR	Fourier Transform Infrared

g	gram
-g-	-graft-
GPC	gel permeation chromatography
G.E.	grafting efficiency
hrs	hours
HPLC	high performance liquid chromatography
HSPAN	hydrolyzed starch-g-polyacrylonitrile
HWAP	high water absorbing polymer
[I]	initiator concentration
I	ionic strength
J	joule
K	degree kelvin
K <sup>+</sup>	potassium ion
k <sub>d</sub>	initiator dissociation rate constant
k <sub>p</sub>	propagation rate constant
k <sub>t</sub>	termination rate constant
kcal	kilocalorie
l	liquid
M	molarity
m	metre
MEHQ	monomethyl ether of hydroquinone
microns	micrometres
min	minute
MA	methyl acrylate



$Mn^{+3}$	manganese (III) ion
M.W.	molecular weight
$M_v$	viscosity average molecular weight
PAA	poly(acrylic acid)
PAN	polyacrylonitrile
ppm	parts per million
PS	polysaccharide
$PS^{\cdot}$	polysaccharide radical
RH	relative humidity
$R^{\cdot}$	radical
$R_p$	rate of propagation
s	second
S-PAN	starch-polyacrylonitrile
$t_R$	retention time
THF	tetrahydrofuran
$V^{+5}$	vanadium (V) ion
$V_e$	elution volume
WRV	water retention value
w/v	weight by volume
w/w	weight by weight
$^{\circ}F.$	องศาฟาเรนไฮต์
$^{\circ}C$	degrees Celsius
%	per cent
<	less than
>	more than
$\alpha$	alpha
$\gamma$	gamma

$\mu\text{m}$	micrometre
$\nu$	kinetic chain length
Chem. Tech.	Chemical Technology
Eur. Polym. J	European Polymers Journal
Makromol. Chem.	Makromolekulare Chemie
J. Dent. Res.	Journal of Dental Research
J. Natl. Res. Council Thailand	Journal of the National Research Council of Thailand
J. Polym. Sci. A	Journal of Polymer Science, part A
J. Polym. Sci. C	Journal of Polymer Science, Part C
J. Appl. Polym. Sci.	Journal Applied Polymer Science
J. Macromol. Sci. Chem.	Journal of Macromolecular Science and Chemistry
J. Sci. Res. Chula. Univ.	Journal of Science Research, chulalongkorn University
Polym.	Polymer
Polym. Bull.	Polymer Bullatin
Polym. lett.	Polymer letter

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