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**GRAFT COPOLYMERIZATION OF METHYL METHACRYLATE ONTO  
NATURAL RUBBER LATEX BY MICROWAVE INDUCTION**

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**A Thesis Submitted in Partial Fulfillment of the Requirements  
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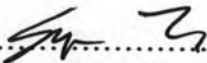
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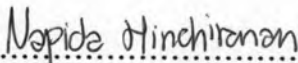
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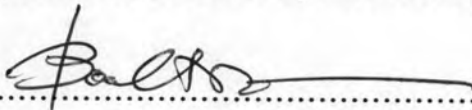
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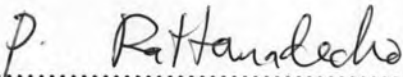
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ศิริชัย ปิยะอักษรศักดิ์ : กราฟต์โคพอลิเมอร์ไรเซชันของเมทิลเมทาคริเลตบนน้ำยางธรรมชาติโดยการเหนี่ยวนำด้วยไมโครเวฟ. (GRAFT COPOLYMERIZATION OF METHYL METHACRYLATE ONTO NATURAL RUBBER LATEX BY MICROWAVE INDUCTION) อ. ที่ปรึกษาวิทยานิพนธ์หลัก : ผศ.ดร.นพิตา ใหญ่ชีระนันท์, อ. ที่ปรึกษาวิทยานิพนธ์ร่วม : ผศ.ดร.บุญโชติ เผ่าสวัสดิ์ยรรยง, 115 หน้า.

ยางธรรมชาติเป็นอีลาสโตเมอร์ไม่อิ่มตัวที่มีสมบัติเชิงกลที่ดี แต่อย่างไรก็ตามมันมีความต้านทานต่อปฏิกิริยาออกซิเดชัน น้ำมันและตัวทำละลายอินทรีย์ต่ำเนื่องจากโครงสร้างสายโซ่ที่ไม่อิ่มตัวและความไม่มีขั้วของยาง ข้อเสียเหล่านี้จึงจำกัดการนำไปใช้งานในอุตสาหกรรม ดังนั้นปฏิกิริยากราฟต์โคพอลิเมอร์ไรเซชันผ่านทางวัฏภาคลาเท็กซ์จึงเป็นวิธีการดัดแปรทางเคมีวิธีหนึ่งที่จะช่วยปรับปรุงสมบัติของยางธรรมชาติ เมทิลเมทาคริเลตถูกนำมาใช้ในปฏิกิริยากราฟต์โคพอลิเมอร์ไรเซชันเพื่อเพิ่มความมีขั้วให้กับยางธรรมชาติโดยใช้ควิมีนไฮโดรเปอร์ออกไซด์และเตตระเอทิลสเฟนทามีนเป็นตัวริเริ่มปฏิกิริยาแบบรีดอกซ์ แต่ปฏิกิริยากราฟต์โคพอลิเมอร์ไรเซชันแบบธรรมดาต้องใช้เวลาค่อนข้างนาน (ประมาณ 6-8 ชม.) ดังนั้นไมโครเวฟจึงถูกนำมาใช้เหนี่ยวนำปฏิกิริยากราฟต์โคพอลิเมอร์ไรเซชันของเมทิลเมทาคริเลตบนน้ำยางธรรมชาติเนื่องจากไมโครเวฟใช้พลังงานน้อยและมีอัตราการให้ความร้อนที่เร็วกว่า เมื่อเปรียบเทียบประสิทธิภาพการกราฟต์ที่ระดับ 60% เท่ากันพบว่าวิธีการกราฟต์ด้วยไมโครเวฟใช้เวลาเพียง 15 นาทีที่กำลัง 100 วัตต์ ขณะที่วิธีให้ความร้อนแบบธรรมดาใช้เวลาถึง 7 ชม. ศึกษาปัจจัยต่าง ๆ ที่มีผลกระทบต่อสมบัติการกราฟต์ เช่น ความเข้มข้นของตัวริเริ่มปฏิกิริยา ความเข้มข้นของมอนอเมอร์ กำลังไมโครเวฟ และเวลาที่ให้ไมโครเวฟ ศึกษาผลกระทบของตัวแปรต่าง ๆ ต่อสมบัติการกราฟต์ในเชิงสถิติแบบแพกทอเรียลสองระดับและการทดลองเชิงเดียว วิเคราะห์โครงสร้างของยางธรรมชาติกราฟต์ด้วยอินฟราเรดและโปรตอนสเปกโตรสโคปี นอกจากนี้ยังวิเคราะห์สัณฐานวิทยาของอนุภาคยางกราฟต์ด้วยกล้องจุลทรรศน์อิเล็กตรอนแบบส่องผ่านอีกด้วย

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SIRICHAH PIYAAUKSORNSAK: GRAFT COPOLYMERIZATION OF METHYL METHACRYLATE ONTO NATURAL RUBBER LATEX BY MICROWAVE INDUCTION. THESIS ADVISOR: ASST. PROF. NAPIDA HINCHIRANAN, Ph.D., THESIS CO-ADVISOR: ASST. PROF. BOONCHOAT PAOSAWATYANYONG, Ph.D., 115 pp.

Natural rubber (NR) is an unsaturated elastomer with excellent mechanical properties. However, NR has poor resistance to oxidation, oil and organic solvents mainly due to its unsaturated chain structure and nonpolarity. These drawbacks have limited its industrial applications. The graft copolymerization via latex phase is one of chemical modification methods to improve NR's properties. To enhance the polarity of NR, methyl methacrylate (MMA) was grafted onto the NR in the presence of cumene hydroperoxide (CHPO) and tetraethylene pentamine (TEPA) as redox initiators. However, conventional graft copolymerization generally needs long reaction time (ca. 6-8 h). Due to less energy consumption with faster heating rate, the microwave irradiation was used to induce graft copolymerization of MMA onto NR latex. By comparing with the conventional grafting method at 60%grafting efficiency, the graft copolymerization of MMA onto NR induced by microwave at 100 W required short reaction time (ca. 15 min); whilst, upto 7 h was needed when the conventional method was carried out. The influence of initiator concentration, monomer concentration, microwave power and exposure time on the grafting properties were statistically evaluated by a two level factorial design and univariate experiments. The graft natural rubber (GNR) was characterized by FT-IR and <sup>1</sup>H-NMR spectroscopy. Furthermore, the particle morphology of GNR was also characterized by using transmission electron microscope (TEM).

Field of Study :..Petrochemistry and Polymer Science..

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## LIST OF ABBREVIATIONS

Ave.	:	Average
CHPO	:	Cumene hydroperoxide
DRC	:	Dry rubber content
ET	:	Exposure time
Exp.	:	Experiment
FTIR	:	Fourier Transform Infrared spectroscopy
GE	:	Grafting efficiency
GNR	:	Graft natural rubber
INT	:	Initiator concentration
MMA	:	Methyl methacrylate
MWP	:	Microwave power
NMR	:	Nuclear Magnetic Resonance spectroscopy
NR	:	Natural rubber
phr	:	Parts per hundred of rubber by weight
PMMA	:	Poly(methyl methacrylate)
Rep.	:	Replicate
TEPA	:	Tetraethylene pentamine
TEM	:	Transmission Electron Microscope
Temp.	:	Temperature