

**MODIFICATION OF SILICA SURFACE FOR RUBBER  
REINFORCEMENT USING A CONTINUOUS ADMICELLAR  
POLYMERIZATION SYSTEM**



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## บทคัดย่อ

ศิริพร ชัยศิริมหามรกด : การปรับปรุงผิวซิลิกาเพื่อใช้เป็นตัวเสริมแรงในยางโดยวิธีแอตโมเซลล์าร์ โพลีเมอไรเซชันแบบต่อเนื่อง (Modification of Silica Surface For Rubber Reinforcement using a Continuous Admicellar Polymerization System) อ. ที่ปรึกษา : ศ. ดร.เจฟฟรีย์ เฮซ ฮาร์เวลล์ (Prof. Dr. Jeffrey H. Harwell), ผศ. ดร. จอห์น เฮซ โอ เฮเวอร์ (Asst. Prof. Dr. John H. O'Haver), รศ. ดร. สุเมธ ชวเดช และ ดร. ปราโมช รังสรรค์วิจิตร 76 หน้า ISBN 974-13-0688-1

การใช้ซิลิกาในยางทำให้เกิดผลดีต่อคุณสมบัติของยาง เช่น เพิ่มความแข็งแรงในการต้านทานการยืด ค่าโมดูลัสและค่าการกระดอน การผสมเข้ากันได้ดีขึ้นระหว่างยางกับซิลิกาสามารถทำได้โดยอาศัยกระบวนการแอตโมเซลล์าร์โพลีเมอไรเซชัน ในปัจจุบันกระบวนการนี้ถูกทำสำเร็จจริงแค่ในระบบแบบกะเท่านั้นซึ่งไม่เหมาะต่อการใช้งานให้เชิงอุตสาหกรรม งานวิจัยนี้มุ่งศึกษาพัฒนาเครื่องปฏิกรณ์แอตโมเซลล์าร์โพลีเมอไรเซชันแบบต่อเนื่อง เซลล์ไตรเมทิลแอมโมเนียมโบรไมด์ สไตรีน และ ไอโซพรีน ถูกเลือกใช้เป็นสารลดแรงตึงผิวและโค-โมโนเมอร์ ตามลำดับ การปรับปรุงผิวของซิลิกานี้ทำให้พื้นที่ผิวลดลงและค่ากึ่งกลางของขนาดการจับตัวของเม็ดซิลิกาของทุกตัวอย่างเพิ่มขึ้น ผลจากเครื่องสแกนนิ่งอิเล็กตรอนไมโครสโคป แสดงการเพิ่มขึ้นของการเกาะตัวกันของเม็ดซิลิกา ผลจากเครื่องฟูเรียรทรานส์ฟอร์มอินฟราเรดสเป็คโตรสโคป พิสูจน์ว่ามีสไตรีนและไอโซพรีนบนผิวของซิลิกาที่ได้รับการปรับปรุงแล้ว จากการศึกษาผลกระทบจากปริมาณโมโนเมอร์และเวลาที่ใช้ทำปฏิกิริยาต่อกระบวนการแอตโมเซลล์าร์โพลีเมอไรเซชัน พบว่า 5 กรัมโมโนเมอร์ต่อ 1 กิโลกรัม ซิลิกา และ ที่เวลาในการทำปฏิกิริยา 60 นาที ให้ปริมาณโพลีเมอร์สูงที่สุดบนผิวของซิลิกา

## ABSTRACT

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Use of silica in rubber compounds provides beneficial properties such as increase in tensile strength, modulus and resilience. The better compatibility between elastomer and silica has been achieved by admicellar polymerization. Currently, this process has been successfully performed only in a batch system, which is not feasible for industrial applications. In the present work, a continuous reactor for the admicellar polymerization was developed. Cetyltrimethylammonium bromide, styrene and isoprene were used as a surfactant and co-monomers, respectively. Modification of silica surface reduced the BET surface area and increased the mean agglomerate particle size of all samples. Scanning electron micrographs showed the increase in the particle agglomeration as well as an apparent loss of small diameter particles. The Fourier transform infrared spectroscopes proved the existence of styrene and isoprene polymer on the modified silicas. Effects of co-monomers loading and retention time on the admicellar polymerization were also investigated. The results showed that the 5 g co-monomer per kilogram silica and 60 minutes polymerization time provided the largest amount of polymer on silica surface.

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