

**Rheological Behavior for Unfilled & Filled Natural Rubber (NR)
and Linear Low Density Polyethylene (LLDPE) Blends with
Maleic Anhydride (MA) as a Compatibilizer**



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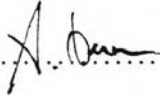
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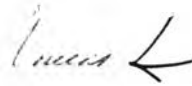
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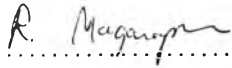
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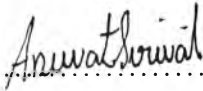
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ABSTRACT

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The rheological behavior of linear low density polyethylene (LLDPE), natural rubber (NR) and their blends were studied by a cone-and-plate rheometer in dynamic mode at a frequency ranges from 0.1-100 rad/sec and a capillary rheometer in steady mode at high shear rates. Maleic anhydride (MA) was added to the blends as a compatibilizer. The presence of a single $\tan \delta$; i.e. a single glass transition temperature, indicated that the compatibility of LLDPE/NR blends was improved by the addition of maleic anhydride. The results illustrated the effects of blend ratio, maleic anhydride concentration, shear stress/shear rate and temperature on melt viscosity and melt elasticity of the blends. Addition of NR caused the increase in viscosity and modulus. But blend viscosity reduced at high shear rate while the storage modulus increased. SEM analysis of the fracture surfaces of the compatibilized blends showed that the addition of a small percentage of the compatibilizer was enough to decrease and stabilize the domain size of dispersed NR phase. Without MA, the morphology was altered by shear rate due to the change of viscosity with shear rate. Dynamic mechanical properties of the blends were also investigated. Master curves of G' and G'' for the blend system were constructed by using the time-temperature superposition principle. It was

observed that the master curves of the blends did not fall on the same curve due to morphological changes induced by the viscosity difference and the drop-coalescence mechanism. Fine calcium carbonate was used as a filler in the blends. It was found that viscosity of the filled blends increased significantly with amount of filler at low frequency.

บทคัดย่อ

นางสาวกัญญา อินทร์รักษา : ชื่อหัวข้อวิทยานิพนธ์ การศึกษาพฤติกรรมการไหลของพอลิเอทิลีนชนิดความหนาแน่นต่ำเชิงเส้นตรง (LLDPE) ซึ่งผสมกับยางธรรมชาติ (NR) โดยมีมาเลอิกแอนไฮไดรด์ (MA) เป็นตัวประสาน (Compatibilizer) (ภาษาอังกฤษ) (Rheological Behavior for Unfilled & Filled Natural Rubber (NR) and Linear Low Density Polyethylene (LLDPE) Blends with Maleic Anhydride (MA) as a Compatibilizer) อ. ที่ปรึกษา : ศ. ใ่อ่ำ มานาส-สล็อตโซเวอร์ และ ดร. รัตนวรรณ มกรพันธุ์ 81 หน้า ISBN 974-331-939-5

การวิจัยนี้เป็นการศึกษาพฤติกรรมการไหลของพอลิเอทิลีนชนิดความหนาแน่นต่ำเชิงเส้นตรง, ยางธรรมชาติ และสารผสมระหว่างสารทั้งสองชนิดนี้ซึ่งมีมาเลอิกแอนไฮไดรด์เป็นตัวช่วยประสานโดยใช้เครื่องมือวัดการไหลแบบโคนและเพลทที่มีความถี่ต่ำ และเครื่องมือวัดการไหลแบบแคปิลารีที่อัตราแรงเฉือนสูง จากผลของการทดสอบทางเชิงกลแบบไดนามิกพบว่ามาเลอิกแอนไฮไดรด์ช่วยให้พอลิเอทิลีนชนิดความหนาแน่นต่ำเชิงเส้นตรงและยางธรรมชาติผสมเข้ากันได้ดีซึ่งเห็นได้จากพิกของแทนเดลตาเกิดขึ้นเพียงเส้นเดียวที่ -64 องศาเซลเซียส นอกจากนี้การศึกษาโครงสร้างของสารผสมโดยใช้เครื่องมือสแกนนิ่งอิเล็กตรอนไมโครสโคป (SEM) พบว่าขนาดอนุภาคของยางลดลงเมื่อเติมมาเลอิกแอนไฮไดรด์ลงไปในสารผสมนี้ ซึ่งบ่งบอกถึงการเพิ่มขึ้นของแรงกระทำระหว่างสารทั้งสอง จากการศึกษาคุณสมบัติการไหลของสารผสมเมื่อมีและไม่มีมาเลอิกแอนไฮไดรด์พบว่าความหนืดและความยืดหยุ่นของสารผสมเพิ่มขึ้นเมื่อปริมาณมาเลอิกแอนไฮไดรด์เพิ่มมากขึ้นจนถึงจุดอิ่มตัว หลังจากนั้นคุณสมบัติทั้งสองนี้จะลดลง

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FIGURE

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- A The complex viscosity as a function of frequency at different temperature for 70/30 LLDPE/NR blends at various %MA: (a) 1%MA, (b) 3%MA(c) 5%MA and (d) 7%MA

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