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เพื่อใช้เป็นสารเติมแต่งสำหรับพอลิเมอร์

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APPLICATION OF LOW MOLAR MASS THERMOTROPIC LIQUID CRYSTALS
AS AN ADDITIVE FOR POLYMERS

Mr. Suraphan Powanusorn

A Thesis Submitted in Partial Fulfillment of the Requirements
for the Degree of Master of Engineering in Chemical Engineering

Department of Chemical Engineering

Faculty of Engineering

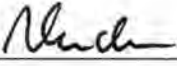
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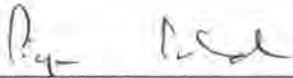
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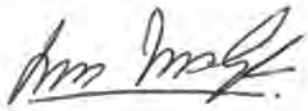
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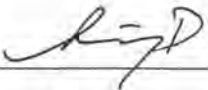
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สุรพันธ์ โปวอนุสรณ์ : การประยุกต์ใช้ผลึกเหลวชนิดเทอร์โมโทรปิกที่มีน้ำหนักโมเลกุลต่ำเพื่อใช้เป็นสารเติมแต่งสำหรับพอลิเมอร์ (Application of Low Molar Mass Thermotropic Liquid Crystals as an Additive for Polymers) อาจารย์ที่ปรึกษา : ผศ. ดร. มล. ศุภกนก ทองใหญ่, 193 หน้า. ISBN 974-13-0168-5

งานวิจัยนี้เกี่ยวข้องกับการประยุกต์ใช้ผลึกเหลวที่มีน้ำหนักโมเลกุลต่ำ (low molar mass liquid crystals) เพื่อเป็นสารเติมแต่งสำหรับวัสดุพอลิเมอร์หลากหลายชนิด ไม่ว่าจะเป็นพลาสติกเชิงวิศวกรรม เช่น ไนลอน หรือ พอลิเอทิลีน และ พลาสติกเชิงอุตสาหกรรมที่ใช้กันทั่วไป เช่น พอลิเอทิลีน หรือ พอลิโพรพิลีน เป็นต้น. ของผสมระหว่างผลึกเหลวและพอลิเมอร์ชนิดต่างๆถูกเตรียมโดยวิธีการผสมหลอมเหลวด้วยความร้อน (melt - mixing) ที่อัตราส่วนผสม 0.1, 0.2 และ 0.4 เปอร์เซนต์โดยน้ำหนักของผลึกเหลว. พอลิเมอร์ผสมที่ได้จะถูกนำไปทดสอบคุณสมบัติต่างๆ ทั้งคุณสมบัติทางรีโอโลยี (rheological properties) โดยการศึกษาความหนืด, คุณสมบัติทางความร้อนโดยการศึกษาอุณหภูมิการเปลี่ยนสถานะคล้ายแก้วและจุดหลอมเหลว (T_g and T_m) และคุณสมบัติทางกลโดยการศึกษาความแข็งแรงทางแรงดึง (tensile strength) เปรียบเทียบกับพอลิเมอร์บริสุทธิ์ ผลที่ได้พบว่า พอลิเมอร์ผสมที่เติมผลึกเหลวเป็นสารเติมแต่งมีความหนืดลดลงตั้งแต่ 20% ขึ้นไปสำหรับพอลิเอทิลีน และ ตั้งแต่ 50% ถึงมากกว่า 80% ขึ้นไปสำหรับพอลิเมอร์ชนิดอื่นๆ ในขณะที่คุณสมบัติทางกลและทางความร้อนแทบจะไม่เปลี่ยนแปลงไปจากเดิม การใช้ผลึกเหลวที่มีน้ำหนักโมเลกุลต่ำเป็นสารเติมแต่งจึงอาจทำได้โดยอาจพิจารณาใช้ได้หลายทาง ไม่ว่าจะเป็นการเพิ่มความสามารถในการไหลทำให้สามารถเพิ่มกำลังการผลิตสำหรับอุตสาหกรรมพลาสติก, สามารถขึ้นรูปพลาสติกเชิงวิศวกรรมที่มีความยุ่งยากมากให้ง่ายขึ้น หรือสามารถลดการใช้พลังงานในการขึ้นรูปพลาสติกได้.

ในงานวิจัยนี้ยังได้ทำการศึกษาเบื้องต้นถึงระบบพอลิเมอร์ผสมของสไตรีนอะครีโลไนไตรโคพอลิเมอร์ (SAN) และ พอลิมethyl methacrylate (PMMA) ที่อัตราส่วนผสม 80/20, 60/40, 40/60 และ 20/80 % โดยน้ำหนัก และผลของการเติมผลึกเหลวที่มีน้ำหนักโมเลกุลต่ำเป็นเฟสที่สาม. ที่อุณหภูมิที่ใช้ในการศึกษาคือ 200 องศาเซลเซียสพบว่าที่อัตราส่วน 20/80 เปอร์เซนต์ของ SAN ระบบมีคุณสมบัติเป็นของผสมที่ไม่เข้ากันคือเกิดการแยกเฟส (phase separation) ทำให้ระบบนี้มีค่าความหนืดต่ำที่สุดและเมื่อเติมผลึกเหลวลงไปอาจส่งผลในการเพิ่มความเข้ากันได้ของระบบพอลิเมอร์ผสมทำให้ความหนืดของระบบนี้เพิ่มขึ้น แตกต่างจากระบบอื่นๆ คือ 80/20, 60/40 และ 40/60 ซึ่งระบบมีความเข้ากันได้ในช่วงอุณหภูมิที่ศึกษาและเมื่อเติมผลึกเหลวลงไปส่งผลในการลดความหนืดเช่นเดียวกันกับการศึกษาพอลิเมอร์เดี่ยวในส่วนแรก

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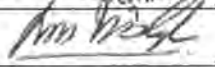
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SURAPHAN POWANUSORN: APPLICATION OF LOW MOLAR MASS THERMOTROPIC LIQUID CRYSTALS AS AN ADDITIVE FOR POLYMERS.

THESIS ADVISOR : ASSISTANT PROFESSOR SUPAKANOK THONGYAI, Ph.D.
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This research is involved in the applications of low molar mass thermotropic liquid crystals as an additive for several base polymers, including engineering polymers, such as polyamide, polyacetal and commodity plastics, such as polyethylene and polypropylene. Melt mixing was the preparation method for blending liquid crystal and base polymers together at 0.1, 0.2, and 0.4 percent by weight of LC. The rheological, thermal and mechanical properties of the blends are investigated in order to compare with the base polymer that absence of liquid crystal. The results show that liquid crystal may improve the processability of the base polymer by reducing the melt viscosity of the base polymer while the LCs did not affect the thermal and mechanical properties of the base polymer. So the blends may be applied by using the liquid crystal to increase the capacity of polymer processing process, improve processability of engineering polymer or reduce the energy consumption of polymer processing process.

This work also include the preliminary investigation the ternary blend of polymer alloys SAN/PMMA at percent composition of 80/20, 60/40, 40/60, and 20/80 weight percent of SAN/PMMA with the ternary component of low molar mass liquid crystal with their binary blend properties. The results of 80/20, 60/40 and 40/60 percent of SAN that represent the partially miscible blend at the studying temperature are as same as the study in the first part that the LC can be reduce the melt viscosity, while not affect the other properties, but at 20/80 percent of SAN, the investigating temperature might be in the phase separation limit which the study temperature might be affected by the two phase blend when added the liquid crystal.

Department Chemical Engineering Student Signature 
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Finally I would like to dedicate this thesis to my parents and my families, who generous supported and encouraged me through the year spent on this study.

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