

**PHYSICAL INTERACTION BETWEEN POLYMER MELTS AND  
SOLID SURFACE**

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for the Degree of Master of Science  
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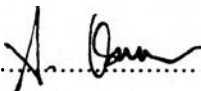
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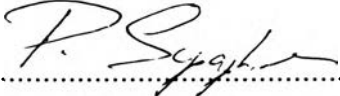
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**ABSTRACT**

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Slip velocity between HDPE melts and tungsten capillary was determined by means of the classical Mooney analysis. Above a critical shear stress, wall slip occurred and the plots of the extrapolation length,  $b$ , versus wall slip velocity,  $V_s$ , were qualitatively amenable to the Brochard and de Gennes' disentanglement model which predicted three distinct regimes: (I) Entangled slip regime,  $b_0$  is independent of temperature and increases as polydispersity increases but decreases as molecular weight increases with the scaling exponent of -0.36; (II) Marginal regime,  $b$  depends on  $V_s$  following a power law with the scaling exponent in the range of 0.42-0.68 but it is independent of temperature and polydispersity; (III) Rouse regime,  $b_\infty$  is found when molecular weight is greater than  $2.4 \times 10^5$  g/mol and obviously increases as polydispersity increases but slightly decreases as temperature increases with the scaling exponent of -1.21. We attempted to construct a common HDPE master curve of wall shear stress normalized by the crossover storage modulus vs. the true shear normalized by the inverse of the cross over frequency. The normalized curves collapse at low elastic effect ( $Wi < 1$ ). For  $Wi > 1$ , the normalized curves do not collapse since the elastic is predominant as molecular weight, polydispersity and temperature were varied.

## บทคัดย่อ

นรินทร์ สารภีกริมย์ : ความสัมพันธ์ทางกายภาพระหว่างพอลิเมอร์หลอมเหลวและพื้นผิวแข็ง (Physical Interaction between Polymer Melts and Solid Surface) อ. ที่ปรึกษา : ศ. โรนาลด์ จี ลาร์สัน (Prof. Ronald G. Larson) และ ร.ศ. ดร. อนุวัฒน์ ศิริวัฒน์ 137 หน้า ISBN 974-334-178-1

งานวิจัยนี้ได้ทำการศึกษาความเร็วการลื่นไหลระหว่างพอลิเอทิลีนหลอมเหลวกับท่อกลมทั้งสแตน โดยเชิงการวิเคราะห์แบบมุนนี่ เหนือจุดวิกฤตความเค้นเฉือน การลื่นไหลที่พื้นผิวเกิดขึ้น ความสัมพันธ์ระหว่างความยาวของการลื่นกับความเร็วของการลื่นที่ผิว พบว่าความสัมพันธ์ที่ได้สอดคล้องเป็นไปตามแบบจำลองการคลายตัวการพันกันของสายโซ่พอลิเมอร์ที่เกี่ยวข้องพันกัน โดยแบบจำลองนี้แบ่งช่วงการเปลี่ยนแปลงที่แตกต่างกันดังนี้ ช่วงแรกคือ ช่วงการลื่นที่เกี่ยวข้องพันกันของสายโซ่ ( $b_0$ ) ซึ่งค่านี้ไม่ขึ้นอยู่กับอุณหภูมิและมีค่าเพิ่มขึ้นเมื่อค่าการกระจายของมวลโมเลกุลเพิ่มมากขึ้น แต่มีค่าลดลงเมื่อค่ามวลโมเลกุลเพิ่มขึ้นด้วยเอกซ์โพเนนซ์ของ  $-0.36$  ช่วงที่ 2 คือช่วงมาจินอล ค่าความยาวของการลื่นจะขึ้นอยู่กับความเร็วของการลื่นในช่วงเอกซ์โพเนนซ์  $0.42-0.68$  แต่ไม่ขึ้นอยู่กับอุณหภูมิและค่าการกระจายของมวลโมเลกุล ช่วงที่ 3 คือช่วงราวส์ ( $b_\infty$ ) พบเมื่อมวลโมเลกุลมีค่ามากกว่า  $2.4 \times 10^5$  กรัมต่อโมล และมีการเปลี่ยนแปลงเล็กน้อยเมื่อค่าการกระจายของมวลโมเลกุลเพิ่มขึ้น แต่มีค่าลดลงเมื่ออุณหภูมิเพิ่มขึ้นในช่วงเอกซ์โพเนนซ์  $-1.21$  นอกจากนี้งานวิจัยนี้พยายามที่จะสร้างกราฟความสัมพันธ์ระหว่างค่าความเค้นเฉือนที่ถูกปรับค่าด้วยค่าสคอเรจมอดูลัส ณ จุดตัดกันกับลอสมอดูลัส กับค่าไวส์เซนเบิร์ก จากผลการทดลองพบว่ากราฟที่ได้ยังไม่ซ้อนทับกันสนิท เมื่อมีการเปลี่ยนแปลงของมวลโมเลกุล การกระจายของมวลโมเลกุล และอุณหภูมิ โดยเฉพาะอย่างยิ่งเมื่อค่าไวส์เซนเบิร์กมีค่ามากกว่า 1

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