

**STRUCTURE AND MECHANICAL PROPERTY RELATIONSHIP OF PCL,
ITS NANOCOMPOSITES, AND ITS GRAFT COPOLYMER**



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A Thesis Submitted in Partial Fulfilment of the Requirements
for the Degree of Master of Science
The Petroleum and Petrochemical College, Chulalongkorn University
in Academic Partnership with
The University of Michigan, The University of Oklahoma,
and Case Western Reserve University

2009

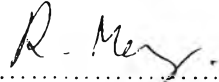
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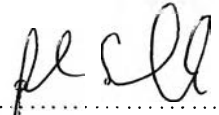
Thesis Title: Structure and Mechanical Property Relationship of PCL, its Nanocomposites, and its Graft Copolymer
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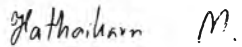
Accepted by the Petroleum and Petrochemical College, Chulalongkorn University, in partial fulfillment of the requirement for the Degree of Master of Science.



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ABSTRACT

5072006063: Polymer Science Program
Buncherd Ngamnawakul: Structure and Mechanical Property
Relationship of PCL, its Nanocomposites, and its Graft Copolymer.
Thesis Advisors: Assoc. Prof. Rathanawan Magaraphan and
Prof. Johannes W. Schwank 140 pp.
Keywords: Polycaprolactone (PCL)/Ethylene vinyl acetate (EVA)/
Nanocomposites/Graft copolymer

Polycaprolactone (PCL) is a biodegradable polyester that is very tough and has a melting point of around 60°C. PCL becomes soft in warm water and can be shaped; therefore, it is proper for use as a boil and bite mouth guard. This work aims to study the relationship of the properties of pure PCL and PCL with added rigid and soft parts for use as mouth guard materials. The different molecular weights affected the mechanical properties and crystallization behavior of the PCL. The impact strength of the PCL increased as the molecular weight increased. The lowest molecular weight PCL ($M_w \sim 17,000$) showed the highest crystallinity and T_c onset. Its nanocomposites and graft copolymers represent the addition of the rigid part (Organoclay) and the soft part (Ethylene Vinyl Acetate: EVA), respectively. The moduli of the PCL nanocomposites were higher than that of the pure one, and thermal stability was also enhanced. On the other hand, its graft copolymers have lower modulus, and the thermal stability decreased clearly from 370°C to around 300°C. These graft copolymers also showed an interesting property: a decreasing of the melting point from pure PCL and EVA, which brings about more viscoelasticity, allowing better shaping of the mouth guard materials at lower temperature.

บทคัดย่อ

บรรณานุกรม : ความสัมพันธ์ทางโครงสร้างและคุณสมบัติเชิงกลของพอลิคาร์โพรแลคโตน นาโนคอมโพสิตของพอลิคาร์โพรแลคโตน และกราฟโคพอลิเมอร์ของพอลิคาร์โพรแลคโตน (Structure and Mechanical Property Relationship of PCL, its Nanocomposites, and its Graft Copolymer) อ. ที่ปรึกษา : รศ. ดร. รัตนาวรรณ มกรพันธุ์ และ ศ. โจฮานเนส ดับเบิลยู แชวงค์ 140 หน้า

พอลิคาร์โพรแลคโตนเป็นพอลิเอสเทอร์ที่ย่อยสลายได้เองทางชีวภาพซึ่งมีความแข็งแรงเหนียวและมีจุดหลอมเหลวที่อุณหภูมิ 60 องศาเซลเซียส พอลิคาร์โพรแลคโตนอ่อนตัวในน้ำอุ่น และสามารถขึ้นรูปได้ ดังนั้นจึงมีคุณสมบัติเหมาะสมสำหรับการนำมาใช้งานเป็นส้นปากชนิดคัมและกั๊ด งานนี้มีจุดมุ่งหมายที่จะศึกษาความสัมพันธ์ทางคุณสมบัติของพอลิคาร์โพรแลคโตนบริสุทธิ์ และพอลิคาร์โพรแลคโตนที่เติมส่วนแข็งและส่วนอ่อนเพื่อใช้สำหรับเป็นวัสดุทำส้นปาก ความแตกต่างของมวลโมเลกุลส่งผลต่อคุณสมบัติเชิงกลและพฤติกรรมการตกผลึกของพอลิคาร์โพรแลคโตน คุณสมบัติการทนต่อแรงกระแทกของพอลิคาร์โพรแลคโตนเพิ่มขึ้นเมื่อมวลโมเลกุลเพิ่มขึ้น พอลิคาร์โพรแลคโตนที่มีมวลโมเลกุลน้อยที่สุด (17000 กรัม/โมล) แสดงพฤติกรรมและอุณหภูมิการตกผลึกมากที่สุด นาโนคอมโพสิตและกราฟโคพอลิเมอร์ของพอลิคาร์โพรแลคโตนเป็นตัวแทนของการเติมส่วนแข็ง (ออร์แกโนเคลย์) และส่วนอ่อน (เอทิลีนไวนิลอะซิเตต) ตามลำดับ ค่าโมดูลัสและค่าการทนต่อความร้อนของพอลิคาร์โพรแลคโตนนาโนเคลย์นาโนคอมโพสิตมีค่าสูงกว่าพอลิคาร์โพรแลคโตนบริสุทธิ์ ในทางกลับกันกราฟโคพอลิเมอร์ของพอลิคาร์โพรแลคโตนมีค่าโมดูลัสที่ลดลง และค่าการทนต่อความร้อนลดลงอย่างชัดเจนจากอุณหภูมิ 370 องศาเซลเซียส มาอยู่ในช่วงอุณหภูมิ 300 องศาเซลเซียส กราฟโคพอลิเมอร์ได้แสดงคุณสมบัติที่น่าสนใจคือการลดลงของจุดหลอมเหลวที่มีค่าต่ำกว่าพอลิคาร์โพรแลคโตนบริสุทธิ์และเอทิลีนไวนิลอะซิเตตซึ่งทำให้สมบัติวิสโคอิลาสติกเพิ่มขึ้นนำไปสู่การขึ้นรูปที่ดีขึ้นของวัสดุทำส้นปากที่อุณหภูมิต่ำลง

ACKNOWLEDGEMENTS

This work would not have been possible without the assistance of the following individuals :

First of all, the author would like to gratefully give special thanks to his advisors, Assoc. Prof. Rathanawan Magaraphan and Prof. Johannes W. Schwank for their intensive suggestions, valuable guidance and vital help throughout this research. In addition, the author deeply thanks to Asst. Prof. Hathaikarn Manuspiya and Dr. Orasa Onjun for serving on his thesis committee. He also gratefully appreciates Mr. Robert Wright for his invaluable suggestion and criticism

The author is grateful for the scholarship and funding of the thesis work provided by the Petroleum and Petrochemical College; and The National Center of Excellence for Petroleum, Petrochemicals, and Advanced Materials, Thailand. He also thanks Polymer Processing and Polymer Nanomaterials Research Unit, and Rachadapisek Sompoch Endowment, Chulalongkorn University for the research fund. The author would like to thank Perstorp UK Ltd. for provide CAPA®6500 to carry out this research.

Special thanks go to all of the Petroleum and Petrochemical College's faculties who have tendered invaluable knowledge and to the college staff who willingly gave support and encouragement.

Finally, the author would like to take this opportunity to thank PPC Ph.D. students and all his PPC friends for their friendly assistance, cheerfulness, creative suggestions, and encouragement. Also, the author is greatly indebted to his parents and his family for their support, love and understanding.

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