

**LIFE CYCLE ENVIRONMENTAL EVALUATION OF PLA- AND PBS-
BASED BIOPLASTIC PRODUCTS**



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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,
Case Western Reserve University and Institut Français du Pétrole
2011

I 28375269

Thesis Title: Life Cycle Environmental Evaluation of PLA- and PBS-
based Bioplastic Products
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Program: Petroleum Technology
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Accepted by the Petroleum and Petrochemical College, Chulalongkorn
University, in partial fulfilment of the requirements for the Degree of Master of
Science.

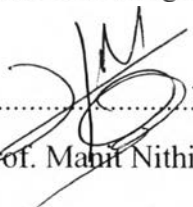


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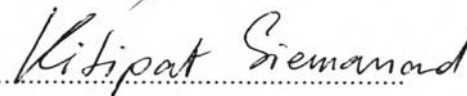
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ABSTRACT

5273011063: Petroleum Technology Program

Panuwat Promnigorn: Life Cycle Environmental Evaluation of PLA-
and PBS-based Bioplastic Products

Thesis Advisors: Asst. Prof. Pomthong Malakul and Asst. Prof. Manit
Nithitanakul, 203 pp.

Keywords: Life Cycle Assessment (LCA)/ Bioplastic products/ Polylactic acid
(PLA)/ Polybutylene succinate (PBS)/Thailand

This research aimed to evaluate the environmental performance of selected bioplastic products produced from polylactic acid (PLA) and polybutylene succinate (PBS) based on life cycle approach. Raw materials used were cassava and sugar cane while the products studied were T-shirt bag, food container, and drinking water bottle. Their performance was then compared to those of the same products produced from conventional plastics (PE, PS, and PET). The scope of the study covered the entire life cycle of the bioplastic products, including raw materials acquisition, resin production, plastic processing, use phase, and various disposal scenarios comprising recycling, composting, landfill, and incineration. The functional units were 1 kg bioplastic resin and 1 kg bioplastic product. The data were compiled and analyzed by using SimaPro 7.0 with the Eco-Indicator 95 and CML baseline 2000 methods to identify the environmental burdens by focusing on global warming potential (GWP). The cradle-to-gate results showed that GWP of both bioplastic resins were higher than GWP of the conventional plastic resins, but it could be significantly reduced by applying practical improvement options. For cradle-to-grave, when using appropriated waste management as composting, the life cycle environmental performance of the bioplastics has shown to be better than those of the conventional plastics for almost all products studied.

บทคัดย่อ

ภาณุวัตร พรหมนิกร : การประเมินผลกระทบด้านสิ่งแวดล้อมตลอดวัฏจักรชีวิตของพลาสติกชีวภาพที่ผลิตจากพอลิแลคติกแอซิดและพอลิบิวทิลีนซัคซิเนต (Life Cycle Environmental Evaluation of PLA- and PBS-based Bioplastic Products) อ. ที่ปรึกษา: ผศ. ดร. ปมทอง มาลากุล ณ อยุธยา และ ผศ. ดร. มานิตย์ นิธิธนากุล 203 หน้า

งานวิจัยนี้ทำการประเมินผลกระทบด้านสิ่งแวดล้อมของผลิตภัณฑ์จากพลาสติกชีวภาพที่ผลิตจากพอลิแลคติกแอซิดและพอลิบิวทิลีนซัคซิเนต วัสดุที่ใช้ในการผลิตคือมันสำปะหลังและอ้อยตามลำดับ ในขณะที่ผลิตภัณฑ์ที่ใช้ศึกษาในงานวิจัยนี้คือ ถูที่ขีด ก่องข้าว และขวดน้ำดื่ม โดยผลิตภัณฑ์เหล่านี้จะถูกนำไปเปรียบเทียบกับผลิตภัณฑ์ชนิดเดียวกัน (ได้แก่ พอลิเอทิลีน พอลิสไตรีน พอลิเอทิลีนเทรฟทาเลต) ที่ผลิตจากพลาสติกจากปิโตรเคมี ขอบเขตการศึกษา รวมถึงการเก็บรวบรวมข้อมูลเพื่อทำบัญชีรายการสารขาเข้าและขาออกทั้งหมดของการผลิตผลิตภัณฑ์พลาสติกชีวภาพตลอดวัฏจักร โดยครอบคลุมทั้งการผลิตสารตั้งต้น การผลิตเม็ดพลาสติก การผลิตผลิตภัณฑ์ การใช้ และรวมถึงการกำจัดของเสีย ซึ่งได้พิจารณาหลายแนวทาง ประกอบด้วยการนำกลับมาใช้ใหม่ การทำปุ๋ยหมัก การฝังกลบ และการเผา ข้อมูลสารขาเข้า การใช้วัตถุดิบ สารเคมี การใช้พลังงานและสาธารณูปโภค และสารขาออก รวมถึงการปลดปล่อยมลสารต่างๆ ถูกเก็บรวบรวมสำหรับการผลิตเม็ดพลาสติกชีวภาพ 1 กิโลกรัมและผลิตภัณฑ์พลาสติกชีวภาพ 1 กิโลกรัม และถูกนำมาวิเคราะห์โดยใช้โปรแกรม SimaPro 7.0 ด้วยวิธีการ Eco-Indicator 95 และ CML baseline 2000 เพื่อประเมินผลกระทบต่อสิ่งแวดล้อมในด้านภาวะโลกร้อน ผลการศึกษาในส่วน cradle-to-gate แสดงให้เห็นว่า เม็ดพลาสติกชีวภาพของทั้งพอลิแลคติกแอซิดและพอลิบิวทิลีนซัคซิเนตนั้นส่งผลต่อภาวะโลกร้อนมากกว่าเม็ดพลาสติกที่ใช้กันทั่วไป แต่ทั้งนี้ทั้งนั้นผลกระทบในส่วนนี้ก็สามารถที่ถูกลดให้น้อยลงได้ โดยการนำกระบวนการปรับปรุงที่มีการใช้กันอย่างแพร่หลายมาช่วยลดผลกระทบ สำหรับในส่วนของ cradle-to-grave เมื่อมีการใช้วิธีการกำจัดของเสียที่เหมาะสมกับผลิตภัณฑ์พลาสติกชีวภาพคือการทำปุ๋ยหมัก จะพบว่าผลกระทบต่อสิ่งแวดล้อมในด้านภาวะโลกร้อนนั้นมีค่าที่น้อยกว่าผลิตภัณฑ์พลาสติกทั่วไปเกือบทุกผลิตภัณฑ์ที่ใช้ในการศึกษาในงานวิจัย

ACKNOWLEDGEMENTS

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

First and foremost, I sincerely appreciate Asst. Prof. Pomthong Malakul, my advisor, and Asst. Prof. Manit Nithitanakul, my co-advisor, for providing invaluable knowledge, creative comments, untouchable experience in classroom, and kind support throughout this research work.

I would like to thank Asst. Prof. Kitipat Siemanond and Dr. Vivan Thammongkol for being my thesis committee. Their suggestions and comments are very beneficial for me and this work.

This thesis work is funded by the Petroleum and Petrochemical College, the National Center of Excellence for Petroleum, Petrochemicals, and Advanced Materials, Thailand, and Petroleum Thailand Public Company Limited (PTT Plc). I would also like to express my appreciation to the National Metal and Materials technology Center (MTEC) for their technical.

I greatly appreciate all PPC staffs and my friends who gave me support and encouragement.

Finally, I am deeply indebted to my family for their love, understanding, encouragement, and support for me at all time.

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