

**RESEARCH AND DEVELOPMENT OF
POLYCARBONATE/POLY(METHYL METHACRYLATE) ALLOYS**

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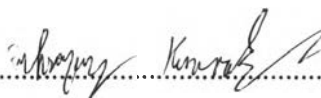


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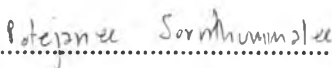
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ABSTRACT

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Polycarbonate (PC), one of the engineering thermoplastic, has been attractive to use in various applications owing to its excellent impact resistance and transparency. However, the poor scratch resistance of PC could limit some applications. In this research, the scratch resistance of PC is aimed to be improved by blending PC with poly(methyl methacrylate) (PMMA). PMMA is well known for high scratch resistance but also has some limitations like low impact strength. Then, the blend of PC and PMMA can cause the synergistic properties of PC and PMMA. PC/PMMA alloys generally are immiscible blends which produce phase separation of these two components and result in poor mechanical properties especially the impact strength. In order to improve the compatibility between PC and PMMA, the compatibilizers, poly(ethylene-co-methacrylic acid) (EMAA), ethylene methyl acrylate copolymer (EMA) and ethylene/methyl acrylate/glycidyl methacrylate terpolymer (EMG), were selected to improve the compatibility of alloys. Most compatibilizers improve the impact strength of the alloys but the drawback is the opaque of alloy resin. To maintain the transparency of PC and PMMA, the transesterification catalysts samarium acetylacetonate hydrate (SMACA) and Tin(II)chloride dihydrate($\text{SnCl}_2 \cdot 2\text{H}_2\text{O}$), were chosen to generate the graft copolymer of PC and PMMA for compatibilization. According to the study, PC80/PMMA20/EMA5 and PC80/PMMA20/EMG1 alloys exhibited the outstanding properties in impact strength than can comparable to neat PC. Therefore, they were selected to compare with commercially available benchmarks.

บทคัดย่อ

อภิขญา บุญลีชัย : การวิจัยและพัฒนาพลาสติกผสมระหว่างพลาสติกวิศวกรรม พอลิคาร์บอเนตและพอลิ(เมทิลเมทาคริเลต) (Research and Development of PC/PMMA Alloys) อ.ที่ปรึกษา : ผศ. ดร.หทัยกานต์ มนัสปิยะ และ ดร.รัชพงษ์ คุณานุรักษ์พงศ์ 166 หน้า

พอลิคาร์บอเนตเป็นพลาสติกเชิงวิศวกรรมชนิดหนึ่งที่มีความใส และสามารถทนแรงกระแทกได้สูง แต่มีความสามารถในการทนทานต่อการขีดข่วนได้ต่ำ ดังนั้นในงานวิจัยนี้ ได้ทำการผสมพอลิคาร์บอเนตกับพอลิ(เมทิลเมทาคริเลต) ซึ่งมีความใสเช่นเดียวกัน และมีความสามารถในการทนทานต่อการขีดข่วนได้ดี เพื่อปรับปรุงและพัฒนาคุณสมบัติการทนทานต่อการขีดข่วน อย่างไรก็ตาม การผสมพอลิคาร์บอเนตและพอลิ(เมทิลเมทาคริเลต) เกิดการแยกวัฏภาคระหว่างพอลิเมอร์ทั้งสองชนิดส่งผลให้พอลิเมอร์ผสมที่ได้มีความทึบ ดังนั้นจึงต้องทำการเพิ่มความเข้ากันได้ระหว่างพอลิคาร์บอเนตและพอลิ(เมทิลเมทาคริเลต) สารเพิ่มความเข้ากันได้จึงถูกเลือกมาใช้ในการผสมพอลิเมอร์ทั้งสองชนิดเพื่อช่วยให้มีความเข้ากันได้ดียิ่งขึ้น สารเพิ่มความเข้ากันได้ที่เลือกใช้ ได้แก่ พอลิเอธิลีน-โค-เมทิลอะคริลิก แอซิด, เอธิลีน-เมทิลอะคริเลต โคพอลิเมอร์ และ เอธิลีน-เมทิลอะคริเลต-ไกลซิซิล เมทาคริเลต เทอร์พอลิเมอร์ และเมื่อทำการเติมสารเพิ่มความเข้ากันได้ลงในกระบวนการผสมแล้วทำให้ความแข็งแรงของพอลิเมอร์ผสมนั้นเพิ่มขึ้น แต่ข้อด้อยคือ พอลิเมอร์ผสมที่ได้ยังคงความทึบอยู่ อีกทั้งคุณสมบัติทางด้านการยึดและการงอมีค่าลดลงเมื่อเพิ่มปริมาณสารเพิ่มความเข้ากันได้ ดังนั้น ตัวเร่งปฏิกิริยา ซามาเลียม อะซิทิลอะซิโทเนต ไฮเดรท และ ทิน(II)คลอไรด์ ไดไฮเดรท จึงถูกเลือกมาใช้ในการเร่งปฏิกิริยาทางเคมีระหว่างพอลิคาร์บอเนตและพอลิ(เมทิลเมทาคริเลต) เพื่อศึกษาความเข้ากันได้และคุณสมบัติทางแสงของพอลิเมอร์ผสม นอกจากนี้วิทยานิพนธ์ฉบับนี้ยังได้ทำการศึกษาและรายงานผลจากการผสมสารเข้ากันได้และสารเติมแต่งของพอลิคาร์บอเนตและพอลิ(เมทิลเมทาคริเลต)ต่อ สัมฐานวิทยา, คุณสมบัติเชิงกายภาพ, คุณสมบัติเชิงกล, และ คุณสมบัติทางความร้อน จากผลการทดลองทั้งหมด พบว่า การเติมสารเพิ่มความเข้ากันได้ คือ เอธิลีน-เมทิลอะคริเลต โคพอลิเมอร์ ในปริมาณ 5 ส่วนใน 100 ส่วนของพอลิเมอร์ผสม และ เอธิลีน-เมทิลอะคริเลต-ไกลซิซิล เมทาคริเลต เทอร์พอลิเมอร์ ในปริมาณ 1 ส่วนใน 100 ส่วนของพอลิเมอร์ผสมลงไปในพอลิเมอร์ผสมระหว่างพอลิคาร์บอเนตและพอลิ(เมทิลเมทาคริเลต)ในอัตราส่วน 80:20 ให้ผลการทดสอบความทนแรงกระแทกสูงเทียบเท่าพอลิคาร์บอเนต ดังนั้น พอลิเมอร์ผสมดังกล่าวจึงถูกนำไปเปรียบเทียบกับคุณสมบัติต่างๆกับพอลิเมอร์ผสมทางการค้า

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ABBREVIATIONS

EMA	Ethylene methyl acrylate
EMAA	Sodium ionomer of poly(ethylene- <i>co</i> -methacrylate)
EMAA(Zn)	Zinc ionomer of poly(ethylene- <i>co</i> -methacrylate)
EMG	Ethylene/methyl acrylate/glycidyl methacrylate terpolymer
HDPE	High density polyethylene
PC	Polycarbonate
PET	Poly(ethylene terephthalate)
PMMA	Poly(methyl methacrylate)
SMACA	Samarium acetylacetonate hydrate
SnCl ₂ .2H ₂ O	Tin(II)chloride dihydrate
T _{cc}	Cold crystallization temperature
T _d	Decomposition temperature
T _g	Glass transition temperature
T _m	Melting temperature
TBATPB	Tetrabutylammonium tetraphenylborate
THF	Tetrahydrofuran

LIST OF SYMBOLS

θ	Diffraction angle
ΔE_{mix}	Energy change of the system
ΔG_{mix}	Gibbs free energy of mixing
ΔH_{mix}	Enthalpy of mixing
ΔS_{mix}	Entropy of mixing
ΔV_{mix}	Volume change of the system
P	Pressure of the system
T	Temperature
$\tan \delta$	Damping or loss factor