

**PREPARATION AND MECHANICAL PROPERTIES OF NR/CLAY  
NANOCOMPOSITE**

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A Thesis Submitted in Partial Fulfillment of the Requirements  
for the Degree of Master of Science  
The Petroleum and Petrochemical College, Chulalongkorn University  
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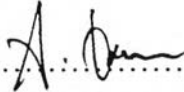
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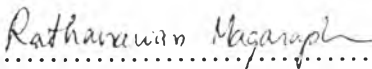
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**By** : Mr. Woothichai Thaijaroen  
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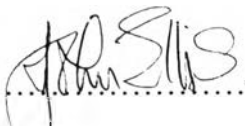
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## ABSTRACT

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Organically modified clays were synthesized via ion-exchange reaction using a series of primary alkylamines and quaternary ammonium salts as modifying agents. Atomic absorption spectroscopy, Fourier transform infrared spectroscopy, thermogravimetric analysis, and X-ray diffraction (XRD) were applied to verify the incorporation of modifying agents into the structure of clay. Natural rubber (NR)/clay nanocomposites were subsequently prepared by means of solution and melt techniques. The XRD results showed that silicate layers could be exfoliated in the matrix of NR and brought about the improvement in mechanical properties and cure characteristics. Especially, composites prepared by the solution technique showed better properties than those prepared by the melt counterpart. Interestingly, the increases in tensile strength, modulus, and hardness of composites were not significantly sacrificed by the loss of elongation at break.

## บทคัดย่อ

นาย วุฒิชัย ไทยเจริญ : การเตรียมและคุณสมบัติเชิงกลของสารนาโนคอมพอสิตของ  
ยางธรรมชาติกับดิน (Preparation and Mechanical Properties of NR/Clay Nanocomposite)  
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ดินที่ได้รับการปรับสภาพให้มีคุณสมบัติเป็นสารอินทรีย์มากขึ้นถูกสังเคราะห์ขึ้นโดยใช้วิธีการแลกเปลี่ยนไอออน ซึ่งใช้ไพรมารีอัลคิลเอมีน และเกลือควอเตอร์นารีแอมโมเนียม เป็นสารปรับสภาพ AAS, FTIR, TGA และ XRD ถูกนำมาใช้เพื่อตรวจสอบการเข้าไปอยู่ของสารปรับสภาพในโครงสร้างของดิน หลังจากนั้นสารนาโนคอมพอสิตของยางธรรมชาติและดินที่ได้รับการปรับสภาพแล้ว ถูกเตรียมขึ้นโดยการใช้เทคนิคสารละลายและเทคนิคหลอมเหลว ผลจาก XRD แสดงให้เห็นว่าโดยการใช้เทคนิคการผสมทั้ง 2 วิธี กลุ่มของชั้นของซิลิเกตสามารถถูกทำให้แยกตัวเป็นชั้นซิลิเกตเดี่ยวๆได้ และกระจายตัวอย่างดีในตัวกลางของยาง ซึ่งนำไปสู่คุณสมบัติเชิงกลและคุณสมบัติการเกิดโครงสร้างแบบร่างแหที่ดีขึ้นของสารคอมพอสิต โดยเฉพาะสารคอมพอสิตที่เตรียมโดยเทคนิคสารละลายให้คุณสมบัติที่ดีกว่าสารคอมพอสิตที่เตรียมโดยเทคนิคหลอมเหลว และที่น่าสนใจเป็นอย่างยิ่ง คือการเพิ่มขึ้นของความแข็งแรงแบบเทนไซล์, โมดูลัส, และความแข็ง ของสารคอมพอสิตที่สังเคราะห์ขึ้นมาไม่ได้ถูกแลกเปลี่ยนกับการสูญเสียการยึดตัว ณ จุดขาดอย่างมีนัยสำคัญ

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**ABBREVIATIONS**

MMT	=	Montmorillonite
Na-MMT	=	Sodium montmorillonite
DO	=	Dodecylamine
TET	=	Tetradecylamine
HEX	=	Hexadecylamine
OC	=	Octadecylamine
HEXT	=	Hexadecyltrimethyl ammonium chloride
OCT	=	Octadecyltrimethyl ammonium bromide
meq	=	Milliequivalent
NR	=	Natural rubber