

**DETERGENCY OF MOTOR OIL REMOVAL
UNDER MICROEMULTION CONDITIONS**

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ABSTRACT

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Detergency is the process of removing unwanted materials from solid surfaces by contact with a surfactant solution. It is hypothesized that both ultra-low interfacial tension and high solubilization play important roles in promoting the detergency efficiency of oily soil such as motor oil. The objective of this study was to investigate the relationship between the phase diagrams of microemulsion formation with motor oil and the detergency performance on fabrics under microemulsion conditions. A mixed surfactant system of branched alcohol propoxylate sulphate sodium salt with 14 – 15 carbons and 3 propylene oxides (Alfotera 145-3PO), an ionic surfactant, and a secondary alcohol ethoxylate nonionic surfactant (Tergitol 15S5) which is a commercial surfactant used in laundry applications and is friendly to the environment, was used to exhibit a Winsor Type III microemulsion (middle phase) at 0.1 wt% Alfotera and 5 wt% Tergitol 15S5 and salinity of 5% with motor oil. From the phase behaviour results, a formulation was selected for the detergency experiments. The recommendation for detergency by selected formulation should be in the range of 30°C-50°C. Moreover, the detergency performance under the microemulsion condition was much higher than commercial detergents at the same active surfactant concentration. The pre-treat by the selected formulation before washing is an advantage to improve the efficiency of detergency. In addition, the salinity concentration in wash step has affected to each step of oil removal.

บทคัดย่อ

จิตติมา รัตนวรีภา : การกำจัดน้ำมันเครื่องภายใต้สภาวะไมโครอิมัลชันเพื่อใช้ในการทำความสะอาด (Detergency of Motor Oil Removal Under Microemulsion Conditions)
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การทำมาสะอาด คือ กระบวนการหนึ่งในการกำจัดสิ่งสกปรกที่เราไม่ต้องการจากผิวผ้า สมมติฐานถูกตั้งไว้ว่า ค่าแรงดึงผิวที่ต่ำมากและค่าการละลายของน้ำมันเครื่องแสดงมีความสำคัญต่อประสิทธิภาพของการทำความสะอาด วัตถุประสงค์ของงานวิจัยเล่มนี้ คือ ศึกษาความสัมพันธ์ระหว่างระบบของสารลดแรงดึงผิวที่เกิดไมโครอิมัลชัน และประสิทธิภาพของการทำความสะอาดภายใต้ระบบไมโครอิมัลชัน สารลดแรงดึงผิวที่ถูกเลือกมาใช้ในการเกิดไมโครอิมัลชันกับน้ำมันเครื่อง ได้แก่ อัลโฟเทอร์รา 145-3 โพลีเอทิลีน ออกไซด์ และ เทอจิทอล 15 เอส 5 ซึ่งใช้ทั่วไปในอุตสาหกรรมทำความสะอาด และไม่เป็นพิษต่อสิ่งแวดล้อม ระบบของสารลดแรงดึงผิวที่สามารถเกิดวินเซอร์ในแบบที่ III คือ 0.1 เปอร์เซ็นต์ของสารลดแรงดึงผิวอัลโฟเทอร์รา 145-3 โพลีเอทิลีน ออกไซด์ และ 5 เปอร์เซ็นต์ของสารลดแรงดึงผิวเทอจิทอล 15 เอส 5 ในปริมาณเกลือ 5 เปอร์เซ็นต์ จากงานวิจัยเล่มนี้ พบว่าช่วงอุณหภูมิที่เหมาะสมต่อการทำความสะอาดคือ 30-50 องศาเซลเซียส นอกจากนี้ ประสิทธิภาพในการทำความสะอาดภายใต้ระบบไมโครอิมัลชันสูงกว่าประสิทธิภาพการทำความสะอาดของผงซักฟอกทั่วไปที่ความเข้มข้นของสารลดแรงดึงผิวที่เท่ากัน ประสิทธิภาพของการทำความสะอาดจะเพิ่มขึ้น หากผ่านกระบวนการทำความสะอาดโดยสารลดแรงดึงผิวที่เข้มข้นก่อนการทำความสะอาดจริง และยังพบว่า ปริมาณความเข้มข้นของเกลือในช่วงการซักมีผลต่อการทำความสะอาดน้ำมันเครื่องในแต่ละชั้นของน้ำซัก และน้ำล้างอีกด้วย

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ABBREVIATIONS

ADPODS	Alkyl diphenyl oxide disulfonate
Alfotera 145-3PO	branched alcohol propoxylate sulphate sodium salt with 14 – 15 carbons and 3 propylene oxides
AOT	Aerosol-OT or dioctyl sodium sulfosuccinate
EACN	Equivalent alkane carbon number
HLB	Hydrophilic-lipophilic balance
IFT	Interfacial tension (mN/m)
IFT _{m/o}	Interfacial tension between middle phase and excess oil phase (mN/m)
IFT _{m/w}	Interfacial tension between middle phase and excess water phase (mN/m)
IFT _{o/w}	Interfacial tension between oil and water (mN/m)
LD	Liquid Detergent
O/W	Oil-in-water microemulsion
W/O	Water-in-oil microemulsion
PIT	Phase inversion temperature
Tergitol 15S5	secondary alcohol ethoxylate nonionic surfactant with 5 ethylene oxide
S*	Optimum salinity (wt%)
SP*	Optimum solubilization parameter (ml/g)
SP	Solubilization parameter (ml/g)
Sp _o	Solubilization parameter of oil (ml/g)
SP _w	Solubilization parameter of water (ml/g)

LIST OF SYMBOLS

θ	Contact angle (degree)
ρ	Density (g/ml)
d	Diameter (mm)
$\gamma_{O/M}$	Interfacial tension between excess oil phase and middle phase (mN/m)
$\gamma_{W/M}$	Interfacial tension between excess water phase and middle phase (mN/m)
γ_{OB}	Interfacial tension at the liquid soil-bath interface (mN/m)
γ_{OS}	Interfacial tension at the liquid soil-substrate interface (mN/m)
γ_{SB}	Interfacial tension at the substrate-bath interface (mN/m)
W_C	Work of cohesion
W_A	Work of adhesion