

**SELECTIVE ADSORPTION OF MIXED POLLUTANTS
ON MESOPOROUS SILICATE**



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for the Degree of Master of Science Program in Environmental Management**

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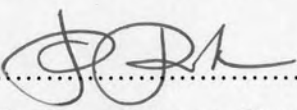
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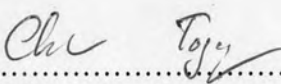
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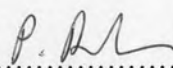
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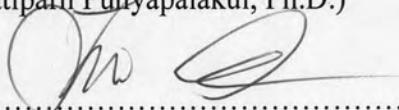
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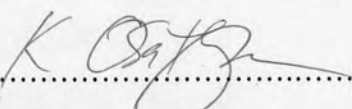

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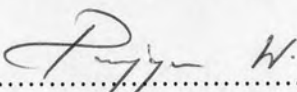
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การดูดซับแบบคัดเลือกของมลสารผสม 3 ชนิด ได้แก่ โลหะหนัก (แคดเมียมและทองแดง) สีย้อมเมทิลีนบลู และสารลดแรงตึงผิวชนิดไม่มีประจุ (Triton X-100) ในน้ำเสียสังเคราะห์ โดยใช้มีโซพอร์ซิลิเกตชนิดหกเหลี่ยม ได้แก่ เฮกซะโกนอลมีโซพอร์ซิลิเกต (HMS) ซึ่งสามารถสังเคราะห์ได้ด้วยกระบวนการใช้สารลดแรงตึงผิวเป็นโครงสร้างผลึกและได้ทำการต่อติดหมู่ฟังก์ชันจำนวน 3 ชนิด ได้แก่ หมู่อะมิโน, หมู่เมอร์แคปโต และหมู่ออกทิล จากการศึกษาประสิทธิภาพการดูดซับในสภาวะมลสารเดี่ยว หมู่เมอร์แคปโตมีสัมประสิทธิ์การดูดซับสูงที่สุดใน การดูดซับแคดเมียมและทองแดงเท่ากับ 3 และ 22 มิลลิกรัมต่อกรัมตามลำดับ ด้วยกระบวนการดูดซับทางเคมี ในขณะที่หมู่ซิลานอลบนตัวกลางเฮกซะโกนอลมีโซพอร์ซิลิเกต มีสัมประสิทธิ์การดูดซับ TX-100 สูงที่สุดเท่ากับ 620 มิลลิกรัมต่อกรัม เนื่องจากพันธะไฮโดรเจนและการรวมตัวของมลสารบนพื้นผิวชนิดมีขั้ว ในกระบวนการดูดซับสีเมทิลีนบลู หมู่ออกทิลให้ค่าสัมประสิทธิ์การดูดซับสูงที่สุดเท่ากับ 65 มิลลิกรัมต่อกรัม เนื่องจากแรงดึงดูดชนิดแรงแรงแวลเดออร์วาลส์ ในสภาวะมลสารผสม ตัวกลางดูดซับทุกชนิดมีค่าการคัดเลือกในการดูดซับของโลหะหนัก (แคดเมียมและทองแดง) สูงขึ้นเมื่อผสมกับ TX-100 ซึ่งเป็นผลมาจากการเปลี่ยนแปลงลักษณะของพื้นผิวของตัวกลางดูดซับเมื่อเกิดการดูดซับ TX-100 และมีค่าการคัดเลือกของโลหะหนัก (แคดเมียมและทองแดง) ลดลงเมื่อผสมกับสีเมทิลีนบลู ซึ่งเป็นผลมาจากการแข่งขันเพื่อเข้าถึงพื้นที่ดูดซับ ตัวกลางดูดซับทุกชนิดยกเว้นหมู่อะมิโน มีค่าการคัดเลือกในการดูดซับของ TX-100 สูงขึ้น เมื่อผสมกับสีเมทิลีนบลู ซึ่งเป็นผลมาจากการแข่งขันเพื่อเข้าถึงพื้นที่ดูดซับ และโครงสร้างของพื้นผิวที่ซับซ้อนขึ้นเนื่องจากสีเมทิลีนบลู

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WORACHAT PAISANJIT : SELECTIVE ADSORPTION OF MIXED
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Selective adsorption of mixed pollutants; heavy metals (Cd(II) and Cu(II)), Methylene blue (MB) and Octylphenol polyethoxylate (Triton X-100®) from synthetic textile wastewater was investigated by using hexagonal mesoporous silicates (HMSs). HMSs were synthesized through surfactant templating method and three of them were grafted with organic functional groups on the surface, 3-aminopropyltriethoxy, 3-mercaptopropyl and n-octyldimethyl groups. For single solution, 3-mercaptopropyl functionalized surface had highest Cd(II) and Cu(II) adsorption capacity (3.0 and 22.0 mg/g, respectively) due to chemical adsorption, however, silanol groups on pristine HMS surface exhibited highest TX-100 adsorption capacity (up to 620 mg/g) due to hydrogen bonding and surface aggregation on hydrophilic surface. For MB adsorption, OD-HMS had highest adsorption capacity (about 65 mg/g) due to strongest van der waals interaction. For bi-solution, all of adsorbents have high selectivity for heavy metals both of Cd(II) and Cu(II) in a mixture with TX-100, which is caused by changing surface characterization of adsorbents by adsorbed TX-100. But, in a mixture with heavy metal (Cd(II) and Cu(II)) and MB, all of adsorbents had lower selectivity because of active site competition. Functionalized HMSs except A-HMS have high selectivity for TX-100 in a mixture with MB, which also might be caused by active site competition and increasing of surface complexity.

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LIST OF ABBREVIATIONS

°C	Degree Celsius
AE	Alcohol Exthoxylates
APnEOs	Alkylphenol Polyethoxylates
APTES	Aminopropyltriethoxysilane
A-HMS	Amino functionalized hexagonal mesoporous silicates
BET	Brunauer-Emmett-Teller
BJH	Barrett-Joyner-Halenda
Cd(II)	Cadmium (²⁺ ions)
Cu(II)	Copper (²⁺ ions)
CMC	Critical micelle concentration
DDA	Dodecylamine
FT-IR	Fourier Transform Infared Spectroscopy
HMS	Hexagonal mesoporous silicates
g	Gram
hr	Hour
ICP-OES	Inductively Coupled Plasma Optical Emission Spectroscopy
L	Liter
LCT	Liquid Crystal Templating mechanism
MB	Methylene Blue
MPTMS	Mercaptopropyltrimethoxysilane
M-HMS	Mercapto functionalized hexagonal mesoporous silicates
M41S	Ordered mesoporous molecular sieve, number 41
MCM-41	Mobil Catalytic Material, number 41
min	Minute
mg/kg	Milligram per kilogram
mg/L	Milligram per liter
mL	Milliliter
mM	Millimolar
mol/L	Mole per liter

nm	Nanometer
OD-HMS	Alkyl functionalized hexagonal mesoporous silicates
PAC	Powdered activated carbon
pH _{zpc}	Zero point of charge
ppm	Part per million
rpm	Round per minute
S [•] I [•]	Neutral synthesis pathway
SF-HMS	Single-functional hexagonal mesoporous silicates
SPE	Solid Phase Extraction
TEOS	Tetraethyl orthosilicate or Tetraethoxysilane
Ti-HMS	Titanium-substituted hexagonal mesoporous silicates
TLV	Threshold limiting values
TN	Total Nitrogen
TX-100	Triton X-100®
XRD	X-Ray Diffraction
UV	Ultraviolet
V	Volume