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ด้วยสเปกโตรฟลูออโรมิสทรีและไพโรไลซิสจีซีเอ็มเอส

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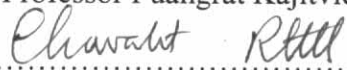

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จงศ์พันธ์ มุสิกะวงศ์: การจำแนกลักษณะกลุ่มสารอินทรีย์ละลายน้ำในน้ำเสียการนิคม
 อุตสาหกรรมโดยการวิเคราะห์ด้วยสเปกโตรฟลูออโรมิสทรีและไพโรไลซิสจีซีเอ็มเอส
 (CHARACTERIZATION OF FRACTIONATED DISSOLVED ORGANIC MATTER IN
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งานวิจัยนี้มีวัตถุประสงค์เพื่อศึกษาหาปริมาณสารอินทรีย์คาร์บอนละลายน้ำ โอกาสการก่อตัวของสารไตร-
 ฮาโลมีเทน(THMFP) และโอกาสการก่อตัวของสารไตรฮาโลมีเทนจำเพาะ (Specific THMFP) ของกลุ่มสารอินทรีย์
 ละลายน้ำในน้ำเสียการนิคมอุตสาหกรรมและน้ำที่ผ่านการบำบัดด้วยระบบบำบัดน้ำเสียรวมของการนิคมอุตสาหกรรม
 ภาคเหนือ จังหวัดลำพูน ประเทศไทย ซึ่งประกอบด้วย บ่อเติมอากาศ บ่อแฟกัลลเททีฟ บ่อออกซิเดชัน และบ่อดีเท็นชัน
 ไพโรไลซิสจีซีเอ็มเอสและสเปกโตรฟลูออโรมิสทรีได้ถูกนำมาใช้ในการวิเคราะห์กลุ่มทางเคมีและกลุ่มสารอินทรีย์ที่
 สามารถวิเคราะห์ได้โดยสเปกโตรฟลูออโรมิสทรีตามลำดับ น้ำตัวอย่างถูกเก็บจากน้ำเสียการนิคมอุตสาหกรรมและน้ำที่
 ผ่านการบำบัดแล้วจากแต่ละบ่อระหว่างเดือนมิถุนายน พ.ศ.2547 ถึง เดือนกรกฎาคม พ.ศ. 2548 กระบวนการเรซิน-
 แพรกชันเนชันด้วยเรซิน 3 ชนิดคือ DAX-8, AG-MP-50 และ WA-10 ถูกนำมาใช้ในการแบ่งกลุ่ม สารอินทรีย์ละลายน้ำ
 (DOM) ออกเป็น 6 กลุ่มได้แก่ ไฮโดรฟอบิกที่เป็นกลาง (HPON) ไฮโดรฟอบิกที่เป็นด่าง (HPOB) ไฮโดรฟอบิกที่เป็น
 กรด (HPOA) ไฮโดรฟิลิกที่เป็นด่าง (HPIB) ไฮโดรฟิลิกที่เป็นกรด (HPIA) และไฮโดรฟิลิกที่เป็นกลาง (HPIN)

จากการทดลองพบว่า HPOA และ HPIN เป็นสารอินทรีย์ที่พบมากที่สุด ในน้ำเสียและน้ำที่ผ่านการบำบัดโดย
 บ่อเติมอากาศ (ผลรวมของ HPOA และ HPIN มีค่ามากกว่า 50% ของ DOM ทั้งหมด) HPOA และ HPIA เป็น
 สารอินทรีย์ที่พบมากที่สุด ในน้ำที่ผ่านการบำบัดโดยบ่อแฟกัลลเททีฟ น้ำที่ผ่านการบำบัดโดยบ่อออกซิเดชัน และน้ำที่
 ผ่านการบำบัดโดยบ่อดีเท็นชัน (ผลรวมของ HPOA และ HPIA มีค่ามากกว่า 50% ของ DOM ทั้งหมด) ค่า THMFP
 ของ HPOA และ HPIA มีค่าค่อนข้างสูงเมื่อเปรียบเทียบกับค่า THMFP ของกลุ่มสารอินทรีย์ละลายน้ำกลุ่มอื่นๆ ส่วน
 ค่า Specific THMFP ของ HPOA และ HPIA นั้นก็มีค่าค่อนข้างสูง สารอินทรีย์กลุ่มอลิฟาติกไฮโดรคาร์บอน
 (ประมาณ 70%) พบมากในน้ำเสียและน้ำที่ผ่านการบำบัดแล้วจากบ่อต่างๆ (25-58%) สารอินทรีย์กลุ่มอโรมาติก-
 ไฮโดรคาร์บอน (ประมาณ 20-55%) และกลุ่มเอสเทอร์ (ประมาณ 5-21%) พบมากใน HPON สารอินทรีย์กลุ่มคาร์-
 บอซิลิก (ประมาณ 27-75%) พบมากใน HPOB สารอินทรีย์กลุ่มอลิฟาติกไฮโดรคาร์บอน(ประมาณ 17-42%) และ
 อโรมาติกไฮโดรคาร์บอน (ประมาณ 26-41%) พบมากใน HPOA สารอินทรีย์กลุ่มอลิฟาติกไฮโดรคาร์บอน (ประมาณ
 25-71%) พบมากใน HPIB, HPIA และ HPIN เมื่อพิจารณาโอกาสการก่อตัวของสารไตรฮาโลมีเทน สารอินทรีย์กลุ่ม
 ไฮโดรฟอบิกซึ่งประกอบด้วยสารอินทรีย์กลุ่มอโรมาติกไฮโดรคาร์บอน คาร์บอกซิลิก ฟีนอล เอสเทอร์และสารอินทรีย์
 กลุ่มอลิฟาติกไฮโดรคาร์บอน ($C_{12} \leq$ อลิฟาติกไฮโดรคาร์บอนแฟรกเมนต์ $\leq C_{11}$) เป็นสารอินทรีย์ที่ก่อให้เกิดสารไตร-
 ฮาโลมีเทนได้ค่อนข้างสูง ส่วนสารอินทรีย์กลุ่มอลิฟาติกไฮโดรคาร์บอน ($C_{18} \leq$ อลิฟาติกไฮโดรคาร์บอนแฟรกเมนต์
 $\leq C_{24}$) และอลิฟาติกไฮโดรคาร์บอนเป็นสารอินทรีย์ที่ก่อให้เกิดสารไตรฮาโลมีเทนได้ค่อนข้างต่ำ จากผลการวิเคราะห์ด้วย
 สเปกโตรฟลูออโรมิสทรีพบว่าสารอินทรีย์กลุ่ม tyrosine-like และ tryptophan-like พบมากใน HPON ส่วน
 สารอินทรีย์กลุ่ม tyrosine-like และ humic and fulvic acids-like พบมากใน HPOA HPIA HPIB และ HPIN บ่อเติม
 อากาศ บ่อแฟกัลลเททีฟ สามารถลด HPON HPIB และ HPIN ได้ดี HPOA และ HPIA สามารถลดได้ดีโดยบ่อเติม
 อากาศ ส่วนบ่ออื่นๆ นั้นมีประสิทธิภาพในการลด HPOA และ HPIA ค่อนข้างต่ำ ระบบบำบัดน้ำเสียรวมของการ
 นิคมอุตสาหกรรมภาคเหนือซึ่งประกอบด้วย บ่อเติมอากาศ บ่อแฟกัลลเททีฟ และบ่อออกซิเดชัน สามารถลด HPON
 HPIN HPIB HPIA และ HPOA ได้ 73% 46% 60% 18% และ 11% ตามลำดับ

สาขาวิชาการจัดการสิ่งแวดล้อม

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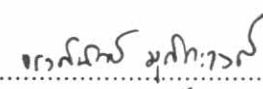
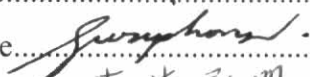

ลายมือชื่อนิสิต..... จงศ์พันธ์ มุสิกะวงศ์
 ลายมือชื่ออาจารย์ที่ปรึกษา..... Suraphon
 ลายมือชื่ออาจารย์ที่ปรึกษาร่วม..... 古米弘明

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 KEY WORD: FRACTIONATED DISSOLVED ORGANIC
 MATTER/FLUORESCENT EXCITATION-EMISSION MATRIX/PYROLYSIS
 GC/MS/STABILIZATION PONDS/INDUSTRIAL ESTATE WASTEWATER
 CHARONGPUN MUSIKAVONG: CHARACTERIZATION OF
 FRACTIONATED DISSOLVED ORGANIC MATTER IN INDUSTRIAL
 ESTATE WASTEWATER USING SPECTROFLUOROMETRY AND
 PYROLYSIS GC/MS ANALYSIS: THESIS ADVISOR: ASST.PROF.
 SURAPHONG WATTANACHIRA, D.Eng, THESIS CO-ADVOSOR:
 PROF.HIROAKI FURUMAI, D.Eng. 272 pp. ISBN 974-14-2706-9.

The aims of this research were to investigate the dissolved organic carbon (DOC) mass distribution, trihalomethane formation potential (THMFP) and specific THMFP of dissolved organic matter (DOM) fractions in industrial estate wastewater and effluent water from the aeration, facultative, oxidation and detention ponds of the central wastewater treatment plant of the Northern-Region Industrial Estate, Lamphun province, Thailand. Pyrolysis gas chromatography mass spectrometer and three-dimensional fluorescent spectroscopy (fluorescent excitation-emission matrix, FEEM) analysis were utilized on the DOM fractions of all water samples to identify the fluorescent organic matter and chemical classes, respectively. Industrial estate wastewater and treated effluent from each pond were collected from June 2004 to July 2005. The resin fractionation technique, used with three different types of resins (i.e. DAX-8, AG-MP-50 and WA-10), was employed to characterize the DOC in all water samples into six fractions, namely hydrophobic neutral (HPON), hydrophobic base (HPOB), hydrophobic acid (HPOA), hydrophilic base (HPIB), hydrophilic acid (HPIA), and hydrophilic neutral (HPIN).

The results showed that HPOA and HPIN were the major DOM fractions in the industrial estate wastewater and aeration pond effluent; summations of HPOA and HPIN were more than 50%. However, HPOA and HPIA were the dominant DOM fractions in the effluent from the facultative, oxidation, and detention ponds; summations of HPOA and HPIA were more than 50%. THMFP_{HPOA} and THMFP_{HPIA} were found in the largest quantities when compared with the THMFP of others species. In addition, the specific THMFPs of HPOA and HPIA were considerably high. The aliphatic hydrocarbon class (approx. 70%) was dominant in the industrial estate wastewater and in the treated effluent from each pond (25-58%). Aromatic hydrocarbon (20-55%) and ester (5-21%) were the major chemical classes of HPON; whereas carboxylic acid (27-75%) was the major chemical class of HPOB. Aliphatic (17-42%) and aromatic hydrocarbons (26-41%) were classified as the major chemical classes of HPOA. In the case of the hydrophilic organic (HPI) fraction, aliphatic hydrocarbon (45-71%) was identified as the major chemical class in HPIB, HPIA, and HPIN. Trihalomethanes could be easily associated with hydrophobic organic (HPO) fractions that are mainly composed of the aromatic hydrocarbon, carboxylic acids, phenol and ester classes, along with the aliphatic hydrocarbon class ($C_5 \leq$ aliphatic hydrocarbon fragments $\leq C_{11}$). The aliphatic hydrocarbon ($C_{18} \leq$ aliphatic hydrocarbon fragments $\leq C_{24}$) and organic nitrogen classes (mainly composed of aliphatic organic nitrogen fragments), when combined with chlorine could be inactive and fail to form THMs. With regard to the FEEM results, tyrosine-like and tryptophan-like substances were classified as major fluorescent organic matter in HPON. For HPOA, tyrosine-like and humic and fulvic acids-like substances were the major fluorescent organic matter. In the HPI fractions, tyrosine-like and humic and fulvic acids-like substances were the dominant fluorescent organic matter of HPIB, HPIA, and HPIN. With regard to DOM reductions, the aeration and facultative ponds were the main processes that reduced HPON, HPIN, and HPIB. Only the aeration ponds reduced HPOA and HPIA, however, only moderately. In total, the aeration + facultative + oxidation ponds] reduced HPON, HPIN, HPIB, HPOA, and HPIA by 73%, 46%, 60%, 18%, and 11%, respectively.

Field of study Environmental Management
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ABBREVIATIONS AND SYMBOLS

AC	Activated carbon
AH	Aldehydes
AL	Aliphatic hydrocarbon
AMW	Apparent molecular weight
AR	Aromatic hydrocarbon
As	Amino sugars
Br	Bromide ion
°C	Degree Celsius
CH	Chloral hydrate
CHBr ₃	Bromoform
CHCl ₃	Chloroform
CHCl ₃ -FP	Chloroform formation potential
CHCl ₂ Br-FP	Dichlorobromoform formation potential
CHClBr ₂ -FP	Dibromochloroform formation potential
CH ₃ OH	Methanol
CP	Chloropicrin
DPD	N, N-decethyl-p-phenylenediamine
DBPFP	Disinfection by-product formation potential
DBPs	Disinfection by-products
DOC	Dissolved organic carbon
DOM	Dissolved organic matter
D/DBP rule	Disinfectant and disinfection by-product rule
ECD	Electron capture detector
EfOM	Effluent-derived organic matter
FEEM	Fluorescent excitation-emission matrix
FTIR	Fourier Transform Infrared
GAC	Granular activated carbon
GC	Gas chromatography
GC/MS	Gas chromatography mass spectrometer
GPC	Gel permeation chromatography
HAAs	Haloacetic acids

HANs	Haloacetonitriles
HCl	Hydrochloric acid
HKs	Haloketons
HOBr	Hypobromous acid
HOCl	Hypochlorite
HPI	Hydrophilic organic
HPIA	Hydrophilic acid
HPIB	Hydrophilic base
HPIN	Hydrophilic neutral
HPO	Hydrophobic organic
HPOA	Hydrophobic acid
HPOB	Hydrophobic base
HPON	Hydrophobic neutral
H ₂ SO ₄	Sulfuric acid
KHP	Potassium hydrogen phthalate
KT	Ketones
MCL	Maximum contaminant level
mg/L	Milligram per liter
mL/min	Milliliter per minute
NaOH	Sodium hydroxide
NOM	Natural organic matter
nm	Nanometer
NTU	Nephelometric turbidity unit
ON	Organic Nitrogen
OM	Organic matter
PHA	Polyhydroxy aromatics
PN	Phenol
POC	Particulate organic carbon
Pr	Proteins
Ps	Polysaccharides
QSU	Quinine sulfate unit
psi	Pound square per inch
RO	Reverse osmosis
RW	Raw water

SUVA	Specific ultraviolet absorbance
THM	Trihalomethane
THMFP	Trihalomethane formation potential
THMs	Trihalomethanes
TOC	Total organic carbon
TOX	Total organic halides
TOXFP	Total organo-halide formation potential
TW	Treated wastewater
USEPA	United States Environmental Protection Agency
UV	Ultraviolet
UVA	Ultraviolet absorbent
μm	Micro meter
$\mu\text{s/cm}$	Microsemen per centimeter
$\mu\text{g/L}$	Microgram per liter