

**ENHANCEMENT OF SEPARATE HYDROGEN AND METHANE
PRODUCTION FROM ETHANOL WASTEWATER BY MICROAERATION**

Nhatthaphon Sri-ubon

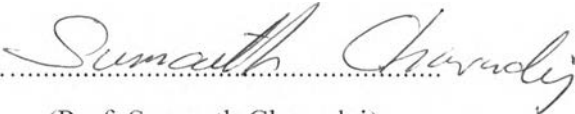
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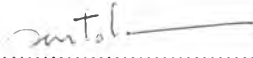
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ABSTRACT

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The objective of this research was to examine effects of microaeration on the separate hydrogen and methane production from ethanol wastewater using a two-stage upflow anaerobic sludge blanket reactor (UASB) system, with recycle ratio of 1:1 (methane effluent flow rate: feed flow rate) under mesophilic temperature, with and without pH control at 5.5 in hydrogen and methane production tank, respectively. The results showed that, under optimum COD loading rate of $6.0 \text{ kg/m}^3 \text{ d}$ based on the methane UASB volume ($36.0 \text{ kg/m}^3 \text{ d}$ based on the hydrogen UASB volume), the methane UASB unit had the highest process performance in terms of COD removal of 55 %, a gas production rate of 27.5 l/d, CH_4 content of 74 % and a methane yield of 66.6 l/g COD applied. Under optimum COD loading rate ($6 \text{ kg/m}^3 \text{ d}$ base on methane UASB tank) with the optimum oxygen supply load ($4 \text{ ml O}_2/\text{L}_R \text{ d}$), the methane production performance (COD removal of 62.5 %, a gas production rate of 45.5 l/d, CH_4 content of 75 % and a methane yield of 191.8 l/g COD applied) was maximized. Furthermore, the H_2S in the produced gas was totally removed from the methane UASB unit.

บทคัดย่อ

ณัฐพล ศรีอุบล : การเพิ่มประสิทธิภาพในการผลิตไฮโดรเจนและมีเทนด้วยน้ำเสียจากโรงงานผลิตเอทานอลโดยการเติมออกซิเจนในปริมาณน้อยและจำกัด (Enhancement of Separate Hydrogen and Methane Production from Ethanol Wastewater by Microaeration) อ. ที่ปรึกษา : ศ. ดร. สุเมธ ชวเวช 101 หน้า

จุดประสงค์ของงานวิจัยนี้คือการศึกษาผลกระทบของการเติมออกซิเจนในปริมาณน้อยและจำกัดต่อกระบวนการผลิตไฮโดรเจนและมีเทนด้วยน้ำเสียจากโรงงานผลิตเอทานอลในถังปฏิกรณ์แบบต่อเนื่องสองขั้นตอนภายใต้อุณหภูมิ 37 องศาเซลเซียส ค่าความเป็นกรด-ด่างเท่ากับ 5.5 ในถังผลิตไฮโดรเจน และไม่มีการควบคุมความเป็นกรด-ด่างในถังผลิตมีเทนซึ่งอัตราการป้อนกลับของน้ำเสียเอทานอลจากถังผลิตมีเทนไปยังถังผลิตไฮโดรเจนถูกกำหนดที่ 1:1 จากการศึกษาพบว่าสภาวะที่ผลิตก๊าซไฮโดรเจนได้สูงสุดคือที่อัตราการป้อนสารอินทรีย์ 6.0 กิโลกรัมต่อลูกบาศก์เมตรต่อวัน ซึ่งคำนวณด้วยขนาดถังผลิตมีเทน(หรือ 36.0 กิโลกรัมต่อลูกบาศก์เมตรต่อวันซึ่งคำนวณด้วยขนาดถังผลิตไฮโดรเจน) สามารถกำจัดสารอินทรีย์ได้ร้อยละ 55 อัตราการผลิตก๊าซรวม 27.5 ลิตรต่อวัน ก๊าซมีเทนที่ผลิตได้ร้อยละ 68.0 ผลได้ของก๊าซมีเทน 66.1 มิลลิลิตรของก๊าซมีเทนต่อกรัมของสารอินทรีย์ที่ถูกป้อน จากนั้นเติมออกซิเจนในอัตรา 4.0 มิลลิลิตรต่อปริมาณถังมีเทนต่อวันที่อัตราการป้อนสารอินทรีย์ 6.0 กิโลกรัมต่อลูกบาศก์เมตรต่อวันพบว่า สามารถกำจัดสารอินทรีย์ได้ถึงร้อยละ 62.5 อัตราการผลิตก๊าซ 45.5 ลิตรต่อวัน ก๊าซมีเทนที่ผลิตได้ร้อยละ 72.5 ผลได้ของก๊าซมีเทน 191.8 มิลลิลิตรของก๊าซมีเทนต่อกรัมของสารอินทรีย์ที่ถูกป้อนในสภาวะเดียวกันนี้ยังสามารถกำจัดก๊าซไฮโดรเจนซัลไฟด์ที่ผลิตได้ทั้งหมดอีกด้วย

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ABBREVIATIONS

ABBREVIATION	DESCRIPTION
ABR	Anaerobic Baffled Reactor
AEBR	Anaerobic Expanding-Bed Reactor
AMBR	Anaerobic Migrating Blanket Reactor
ASBR	Anaerobic Sequencing Batch Reactor
COD	Chemical Oxygen Demand
COD:N:P	Chemical Oxygen Demand: Nitrogen: Phosphorus ratio
d	Day
g	Gram
HRT	Hydraulic Retention Time
L_R	Reactor Volume
ml	Milliliter
MLVSS	Microbial Liquor Volatile Suspended Solid
mM	Millimolar
SHPR	Specific Hydrogen Production Rate
SMPR	Specific Methane Production Rate
TS	Total Solid
TSS	Total Suspended Solid
UASB	Upflow Sludge Blanket Reactor
VSS	Volatile Suspended Solid

LIST OF SYMBOLS

SYMBOL	DESCRIPTION
τ	Hydraulic retention time