

**BIOHYDROGEN PRODUCTION FROM GLUCOSE-CONTAINING  
WASTEWATER IN ANAEROBIC SEQUENCING BATCH REACTORS:  
EFFECT OF OPERATING CONDITIONS**



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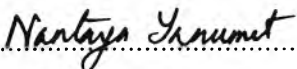
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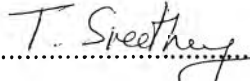
**Thesis Advisors:** Dr. Thammanoon Sreethawong  
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Accepted by the Petroleum and Petrochemical College, Chulalongkorn University, in partial fulfilment of the requirements for the Degree of Master of Science.

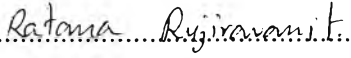
  
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## ABSTRACT

4971024063: Petrochemical Technology Program

Tharathip Niyamapa: Biohydrogen Production from Glucose-Containing Wastewater in Anaerobic Sequencing Batch Reactors: Effect of Operating Conditions

Thesis Advisors: Dr. Thammanoon Sreethawong, Assoc. Prof. Sumaeth Chavadej, and Assoc. Prof. Pramoch Rungsunvigit, 122 pp.

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Hydrogen is one of the alternative energy resources that is increasingly used instead of fossil fuel to reduce the emission of greenhouse gases. Biohydrogen production is interesting because it can be produced from renewable resources, including wastewaters, under ambient conditions. Hydrogen production from glucose-containing wastewater by dark fermentation process in an anaerobic sequencing batch reactor (ASBR) was evaluated. The anaerobic sludge taken from a brewery wastewater-treating anaerobic unit was pretreated by boiling for 15 min before being added into the ASBR units as the seeding sludge. The ASBR units were operated at different chemical oxygen demand (COD) loading rates from 10 to 50 kg m<sup>-3</sup> d<sup>-1</sup> under controlled pH at 5.5, 37°C, and 24 h HRT. The results showed that at the optimum COD loading rate of 40 kg m<sup>-3</sup> d<sup>-1</sup>, the produced gas was found to contain 43% H<sub>2</sub> and 57% CO<sub>2</sub>, and no methane in produced gas was detected at all operating conditions. The highest hydrogen yield was 1.46 mol-H<sub>2</sub>/mol-glucose consumed. Additionally, the main organic components in effluent liquid were butyric and acetic acids. The effect of COD:N ratio was also studied by varying the amount of NH<sub>4</sub>HCO<sub>3</sub> in the feed solution. The optimum N content was achieved at COD:N ratio of 100:2.4 under the system with pH control at 5.5, from which the produced gas mainly contained 44% H<sub>2</sub>, and the H<sub>2</sub> production rate was 1.24 L h<sup>-1</sup>.

## บทคัดย่อ

รราธิป นิยมภา : การผลิตไฮโดรเจนชีวภาพจากน้ำเสียที่มีกลูโคสเป็นองค์ประกอบในถังปฏิกรณ์แบบ Anaerobic Sequencing Batch Reactor: ผลกระทบของสภาวะที่ใช้ในการทดลอง (Biohydrogen Production from Glucose-Containing Wastewater in Anaerobic Sequencing Batch Reactors: Effect of Operating Conditions) อ. ที่ปรึกษา : ดร. ชรรมนุญ ศรีทะวงศ์, รศ. ดร. สุเมธ ชวเดช และ รศ. ดร. ปราโมช รังสรรค์วิจิตร 122 หน้า

ก๊าซไฮโดรเจนเป็นแหล่งเชื้อเพลิงทางเลือกชนิดหนึ่งซึ่งถูกนำมาใช้ทดแทนเชื้อเพลิงที่เกิดจากการทับถมของซากพืชซากสัตว์ เพื่อลดการปลดปล่อยของก๊าซเรือนกระจก ก๊าซไฮโดรเจนชีวภาพเป็นเชื้อเพลิงที่น่าสนใจมากเนื่องจากสามารถผลิตจากแหล่งเชื้อเพลิงที่สามารถนำกลับมาใช้ใหม่ได้ซึ่งรวมถึงน้ำเสีย ภายใต้สภาวะปกติ ถึงปฏิกรณ์แบบ Anaerobic Sequencing Batch Reactor (ASBR) ได้ถูกนำมาใช้ในการผลิตก๊าซไฮโดรเจนชีวภาพจากน้ำเสียที่มีกลูโคสเป็นองค์ประกอบโดยกระบวนการหมักแบบไม่ใช้แสง กากจากกระบวนการบำบัดน้ำเสียแบบไม่ใช้ออกซิเจนที่นำมาจากหน่วยบำบัดน้ำเสียของโรงงานผลิตเบียร์ถูกนำมาต้มให้เดือดเป็นเวลา 15 นาที ก่อนใส่ลงในถังปฏิกรณ์เพื่อใช้เป็นเชื้อจุลินทรีย์เริ่มต้น ถึงปฏิกรณ์แบบ ASBR ถูกทำการทดลองที่ค่าอัตราการป้อนสารอินทรีย์จาก 10 ไปจนถึง 50 กิโลกรัมต่อลูกบาศก์เมตรต่อวัน ภายใต้ความเป็นกรดต่างที่ 5.5 อุณหภูมิ 37 องศาเซลเซียส และค่า Hydraulic Retention Time (HRT) เท่ากับ 24 ชั่วโมง ผลการทดลองแสดงให้เห็นว่า ณ ค่าอัตราการป้อนสารอินทรีย์ที่เหมาะสมที่ 40 กิโลกรัมต่อลูกบาศก์เมตรต่อวัน ก๊าซที่ผลิตได้ประกอบด้วยก๊าซไฮโดรเจน 43% และก๊าซคาร์บอนไดออกไซด์ 57% โดยไม่พบก๊าซมีเทนในทุกสภาวะการทดลอง ผลได้ของก๊าซไฮโดรเจนสูงสุดเท่ากับ 1.46 โมลของไฮโดรเจนต่อโมลของกลูโคสที่ถูกใช้ไป ยิ่งไปกว่านั้น ส่วนประกอบหลักของกรดอินทรีย์ที่ผลิตได้คือ กรดบิวทิริก และ กรดแอสติค ปริมาณไนโตรเจนที่เหมาะสมคือที่อัตราส่วนระหว่างสารอินทรีย์ต่อไนโตรเจนเท่ากับ 100:2.4 ภายใต้สภาวะการควบคุมความเป็นกรดต่างที่ 5.5 ซึ่งก๊าซที่ผลิตได้มีส่วนประกอบของก๊าซไฮโดรเจน 44% และอัตราการผลิตของก๊าซไฮโดรเจนเท่ากับ 1.24 ลิตรต่อชั่วโมง

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