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ในเครื่องปฏิกรณ์แบบอากาศยก



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**PHOTOCATALYTIC DEGRADATION OF ORGANIC DYES BY TITANIUM
DIOXIDE IN AN AIR-LIFT REACTOR**

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**A Thesis Submitted in Partial Fulfillment of the Requirements
for the Degree of Master of Engineering Program in Chemical Engineering**

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Faculty of Engineering

Chulalongkorn University

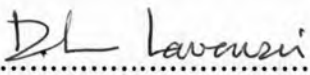
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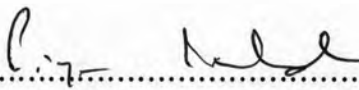
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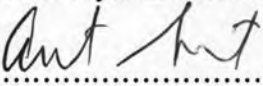
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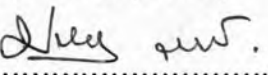
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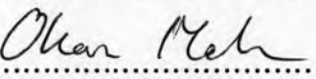
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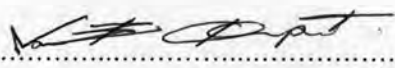

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งานวิจัยนี้ได้ศึกษาปฏิกิริยาการย่อยสลายโดยใช้แสงของสารละลายสีย้อมอินทรีย์โครซีน ออเรนจี และเมทิลีนบลูด้วยไทเทเนียมไดออกไซด์ในเครื่องปฏิกรณ์แบบใช้แสงที่แตกต่างกัน 3 ชนิด คือ เครื่องปฏิกรณ์แบบอากาศยก เครื่องปฏิกรณ์แบบถังสัมผัสอากาศธรรมดา และเครื่องปฏิกรณ์แบบถังกวน ตัวเร่งปฏิกิริยาไทเทเนียมไดออกไซด์เตรียมได้จากวิธีโซล-เจลโดยใช้ไทเทเนียมไอโซโพรพอกไซด์เป็นสารตั้งต้น จากการทดสอบสมบัติของตัวเร่งปฏิกิริยาพบว่า ตัวเร่งปฏิกิริยาไทเทเนียมไดออกไซด์ประกอบด้วยเฟสอนาเทสเป็นส่วนใหญ่และมีเฟสรูคโคที่อยู่เพียงเล็กน้อย ตัวเร่งปฏิกิริยาไทเทเนียมไดออกไซด์ที่เตรียมได้มีผลึกของเฟสอนาเทสขนาดประมาณ 5 นาโนเมตร และมีพื้นที่ผิว 170 ตารางเมตรต่อน้ำหนักตัวเร่งปฏิกิริยา (กรัม) การทดลองนี้ทำการศึกษาค่าความเข้มข้นผ่านศูนย์กลางของท่อภายในของเครื่องปฏิกรณ์แบบอากาศยก อัตราการป้อนอากาศ ค่าความเป็นกรด-เบสของสารละลายสีย้อม ความเข้มข้นเริ่มต้นของสารละลายสีย้อม และชนิดของเครื่องปฏิกรณ์แบบใช้แสง ผลการศึกษาพบว่าขนาดเส้นผ่านศูนย์กลางของท่อภายในของเครื่องปฏิกรณ์แบบอากาศยกไม่มีผลต่อประสิทธิภาพของระบบระบบมีประสิทธิภาพดีขึ้นเมื่อ อัตราการป้อนอากาศเพิ่มขึ้น ค่าความเป็นกรด-เบสของสารละลายสีย้อมแต่ละชนิดนั้นเหมาะสม และความเข้มข้นเริ่มต้นของสารละลายสีย้อมลดลง จากการศึกษาผลของเครื่องปฏิกรณ์แบบใช้แสงทั้ง 3 ชนิดพบว่า เครื่องปฏิกรณ์แบบอากาศยกมีประสิทธิภาพดีที่สุดซึ่งเป็นผลมาจาก ค่าความเข้มข้นของออกซิเจนที่มาก เครื่องปฏิกรณ์มีการผสมและการหมุนเวียนที่ดี นอกจากนี้แบบจำลองทางจลนศาสตร์ของแลงเมียร์อินเซลวูดสามารถอธิบายข้อมูลทางจลนศาสตร์ของปฏิกิริยาได้เป็นอย่างดี

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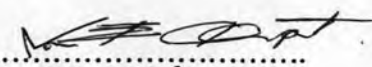
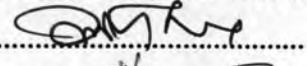
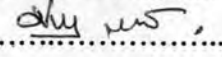
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NARAKORN CHANPRASERT: PHOTOCATALYTIC DEGRADATION OF ORGANIC DYES BY TITANIUM DIOXIDE IN AN AIR-LIFT REACTOR. THESIS ADVISOR: AKAWAT SIRISUK, Ph.D., THESIS CO-ADVISOR: ASSOC. PROF. PRASERT PAVASANT, Ph.D. 84 pp.

The photocatalytic degradation of crocein orange G and methylene blue in aqueous solution over TiO_2 in three different photoreactors, namely, airlift reactor, bubble column reactor, and stirred tank reactor were investigated. Titanium dioxide was synthesized via a sol-gel method and titanium isopropoxide is employed as a precursor. Characterization of the catalyst revealed that TiO_2 primarily consists of anatase phase with a very small amount of brookite phase. The crystallite size of anatase TiO_2 was approximately 5 nm and the specific surface area of TiO_2 was $170 \text{ m}^2 \text{ g}^{-1}$. The parameters studied included diameter of draft tube, aeration rate, pH of dye solution, initial concentration of dye, and types of photoreactors. Diameter of draft tube had no significant effect on the performance of the photoreactor system. The performance of the system was better when aeration rate was higher, pH of the solution is suitable to the type of dyes, and the initial concentration of dye was lower. Among the three photoreactors studied, an airlift reactor performed the best due to high dissolved oxygen concentration and good mixing and good circulation in the reactor. Furthermore, the Langmuir-Hinshelwood kinetic model was able to describe the reaction kinetics fairly well.

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