

**PHOTOCATALYTIC DEGRADATION OF 4-CHLOROPHENOL USING  
A MULTI-STAGE-REACTOR SYSTEM**

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## ABSTRACT

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Photocatalytic oxidation of 4-chlorophenol (4-CP) was investigated by using a multi-stage reactor system with titania immobilized on a stainless steel mesh under an irradiation of 11 W low pressure mercury lamp with the wave length of 200-300 nm. Catalytic activities of 4-chlorophenol degradation over Ag/TiO<sub>2</sub> (Degussa P25), Au/TiO<sub>2</sub> (Degussa P25) and temperature treated TiO<sub>2</sub> (Degussa P25) were studied in both the batch suspended and continuous immobilized systems. The presence of either temperature treated TiO<sub>2</sub>, Ag/TiO<sub>2</sub> or Au/TiO<sub>2</sub> affects insignificantly the 4-CP degradation compared to the photolysis. In contrast, TiO<sub>2</sub> significantly affects the intermediates, hydroquinone and hydroxyhydroquinone. The presence of Ag and Au does not improve the catalytic activity of TiO<sub>2</sub> in the 4-CP degradation but it affects the degradation of intermediate products. The commercial TiO<sub>2</sub> was immobilized on the cylindrical stainless steel mesh by dip-coating with the suspension of TiO<sub>2</sub> (Degussa P25) in methanol and used as the catalyst in the multi-stage reactor unit. The titania on the stainless steel mesh support was found to be well adhered and its activity was still high after the regeneration.

## บทคัดย่อ

สิทธิชัย ตั้งสัจจะธรรม : การสลายตัวของ 4-คลอโรฟีนอลด้วยโฟโตคะตะไลซิสในเครื่องปฏิกรณ์แบบหลายขั้นตอน (Photocatalysis Degradation of 4-chlorophenol using a Multi-stage-reactor System) อ. ที่ปรึกษา: รศ. ดร. สุเมธ ชวเดช ผศ. ดร. ปราโมช รั้งสรรค์ วิจิตร และ ศ. เอโดแกเน กุฏาริ 77 หน้า ISBN 974-9651-42-1

งานวิจัยนี้ศึกษาการเกิดปฏิกิริยาออกซิเดชันของ 4-คลอโรฟีนอล ด้วยวิธีโฟโตคะตะไลซิสโดยใช้ตัวเร่งปฏิกิริยาไททาเนีย (เดอกูสซา พี25) เคลือบบนตะแกรงเหล็กปลอดสนิมในเครื่องปฏิกรณ์แบบหลายขั้นตอนที่ใช้หลอดไฟฟ้าขนาด 11 วัตต์ที่มีความยาวคลื่น 200-280 นาโนเมตร และศึกษาความสามารถในการสลายตัวของ 4-คลอโรฟีนอลโดยใช้ไททาเนีย (เดอกูสซา พี25) ที่ผ่านการเผาที่อุณหภูมิต่างๆ, เงินบนไททาเนีย (เดอกูสซา พี25) และทองบนไททาเนีย (เดอกูสซา พี25) นอกจากนั้นยังได้ศึกษาการสลายตัวของสารมัธยันต์ในเครื่องทำปฏิกิริยาแบบกะโดยใช้ตัวเร่งปฏิกิริยาแขวนลอยในสารละลาย จากผลการทดลองพบว่า ตัวเร่งปฏิกิริยาที่ใช้ไม่ได้ช่วยเพิ่มประสิทธิภาพการสลายตัวของ 4-คลอโรฟีนอลในสารละลายเปรียบเทียบกับในกรณีที่ใช้เฉพาะแสงไฟ (โฟโตคะตะไลซิส) ในทางตรงกันข้ามไททาเนียมีผลต่อค่าการลดลงของสารมัธยันต์ที่เกิดขึ้นในระหว่างการสลายตัวของ 4-คลอโรฟีนอลซึ่งในที่นี้คือ สารไฮโดรควิโนน และไฮดรอกซีไฮโดรควิโนน

สำหรับตัวเร่งปฏิกิริยาไททาเนียที่เคลือบลงบนตะแกรงเหล็กปลอดสนิมเตรียมโดยวิธีจุ่มเคลือบในสารแขวนลอยของไททาเนีย (เดอกูสซา พี25) ในเมทานอล ได้ถูกนำมาทำการศึกษาในเครื่องปฏิกรณ์โฟโตคะตะไลซิสแบบหลายขั้นตอน จากการทดลอง พบว่าไททาเนียสามารถเคลือบติดบนตะแกรงเหล็กไร้สนิมได้ดี และประสิทธิภาพยังคงเท่าเดิมเมื่อนำมาใช้ซ้ำโดยมีการทำรีเจนเนอเรชั่นทุกครั้ง

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