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PHOTODEGRADATION OF DIURON ON TITANIA AND ZINC OXIDE

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

Department of Chemical Engineering

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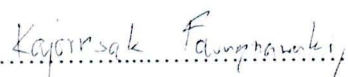
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การย่อยสลายไดยูรอนด้วยแสงได้ถูกศึกษาโดยใช้ซิงค์ออกไซด์และไทเทเนียมไดออกไซด์เป็นตัวเร่งปฏิกิริยา โดยตัวเร่งปฏิกิริยาได้ถูกสังเคราะห์ด้วยวิธีการ โซล-เจล และเติมแอมโมเนียลงไป ปริมาณ 0% 7% และ 28% โดยมวล ตัวเร่งปฏิกิริยาที่ได้ถูกวิเคราะห์สมบัติด้วยหลายเทคนิค จากนั้น ทำการศึกษาการย่อยสลายไดยูรอนที่ความเข้มข้น 10 ppm ในเครื่องปฏิกรณ์แบบกะและเก็บตัวอย่างสารละลายไปวัดความเข้มข้นของไดยูรอนที่เปลี่ยนไปด้วยเครื่องโครมาโทกราฟีชนิดของเหลวเป็นระยะๆ การลดลงของปริมาณสารอินทรีย์รวมที่ละลายอยู่ในน้ำนั้นเป็นผลของการย่อยสลายไดยูรอนซึ่งพบว่า ความว่องไวของตัวเร่งปฏิกิริยาเพิ่มขึ้นเมื่อปริมาณแอมโมเนียเพิ่มขึ้น ซิงค์ออกไซด์มีประสิทธิภาพในการย่อยสลายและกำจัดไดยูรอนได้ดีกว่าไทเทเนียมไดออกไซด์ แม้ว่าซิงค์ออกไซด์จะมีพื้นที่ผิวน้อยกว่าก็ตาม ซิงค์ออกไซด์สามารถย่อยสลายไดยูรอนได้ 98% ภายใน 6 ชั่วโมงในขณะที่ไทเทเนียมไดออกไซด์ทำการย่อยสลายไดยูรอนได้เพียง 45% นอกจากนี้การย่อยสลายไดยูรอนยังทำให้เกิดสารตัวกลางของการเกิดปฏิกิริยาซึ่งสามารถระบุถึงสารตัวกลางที่เกิดขึ้นได้โดยใช้เครื่องโครมาโทกราฟีชนิดของเหลวกับแมสสเปกโตรมิเตอร์ การย่อยสลายไดยูรอนจะเกิดสารตัวกลางต่างชนิดกัน โดยขึ้นอยู่กับค่าความเป็นกรดเบสของสารละลาย ความยาวคลื่นของแสงเหนือม่วงที่ใช้และชนิดของตัวเร่งปฏิกิริยา สารตัวกลางที่เกิดจากปฏิกิริยานั้นเกิดจากการเข้าทำปฏิกิริยาของอนุมูลไฮดรอกซีที่ตำแหน่งต่างๆ ของไดยูรอน

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Photocatalytic degradation of diuron was investigated in the presence of zinc oxide and titanium dioxide as photocatalysts. The photocatalysts were synthesized via sol-gel method with an addition of ammonia at the content of 0%, 7%, and 28% by mass. The powder obtained was characterized by various techniques. The photocatalytic degradation of 10 ppm diuron aqueous solution was conducted in a batch photo-reactor. The solution was periodically sampled to monitor the concentration of diuron via HPLC. The decrease of total organic carbon as a result of mineralization of diuron was also observed during the degradation process. It was found that the activity of photocatalysts increases when the ammonia content is increased. Zinc oxide shows higher performance in degradation and mineralization of diuron than titanium dioxide, regardless of much lower surface area. The degradation of diuron on zinc oxide is about 98% within 6 hours, while that achieved on titanium dioxide is only 45%. The degradation generates several intermediates. The intermediates species were identified by LC-MS. Degradation of diuron produces different degradation products depending on pH of the solution, wavelength of UV-radiation, and type of photocatalyst. Several degradation intermediates are generated by reactions of hydroxyl radical attacking to several sites of diuron structure during the photocatalytic degradation process.

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