

ผลของไดเอทิลีนไกลคอล และ โพลีเอทิลีนไกลคอล น้ำหนักโมเลกุล 600  
ในการสังเคราะห์ผงนาโนไททาเนียมไดออกไซด์ และการประยุกต์ใช้ในการกำจัดโครเมียม



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EFFECT OF DIETHYLENE GLYCOL AND POLYETHYLENE GLYCOL (M.W. 600)  
ON SYNTHESIS OF TiO<sub>2</sub> NANOPOWDER  
AND ITS APPLICATION FOR CHROMIUM (VI) REMOVAL



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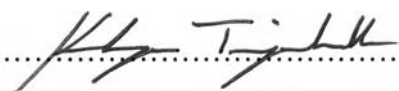
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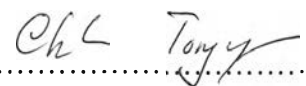
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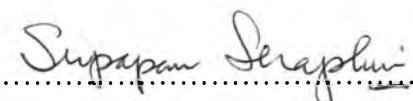
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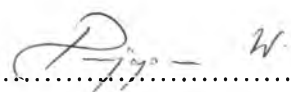
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จิรภัทร์ อนันต์ภัทรชัย : ผลของไดเอทิลีนไกลคอล และ โพลีเอทิลีนไกลคอล น้ำหนักโมเลกุล 600 ในการสังเคราะห์ผงนาโนไททาเนียมไดออกไซด์ และการประยุกต์ใช้ในการกำจัดโครเมียม.

(EFFECT OF DIETHYLENE GLYCOL AND POLYETHYLENE GLYCOL (M.W. 600) ON SYNTHESIS OF  $\text{TiO}_2$  NANOPOWDER AND ITS APPLICATION FOR CHROMIUM (VI) REMOVAL) อ. ที่ปรึกษา : ผศ.ดร.พวงรัตน์ จิตวิชยานุกูล, อ.ที่ปรึกษาร่วม: Prof.SUPAPAN SERAPHIN จำนวน 113 หน้า ISBN 974-53-2877-4

ในงานวิจัยนี้ทำการเตรียมนาโนไททาเนียมไดออกไซด์ด้วยวิธีโซลเจล โดยทำการเติมสารอินทรีย์สองชนิด คือ ไดเอทิลีนไกลคอล และ โพลีเอทิลีนไกลคอลที่มีน้ำหนักโมเลกุล 600 ลงในสารละลายเริ่มต้นเพื่อศึกษาคุณลักษณะของไททาเนียมไดออกไซด์ และประสิทธิภาพในการกำจัดโครเมียมที่มีประจุบวก 6 ออกจากน้ำเสีย ผลการศึกษาพบว่า การเติมสารอินทรีย์ทั้งสองชนิดลงไปนั้นทำให้การเปลี่ยนแปลงโครงสร้างผลึกของอนาเทสไปเป็นรูไทล์ช้าลง และสารอินทรีย์ที่มีโครงสร้างเป็นเส้นสายที่ยาวกว่ามีประสิทธิภาพในการทำให้ผลึกนาโนไททาเนียมไดออกไซด์จับเป็นกลุ่มเป็นก้อนได้ดีกว่า ดังนั้น โพลีเอทิลีนไกลคอลที่มีน้ำหนักโมเลกุล 600 จึงทำให้ผลึกของอนาเทสมีปริมาณมาก และเปลี่ยนแปลงไปเป็นผลึกของรูไทล์ที่อุณหภูมิต่ำ ( $500^\circ\text{C}$ ) เมื่อเปรียบเทียบกับ ไดเอทิลีนไกลคอล ( $600^\circ\text{C}$ ) โดยสารอินทรีย์ทั้งสองชนิดนั้นต่างก็ช่วยในการลดขนาดของนาโนคริสตัล และช่วยเพิ่มพื้นที่ผิวของไททาเนียมไดออกไซด์ได้ โดยที่ขนาดของผลึกไททาเนียมไดออกไซด์มีแนวโน้มที่จะลดลงเมื่อทำการเพิ่มน้ำหนักโมเลกุลของโพลีเอทิลีนไกลคอล เช่น โพลีเอทิลีนไกลคอลที่มีน้ำหนักโมเลกุล 600 ส่งผลให้ผลึกของไททาเนียมไดออกไซด์มีขนาดเป็น 18.84 นาโนเมตร เมื่อเปรียบเทียบกับไดเอทิลีนไกลคอล ซึ่งผลึกของไททาเนียมไดออกไซด์มีขนาดเป็น 19.54 นาโนเมตร คุณสมบัติในการดูดซับของไททาเนียมไดออกไซด์ที่มีการเติมสารอินทรีย์สองชนิด คือ ไดเอทิลีนไกลคอล และ โพลีเอทิลีนไกลคอลที่มีน้ำหนักโมเลกุล 600 ลงไปนั้น สามารถอธิบายได้ด้วยสมการการดูดซับของแลงเมียร์ สำหรับกระบวนการโฟโตคะตะไลซิส หากความเข้มข้นเริ่มต้นของเฮกซะวาเลนซ์โครเมียมต่ำกว่า 50 มิลลิกรัมต่อลิตร ปฏิริยาจะเป็นไปตามปฏิริยาลำดับศูนย์ เมื่อความเข้มข้นเริ่มต้นของเฮกซะวาเลนซ์โครเมียมสูงขึ้นปฏิริยาจะเปลี่ยนแปลงไปเป็นปฏิริยาลำดับหนึ่ง ซึ่งค่าความสามารถในการทำปฏิริยาของไททาเนียมไดออกไซด์ที่เติมไดเอทิลีนไกลคอล และ โพลีเอทิลีนไกลคอลที่มีน้ำหนักโมเลกุล 600 ลงไปนั้น มีค่าคงที่ในการดูดซับ ( $K_c$ ) เป็น 0.287 และ 0.480 ลิตรต่อมิลลิกรัม ตามลำดับ และมีค่าคงที่ของปฏิริยาลำดับสอง ( $k_2$ ) เป็น 0.168 และ 0.220 มิลลิกรัมต่อลิตรต่อนาที่ตามลำดับ

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JIRAPAT ANANPATTARACHAI: EFFECT OF DIETHYLENE GLYCOL AND POLYETHYLENE GLYCOL 600 ON SYSTHENSIS OF TiO<sub>2</sub> NANOPOWDER AND ITS APPLICATION FOR CHROMIUM (VI) REMOVAL. THESIS

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TiO<sub>2</sub> nanoparticles with different types of additive are prepared from alkoxide solutions via sol-gel method. The effects of diethylene glycol (DEG) and polyethylene glycol with molecular weight 600 (PEG 600) addition to the precursor solution on the TiO<sub>2</sub> properties and photocatalytic activity in chromium (VI) removal were studied. Results show that DEG and PEG 600 delayed the phase transformation from anatase to rutile phase. It was found that the long chain of PEG 600 can agglomerate the nanocrystal TiO<sub>2</sub> better than the short chain of DEG. Consequently, PEG 600 can accumulate the anatase and transform from the anatase to rutile phase in the lower temperature (500°C) comparing to DEG (600°C). Both DEG and PEG 600 also exerted the pronounced effect on reducing of nanocrystal size and increasing surface area of TiO<sub>2</sub>. The crystallite size of TiO<sub>2</sub> tends to increase with increasing of molecular weight of PEG as the PEG 600 can enhance the smaller size of TiO<sub>2</sub> as 18.84 nm comparing to 19.54 nm obtained from DEG. Adsorption characteristics for both of TiO<sub>2</sub> from DEG and PEG 600 are well described by Langmuir adsorption isotherm. For photocatalytic process, with initial concentration of chromium (VI) less than 50 mg/L, the kinetic pattern for both types of TiO<sub>2</sub> was followed zero order pattern. As the initial concentration of chromium (VI) was leveled up, the kinetic pattern was changed to be pseudo first order pattern. The intrinsic kinetic values of TiO<sub>2</sub> with DEG and PEG 600 were calculated with the value of the adsorption equilibrium constant ( $K_C$ ) was found to be 0.287 and 0.480 l/mg, respectively and the second-order rate constant ( $k_c$ ) were obtained as 0.168 and 0.220 mg/l min, respectively.

Field of study Environmental Management (Inter-Department) Student's signature Jirapat  
 Academic year 2005 Advisor's signature K. Puangrat  
 Co-advisor's signature S. Seraphin

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