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PREPARATION, CHARACTERIZATION AND APPLICATION OF TITANIUM  
DIOXIDE/ACTIVATED CARBON COMPOSITE IN  
2-CHLOROPHENOL REMOVAL

Miss Nalinee Wanmakok

A Thesis Submitted in Partial Fulfillment of the Requirements  
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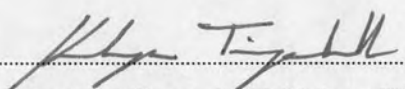
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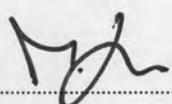
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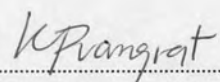
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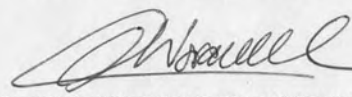
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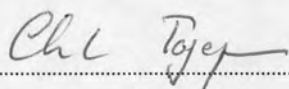
  
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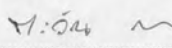
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ผสมไททาเนียมไดออกไซด์และผงถ่านกัมมันต์ในการกำจัด 2-คลอโรฟีนอล.

(PREPARATION, CHARACTERIZATION AND APPLICATION OF TITANIUM DIOXIDE/ACTIVATED CARBON COMPOSITE IN 2-CHLOROPHENOL REMOVAL)

อ. ที่ปรึกษา: ผศ.ดร.พวงรัตน์ ขจิตวิทยานุกูล., 87 หน้า

การศึกษาผลของอัตราส่วนโมลที่แตกต่างกัน ของวัสดุผสมไททาเนียมไดออกไซด์และผงถ่านกัมมันต์ ในอัตราส่วน 1:0 1:10 1:33 1:50 1:70 และ 1:100 เตรียมโดยให้ความร้อน 500°C ซึ่งเตรียมวัสดุผสมโดยวิธีโซลเจล เพื่อศึกษาถึงคุณลักษณะของวัสดุผสม และประสิทธิภาพในการกำจัด 2-คลอโรฟีนอล ออกจากน้ำเสีย ผลการศึกษาอัตราส่วนผลึกอนาเทส ต่อผลึกรูไทล์ พบว่าในอัตราส่วนโมลที่ 1:0 และ 1:10 มีผลึกอนาเทสทั้งหมด และ 1:33 เริ่มปรากฏผลึกรูไทล์ ในงานวิจัยนี้ได้ศึกษาถึงผงไททาเนียมไดออกไซด์ชนิดอื่นด้วย คือไททาเนียมไดออกไซด์ที่ให้ความร้อนโดยผ่านก๊าซออกซิเจนและ ไททาเนียมไดออกไซด์ P-25 เพื่อใช้ในการเปรียบเทียบในเรื่องของการดูดซับและการฉายแสง พบว่าไททาเนียมไดออกไซด์และผงถ่านกัมมันต์ที่ผ่านก๊าซไนโตรเจน มีการดูดซับเป็นการดูดซับแบบหลายชั้น ตามการดูดซับแบบฟรุนดิช ไททาเนียมไดออกไซด์ที่ให้ความร้อนโดยผ่านก๊าซออกซิเจน และไททาเนียมไดออกไซด์ P-25 มีการดูดซับแบบชั้นเดียวตามการดูดซับแบบแลงเมียร์ จากการศึกษาพบว่าความสามารถในการดูดซับและการฉายแสงของวัสดุผสมจากมากไปน้อยตามลำดับนี้ ไททาเนียมไดออกไซด์และผงถ่านกัมมันต์ที่ผ่านก๊าซไนโตรเจนมีความสามารถมากกว่า ไททาเนียมไดออกไซด์ที่ผ่านก๊าซไนโตรเจนซึ่งมีความสามารถมากกว่าไททาเนียมไดออกไซด์ที่ผ่านก๊าซออกซิเจน และไททาเนียมไดออกไซด์ P-25 มีความสามารถน้อยที่สุด ในการศึกษาถึงผลของการให้ความร้อนที่แตกต่างกันในการสังเคราะห์ไททาเนียมไดออกไซด์และผงถ่านกัมมันต์ ที่ 500°C 800°C 1100°C และ 1300°C จากผลการทดลองพบว่า 500°C เป็นอุณหภูมิที่ให้ประสิทธิภาพของวัสดุผสมได้ดีที่สุด เมื่อศึกษาถึงคุณสมบัติในการดูดซับ สามารถอธิบายได้ด้วยสมการการดูดซับของฟรุนดิช ในการศึกษาการย่อยสลาย 2-คลอโรฟีนอล จากการวัดค่าสารอินทรีย์ที่เหลืออยู่ทั้งหมด และวัดสารตัวกลางด้วย GC/MS พบว่าไม่เกิดสารตัวกลาง ซึ่งแสดงถึงการย่อยสลาย 2-คลอโรฟีนอลอย่างสมบูรณ์เกิดขึ้น

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$\text{TiO}_2$ /AC composite nanoparticles in this work were prepared from alkoxide solution via sol-gel method.  $\text{TiO}_2$ /AC composite with different molar ratios (1:0, 1:10, 1:33, 1:50, 1:70, and 1:100) were determined. It was found that the ratios of  $\text{TiO}_2$ : AC at 1:0 and 1:10 have anatase as predominant phase, while rutile phase appeared at ratio 1:33. Other types of  $\text{TiO}_2$ ,  $\text{TiO}_2/\text{O}_2$  and  $\text{TiO}_2/\text{P-25}$  were also investigated in this work as well. In the adsorption isotherm part, it was found that  $\text{TiO}_2/\text{O}_2$  was followed Langmuir adsorption isotherm, while  $\text{TiO}_2/\text{AC}/\text{N}_2$  and  $\text{TiO}_2/\text{N}_2$  were followed Freundlich adsorption isotherm. In photocatalytic process, the 2-chlorophenol removal efficiency can be ordered as  $\text{TiO}_2/\text{AC}/\text{N}_2 > \text{TiO}_2/\text{N}_2 > \text{TiO}_2/\text{O}_2 > \text{TiO}_2/\text{P-25}$ . In the determination of effects of different calcination temperature (500°C, 800°C, 1100°C, and 1300°C) on the properties of  $\text{TiO}_2/\text{AC}$ . It was found that the calcinations temperature at 500°C provided the most appropriate properties of  $\text{TiO}_2/\text{AC}$  for 2-chlorophenol removal. In a study of 2-chlorophenol degradation using TOC and GC/MS, no intermediates were detected. As the TOC appeared during the degradation process solely come from 2-chlorophenol, it can be concluded that the mineralization of 2-chlorophenol is achievable under  $\text{TiO}_2/\text{AC}$  process.

Field of study Environmental Management..... Student's signature *Nalinee W.*  
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## LIST OF ABBREVIATIONS

$\text{TiO}_2/\text{AC}$	Composite material of titanium dioxide and activated carbon
$\text{TiO}_2/\text{AC}/\text{N}_2$	Composite material of titanium dioxide and activated carbon synthesized under nitrogen atmosphere
$\text{TiO}_2/\text{N}_2$	Titanium dioxide synthesized under nitrogen atmosphere
$\text{TiO}_2/\text{O}_2$	Titanium dioxide synthesized under oxygen atmosphere
$\text{TiO}_2/\text{P-25}$	Commercial titanium dioxide with P-25 brand
2-CP	2-chlorophenol
$K_{2\text{-CP}}$	The equilibrium adsorption constants of 2-CP onto $\text{TiO}_2/\text{AC}$ composite
$k_{\text{obs}}$	The observed pseudo first-order rate constant for the photocatalytic reduction of 2-CP
$k_c$	The second-order rate constant of irradiation process