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TEXTILE DYEING WASTEWATER TREATMENT  
BY FLUIDIZED-BED FENTON PROCESS

Ms. Massakul Kitmongkonsak

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

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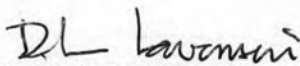
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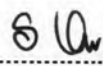
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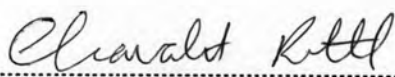
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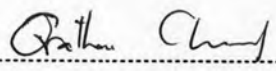
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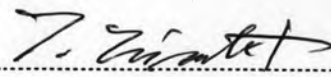
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มาศสกุล กิจมงคลศักดิ์ : การบำบัดน้ำเสียจากโรงงานฟอกย้อมด้วยกระบวนการฟลูอิดไดซ์เบดเฟนตัน (TEXTILE DYEING WASTEWATER TREATMENT BY FLUIDIZED-BED FENTON PROCESS) อ. ที่ปรึกษา: ผศ. ดร. ชวลิต รัตนธรรมสกุล, อ. ที่ปรึกษาร่วม : PROF. MING-CHUN LU, PH.D. , 131 หน้า, ISBN 974-14-2036-6

อุตสาหกรรมสิ่งทอนับว่าเป็นอุตสาหกรรมที่สำคัญมาก แต่อย่างไรก็ตามการผลิตสินค้าประเภทสิ่งทอนี้ก่อให้เกิดน้ำเสียที่มีมลสารต่างๆเช่น สารอินทรีย์, ของแข็ง, น้ำมันและไขมันและสี สีมี่ทั้งหมด 8 ชนิดคือไดเรกต์, กำมะถัน, อะโซอิก, รีแอคทีฟ, แร็ด, แอลดี, เบสิด และดิสเพอร์ส ซึ่งวิธีในการบำบัดสีขึ้นอยู่กับน้ำเสียนั้นประกอบด้วยสีชนิดละลายน้ำหรือไม่ละลายน้ำ เช่น กระบวนการโคแอกกูเลชันเหมาะกับการบำบัดน้ำเสียสีชนิดไม่ละลายน้ำเช่นสิดิสเพอร์ส แต่ไม่เหมาะกับสีชนิดละลายน้ำอย่างรีแอคทีฟที่นิยมใช้อย่างมากในอุตสาหกรรม ดังนั้นการใช้กระบวนการฟลูอิดไดซ์เบดเฟนตันจึงเป็นอีกวิธีหนึ่งที่น่าสนใจ

สารเคมีที่ผสมกันระหว่างไฮโดรเจนเปอร์ออกไซด์กับเหล็ก เรียกว่า "สารเคมีเฟนตัน" ซึ่งทำปฏิกิริยากันได้อนุมูลไฮดรอกซิล ( $\text{OH}\cdot$ ) อนุมูลไฮดรอกซิลมีความสามารถในการออกซิไดซ์สูง และสามารถออกซิไดซ์สารอินทรีย์ได้อย่างรวดเร็วและเกิดสารละลายสภาพกรดเนื่องจากการสลายของไฮโดรเจนเปอร์ออกไซด์ การวิจัยนี้จึงมุ่งทำการศึกษากการลดสีและสารอินทรีย์ของรีแอคทีฟสังเคราะห์ ด้วยกระบวนการฟลูอิดไดซ์เบดเฟนตัน ในประเทศไต้หวันน้ำเสียที่มีสีและสารอินทรีย์เป็นอีกปัญหาที่ต้องการแก้ไข สารเฟนตันสามารถกำจัดสีและซีไอดีของสีย้อมผ้ารีแอคทีฟสังเคราะห์ได้โดยแปรผันค่าความเข้มข้นของเฟอร์รัสและไฮโดรเจนเปอร์ออกไซด์ โดยค่าที่เข้ตั้งต้นเท่ากับ 3 จากผลการวิจัยเมื่อความเข้มข้นของเฟอร์รัสและไฮโดรเจนเปอร์ออกไซด์เพิ่มขึ้นประสิทธิภาพในการกำจัดสีและซีไอดีเพิ่มขึ้น แต่เมื่อค่าความเข้มข้นของไฮโดรเจนเปอร์ออกไซด์สูงกว่าจุดวิกฤต ประสิทธิภาพในการกำจัดสีย้อมผ้ารีแอคทีฟลดลง เนื่องจากการทำปฏิกิริยาของไฮโดรเจนเปอร์ออกไซด์เอง นอกจากนี้ยังพบว่าอัตราการกำจัดสีเกิดขึ้นได้เร็วกว่าการกำจัดซีไอดี เมื่อทำการศึกษาค่าจลนพลศาสตร์ทั้งอัตราการกำจัดสีและซีไอดี ค่าคงที่ของสมการปฏิกิริยาเป็นแบบอันดับที่สอง

จากนั้นได้ทำการประยุกต์การกำจัดสีและซีไอดีมาใช้น้ำเสียจากโรงงานย้อมผ้าในประเทศไต้หวัน (Nan-Woei Industrial Co., Ltd) โดยจุดมุ่งหมายของงานวิจัยส่วนนี้ต้องการค่าสีและซีไอดีผ่านมาตรฐานน้ำทิ้งโรงงานอุตสาหกรรมย้อมผ้าของประเทศไต้หวัน (1998) คือ ค่าซีไอดีต่ำกว่า 100 มิลลิกรัมต่อลิตร และค่าสีต่ำกว่า 400 หน่วยเอดีเอ็มไอ เมื่อทำการแปรผันค่าความเข้มข้นของเฟอร์รัส, ค่าที่เข้ตั้งต้น และความเข้มข้นของไฮโดรเจนเปอร์ออกไซด์ สภาวะที่น้ำเสียจากโรงงาน Nan-Woei Industrial Co., Ltd หลังจากผ่านกระบวนการฟลูอิดไดซ์เบดเฟนตัน โดยผ่านมาตรฐานน้ำทิ้งโรงงานอุตสาหกรรมย้อมผ้าของประเทศไต้หวัน (1998) คือ อัตราส่วนของ ซีไอดีต่อความเข้มข้นเฟอร์รัสต่อความเข้มข้นไฮโดรเจนเปอร์ออกไซด์ เท่ากับ 1:0.95:7.94, ปริมาณซิลิกาออกไซด์ 74.07 กรัมต่อลิตรและค่าที่เข้ตั้งต้นเท่ากับ 3

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## 4770413821: MAJOR ENVIRONMENTAL ENGINEERING

KEY WORD: Fenton's reagent/ fluidized-bed/ reactive dyes/ color removal/ COD removal

MASSAKUL KITMONGKONSAK: TEXTILE DYEING WASTEWATER TREATMENT BY FLUIDIZED-BED FENTON PROCESS. THESIS ADVISOR: ASST. PROF. CHAVALIT RATANATAMSAKUL, PH.D. , THESIS CO-ADVISOR: PROF. MING-CHUN LU, PH.D., 131 pp. ISBN 974-14-2036-6.

The textile industry involves in the manufacture of fabrics from both natural and man-made fibers. It generates a large amount of wastewater containing various pollutants such as organic matter, solid, oil and grease and dyes. Dyes can be divided into eight types: direct, sulfur, azoic, reactive, vat, acid, basic and disperse dyes. There are several methods for decolorize dye wastewater but they cannot be effectively used individually to deal with the wastewater, containing soluble and insoluble dyes. For example, the coagulation process can effectively decolorize the wastewater containing insoluble dyes such as disperse dyes. However, it does not work well for soluble dyes such as reactive dyes widely used in textile industry. Therefore, the fluidized-bed Fenton process was of interested in this investigation.

The combination of hydrogen peroxide and a ferrous ion has been referred to as "Fenton's reagent". Fenton reactions exploit the reactivity of the hydroxyl radical (OH·), which has a very high oxidation potential and is able to oxidize almost all organic pollutants quickly with non-selectivity, produced in acidic solution by the catalytic decomposition of H<sub>2</sub>O<sub>2</sub>. This study investigated degradation of reactive dyes by fluidized-bed Fenton process for the removal of color and chemical oxygen demand (COD) from synthetic textile wastewater. In some local cases in Taiwan, wastewater color and COD were found to be the only problem in meeting local effluent standards. This investigation reveals that fluidized Fenton methods can remove the color and COD of these dyes. The effects of Fe<sup>2+</sup> and H<sub>2</sub>O<sub>2</sub> on dye decolorization and COD removal have been demonstrated in this study. The pH of all experiments was fixed at 3.0. Increasing the dose of ferrous enhanced the dye decolorization and COD removal. The optimal levels of H<sub>2</sub>O<sub>2</sub> required for the process were also examined. High levels of H<sub>2</sub>O<sub>2</sub> appeared to reduce color and COD removal. However, when the H<sub>2</sub>O<sub>2</sub> concentration was higher than a specific level, the degradation rate of reactive dyes slightly slows down. This can be explained by the so-called scavenging effect. In addition, it is also found that decolorization of reactive dyes underwent a faster reaction rate than COD removal. The second order degradation rate constant values (k) of color and COD were also determined.

Then, the COD and color removal by fluidized-bed Fenton process was applied to remove the COD and color of wastewater from textile factory in Taiwan (Nan-Woei Industrial Co., Ltd). Target remaining COD and color for treating the wastewater from textile factory in this study was less than the discharge standard of Taiwan. Due to the discharge standards of 1998, textile industries are required by Environmental Protection Administration of Taiwan to comply with the COD and color less than 100 mg/l and 400 in American Dye Manufacturer Institute (ADMI) unit, respectively. The Fe<sup>2+</sup> dosage, initial pH and H<sub>2</sub>O<sub>2</sub> dosage were varied in this part. From the results, the condition for treating the wastewater of Nan-Woei Industrial Co., Ltd was [COD]:[Fe<sup>2+</sup>]:[H<sub>2</sub>O<sub>2</sub>] = 1:0.95:7.94, carrier = 74.07 g/l, initial pH = 3.

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