

การกำจัดสิ่งก่ะตีโดยใช้การตกตะกอนซ้ลไฟต์ในถังไร้อากาศแบบกวนสมบูรณ้

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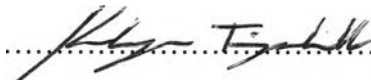
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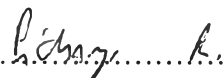
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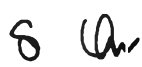
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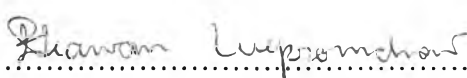
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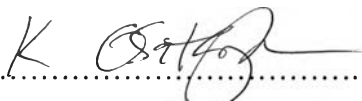
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ธนา เตชะภักดีวงศ์ : การกำจัดสังกะสีโดยใช้การตกตะกอนซัลไฟด์ในถังไร้อากาศแบบ  
กวนสมบูรณ์ (REMOVAL OF ZINC BY SULFIDE PRECIPITATION IN  
COMPLETELY-MIXED ANAEROBIC REACTOR) อ. ที่ปรึกษา: ดร. พิชญ  
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วิธีการตกตะกอนเป็นวิธีที่นิยมใช้ในการบำบัดน้ำเสียที่มีโลหะหนักเกือบปน  
การตกตะกอนโดยใช้ซัลไฟด์ซึ่งมีประสิทธิภาพค่อนข้างสูงและใช้ระยะเวลาในการทำปฏิกิริยาสั้น  
อีกทั้งโลหะซัลไฟด์ยังสามารถนำกลับมาสกัดเพื่อนำโลหะกลับมาใช้ใหม่ได้ การสร้างซัลไฟด์โดย  
ใช้ซัลเฟตรีดิวซิงแบคทีเรียเป็นวิธีหนึ่งที่สามารถพัฒนามาใช้ในระบบบำบัดจริง ขั้นตอนทาง  
ธรรมชาติของการบำบัดได้แบ่งกระบวนการตกตะกอนโลหะหนักโดยใช้ซัลเฟตรีดิวซิงแบคทีเรีย  
ออกเป็น 2 ขั้นตอน โดยในขั้นตอนแรกซัลไฟด์สามารถเกิดขึ้นได้ในระบบบำบัดน้ำเสียแบบไร้อากาศ  
โดยซัลเฟตรีดิวซิงแบคทีเรียจะใช้ซัลเฟตเป็นตัวรับอิเล็กตรอนจากสารอินทรีย์ในน้ำเสีย  
แล้วเปลี่ยนรูปซัลเฟตเป็นซัลไฟด์ ขั้นที่สองคือการตกตะกอนของโลหะซัลไฟด์ จุดประสงค์ของ  
งานวิจัยนี้คือเพื่อการศึกษา สภาพแวดล้อมและปัจจัยที่เหมาะสมของการตกตะกอนโลหะหนักโดย  
ใช้ซัลไฟด์ในถังไร้อากาศแบบกวนสมบูรณ์ และปริมาณสังกะสีที่ถึงบำบัดไร้อากาศนี้จะสามารถ  
บำบัดได้สูงสุด ในการทดลองได้แบ่งออกเป็น 2 ขั้นตอน ขั้นตอนแรกทำการเริ่มต้นเดินระบบถังไร้อากาศ  
เป็นเวลา 8 วัน ขั้นที่สอง ทำการเติมสังกะสีซัลเฟต 9 ครั้ง ที่ความเข้มข้นของสังกะสี 10 มก./  
ล.สำหรับครั้งที่ 1 20 มก./ลิตรสำหรับครั้งที่ 2 ถึง ครั้งที่ 5 50 มก./ล.สำหรับครั้งที่ 6 และครั้งที่ 7 100  
มก./ล.สำหรับครั้งที่ 8 และครั้งที่ 9 ผลการศึกษาพบว่า สภาพที่เหมาะสมกับถังไร้อากาศ คือ ที่ pH  
ระหว่าง 7.0-7.2 ORP ต่ำกว่า -100 mV และอุณหภูมิระหว่าง 28-32 องศาเซลเซียส สังกะสีที่ถูกเติม  
ลงในถังไร้อากาศ จะตกตะกอนอย่างรวดเร็วภายใน 10 นาที ที่ปริมาณความเข้มข้นสังกะสี 100 มก./  
ลิตร มีผลทำให้การเปลี่ยนรูปซัลเฟตเป็นซัลไฟด์เกิดขึ้นช้าและน้อยลง และที่ความเข้มข้นสะสม  
ของสังกะสีในถังถึง 290 มก./ลิตร จะทำให้ ORP มีค่ามากกว่า ศูนย์ pH ลดลงจนต่ำกว่า 7.0 และไม่เกิด  
การเปลี่ยนรูปซัลเฟตเป็นซัลไฟด์ ทำให้ซัลไฟด์ในระบบเป็น ศูนย์ และไม่เกิดการตกตะกอนของ  
สังกะสีซึ่งแสดงถึงการล้มเหลวของระบบ

สาขาวิชา..การจัดการสิ่งแวดล้อม.(สหสาขาวิชา) ลายมือชื่อนิสิต.....ธนา.....  
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# # 4689433520: MAJOR ENVIRONMENTAL MANAGEMENT  
 KEY WORD: ZINC/PRECIPITATION/SULFATE/SULFIDE/SULFATE REDUCING  
 BACTERIA(SRB)

THANA TECHAPAKDIVONGSE: REMOVAL OF ZINC BY SULFIDE  
 PRECIPITATION IN COMPLETELY MIXED ANAEROBIC REACTOR.

THESIS ADVISOR: PICHAYA RACHDAWONG, Ph.D., 146 pp. ISB 974-53-  
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Precipitation is a widely used method for treating heavy metals in wastewater. Sulfide precipitation is popularly employed due to its low hydraulic retention time and ability for metal recovery. Sulfide precipitation process can be employed using various sulfide sources. Generation of sulfide by sulfate reducing bacteria (SRB) is one method that can be applied for wastewater treatment plant. The treatment process is separated into two steps. In the first step,  $S^{2-}$  was formed in the anaerobic water treatment system. The SRB used  $SO_4^{2-}$  as an electron acceptor and the sulfate was transformed to  $S^{2-}$ . In the second step, sulfide was precipitated with metals in metal sulfide form. The purpose of this research was to study the optimum condition for zinc precipitation by  $S^{2-}$  in completely-mixed anaerobic reactor and the amount of zinc in the anaerobic reactor that can be efficiently removed. This experiment was separated into two steps. The first was starting up the reactor for eight days. The second was injecting zinc sulfate for 9 times (in 27 days). The concentration of zinc for the injection was as follows: 10 ppm for the 1<sup>st</sup>, 20 ppm for the 2<sup>nd</sup> to 5<sup>th</sup>, 50 ppm for the 6<sup>th</sup>, and the 7<sup>th</sup>, and 100 ppm for the 8<sup>th</sup>, and the 9<sup>th</sup> injection. From the experiment, the optimum for SRB in the anaerobic reactor was the pH between 7.0-7.2, ORP less than -100mV, and temperature between 28-32 °C. The injected zinc precipitated rapidly in the first 10 minutes at the concentration of 100 ppm of zinc. The concentration of 290 ppm of zinc accumulated in the reactor and made ORP to increase to higher than zero. The pH decreased to lower than 7.0 and strongly inhibited sulfate reducing process. The residual sulfide in the reactor decreased to zero and zinc precipitation did not occur and indicated the failure of the system.

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## LIST OF ABBREVIATIONS

AA	=	Atomic Absorption Spectrophotometer
Alk	=	Alkalinity
BOD	=	Biochemical Oxygen Demand
CH <sub>4</sub>	=	Methane
GC	=	Gas chromatography
MLSS	=	Mixed Liquor Suspended Solid
COD	=	Chemical Oxygen Demand
MPB	=	Methane Producing Bacteria
ORP	=	Oxidation Reduction Potential
S <sup>2-</sup>	=	Sulfide
SO <sub>4</sub> <sup>2-</sup>	=	Sulfate
SRB	=	Sulfate Reducing Bacteria
TDS	=	Total Dissolved Solid
TKN	=	Total Kjeldahl Nitrogen
TS	=	Total Sulfide
VFA	=	Volatile Fatty Acids
Zn	=	Zinc