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EXAMINATION OF SOLIDIFIED AND STABILIZED MATRICES OF ARSENIC CONTAINING SLUDGE



Mr. Tanapon Phenrat

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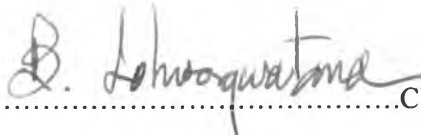
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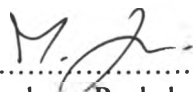
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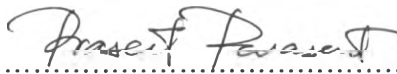


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กากตะกอนสีน้ำตาลดำซึ่งเกิดมาจากการกำจัดสารหนูโดยกระบวนการโคแอกกูเลชันและตกตะกอน  
ร่วมนั้นที่จริงแล้วคือสารหนูที่ถูกดูดซับที่ผิวหน้าของเหล็กไฮดรอกไซด์ งานวิจัยนี้เป็นการศึกษาพฤติกรรม  
ของละลายของสารหนูในกากตะกอน และ ความเป็นไปได้ของกากตะกอนที่จะเป็นของเสียอันตรายซึ่งมีความ  
สัมพันธ์กับความเข้มข้นเริ่มต้นของสารหนูในน้ำ และ ค่าความเข้มข้นหลังบำบัด จากการศึกษาพบว่า ค่า pH ของ  
น้ำชะละลายเริ่มต้นเป็นปัจจัยสำคัญที่ควบคุมการชะละลายของสารหนู เนื่องจากว่า pH ส่งผลต่อการคายตัวและ  
การดูดซับใหม่ของสารหนู รวมทั้ง การ ละลาย และ ก่อตัวใหม่ของเหล็กไฮดรอกไซด์ จากการศึกษาสามารถ  
สรุปได้ว่า กากตะกอนที่เกิดจากการกำจัดสารหนูที่มีความเข้มข้นเริ่มต้นของสารหนูในน้ำในช่วง 140 ถึง 12,790  
 $\mu\text{g/L}$  เพื่อผลิตน้ำดื่มที่มีค่าการปนเปื้อนที่ยอมรับได้คือ 10 และ 50  $\mu\text{g/L}$  ไม่น่าจะถูกจัดเป็นของเสียอันตราย แต่  
กากตะกอนที่เกิดจากกระบวนการกำจัดสารหนูเบื้องต้นของน้ำที่มีสารหนูเข้มข้นจากกระบวนการ Ion Exchange  
จนผ่าน TBLs บางค่า น่าจะถูกจัดเป็นของเสียอันตราย และเพื่อที่จะมีวิธีการจัดการกับของเสียที่ทั้งราคาสม  
เหตุผล และ เป็นผลดีต่อความเสถียรของตะกอนในระยะยาว งานวิจัยนี้ยังได้ศึกษาความเป็นไปได้ในการใช้  
ประโยชน์จากก้อนหล่อแข็งของกากตะกอนนี้ ถึงแม้ว่า กากตะกอนสารหนูที่ถูกดูดซับที่ผิวหน้าของเหล็กไฮดรอก  
ไซด์ จะส่งผลเสียต่อความแข็งแรงของก้อนหล่อแข็งทั้งทางกายภาพและเคมี โดยการแทนที่ซีเมนต์, ลดพื้นที่รับ  
แรงอัดโดยการฝังตัวของตะกอน, และ การหน่วง ปฏิกิริยาไฮเดรชันโดย สารประกอบของแคลเซียมกับสารหนู  
การใช้ประโยชน์จากก้อนหล่อแข็งของกากตะกอนนี้เป็นก้อนคอนกรีตประสานปูนพื้นยังคงเป็นไปได้ตามมาตร  
ฐาน มอก. 827-2531 โดยส่วนผสมที่ใช้เพื่อการนี้นั้นมีอัตราส่วนน้ำต่อวัสดุประสานเท่ากับ 0.4, กากตะกอนต่อ  
วัสดุประสานเท่ากับ 0.15, และ ปูนขาวต่อวัสดุประสานเท่ากับ 0

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ลายมือชื่อนิติ.....  
ลายมือชื่ออาจารย์ที่ปรึกษา.....  
ลายมือชื่ออาจารย์ที่ปรึกษาร่วม.....

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KEY WORD: ARSENIC-IRON HYDROXIDE SLUDGE / LEACHABILITY/ SOLIDIFICATION  
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TANAPON PHENRAT: EXAMINATION OF SOLIDIFIED AND STABILIZED

MATRICES OF ARSENIC CONTAINING SLUDGE. THESIS ADVISOR: ASSOC. PROF.

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Brownish sludge as a by-product of arsenic removal by coagulation/co-precipitation with ferric chloride is in fact arsenic bonded to surface of iron hydroxide through either inner or outer-sphere surface mechanism. This research was conducted to investigate leaching behavior of arsenic from the sludge and potential of the sludge to be hazardous waste as a function of initial arsenic concentrations and finished water targets. It was found that pH of extraction fluid might play a crucial role in controlling leachability of arsenic from the sludge because it influenced arsenic desorption and resorption as well as dissolution and reformation of iron hydroxide surface. In addition, it can be concluded that the sludge produced from removal of initial arsenic concentration ranging from 140 to 12,790  $\mu\text{g/l}$  to comply with the drinking water standards of 10 and 50  $\mu\text{g/l}$  of arsenic is unlikely to be hazardous waste. In contrast, the sludge from pretreatment of Ion Exchange brine to some TBLLs can be classified as hazardous waste. To reach a compromise between reasonable operation costs of waste management and sufficient long-term stability of the waste itself, this study also examined utilization potential of solidified/stabilized products. Although addition of arsenic-iron hydroxide sludge seemed to physically and chemically reduce compressive strength of the mortar due to replacement of cement, reduction of bearing by macroencapsulation of the sludge, and hydration inhibition by calcium-arsenic compounds, utilization of the solidified/stabilized sludge as an interlocking concrete paving block is also possible according to TIS 827-2531 (1988). The mix proportion for this purpose is water-to-binder ratio of 0.4, waste-to-binder ratio of 0.15, and lime-to-binder ratio of 0.

Inter-department Environmental Management

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## NOMENCLATURES

ASTM	=	American Society for Testing and Materials
CFR	=	Code of Federal Regulations
C-S-H	=	Calcium silicate hydrate
FT-IR	=	Fourier Transform Infrared Spectroscopy
LP-NO.6	=	Leaching procedure under the Notification of the Ministry of Industry No. 6 used in Thailand
MCL	=	Maximum Contaminant Level
SEM-EDS	=	Scanning Electron Microscopy equipped with Energy Dispersive Analysis of X-ray
S/S	=	Solidification/Stabilization
TBLL	=	Technically Based Local Limits
TCLP	=	Toxicity Characteristic Leaching Procedure
UCS	=	Unconfined Compressive Strength
USEPA	=	U.S. Environmental Protection Agency
WHO	=	the World Health Organization
XRD	=	X-ray Diffraction Spectroscopy