

**PHYTOREMEDIATION OF ARSENIC CONTAMINATED
SUBMERGED SOIL BY AQUATIC PLANTS**

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**A Dissertation Submitted in Partial Fulfillment of the Requirements
for the Degree of Doctor of Philosophy Program in Environmental Management
(Interdisciplinary Program)
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การบำบัดสารหนูในพื้นที่ชุ่มน้ำโดยใช้พืชน้ำบ้ำบ

นางสาว จอมจันทร์ นทีวัฒนา

วิทยานิพนธ์นี้เป็นส่วนหนึ่งของการศึกษาตามหลักสูตรปริญญาวิทยาศาสตรดุษฎีบัณฑิต
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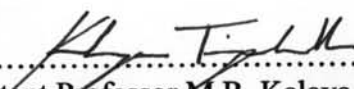
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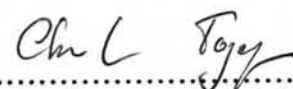
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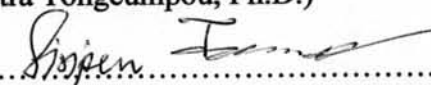
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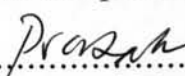
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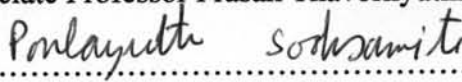
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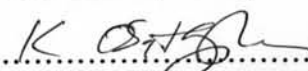
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จอมจันทร์ นทีวัฒนา : การบำบัดสารหนูในพื้นที่ชุ่มน้ำโดยใช้พืชน้ำบ้ำบด

PHYTOREMEDIATION OF ARSENIC CONTAMINATED SUBMERGED SOIL BY AQUATIC PLANTS อ. ที่ปรึกษา : รศ. ดร.ศิริเพ็ญ ตรีไชยาพร,

อ.ที่ปรึกษาร่วม : รศ. ดร. สมพร ชุนท์ลือชานนท์, 199 หน้า.

การบำบัดสารพิษโดยใช้พืช (Phytoremediation) เป็นวิธีการทำความสะอาดสารพิษที่ปนเปื้อนในดิน โคลน ตะกอนดิน และ น้ำใต้ดิน โดยใช้พืชเป็นตัวเคลื่อนย้ายสารพิษเหล่านั้นมาสะสมอยู่ในพืช งานวิจัยนี้มีวัตถุประสงค์ เพื่อ ศึกษาปริมาณและประสิทธิภาพการสะสมสารหนูในส่วนต่างๆของพืชและเปรียบเทียบประสิทธิภาพการเคลื่อนย้ายสารหนูของพืชน้ำ 4 ชนิดคือ บอน พุทธรักษา กกอียิปต์ และ ฐปถายี รวมทั้งความเป็นไปได้ของการเปลี่ยนรูปของสารหนูในรูป As(III) และรูป As(V) ในพืชน้ำทั้ง 4 ชนิด วางแผนการทดลองเป็นแฟกทอเรียล แบบอาร์ซีบี มี 2 ปัจจัย ได้แก่ พืชน้ำ 4 ชนิด, ชุดการทดลองจำนวน 3 ชุด (ชุดควบคุม ชุดใส่สารหนูในรูป As(III) และ ชุดใส่สารหนูในรูป As(V) ที่ความเข้มข้น 175 มิลลิกรัมต่อกิโลกรัม โดยมีระยะเวลาการเก็บเกี่ยว 4 ระยะ คือ 15, 30, 45 และ 60 วัน

ผลการทดลอง พบว่า พืชที่มีประสิทธิภาพในการสะสมสารหนูมากที่สุด คือ ฐปถายี รองลงมาคือ กกอียิปต์ พุทธรักษา และ บอน ซึ่งพืชทุกชนิดดูดสะสมสารหนูในดินที่ปนเปื้อน As(V) มากกว่า As(III) พืชแต่ละชนิดดูดสะสมสารหนูไว้ในส่วนของพืชแตกต่างกัน โดยลำต้นใต้ดินเป็นส่วนที่ดูดสะสมสารหนูมากที่สุด สำหรับพุทธรักษาและ ฐปถายี ส่วนบอนและกกอียิปต์ดูดสะสมสารหนูมากที่สุดในราก

การเปลี่ยนรูปสารหนูในดิน ไม่พบ การรีดิวซ์ของ As(V) แต่ พบการออกซิไดซ์ของ As(III) โดยมีการออกซิไดซ์เพิ่มสูงขึ้นจาก 33% ในวันที่ 15 เป็น 91% ในวันที่ 60 สำหรับการเปลี่ยนรูปของสารหนูในพืช พบว่า พืชทุกชนิดสามารถเปลี่ยนรูป As(III) เป็น As(V) และ เปลี่ยนรูป As(V) เป็น As(III) ยกเว้นพุทธรักษาที่พบเฉพาะการเปลี่ยนรูปจาก As(III) เป็น As(V) เท่านั้น พืชทั้ง 4 ชนิดมีประสิทธิภาพการเปลี่ยนรูปเป็น As(V) สูงที่สุดในวันที่ 15 โดยกกอียิปต์มีประสิทธิภาพในการเปลี่ยนรูปมากที่สุด รองลงมาคือ ฐปถายี พุทธรักษา และ บอน ซึ่งส่วนของกกอียิปต์ที่มีประสิทธิภาพในการเปลี่ยนรูปมากที่สุด คือ ใบ รองลงมาได้แก่ ก้านใบ ลำต้นใต้ดินและ ก้านใบ ตามลำดับ

สาขาวิชา การจัดการสิ่งแวดล้อม
ปีการศึกษา 2550

ลายมือชื่อนิติ..... จอมจันทร์⁶ นทีวัฒนา
ลายมือชื่ออาจารย์ที่ปรึกษา.....
ลายมือชื่ออาจารย์ที่ปรึกษาร่วม.....

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KEY WORD: PHYTOREMEDIATION/ As(III)/ As(V)/TOTAL ARSENIC/ *Canna sp.*/ *Colocasia esculenta* (L.) / *Typha angustifolia* (L.)/ *Cyperus papyrus* (L.)

JOMJUN NATEEWATTANA: PHYTOREMEDIATION OF ARSENIC CONTAMINATED SUBMERGED SOIL BY AQUATIC PLANTS. THESIS ADVISOR: ASSOC.PROF. SIRIPEN TRAICHAİYAPORN, Ph.D., THESIS COADVISOR : ASSOC.PROF. SOMPORN CHOONLUCHANON, Ph.D., 199 pp.

Phytoremediation is actually a generic term for several ways in which plants can be used to clean up contaminated soil, sludge, sediments, and ground water. The objectives of this research were to determine the amount and efficiency of total arsenic accumulation in various organs, the total arsenic removal efficiency arsenic in *Colocasia esculenta* (L.), *Canna sp.*, *Cyperus papyrus* (L.), and *Typha angustifolia* (L.), and possibility of As(III) and As(V) transformation of four aquatic plants. A 4 x 3 Factorial designed in RCB was conducted with four aquatic plants and three treatments (control, As(III) and As(V) at 175 mg.kg⁻¹) at four harvested time 15 days, 30 days, 45 days and 60 days.

The result showed that *T. angustifolia* had the highest arsenic accumulation followed by *C. papyrus*, *Canna sp.*, and *C. esculenta*. All plants accumulated arsenic content in As(V) incorporated soil more than As(III). Each plant accumulated arsenic in difference organs. The highest accumulation organ of *Canna sp.* and *T. angustifolia* and were rhizome; however *C. esculenta* and *C. papyrus* was accumulated the maximum at root.

Naturally, the oxidization reaction of As(III) to As(V) was always found, but the reduction reaction of As(V) to As(III) was not occurred in the submerged soil. The oxidized reaction increased from 33% to 91% at 15 and 60 days, respectively. However, transformation of both As(III) to As(V) and As(V) to As(III) were found in the plants, except the transformation of As(V) to As(III) in *Canna sp.* Percentage of As(V) transformation efficiency of all plants was at the maximum in 15 days, and then decreased to minimum at 60 days. Among the tested plants, *C. papyrus* was at the highest As(V) transformation efficiency followed by *T. angustifolia*, *Canna sp.*, and *C. esculenta*. Leaf of *C. papyrus* was the highest organ of transformation efficiency, followed by culm, rhizome, and root.

Field of study: Environmental Management.

Student's signature JomJun Nateewattana

Academic year: 2007

Advisor's signature..... Siripen Traichaiyaporn

Co-advisor's signature..... Somporn Choonluhanon

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