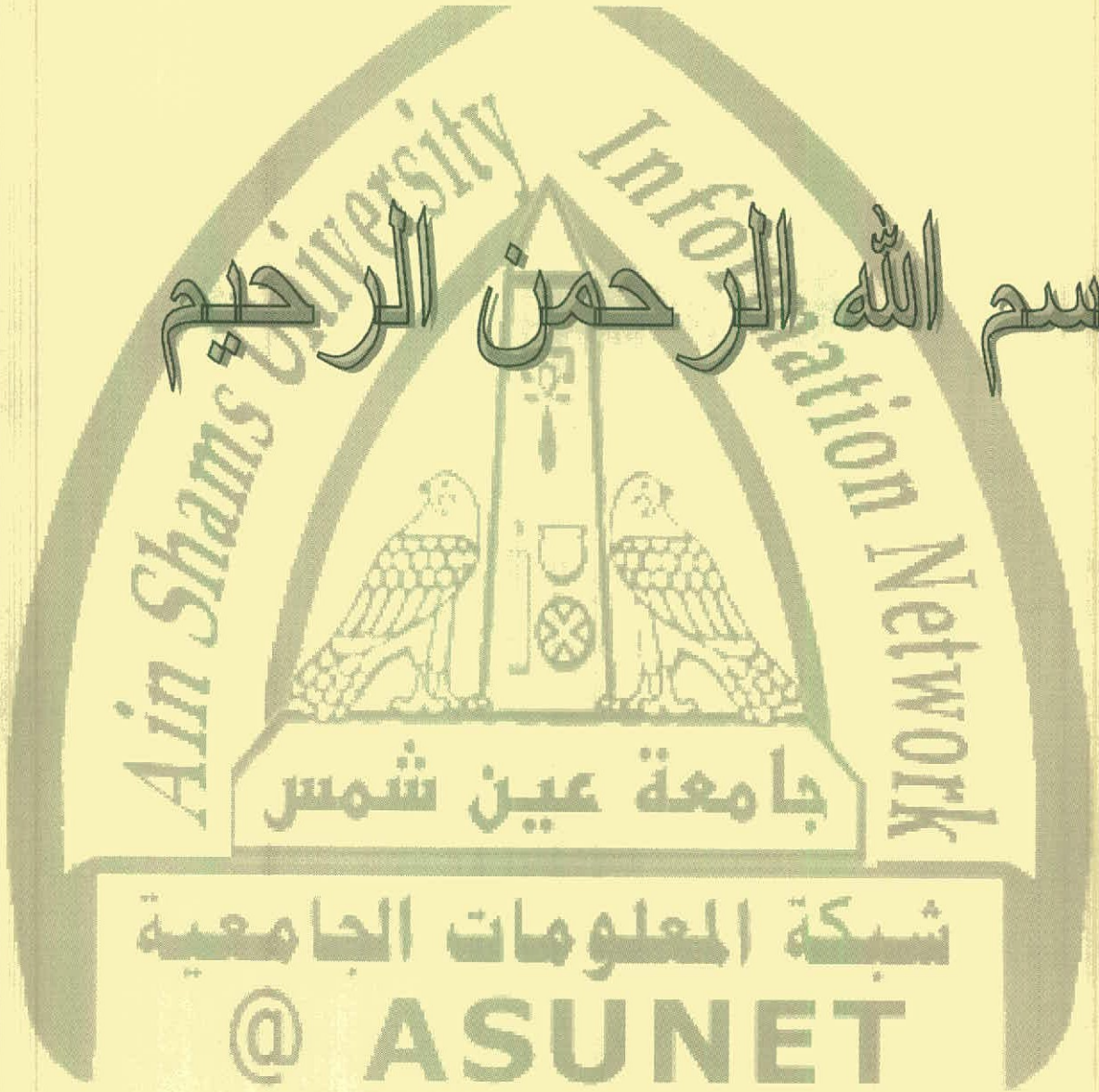
شبكة المعلومات الجامعية



بسم الله الرحمن الرحيم

شبكة المعلومات الجامعية

التوثيق الالكتروني والميكروفيلم

شبكة المعلومات الجامعية

جامعة عين شمس

التوثيق الالكتروني والميكروفيلم

قسم

نقسم بالله العظيم أن المادة التي تم توثيقها وتسجيلها
علي هذه الأفلام قد أعدت دون أية تغيرات

يجب أن

تحفظ هذه الأفلام بعيدا عن الغبار

في درجة حرارة من ١٥-٢٥ مئوية ورطوبة نسبية من ٢٠-٤٠%

To be Kept away from Dust in Dry Cool place of 15-25- c and relative humidity 20-40%

بعض الوثائـــــــق الاصليـــــة تالفـــة

بالرسالة صفحات لم ترد بالاصل

Remediation Techniques of Heavy Metals in Sludge

A Thesis Presented
To

Chemistry Department
Faculty of Science
Cairo University

By

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Environmental Research Division
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For

The Degree of
Master in Science

2010

APPROVAL SHEET FOR SUBMISSION

Title of (M.Sc) thesis: Remediation Techniques of Heavy Metals in Sludge.

Name of the candidate: Shimaa Mohamed Abdel Moniem Mohamed.

This thesis has been approved for submission by the supervisors:

1. **Prof. Dr. Motaza M. Khater**

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2. **Prof. Dr. Azza M. Abdel Moniem Ashmawy**

Signature:

Prof. Dr. Mohammed A. Badawy

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ABSTRACT

Name: Shimaa Mohamed Abdel Moniem Mohamed
Title of thesis: Remediation Techniques of Heavy Metals in Sludge
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Industry has become an essential part for progressive economic development in Egypt; solid waste production is an inevitable outcome of the developmental activities. Especially industrial solid wastes that are contaminated with heavy metals may pose a potential hazard to the human health or the environment when improperly treated, stored, transported, disposed off or managed. Heavy metals contaminated sewage sludge is the other kind of solid waste, which is produced through a sewerage system, the different metal forms are released and accumulated in the sludge, which limits its profitable use as a fertilizer and considered as hazardous waste. As the environment protection from hazardous pollutants associated with waste generation and its disposal are a major concern in today's heavily industrialized world. Therefore, the incentive objectives and results of this study are: (I) Monitoring the level and types of metals in sludge from different Wastewater Treatment Plants, where the metals concentration in all sludge samples were within the permissible values adopted by Egyptian Regulations in Decree 214/1997 for sludge permitted to be re-used in agriculture, except for lead in of El Gabal El Asfar (16, 19), El-Berka, Balaqus and Al-Sadat WWTP. (II) Assessment of the different remediation techniques for metals immobilization in sludge to reduce their negative impacts on human heath and environment. Two different types of binding materials were used during immobilization technique of heavy metals contaminated sludge; from waste products such as (cement dust, cement clinker dust, fly ash, granite waste sludge and rice straw) and from low cost chemicals such as (low grade MgO and sodium silicate). Efficiency of using these different binders was evaluated with respect to the leachability of metals from the treated sludge for estimating the optimum binder to waste ratio in order to produce a waste form with high physical stability. The unconfined compressive strength test (UCS) after 28 days, were used for estimating the efficiency of metals solidified sludge matrix. Different leaching tests were selected, such as (the EN 12457-2 leaching test; TCLP test and MEP test). By comparing between different leaching tests used (European Union EN 12457-2 and US EPA TCLP test) to establish the interactions between countries with different regulatory requirements and to consider several relevant aspects of leaching behavior, statistical analysis of our results concluded that there was no significant variation between the two compared leaching standard methods to estimate the mobility of heavy metals under their specific condition. However, the MEP test represents the long term leaching effect which indicated that the heavy metals present in the sludge are highly stable and are not likely to dissolve in a natural environment for a long period of environmental exposure. The leachability results and application of optimum binder to waste ratio on three case studies from industrial and municipal contaminated sludge showed that, the concentration of all metals under investigation (Cd, Cr, Cu, Pb, Ni, Zn) were lower than the limit values set by Egyptian Regulations law 4/1994 for hazardous waste management. In addition, the unconfined compressive strength test concluded that all sludge samples that solidified with the optimum doses of the different binders have UCS higher than 0.35MPa which is the minimal compressive strength required for solid waste disposal at landfills, which indicated that the remediate sludge were well solidified and safe to be considered for use in a wide variety of applications such as a raw material to build concrete blocks or to be sold as pavement blocks or used in roadbeds and/or parking lots. Finally, heavy metals immobilization is considered as a cost-effective process for disposing solid hazardous wastes containing unacceptable levels of leachable metals in landfill and producing strong and durable stabilized products using waste materials or industrial by-products which themselves have negative impact on the environment.

Keywords: Hazardous sludge, Heavy metals; Remediation; Immobilization; Leachability; Compressive strength.

Supervisors:

1. **Prof. Dr. Motaza M. Khater**

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2. **Prof. Dr. Azza Ashmawy**

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SHIMAA MOHAMED ABDEL MONIEM

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