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Foto: Zona lacustre de Xochimilco, Ciudad de México

Autores: Claudia Campos Silva, Eric Alvarado Martínez, José Elías Becerril Bravo



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La Revista AIDIS de Ingeniería y Ciencias Ambientales: Investigación, desarrollo y práctica es una publicación electrónica cuatrimestral coeditada por AIDIS y el Instituto de Ingeniería UNAM. Publica contribuciones originales de calidad y actualidad evaluadas por pares, dentro de su área de competencia. Se presentan trabajos que abarcan aspectos relacionados con el conocimiento científico y práctico, tanto tecnológico como de gestión, dentro del área de Ingeniería y Ciencias Ambientales en Latinoamérica.

El enfoque es multidisciplinario, buscando contribuir en forma directa a la generación de conocimiento, al desarrollo de tecnologías y a un mejor desempeño profesional. Entre los temas cubiertos por la revista están los siguientes: agua potable, calidad de agua, aguas residuales, residuos sólidos, energía, contaminación, reciclaje, cambio climático, salud ambiental, nuevas tecnologías, ética, educación, legislación y política ambiental, gestión ambiental, sostenibilidad y participación social, entre otros.

Cada edición muestra los trabajos que derivan del arbitraje académico estricto de carácter internacional. También se publican números especiales de temas particulares que fueron presentados en los diversos Congresos Interamericanos realizados por la Asociación Interamericana de Ingeniería Sanitaria y Ambiental (AIDIS) y que en forma adicional fueron sometidos al proceso de revisión interno de la revista.

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# REVISTA AIDIS

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## USO DA TRANSFORMADA DE FOURIER PARA A PROJEÇÃO DE MÉDIO PRAZO DAS PRECIPITAÇÕES NO ESTADO DO CEARÁ, BRASIL

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Luiz Martins Araújo Júnior<sup>2</sup>

USING FOURIER TRANSFORM TO THE MEDIUM-TERM  
PROJECTION OF PRECIPITATION IN THE STATE OF  
CEARÁ, BRASIL

Recibido el 21 de septiembre de 2015; Aceptado el 7 de junio de 2017

### Abstract

*The objective of this work is to analyze the temporal variability of precipitation for the State of Ceará (Brazil) and analyze projections from 4 to 10 years into the future utilizing the Fourier transformation. Methodology utilized precipitation observations from the Fundação Cearense de Meteorologia e Recursos Hídricos and the Superintendência do Desenvolvimento do Nordeste from 1912 to 2002, as well as a calibration period from 2003 to 2012. To generate the model, Man Kendall-Sen test is applied to identify and filter any trends. The primary harmonics of the Fourier series are selected and, if orthogonal, used in the model. To evaluate the effectiveness of the model, qualitative analysis of the distribution of accumulated probabilities of the projected period was used, showing four principal harmonics, two in the low-frequency domain and two in the medium-frequency domain. The model identified the distribution function for these probabilities during the projected years, indicating that the methodology presented in this paper effectively captures variability in the medium-frequency domain.*

**Key Words:** Ceará, Fourier, medium-term projection.

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## ELIMINACIÓN DE Cd y Pb UTILIZANDO MATERIALES MCM-41 PURO DE ÓXIDO DE SILICIO Y FUNCIONALIZADO CON 3-METOXI-MERCAPTOPROPILSILANO

\*Ernesto Bastardo-González<sup>1</sup>  
Rosa A. Malavé<sup>1</sup>  
Joaquín L. Brito<sup>2</sup>

ELIMINATION OF Cd AND Pb USING MCM-41 PURELY  
SILICEOUS MATERIALS AND FUNCTIONALIZED WITH  
(3-MERCAPTOPROPYL)TRIMETHOXYSILANE

Recibido el 2 de junio de 2016; Aceptado el 15 de julio de 2017

### Abstract

A purely siliceous mesoporous material MCM-41 was prepared and then functionalized with (3-mercaptopropyl)trimethoxysilane to be used as adsorbents in solutions of known concentrations of cadmium and lead. The XRD patterns showed the typical reflections of the hexagonal structure of the starting MCM-41 material in the (100), (110), (200) and (210) planes, with specific area by the BET method of 992 m<sup>2</sup>/g. The functionalized material showed a diffraction pattern with the basal reflection (100) with an intensity decrease product of the structural disorder due to the incorporation of (3-mercaptopropyl)trimethoxysilane with a BET specific area of 786 m<sup>2</sup>/g. By FTIR the efficiency of the functionality process was proved, observing the bands of the different groups of the functionality agent, while by <sup>13</sup>C NMR the peaks of the carbon atoms of the thiol group (Si-CH<sub>2</sub>-CH<sub>2</sub>-CH<sub>2</sub>-SH) were distinguished. The removal of Pb<sup>2+</sup> y Cd<sup>2+</sup> ions was performed using a batch system and the Langmuir model the grams adsorbed by the studied solids were determined, obtaining a Pb > Cd tendency. This study showed that the metals have higher affinity towards MCM-41F, moreover pH 5 was the optimum one to adsorb higher amount of ions, product of a lower amount of hydronium ions in the medium that interfere the metal-active sites interaction.

**Key Words:** MCM-41, functionality, heavy metals MCM-41.

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## QUEM RESPONDE PELOS IMPACTOS AMBIENTAIS DA INCINERAÇÃO DE RESÍDUOS DE SERVIÇO DE SAÚDE? O CASO DE BELO HORIZONTE (BRASIL)

\*Marcos Paulo Gomes Mol<sup>1</sup>  
Liséte Celina Lange<sup>2</sup>

## WHO ANSWER FOR ENVIRONMENTAL IMPACT DUE TO INCINERATION OF HEALTHCARE WASTE? CASE OF BELO HORIZONTE (BRAZIL)

Recibido el 9 de julio de 2016; Aceptado el 6 de noviembre de 2017

### Abstract

*The Healthcare Waste (HCW) management is a challenge to the institutions involved. A technology of treating this waste widely adopted in Brazilian State of Minas Gerais is incineration. This study aims to assess the perception of the involved in the incineration process of HCW generated in Belo Horizonte city regard to the principle of shared liability. For this, was adopted a qualitative methodology (interviews with generators of HCW, incinerators companies and environmental agencies). Results showed that those actors involved with managing of HCW presented divergent concepts about attributing liability for the possible environmental impacts caused by inappropriate management of these wastes.*

**Key Words:** incineration, health care waste, shared liability.

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## USO DE CISTERNAS PARA ABASTECIMIENTO HUMANO POR MEIO DA CAPTAÇÃO DE ÁGUA DA CHUVA: A EXPERIÊNCIA DO BRASIL NOS ÚLTIMOS ANOS

\*Anne Rosse Silva'  
Patrícia Campos Borja'

THE USE OF CISTERNS FOR HUMAN CONSUMPTION  
THROUGH RAINWATER HARVESTING: THE  
EXPERIENCE OF BRAZIL IN RECENT YEARS

Recibido el 3 de agosto de 2016; Aceptado el 6 de noviembre de 2017

### Abstract

*The use of cisterns for capture and store rainwater with a view to human consumption has been widely adopted in the Brazilian's Semiarid region in recent years. However, for this workaround reach it goals is essential to ensure the water with the appropriate quality and quantity, besides the continued access to this well. With the start of the program One Million Cisterns this technology entered more consistently on the stage of discussions and Brazilian's scientific productions. In this context, this study aims to understand how scientific publications have addressed this subject, and identify the most analyzed aspects and possible knowledge gaps. The methodology involved a review of the literature published between the years 2003 and 2015, followed by it's contents critical analysis. The results showed the need for progress in the polls, since some topics were not exploited enough, while others need to be consolidated and the existence of not addressed points. It is noticeable that make an assessment of the existing production compared to an object of study can lead to a better understanding of it and assist the development for further research.*

**Key Words:** cisterns, P1MC, rainwater harvesting.

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# REVISTA AIDIS

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## DETERMINACIÓN DE FÁRMACOS Y METABOLITOS EN MUESTRAS DE AGUA, SUELO Y SEDIMENTO DE LA ZONA LACUSTRE DE LA CIUDAD DE MÉXICO, POR EXTRACCIÓN ACELERADA CON DISOLVENTES Y CROMATOGRAFÍA DE GASES ACOPLADA A ESPECTROMETRÍA DE MASAS

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DETERMINATION OF PHARMACEUTICALS AND METABOLITES  
IN WATER, SOIL AND SEDIMENT FROM MÉXICO CITY'S LAKE  
AREA, BY ACCELERATED SOLVENT EXTRACTION AND GAS  
CHROMATOGRAPHY TANDEM MASS SPECTROMETRY

Recibido el 23 de agosto de 2016; Aceptado el 6 de noviembre de 2017

### Abstract

*This study determined and quantified pharmaceuticals including carbamazepine, diclofenac, gemfibrozil, ibuprofen, ketoprofen and naproxen, and metabolites including clofibric acid and salicylic acid. This group of contaminants was analyzed in various environmental matrices from a lake area in Xochimilco: soil from a raised agricultural field, "chinampa"; sediment of a canal bottom; and water from the canal. The samples were processed according to an analytical method validated by the treatment and reuse group (GTR) of the engineering institute at UNAM, which consists in accelerated solvents extraction (ASE) (for use with soil and sediment), solid phase extraction (SPE), liquid-liquid extraction, a derivatization and finally an analysis by gas chromatography tandem mass spectrometry (GC-MS). The results showed the presence of analytes in the soil and sediment; however, the concentrations of these were higher in sediment than in soil. In the case of the water from the canal, the analytes were not detected at all sampling sites. The importance of this study is to show the potential risks to all species that live in that lake area as well as the risk for people who consume fish and vegetables from Xochimilco.*

**Key Words:** ASE-SPE-GC-MS, metabolites, pharmaceuticals, sediment and soil.

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## EFICIÊNCIA ENERGÉTICA NAS CIDADES DO RIO GRANDE DO SUL: FATO OU FICÇÃO?

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Luciana Londero Brandli<sup>1</sup>  
Marcos Antonio Leite Frandoloso<sup>2</sup>

ENERGY EFFICIENCY IN THE CITIES OF RIO GRANDE DO  
SUL: FACT OR FICTION?

Recibido el 21 de septiembre de 2015; Aceptado el 7 de junio de 2017

### Abstract

*The increase in urban population brings pressure to infrastructure and the environment, particularly with regard to the demand for resources and energy. Hence, energy efficient can be considered a priority in the management of cities, in order to seek sustainability. The aim of this paper is to discuss the current state of energy efficiency in the cities of Rio Grande do Sul. Three aspects are taken into account: the in-depth analysis of the cities of Passo Fundo, Porto Alegre and Santa Maria; use of indicators of the project Prerequisites for the sustainability of the municipalities of Rio Grande do Sul (PRESUST-RS); the comparison of state data with national and with Germany as benchmark data. The results point to positive aspects of cities in terms of efficiency, but also suggest deficiencies that indicate points to receive more attention from the public administration, contributing to a more efficient consumption. Still, the benchmark analysis implies that the energy efficiency of the cities under study is closer to fiction than reality, especially in terms of renewable energy supply.*

**Key Words:** electricity consumption, energy efficiency indicators, sustainable cities.

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## ADSORÇÃO DE FÓSFORO EM LATOSSOLO TRATADO COM LODO DE ESTAÇÃO DE TRATAMENTO DE ÁGUA

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PHOSPHORUS SORPTION ON OXISOL AMENDED  
WITH WATER TREATMENT SLUDGE

Recibido el 27 de septiembre de 2016; Aceptado el 6 de octubre de 2017

### Abstract

*The low quality of water catchments and the need to provide high quality water for a growing population results in a significant increase in water treatment sludge (WTS). The reuse in agricultural or degraded areas is a possible alternative for this waste. However, in tropical soils phosphorus is usually the limiting factor for cropping. This study aimed to determine the extent of phosphorus adsorption in an Oxisol treated with different doses of WTS and two soil pH (original pH = 4.8 and modified pH = 6.5), assessing its potential impact on agricultural soil. For this, soil samples treated with different doses of WTS were subjected to P solutions with increasing concentrations until reaching the balance, adjustment of sorption isotherms, determination of P sorption capacity and sorption strength on soils. The WTS application increased the soil P sorption capacity and sorption strengths at both pHs, especially at pH 6.5, with the respective P-labile decrease in soil solution. The adsorption test performed can be used as a decision tool for soil application of the WTS.*

**Key Words:** Langmuir adsorption isotherms, urban residues, soil quality, soil fertility.

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# REVISTA AIDIS

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## EVALUACIÓN AMBIENTAL DE LA PRODUCCIÓN DE BLOQUES DE CERÁMICA CON ADICIÓN DE LODO DE LA FOSFATACIÓN: ANÁLISIS DE CICLO DE VIDA

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Rosângela A. Bersch<sup>1</sup>  
Carlos Alberto Mendes Moraes<sup>1</sup>  
Amanda G. Kieling<sup>2</sup>  
Regina Célia Espinosa Modolo<sup>1</sup>

ENVIRONMENTAL EVALUATION OF THE PRODUCTION  
OF CERAMIC BRICKS WITH ADDITION OF PHOSPHATE  
SLUDGE: LIFE CYCLE ANALYSIS

Recibido el 12 de marzo de 2017; Aceptado el 1 de agosto de 2017

### Abstract

*The value of phosphatization sludge (PS), a solid waste generated from the phosphatization process of automotive parts, as a product and raw material for manufacturing ceramic hollow bricks demands an environmental analysis of the product. The methodology developed on bench scale consisted on the waste chemical and mineralogical characterization followed by preliminary tests where the specimens were molded with the addition of 0%, 2.5%, 5.0% and 7.5% (by weight of PS) to the clay and these were sintered at 850, 900 and 950°C. Then, physical, mechanical and environmental characterization tests were conducted. The industrial scale test was performed with 2.5% PS addition. The production process was monitored during approximately 5 years with a periodic sampling (each 6 months) and samples had been physically, mechanically and environmentally characterized. Tests developed showed that PS can be used as raw-material in the ceramic hollow brick production process without compromising the final product properties. Besides, the use of the environmental tool "Life Cycle Analysis" allowed a comparative evaluation of the environmental impacts linked to the extraction, transport and production phases of generating conventional bricks and bricks with a 2.5 wt% addition of waste to the mass. The results showed that the consumption of clay, diesel oil and atmospheric pollutants were the most significant detected impacts. The production of containing PS bricks, in consuming less clay, ensures the clay pit a longer useful life, thereby; contributing to the conservation of a non-renewable natural resource and also conserving the local ecosystem. It also avoids the disposal of this solid waste in an industrial landfill.*

**Key Words:** phosphatization sludge, co-product, recycling, ceramic hollow brick, life cycle analysis.

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