

# REVISTA AIDIS



de Ingeniería  
y Ciencias Ambientales:  
Investigación, desarrollo y práctica.

<http://www.journals.unam.mx/index.php/aidis/index>

DOI: <http://dx.doi.org/10.22201/iingen.0718378xe.2019.12.3>

Vol. 12, No. 3  
6 de diciembre de 2019

ISSN 0718-378X

Editado por:



Autor: Igor Campos da Silva Cavalcante

Foto: Ponto de coleta, diagnóstico da qualidade da água da Bacia hidrográfica do Igarapé da Prata, Município de Capitão Poço, Estado do Pará, Brasil





ISSN 0718-378X

# REVISTA AIDIS

de Ingeniería y Ciencias Ambientales:  
Investigación, desarrollo y práctica.

## Temática y alcance

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.

## Editor en Jefe de la revista

Dr. Germán Buitrón Méndez  
Investigador Instituto de Ingeniería-UNAM

## ISSN

0718-378X

## Entidad editora

Instituto de Ingeniería, UNAM  
Ciudad Universitaria, Coyoacán, México D.F., C.P. 04360  
Teléfono: (52) (55) 56-23-36-00; Fax: (52) (55) 56-16-28-94

## Coordinadora editorial y Secretaría técnica

Biól. Blanca P. Gamboa Rocha  
Instituto de Ingeniería, UNAM, México. DF.

## Información Legal

La Revista AIDIS de Ingeniería y Ciencias Ambientales: Investigación, desarrollo y práctica es una publicación electrónica cuatrimestral, editada en el Instituto de Ingeniería, UNAM.

## Administrador de la plataforma (OJS)

Biól. Blanca P. Gamboa Rocha  
Instituto de Ingeniería, UNAM, México. DF.

Reservas de derechos al uso exclusivo:  
04-2011-011413271800-203

## Contacto

revista\_aidis@pumas.iingen.unam.mx (Principal)  
revista.aidis@gmail.com



ISSN 0718-378X

# REVISTA AIDIS

de Ingeniería y Ciencias Ambientales:  
Investigación, desarrollo y práctica.

Directorio

## Junta editorial

Dr. Germán Buitrón Méndez  
Editor en jefe

Ing. Hugo Esteban Leigue  
Presidente de AIDIS

Dra. Rosa María Ramírez Zamora  
Directora del Instituto de Ingeniería, UNAM

## Consejo editorial

Dr. Adalberto Noyola Robles  
Instituto de Ingeniería, UNAM, México.

Prof. André Bezerra dos Santos  
Universidade Federal do Ceará, Brasil.

Prof. Cleverson V. Andreoli  
Instituto Superior de Administração e Economia,  
ISAE/FGV, Brasil.

Dr. Darci Campani  
Universidade Federal do Rio Grande do Sul, Brasil.

Dr. David Jeison Núñez  
Universidad de la Frontera, Chile.

Dr. Eric Houbron  
Universidad Veracruzana, México.

Prof. Eugenio Foresti  
Universidade de São Paulo, Brasil.

Dr. Francisco Cervantes Carrillo  
Instituto de Ingeniería, UNAM, México.

Dra. Gabriela Moeller Chávez  
Universidad Politécnica de Morelos, México.

Dr. Germán Buitrón Méndez  
Instituto de Ingeniería, UNAM, México.

Prof. Leo Heller  
Universidade Federal de Minas Gerais, Brasil.

Dr. Manuel Salvador Rodríguez Susa  
Facultad de Ingeniería,  
Universidad de los Andes, Bogotá, Colombia.

Dr. Marcel Szanto Narea  
Pontificia Universidad Católica de Valparaíso,  
Chile.

Prof. Marcelo Zaiat  
Escola de Engenharia de Sao Carlos, Brasil.

Prof. Marcos von Sperling  
Universidade Federal de Minas Gerais, Brasil.

Dra. Mirna Argueta Iria  
Servicio Autónomo Nacional de Acueductos y  
Alcantarillados, Honduras.

Prof. Rafael Bastos  
Universidade Federal de Visosa, Brasil.

Dr. Rolando Chamy Maggi  
Universidad Católica de Valparaíso, Chile.



Universidad Nacional  
Autónoma de México

Portal de revistas  
*científicas y arbitradas*  
de la UNAM

## Tabla de Contenido

Vol. 12, No 3

- ALTERNATIVA DE COMPOSTAGEM DO LODO RESIDUAL E REUSO PARA PRODUÇÃO DE MUDAS E PAISAGISMO DE ATERRO SANITÁRIO.** 383 - 398  
*ALTERNATIVE COMPOSITION OF RESIDUAL SLUDGE AND REUSE FOR THE PRODUCTION OF CHANGES AND LANDSCAPING OF SANITARY LAND.*  
Zorayde Lourenco de Oliveira, Marília Regina Costa Castro Lyra, Jose Fernando do Nascimento, Silvio Romero de Melo Ferreira
- ANÁLISE DO POTENCIAL DE IMPACTO AMBIENTAL PARA IMPLANTAÇÃO DE PEQUENAS CENTRAIS HIDROELÉTRICAS NAS UNIDADES HIDROGRÁFICAS DO ESTADO DO PARÁ.** 399 – 412  
*ANALYSIS OF ENVIRONMENTAL IMPACT POTENTIAL FOR IMPLEMENTATION OF SMALL HYDROELECTRIC POWER PLANTS IN THE HYDROGRAPHIC UNITS OF THE STATE OF PARÁ.*  
Mayke Feitosa Progênio, Felipe Antônio Melo da Costa Filho, Marcelo José Raiol Souza, Francisco Carlos Lira Pessoa
- ANÁLISE DA QUALIDADE DA ÁGUA DE UMA BACIA HIDROGRÁFICA PERIURBANA NO MUNICÍPIO DE CAPITÃO POÇO/PA.** 413 – 431  
*WATER QUALITY ANALYSIS OF A PERI-URBAN WATERSHED IN THE MUNICIPALITY OF CAPITÃO POÇO/PA.*  
Igor Campos da Silva Cavalcante, Raimunda da Silva e Silva, Claudio José Cavalcante Blanco, Luiza Carla Girard Mendes Teixeira, Lindemberg Lima Fernandes
- ESTUDO DA DEGRADAÇÃO DO PARAQUAT EM REGIME DE BATELADA AGITADA INOCULADOS COM *Phanerochaete chrysosporium* COM ADIÇÃO DE GLICOSE OU SACAROSE.** 432 - 452  
*STUDY OF THE DEGRADATION OF THE PARAQUAT IN REACTORS IN AGITED BATCH REGIME INOCULED WITH *Phanerochaete chrysosporium* WITH ADDED GLUCOSE OR SUCROSE.*  
Victória Maura Silva Bermúdez, Letícia Bezerra Farias, Germana Maria Marinho, Kelly de Araújo Rodrigues Pessoa, Glória Maria Marinho Silva
- DESENVOLVIMENTO DE UM INSTRUMENTO PARA AVALIAÇÃO DE DESEMPENHO AMBIENTAL DE SERVIÇOS DE MANUTENÇÃO RODOVIÁRIA COM AUXÍLIO DA METODOLOGIA MULTICRITÉRIO DE APOIO À DECISÃO CONSTRUTIVISTA.** 453 – 466  
*DEVELOPMENT OF AN INSTRUMENT TO EVALUATE ENVIRONMENTAL PERFORMANCE OF ROAD MAINTENANCE SERVICES USING THE MULTI-CRITERIA DECISION AID – CONSTRUCTIVIST.*  
Luís Fernando Sequinel, Roque Rodrigo Rodrigues, Carlos Alberto Prado da Silva Junior, Heliana Barbosa Fontenele
- SENSITIVITY OF THE HYDRUS-1D MODEL TO CHANGES IN HYDRODYNAMIC PARAMETERS IN YELLOW LATOSOL.** 467 – 481  
*SENSIBILIDADE DO MODELO HYDRUS-1D AOS PARÂMETROS HIDRODINÂMICOS DE UM LATOSSOLO AMARELO.*  
Marco Aurélio Calixto Ribeiro de Holanda, Willames de Albuquerque Soares, Simone Rosa da Silva, Diogo Botelho Correa de Oliveira

- PÓS-TRATAMENTO DE EFLUENTE DOMÉSTICO POR COAGULAÇÃO, FLOCULAÇÃO, SEDIMENTAÇÃO, FILTRAÇÃO E DESINFECÇÃO, VISANDO O REUSO.** 482 - 495  
*POST-TREATMENT OF DOMESTIC WASTEWATER BY COAGULATION, FLOCCULATION, SEDIMENTATION, FILTRATION AND DISINFECTION, AIMING REUSE.*  
[Ana Cé](#), [Daniel Bartiko](#), [Carlos Magno de Souza Vidal](#), [Jeanette Beber de Souza](#), [Mirelly Manica](#)
- PRODUÇÃO DE GESSO NO ARARIPE PERNAMBUCANO: IMPACTOS AMBIENTAIS E PERSPECTIVAS FUTURAS.** 496 - 509  
*PRODUCTION OF GYPSUM PLASTER IN THE REGION OF ARARIPE, PERNAMBUCO STATE: ENVIRONMENTAL IMPACTS AND FUTURE PERSPECTIVES.*  
[João Paulo de Oliveira Santos](#), [Soraya Giovanetti El-Deir](#)
- SUBSTITUIÇÃO DE  $Na_2SO_4$  POR  $CaSO_4 \cdot 2H_2O$  COMO FONTE DE SULFATO EM BIORREATOR ANAERÓBIO CONTÍNUO DE REDUÇÃO DE SULFATO: DESAFIOS E SOLUÇÕES.** 510 - 523  
*REPLACING  $Na_2SO_4$  WITH  $CaSO_4 \cdot 2H_2O$  AS A SULPHATE SOURCE IN A CONTINUOUS ANAEROBIC BIOREACTOR FOR SULPHATE REDUCTION: CHALLENGES AND SOLUTIONS.*  
[Lucas A. de Oliveira Melgaço](#), [Nayara Carolina Quites](#), [Versiane Albis Leão](#)
- INFLUÊNCIA DO ALQUILBENZENO LINEAR SULFONATO NA PERFORMANCE DA CÉLULA COMBUSTÍVEL MICROBIANA.** 524 - 535  
*INFLUENCE OF LINEAR ALKYL BENZENE SULFONATES ON THE PERFORMANCE OF MICROBIAL FUEL CELLS.*  
[Renata Cristina Galera](#), [Ana Carolina Vieira Araújo](#), [Moema Hausen](#), [Pierre Ferreira do Prado](#), [Iolanda Cristina Silveira Duarte](#)
- AValiação da importância do volume útil de reservatório elevado para a distribuição de água para área urbana.** 536- 551  
*EVALUATION OF THE IMPORTANCE OF USEFUL VOLUME OF HIGH RESERVOIR FOR THE DISTRIBUTION OF WATER FOR URBAN AREA.*  
[Francisca Nara da Conceição Moreira](#), [Augusto da Gama Rego](#), [José Almir Rodrigues Pereira](#)
- AValiação da qualidade das águas em poços destinados ao abastecimento público no noroeste do Rio Grande do Sul.** 552 - 570  
*EVALUATION OF WATER QUALITY IN WELLS FOR PUBLIC SUPPLY IN THE NORTHWEST OF RIO GRANDE DO SUL.*  
[Pedro Carvalho de Mendonça](#), [Ramiro Pereira Bisognin](#), [Márlon de Castro Vasconcelos](#), [Eduardo Lorensi de Souza](#), [Robson E. Gehlen Bohrer](#)
- ANÁLISE ORGANOLÉPTICA (COR E GOSTO) DA ÁGUA FORNECIDA PELO SISTEMA PÚBLICO DE ABASTECIMENTO DO MUNICÍPIO DE ITABAIANA/SE.** 571- 583  
*ORGANOLEPTIC ANALYSIS (COLOR AND TASTE) OF THE WATER SUPPLIED BY THE PUBLIC SUPPLY SYSTEM OF THE MUNICIPALITY OF ITABAIANA / SE.*  
[Tháisa Lima Santos](#), [Neuma Rubia F. Santana](#)
- REVISORES 2019** 584- 586

# REVISTA AIDIS

de Ingeniería y Ciencias Ambientales:  
Investigación, desarrollo y práctica.

## ALTERNATIVA DE COMPOSTAGEM DO LODO RESIDUAL E REUSO PARA PRODUÇÃO DE MUDAS E PAISAGISMO DE ATERRO SANITÁRIO

\*Zorayde Lourenco de Oliveira<sup>1</sup>  
Marília Regina Costa Castro Lyra<sup>2</sup>  
Jose Fernando do Nascimento<sup>1</sup>  
Silvio Romero de Melo Ferreira<sup>1</sup>

## ALTERNATIVE COMPOSITION OF RESIDUAL SLUDGE AND REUSE FOR THE PRODUCTION OF CHANGES AND LANDSCAPING OF SANITARY LAND

Recibido el 25 de octubre de 2017; Aceptado el 16 de octubre de 2018

### Abstract

*Considering the importance of the environmentally sound management of urban solid waste, the composting process is the process of transforming the waste resulting from the treatment of leachate, the proposal is directed to the management of solid waste without leaving wastes after treatment. The objective was to evaluate the effect of the application of the compound developed from the residual sludge resulting from the Moringa oleifera extract after treatment of leachate on the germination and growth variables of Lettuce - Lactuca sativa L. and on the chemical properties of the compound. The experiment was conducted at the CTR-Candeias landfill and at the UFPE phytomedicine laboratory, the compost (residual sludge) came from the CTR-Candeias Landfill in Muribeca, Jaboatão dos Guararapes, Pernambuco. The efficiency of the use of the residual sludge compound through Bioassays with Lettuce seeds was evaluated in the laboratory and in the field. Two experiments were conducted with pots filled with commercial compost and residual sludge grown with lettuce seeds. Physical and chemical characterization of crude leachate (LB), residual sludge and compost were performed. The residual sludge compound did not present toxicity to seedlings and lettuce seedlings developing 100% germination, indicating that the composting process was efficient, mortality of total and fecal coliforms occurred in 96% and 82%. The results indicate the use of the residual sludge compost as a composting alternative for the production of seedlings and landfill landscaping.*

**Keywords:** lettuce, bioassays, compound, coliforms, residual sludge.

<sup>1</sup> Departamento de Engenharia Civil, Universidade Federal de Pernambuco, Brasil.

<sup>2</sup> Instituto Federal de Pernambuco, Brasil.

\*Autor correspondente: Departamento de Engenharia Civil, Universidade Federal de Pernambuco, Avenida Prof. Moraes Rego, 123 - Cidade Universitária, PE, 50670-901. Email: [zoraydelourenco@hotmail.com](mailto:zoraydelourenco@hotmail.com)

# REVISTA AIDIS

de Ingeniería y Ciencias Ambientales:  
Investigación, desarrollo y práctica.

## ANÁLISE DO POTENCIAL DE IMPACTO AMBIENTAL PARA IMPLANTAÇÃO DE PEQUENAS CENTRAIS HIDROELÉTRICAS NAS UNIDADES HIDROGRÁFICAS DO ESTADO DO PARÁ

Mayke Feitosa Progênio <sup>1</sup>  
Felipe Antônio Melo da Costa Filho <sup>1</sup>  
Marcelo José Raiol Souza <sup>2</sup>  
\*Francisco Carlos Lira Pessoa <sup>3</sup>

## ANALYSIS OF ENVIRONMENTAL IMPACT POTENTIAL FOR IMPLEMENTATION OF SMALL HYDROELECTRIC POWER PLANTS IN THE HYDROGRAPHIC UNITS OF THE STATE OF PARÁ

Recibido el 12 de noviembre de 2017; Aceptado el 19 de mayo de 2019

### Abstract

*As the Amazon region has been the subject of studies aimed at the implementation of small hydroelectric power plants (SHPs), under the perspective of sustainable development and electric power supply to the region, it is necessary to recognize areas with high environmental potential, areas that offer lower environmental impacts (EI) in the face of the installation of these projects, as well as areas of low environmental potential which provide higher EI. The objective of this work is to identify these areas in the hydrographic units of the state of Pará. To perform the analysis, the tools of a Geographic Information System (GIS) were used with the Multicriteria decision analysis method (MDCM) and as input data were selected, through a checklist, some environmental components: hydrography, land use and vegetation. The results showed that the Gurupi, Tapajós, Alto Tocantins and Araguaia units had the smallest potential to generate IA in the installation of SHPs (high environmental potential). Among these basins, the Alto Tocantins unit stands out, having 76.19% of its area prone to the installation of SHPs, since it does not have areas of social interest (conservation units and indigenous lands) inserted in its domains. On the other hand, the Foz do Amazonas unit pointed out the greatest environmental impact potential (low environmental potential), with 99.24% for its areas. Finally, the Gurupi and Alto Tocantins units showed the best conditions for the feasibility of implementing SHPs.*

**Keywords:** SHPs, hydrographic units, environmental impacts.

<sup>1</sup> Programa de Pós-Graduação em Engenharia Civil, Universidade Federal do Pará (UFPA), Brasil.

<sup>2</sup> Departamento de Tecnologia e Recursos Naturais, Universidade do estado do Pará, Brasil.

<sup>3</sup> Faculdade de Engenharia Sanitária e Ambiental, Universidade Federal do Pará (UFPA), Brasil.

\*Autor correspondente: Laboratório de Engenharia Sanitária e Ambiental (LAESA), Universidade Federal do Pará (UFPA). Avenida Augusto Corrêa, 01, Guamá, Belém, Pará, Brasil. CEP 66075-110. Email: [fclpessoa@ufpa.br](mailto:fclpessoa@ufpa.br)

# REVISTA AIDIS

de Ingeniería y Ciencias Ambientales:  
Investigación, desarrollo y práctica.

## ANÁLISE DA QUALIDADE DA ÁGUA DE UMA BACIA HIDROGRÁFICA PERIURBANA NO MUNICÍPIO DE CAPITÃO POÇO/PA

\*Igor Campos da Silva Cavalcante <sup>1</sup>  
Raimunda da Silva e Silva <sup>1</sup>  
Claudio José Cavalcante Blanco <sup>1</sup>  
Luiza Carla Girard Mendes Teixeira <sup>1</sup>  
Lindemberg Lima Fernandes <sup>1</sup>

## WATER QUALITY ANALYSIS OF A PERI-URBAN WATERSHED IN THE MUNICIPALITY OF CAPITÃO POÇO/PA

Recibido el 21 de diciembre de 2017; Aceptado el 9 de abril de 2019

### Abstract

*The objective of this study was to analyze the water quality of the Igarapé da Prata, in the municipality of Capitão Poço/PA, to identify the most relevant quality parameters in the determination of water quality indicatives, using descriptive and multivariate statistics. Therefore, 3 sampling points were selected along the hydrous body, considering rainy periods and dry periods, using a total of 11 parameters of water quality. By analyzing the main components, it was verified that the first 4 components explained 73.7% of the total variance of the samples for the rainy season and the first 3 components of the dry period explained 67.5% of the total variance. The factorial analysis allowed the rotation of the matrix of the main components, maximizing the variance and reducing the number of relevant parameters for the water quality to 6, among the rainier and less rainy periods. It was performed the creation of scores based on the values of the rotated factors and raw data, to create quality ranking among the sampling points, which showed that the PT-01 presented the worst water quality indicatives because it was located in an area with few riparian forests and with a higher concentration of residences and agricultural activities.*

**Keywords:** hydrous body, water quality, multivariate statistics, main components.

<sup>1</sup> Faculdade de Engenharia Sanitária e Ambiental, Universidade Federal do Pará (UFPA), Campus Belém, Brasil.

\*Autor correspondente: Laboratorio de Ingeniería Sanitaria y Ambiental (LAESA), Universidad Federal de Pará. Calle Augusto Corrêa, 01, Guamá, Campus Belém. Belém, Pará, Brasil. CEP 66075-110. E-mail: [eng.igorcampos@gmail.com](mailto:eng.igorcampos@gmail.com)



# REVISTA AIDIS

de Ingeniería y Ciencias Ambientales:  
Investigación, desarrollo y práctica.

## ESTUDO DA DEGRADAÇÃO DO PARAQUAT EM REGIME DE BATELADA AGITADA INOCULADOS COM *Phanerochaete chrysosporium* COM ADIÇÃO DE GLICOSE OU SACAROSE

\*Victória Maura Silva Bermúdez<sup>1</sup>

Letícia Bezerra Farias<sup>2</sup>

Germana Maria Marinho<sup>3</sup>

Kelly de Araújo Rodrigues Pessoa<sup>1</sup>

Glória Maria Marinho Silva<sup>1</sup>

## STUDY OF THE DEGRADATION OF THE PARAQUAT IN REACTORS IN AGITED BATCH REGIME INOCULATED WITH *Phanerochaete chrysosporium* WITH ADDED GLUCOSE OR SUCROSE

Recibido el 31 de enero de 2018; Aceptado el 16 de octubre de 2018

### Abstract

The search to improve food quality and increase crop yields has increased the use of pesticides. As a result of these actions, these have caused environmental problems when they reach aquatic systems. Bioremediation using microorganisms to remove these compounds from the environment is a viable alternative both for its efficiency and cost, since traditional treatments (ozone, hydrogen peroxide, UV radiation and etc.) do not have such an effective action in their removal. The fungus *Phanerochaete chrysosporium* was the microorganism used, with the addition of sucrose or glucose, for the degradation of the herbicide paraquat (30 mg/L) in reactors in agitated batch regime. The reactors were monitored by the analysis of paraquat and reducing sugar concentrations. From the values obtained by the pesticide reduction, the kinetics of the pesticides were fitted with a first order equation. The reactor that obtained the best removal of paraquat was the one with the addition of 3.0 g / L of sucrose (49.0%), with consumption of 11.0% of sucrose and a constant of degradation rate of the pollutant in the value of 0.024 h<sup>-1</sup>. With respect to the toxicity test with *Allium cepa*, the toxicity of the solutions containing paraquat is reduced after the treatment with *Phanerochaete chrysosporium*. The contamination check showed that the presence of fungi was predominant in relation to bacteria. Therefore, this study indicates the possibility of using *Phanerochaete chrysosporium* in the degradation of paraquat.

**Keywords:** bioremediation, co-substrate, fungus, herbicide, pesticide, paraquat.

<sup>1</sup> Programa de Pós-graduação em Gestão e Tecnologia Ambiental (PPGTA-IFCE), Campus Fortaleza, Brasil.

<sup>2</sup> Instituto Federal de Educação, Ciência e Tecnologia do Ceará (IFCE), Campus Fortaleza, Brasil.

\*Autor correspondente: Laboratório de Tecnologia Ambiental – LATAM, Instituto Federal do Ceará – IFCE. Av. Treze de Maio, 2081, Benfica, campus Fortaleza. Fortaleza, Ceará, Brasil. Email: [gloriamarinho@gmail.com](mailto:gloriamarinho@gmail.com)



# REVISTA AIDIS

de Ingeniería y Ciencias Ambientales:  
Investigación, desarrollo y práctica.

## DESENVOLVIMENTO DE UM INSTRUMENTO PARA AVALIAÇÃO DE DESEMPENHO AMBIENTAL DE SERVIÇOS DE MANUTENÇÃO RODOVIÁRIA COM AUXÍLIO DA METODOLOGIA MULTICRITÉRIO DE APOIO À DECISÃO CONSTRUTIVISTA

\*Luis Fernando Sequinel<sup>1</sup>  
Roque Rodrigo Rodrigues<sup>1</sup>  
Carlos Alberto Prado da Silva Junior<sup>1</sup>  
Heliana Barbosa Fontenele<sup>1</sup>

## DEVELOPMENT OF AN INSTRUMENT TO EVALUATE ENVIRONMENTAL PERFORMANCE OF ROAD MAINTENANCE SERVICES USING THE MULTI-CRITERIA DECISION AID - CONSTRUCTIVIST

Recibido el 1 de febrero de 2018; Aceptado el 9 de mayo de 2018

### Abstract

Over the years, the scarcity of investments in conservation of Brazilian paved road network caused an exorbitant drop in its quality. Therefore, actions related to road maintenance and rehabilitation represent a large volume of services, mainly in the most developed regions of Brazil, where the paved network is large, causing several environmental impacts. Environmental management of these services is currently present only in environmental licensing processes. Thus, the aim of this research is to develop an environmental performance index of road maintenance services, based on an array of indicators, using the perception of experts of a highway concessionaire. For this, Multi-criteria Decision Aid - Constructivist (MCDA-C) methodology was used, which resulted in the Environmental Performance Index of Road Maintenance (EPI- RM), based on six indicators, divided into five areas of interest: Waste Management, Environmental Pollution, Equipment Maintenance, Environmental Documentation and Environmental Training. The index value ranged from -134.15 for the worst environmental performance to 140.00 for the best one. The developed index can be considered an objective tool for the continuous monitoring of the environmental management of road maintenance services.

**Keywords:** environmental indicators, road environmental management, performance index.

<sup>1</sup> Centro de Tecnologia e Urbanismo, Universidade Estadual de Londrina, Brasil.

\*Autor correspondente: Departamento de Construção Civil, Centro de Tecnologia e Urbanismo, Universidade Estadual de Londrina, Rodovia Celso Garcia Cid, PR445 Km 380, CEP 86.057-970– Londrina, PR, Brasil. Email: [sequinelutf@gmail.com](mailto:sequinelutf@gmail.com)

# REVISTA AIDIS

de Ingeniería y Ciencias Ambientales:  
Investigación, desarrollo y práctica.

## SENSITIVITY OF THE HYDRUS-1D MODEL TO CHANGES IN HYDRODYNAMIC PARAMETERS IN YELLOW LATOSOL

\*Marco Aurélio Calixto Ribeiro de Holanda<sup>1</sup>  
Willames de Albuquerque Soares<sup>2</sup>  
Simone Rosa da Silva<sup>2</sup>  
Diogo Botelho Correa de Oliveira<sup>1</sup>

## SENSIBILIDADE DO MODELO HYDRUS-1D AOS PARÂMETROS HIDRODINÂMICOS DE UM LATOSSOLO AMARELO

Recibido el 2 de febrero 2018; Aceptado el 16 de mayo de 2019

### Abstract

*In order to predict dynamic water processes in the soil under field conditions, it is necessary to collect a large amount of information, making research expensive and time-consuming, leading some researchers to utilize mathematical models developed to accurately describe the hydrodynamic characterization of soils. The objective of this study was to test the sensitivity of Hydrus-1D to variations in input information, and to determine which items need to be measured with greater accuracy. For this, the moisture and matric potential for a Yellow Latosol were evaluated through simulations. The systematic sensitivity analyses showed that the model was not very sensitive to variations in saturated hydraulic conductivity ( $K_s$ ) and residual moisture ( $\theta_r$ ). For the parameter  $a$  (empirical), the values obtained indicated that the model has low to intermediate sensitivity. For the parameter  $n$  (empirical dimensionless), the simulated values also presented low to intermediate sensitivity. For saturated moisture ( $q_s$ ), the model presented relative sensitivity values from intermediate to high.*

**Keywords:** *mathematical modeling, matric potential, soil moisture.*

<sup>1</sup> Escola Politécnica de Pernambuco – POLI, Universidade de Pernambuco - UPE, Recife, Pernambuco, Brasil.

<sup>2</sup> Universidade de Pernambuco, Docente do programa de pós-graduação em Engenharia Civil da Escola Politécnica de Pernambuco – POLI, Universidade de Pernambuco - UPE, Recife, Pernambuco, Brasil.

\*Autor correspondente: Escola Politécnica de Pernambuco – POLI, Universidade de Pernambuco - UPE, R. Benfica, 455, Madalena, Recife, Pernambuco, CEP 50720-001, Brasil, E-mail: [holandamacr@yahoo.com.br](mailto:holandamacr@yahoo.com.br)

# REVISTA AIDIS

de Ingeniería y Ciencias Ambientales:  
Investigación, desarrollo y práctica.

## PÓS-TRATAMENTO DE EFLUENTE DOMÉSTICO POR COAGULAÇÃO, FLOCULAÇÃO, SEDIMENTAÇÃO, FILTRAÇÃO E DESINFECÇÃO, VISANDO O REUSO

### POST-TREATMENT OF DOMESTIC WASTEWATER BY COAGULATION, FLOCCULATION, SEDIMENTATION, FILTRATION AND DISINFECTION, AIMING REUSE

\* Ana Cé<sup>1</sup>

Daniel Bartiko<sup>2</sup>

Carlos Magno de Souza Vidal<sup>3</sup>

Jeanette Beber de Souza<sup>3</sup>

Mirelly Manica<sup>3</sup>

Recibido el 2 de febrero 2018; Aceptado el 16 de octubre de 2018

#### Abstract

*The high demand of water resources has been considered one of the responsible for the water shortage. In this context, technologies of domestic wastewater treatment have been increasingly explored in order to improve the effluent quality. This improvement is needed for the wastewater discharge into water bodies or for wastewater reuse (non-potable use). Among the used treatments, the processes of coagulation, flocculation, sedimentation, filtration and disinfection have gained special attention. The present study evaluated the performance of coagulation, flocculation and sedimentation processes and from the results, it was made the coagulation diagrams and it was also found three conditions. These conditions showed as following values of remaining turbidity (2.4, 1.05 and 0.98 uT), without the high coagulant dosage and acidifier (50 to 60 mg.L<sup>-1</sup> of FeCl<sub>3</sub>.6H<sub>2</sub>O and 0 to 25 mg.L<sup>-1</sup> of HCl (0.5 mol.L<sup>-1</sup>), respectively). In addition, a sedimentation rate was 1.5 cm.min<sup>-1</sup> with a relatively low hydraulic retention time. Once the three conditions had been found was simulated the conditions for coagulation/flocculation and sedimentation again. It was also simulated the subsequent steps, which was filtration and disinfection. In the last experiment was found parameter values that meet in NBR 13.969/97 and USEPA (2012) guidelines for different types of reuse (urban, industrial, agriculture, etc.).*

**Keywords:** coagulation diagrams, ferric chloride, reuse water, tertiary treatment, wastewater.

<sup>1</sup> Departamento de Engenharia Ambiental, Universidade Tecnológica Federal do Paraná, Brasil.

<sup>2</sup> Departamento de Engenharia Sanitária e Ambiental, Universidade Federal de Santa Catarina, Brasil.

<sup>3</sup> Departamento de Engenharia Ambiental, Universidade Estadual do Centro-Oeste, Brasil.

\*Autor correspondente: Departamento de Engenharia Ambiental, Universidade Tecnológica Federal do Paraná. Linha Santa Bárbara s/n, Francisco Beltrão, Paraná. Caixa Postal 135. 85601-971. Brasil. Email: [anaceamb@gmail.com](mailto:anaceamb@gmail.com)

# REVISTA AIDIS

de Ingeniería y Ciencias Ambientales:  
Investigación, desarrollo y práctica.

## PRODUÇÃO DE GESSO NO ARARIPE PERNAMBUCANO: IMPACTOS AMBIENTAIS E PERSPECTIVAS FUTURAS

\*João Paulo de Oliveira Santos<sup>1</sup>  
Soraya Giovanetti El-Deir<sup>1</sup>

## PRODUCTION OF GYPSUM PLASTER IN THE REGION OF ARARIPE, PERNAMBUCO STATE: ENVIRONMENTAL IMPACTS AND FUTURE PERSPECTIVES

Recibido el 2 de febrero de 2018; Aceptado el 7 de octubre de 2019

### Abstract

*Pernambuco State is responsible for 97% of the production of all gypsum plaster consumed in Brazil. This occurs in large part to the quality of its gypsum ore, which reaches a very high degree of purity. The gypsum reserves located in Pernambuco State are concentrated in the region of Araripe, making up the Araripe Gypsum Pole, an important productive arrangement at national level. Although this activity represents an important source of resources in the region, it is also responsible for the direct and indirect generation of environmental impacts. The main energy source used in the ore beneficiation process is firewood, most often from native Caatinga species. This massive removal of firewood has placed the region under severe anthropic pressure, which has generated consequently changes in the physical and biological structures of the environment. This scenario is accompanied by the expressive release of particulates into the atmosphere, compromising the air quality and promoting health problems to the local population. In this perspective, the search for a new energy matrix becomes necessary, also linking with cleaner production strategies. Panorama that to be implanted depends on a series of actors, both in public and private spheres.*

**Keywords:** *gypsum, energy matrix, clean production*

<sup>1</sup>Grupo de Pesquisa Gestão Ambiental em Pernambuco – Universidade Federal Rural de Pernambuco, Brasil.

\*Autor correspondente: Departamento de Tecnologia Rural, Universidade Federal Rural de Pernambuco. Rua Dom Manoel de Medeiros, s/n, Dois Irmãos, Recife – Pernambuco, CEP: 52171-900, Brasil. Email: [jpos@agro.adm.br](mailto:jpos@agro.adm.br)

# REVISTA AIDIS

de Ingeniería y Ciencias Ambientales:  
Investigación, desarrollo y práctica.

## SUBSTITUIÇÃO DE $\text{Na}_2\text{SO}_4$ POR $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$ COMO FONTE DE SULFATO EM BIORREATOR ANAERÓBIO CONTÍNUO DE REDUÇÃO DE SULFATO: DESAFIOS E SOLUÇÕES

\* Lucas A. de Oliveira Melgaço<sup>1</sup>  
Nayara Carolina Quitês<sup>1</sup>  
Versiane Albis Leão<sup>1</sup>

## REPLACING $\text{Na}_2\text{SO}_4$ WITH $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$ AS A SULPHATE SOURCE IN A CONTINUOUS ANAEROBIC BIOREACTOR FOR SULPHATE REDUCTION: CHALLENGES AND SOLUTIONS

Recibido el 5 de febrero de 2018; Aceptado el 23 de agosto de 2018

### Abstract

*Phosphogypsum is one of mainly wastes generated from fertilizer production using wet method. The composition of this solid waste depends of phosphate ore processed, and it is basically  $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$ , metals and residual acidity. The management of this waste is a challenge because of their characteristics and large amounts produced (5kg per 1kg phosphoric acid). Usually it is disposed in stacks near plants, however phosphogypsum can be leachate and its components run-off contaminating the near waters bodies. Recently, new disposition and treatments has been researched aiming re-use and recovery of materials from phosphogypsum. The current work investigated biogenic sulphate reduction in a lab-scale fluidized bed reactor fed with a saturated-calcium sulphate Postgate medium. After, these biogenic sulphide can be used to produce elemental sulphur or as precipitant agent for transition metals removal from industrial wastewaters. Initially the exchange of the sulphate source from  $\text{Na}_2\text{SO}_4$  to  $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$  was assessed, which revealed that bicarbonate ions were required in the growth medium because  $\text{CaCO}_3$  precipitation reduced alkalinity in the reactor. Subsequently, the effect of  $\text{COD}/\text{SO}_4^{2-}$  mass ratio (1.3 and 1.8) on sulphate bio-reduction was assessed, whereas the highest removal ( $72 \pm 16\%$ ) was observed for the  $\text{COD}/\text{SO}_4^{2-}$  ratio of 1.8 and resulted in a specific sulphate removal rate of a  $0.244 \pm 0.03 \text{ gSO}_4^{2-}/\text{gVSS} \cdot \text{d}$ .*

**Keywords:** calcium sulphate Di-hydrate, sulphate reduction, sulphate-reducing bacteria, fluidized-bed reactor

<sup>1</sup> Departamento de Engenharia Metalúrgica e de Materiais, Escola de Minas, Universidade Federal de Ouro Preto, Brasil.

\*Autor correspondente: Departamento de Engenharia Sanitária e Ambiental, Escola de Engenharia, Universidade Federal de Minas Gerais. Rua Maria da Conceição de São José, 206/Apto1103, Centro, Contagem, Minas Gerais. CEP 32041-300. Brasil.

Email: [lucasant.melgaco@gmail.com](mailto:lucasant.melgaco@gmail.com)

# REVISTA AIDIS

de Ingeniería y Ciencias Ambientales:  
Investigación, desarrollo y práctica.

## INFLUÊNCIA DO ALQUILBENZENO LINEAR SULFONATO NA PERFORMANCE DA CÉLULA COMBUSTÍVEL MICROBIANA

Renata Cristina Galera<sup>1</sup>

Ana Carolina Vieira Araújo<sup>1</sup>

Moema Hausen<sup>2</sup>

Pierre Ferreira do Prado<sup>3</sup>

\* Iolanda Cristina Silveira Duarte<sup>1</sup>

## INFLUENCE OF LINEAR ALKYL BENZENE SULFONATES ON THE PERFORMANCE OF MICROBIAL FUEL CELLS

Recibido el 6 de febrero de 2018; Aceptado el 16 de octubre de 2018

### Abstract

Linear alkylbenzene sulfonate (LAS) is the most commonly used anionic surfactant in cleaning products. Due to its wide distribution in domestic and industrial wastewater, its presence in microbial fuel cell (MFC) was evaluated regarding the generation of electricity and removal of organic matter. A two-chambers, type "H", MFC was constructed in PVC, carbon cloths were used as electrodes and resistors of 100  $\Omega$  and 1 K $\Omega$  as external loads. The anode chambers were filled with synthetic substrate and soil, enriched with sodium acetate, was used as inoculum. The maximum power density generated by the MFC with LAS (MFC 2- 0.12 mW m<sup>-2</sup> and MFC 4- 1.31 mW m<sup>-2</sup>) was lower than the MFC without LAS (MFC 1 - 1.72 mW m<sup>-2</sup> and MFC 3- 2.48 mW m<sup>-2</sup>). Removal of organic matter was comparatively higher in the presence of LAS. Confocal laser scanning microscopy examinations carried out on the electrodes revealed that the anodes of the MFC operating with LAS presented less biofilm on it despite presenting the same bacterial diversity. We concluded that the LAS influenced the generation of electrical energy in these systems and it occurred more intensively when external load was 1 K $\Omega$ .

**Keywords:** bioenergy, detergents, electricity, organic material.

<sup>1</sup> Departamento de Biologia, Universidade Federal de São Carlos – Campus Sorocaba, Brasil.

<sup>2</sup> Departamento de Ciências Fisiológicas, Pontifícia Universidade Católica – Sorocaba, Brasil.

<sup>3</sup> Universidade Estadual Paulista, Brasil.

\*Autor correspondente: Departamento de Biologia, Universidade Federal de São Carlos, João Leme dos Santos, Km 110, SP 264, Zipcode 18052-780, Sorocaba, SP, Brasil. Phone +55 16 32295985. E-mail: [iolanda.duarte@gmail.com](mailto:iolanda.duarte@gmail.com)



# REVISTA AIDIS

de Ingeniería y Ciencias Ambientales:  
Investigación, desarrollo y práctica.

## AVALIAÇÃO DA IMPORTÂNCIA DO VOLUME ÚTIL DE RESERVATÓRIO ELEVADO PARA A DISTRIBUIÇÃO DE ÁGUA PARA ÁREA URBANA

\*Francisca Nara da Conceição Moreira<sup>1</sup>  
Augusto da Gama Rego<sup>2</sup>  
José Almir Rodrigues Pereira<sup>3</sup>

### EVALUATION OF THE IMPORTANCE OF USEFUL VOLUME OF HIGH RESERVOIR FOR THE DISTRIBUTION OF WATER FOR URBAN AREA

Recibido el 8 de marzo de 2018; Aceptado el 7 de junio de 2019

#### Abstract

*The importance of the useful volume of high reservoir for hydroenergetic efficiency in urban water supply systems. The research was carried out in the Guanabara, Ananindeua, Belém, Pará Pumping and Reservation System. The work was divided into three stages, namely, the determination of the Guanabara Sector Flow Hidrogram. In the second stage, the hydroenergetic conditions of the operating volume of the reservoir system were analyzed. And in the third step the cost analysis of the hydroenergetic conditions of the useful volume of the elevated reservoir was carried out. In the research it was verified that the useful volume of the high reservoir of the Guanabara Sector does not allow the reduction of water pumping at the peak hour, which, naturally, influences the value of the electric energy expense and that the high reservoir was being used as "junction box". Thus, there is a need to study alternatives with the purpose of modifying the current operating situation of the Guanabara Sector's reservation unit, aiming at reducing electricity consumption and expenditure.*

**Keywords:** ananindeua, Useful volume, water distribution tank, urban área.

<sup>1</sup> Programa de Pós-Graduação em Engenharia Civil, Universidade Federal do Pará (UFPA), Brasil.

<sup>2</sup> Faculdade de Engenharia Sanitária e Ambiental, Universidade Federal do Pará (UFPA), Brasil.

<sup>3</sup> Instituto Federal do Pará, Brasil.

\* Autor correspondiente: Instituto de Tecnologia da Universidade Federal do Pará (PPGEC/ITEC), Universidade Federal do Pará – UFPA. Email: [naramoreira2012@gmail.com](mailto:naramoreira2012@gmail.com)



# REVISTA AIDIS

de Ingeniería y Ciencias Ambientales:  
Investigación, desarrollo y práctica.

## AVALIAÇÃO DA QUALIDADE DAS ÁGUAS EM POÇOS DESTINADOS AO ABASTECIMENTO PÚBLICO NO NOROESTE DO RIO GRANDE DO SUL

Pedro Carvalho de Mendonça<sup>1</sup>

\* Ramiro Pereira Bisognin<sup>2</sup>

Márlon de Castro Vasconcelos<sup>2</sup>

Eduardo Lorensi de Souza<sup>2</sup>

Robson E. Gehlen Bohrer<sup>2</sup>

## EVALUATION OF WATER QUALITY IN WELLS FOR PUBLIC SUPPLY IN THE NORTHWEST OF RIO GRANDE DO SUL

Recibido el 13 de marzo de 2018; Aceptado el 10 de junio de 2019

### Abstract

*Contamination of groundwater may be associated with several factors such as intensive use of soil, inadequate management of animal and human waste, irregular waste disposal, among others. With this concern, the present study aimed to evaluate the physical-chemical and microbiological quality of wells destined for human consumption in a municipality in the Northwest of Rio Grande do Sul. The study was conducted in Nova Candelária, with the collection of groundwater in 20 wells of the municipality. The analyzed parameters were: pH, nitrate, alkalinity, total dissolved solids, turbidity, electrical conductivity, total coliforms and Escherichia coli, which were compared with Consolidation Ordinance N° 5 (CO n° 5), Annex XX. From the results of the physical-chemical parameters, isoteor maps were prepared for information spatialization, as well as the groundwater classification according to CONAMA Resolution n° 396/2008. Thus, 35% of the wells presented pH values higher than 9, in disagreement with CO n° 5. The values of nitrate, alkalinity, total dissolved solids and turbidity were within the ranges indicated by current legislation. Regarding the microbiological parameters, 65% of the wells presented contamination by total coliforms and/or by E. coli. Only 35% of the studied wells can have water classified as class 1 by the CONAMA resolution, highlighting the importance of conducting studies such as this to improve water management.*

**Keywords:** groundwater, human consumption, contamination.

<sup>1</sup> Fundação Estadual de Proteção Ambiental do Rio Grande do Sul, Brasil.

<sup>2</sup> Universidade Estadual do Rio Grande do Sul, Brasil.

\* *Autor correspondente:* Universidade Estadual do Rio Grande do Sul. Rua Cipriano Barata, n° 211. Três Passos, CEP: 98600-000, Rio Grande do Sul, Brasil. Email: [ramirobisognin@yahoo.com.br](mailto:ramirobisognin@yahoo.com.br); [pcmendonca@yahoo.com.br](mailto:pcmendonca@yahoo.com.br)



# REVISTA AIDIS

de Ingeniería y Ciencias Ambientales:  
Investigación, desarrollo y práctica.

## ANÁLISE ORGANOLÉPTICA (COR E GOSTO) DA ÁGUA FORNECIDA PELO SISTEMA PÚBLICO DE ABASTECIMENTO DO MUNICÍPIO DE ITABAIANA/SE

\*Tháisa Lima Santos<sup>1</sup>  
Neuma Rubia F. Santana<sup>2</sup>

### ORGANOLEPTIC ANALYSIS (COLOR AND TASTE) OF THE WATER SUPPLIED BY THE PUBLIC SUPPLY SYSTEM OF THE MUNICIPALITY OF ITABAIANA / SE

Recibido el 23 de marzo de 2018; Aceptado el 7 de junio de 2019

#### Abstract

*Water plays a key role for human survival and for the development of societies, and then access to safe drinking water is an essential human right. Therefore, it is very important to have drinking water in all residences for both consumptions, as well as for handling at the time of cooking etc. It is known, however, that there is a deficiency regarding the treatment of water and, due to this fact, this work had the objective to make water samples from the kitchen faucet to do analysis of the parameters color and taste, parameters such potability indicators from water. Regarding the results of the analyzes, the potable water ordinances 518/2004 and 2,914 / 2011 were used to make the comparative, besides the analysis was applied questionnaires on the services of the concessionaire that makes the water supply as well as his taste. By combining the results of the analyzes compared with the potability assessments with the answers of the questionnaires, it was concluded that there is a deficit in the treatment of the water supplied to the residences.*

**Keywords:** public supply, potability, water resources.

<sup>1</sup> Faculdade Pio Décimo. Campus Jabotiana, Aracaju, Sergipe, Brasil.

<sup>2</sup> Programa de Pós-Graduação em Desenvolvimento e Meio Ambiente, Universidade Federal de Sergipe, Campos São Cristovão, Aracaju, Sergipe, Brasil.

\* *Autor correspondente:* Faculdade Pio Décimo. Campus Jabotiana, Sergipe, Brasil. Departamento de Engenharia Civil. Av. Tancredo Neves, 5655, Bairro: Jabotiana - Aracaju/SE., Brasil. Email: [eng.civil.thaisa@gmail.com](mailto:eng.civil.thaisa@gmail.com)

La *Revista AIDIS Ingeniería y Ciencias Ambientales: Investigación, desarrollo y práctica* agradece a los siguientes revisores su valioso apoyo en el proceso de evaluación 2019:

Adilson Ben da Costa, Brasil	Denise Helena França Marques Maia, Brasil
Alejandra Martín Domínguez, México	Eduardo Cohim, Brasil
Alejandro Padilla-Rivera, Canadá	Edwin Alvaro Zuleta Iturri, Brasil
Alejandro Vargas Casillas, México	Elaine Regina Lopes Tiburtius, Brasil
Alexandre Augusto Barbosa, Brasil	Eliane Viviani, Brasil
Alfredo Ribeiro Neto, Brasil	Elisangela Maria Rodrigues Rocha, Brasil
Alice Rocha de Souza, Brasil	Emanuel Manfred Freire Brandt, Brasil
Aline Ferrão Custodio Passini, Brasil	Enrique César Valdez, México
Aline Maria Constantin, Brasil	Erika Viviana Miranda Mandujano, México
Aline Maria Meiguins de Lima, Brasil	Esperanza Ramírez, México
Aline Renee Coscione, Brasil	Evangelina Ramírez Lara, México
Alma Concepción Chávez Mejía, México	Fabián Robles Martínez, México
Álvaro Luiz Cantanhede, Brasil	Facundo Iturmendi, Argentina
Ana Barbara de Araújo Nunes, Brasil	Fernanda Sola, Brasil
Ana Lucia Britto, Brasil	Fernando Jorge Correa Magalhães Filho, Brasil
Ana Silvia Pereira Santos, Brasil	Fernando José Araújo da Silva, Brasil
Andrea Sartori Jabur, Brasil	Francianne Vieira Mourão, Brasil
Ann Honor Mounteer, Brasil	Francisca Nara da Conceição Moreira, Brasil
Antonio Ludovico Beraldo, Brasil	Francisco Humberto de Carvalho Junior, Brasil
Antonio Thomé, Brasil	Frederico Yuri Hanai, Brasil
Armando Borges de Castilhos Junior, Brasil	Gabriela E. Moeller-Chávez, México
Arthur Couto Neves, Brasil	Gerardo Javier Arista González, México
Artur Paiva Coutinho, Brasil	German Cuevas Rodriguez, México
Bibiana Cercado Quezada, México	Germário Marcos Araújo, Brasil
Britt-Marie Steenari, Suecia	Gilson Barbosa Athayde Júnior, Brasil
Bruna Fernanda Faria Oliveira, Brasil	Gina Rizpah Besen, Brasil
Carlos Alberto Mendes Moraes, Brasil	Girlene Figueiredo Maciel, Brasil
Carlos Ernando da Silva, Brasil	Gislayne Alves Oliveira, Brasil
Carlos Eugenio Pereira, Brasil	Gloria Moreno Rodríguez, México
Carlos Hoffmann Sampaio, España	Grasiele Soares Cavallini, Brasil
Celso Luiz Franzotti, Brasil	Gray Farias Moita, Brasil
Cláudio Antonio Di Mauro, Brasil	Guiherme Henrique Cavazzana, Brasil
Claudio José Cavalcante Blanco, Brasil	Guilherme Araujo Pimentel, Brasil
Crispín Herrera Portugal, México	Guillermo Goyenola, Uruguay
Cynthia Fantoni Alves Ferreira, Brasil	Gustavo Hnerique Ribeiro da Silva, Brasil
Daniela Chiarello Fastofski, Brasil	Gustavo Solórzano Ochoa, México
Danni Maisa da Silva, Brasil	Harry Alberto Bollmann, Brasil
Darci Barnech Campani, Brasil	Heinrich Hasenack, Brasil

- Hugo Henrique de Simone Souza, Brasil  
Idania Valdez Vazquez, México  
Isaac Yanqui Morales, Perú  
Iván Andrés Sánchez Ortiz, Colombia  
Ivete Vasconcelos Lopes Ferreira, Brasil  
Ixbalank Torres, México  
Izabelle Ferreira, Brasil  
Jaqueline Aida Ferrete, Brasil  
Jean Carlos Machado Alves, Brasil  
Jennifer Alexis Bañuelos Díaz, México  
Joana Tereza Vaz de Moura, Brasil  
João José Hiluy Filho, Brasil  
Joel Avruch Goldenfum, Brasil  
Joel Carlos Zukowski Junior, Brasil  
Jonas de Sousa Correa, Brasil  
José Almir Cirilo, Brasil  
José Avidán Bravo Jácome, México  
José Capelo Neto, Brasil  
José Carlos Alves Barroso Júnior, Brasil  
Juan Alfredo Jácome Burgos, Ecuador  
Juan Gabriel Garcia Maldonado, México  
Julian Carrillo Reyes, México  
Juliana Delgado Tinôco, Brasil  
Juliano Rodrigues Gimenez, Brasil  
Julio Cesar Bizarreta Ortega, Brasil  
Katiucia Nascimento Adam, Brasil  
Kevin Antonio Zepeda, El Salvador  
Leonardo Silveira Conke, Brasil  
Lidia Rangel Blanco, México  
Lina Cardoso Vigueros, México  
Lina Marcela Cárdenas Cleves, Colombia  
Lisete Celina Lange, Brasil  
Lisiane Ilha Librelotto, Brasil  
Lorena Jorquera Martinez, Chile  
Lucas Virgens Dos Santos, Brasil  
Luciana Rezende Alves de Oliveira, Brasil  
Luciano Matos Queiroz, Brasil  
Luís Eduardo Azevedo Modler, Brasil  
Luis Miranda, Brasil  
Luisa Helena Dos Santos Oliveira, Brasil  
Luiz Flavio Autran Monteiro Gomes, Brasil  
Manfred Fehr, Brasil  
Marcel Szanto Narea, Chile  
Marcelo Costa Santos, Brasil  
Marcelo Pereira, Brasil  
Márcia Maria Dos Anjos Mascarenha, Brasil  
Marcio Ricardo Salla, Brasil  
Marcos Adami, Brasil  
Maria Adriana de Freitas Mágero Ribeiro, Brasil  
Maria Cristina de Almeida Silva, Brasil  
Maria Cristina Schiappacasse Dasati, Chile  
María Neftali Rojas Valencia, México  
Marianne Fidalgo de Faria, Brasil  
Marion Cunha Dias Ferreira, Brasil  
Marisol Andrea Belmonte Soto, Chile  
Marta Regina Lopes Tocchetto, Brasil  
Marta Siviero Guilherme Pires, Brasil  
Martín Barragán Trinidad, México  
Maurício Alves da Motta Sobrihno, Brasil  
Miguel Ángel Vital Jácome, México  
Miriam de Fátima Carvalho Machado, Brasil  
Miriam de Fátima Carvalho, Brasil  
Neyson Martins Mendonça, Brasil  
Nicolás Reinaldo Finkelr, Brasil  
Orencio M. Vilar, Brasil  
Orlando de Carvalho Junior, Brasil  
Oscar González Barceló, México  
Pablo Heleno Sezerino, Brasil  
Patrícia Campos Borja, Brasil  
Patricia Freire Chagas, Brasil  
Pedro Augusto Pinheiro Fantinatti, Brasil  
Pedro de Souza Quevedo Neto, Brasil  
Pilar Tello Espinoza, México  
Rafael K X Bastos, Brasil  
Raphael Corrêa Medeiros, Brasil  
Régia Lúcia Lopes, Brasil  
Renata de Oliveira Pereira, Brasil  
Renato de Oliveira Fernandes, Brasil  
Ricardo Ferreira Carlos de Amorim, Brasil  
Rita de Cássia Pompeu de Sousa, Brasil  
Rodolfo Sosa Echeverría, México  
Rodrigo Bordignon, Brasil  
Ronan Cleber Contrera, Brasil  
Sandra Maria Feliciano de Oliveira E Azevedo, Brasil



Santiago D. Salas, Ecuador  
Sergio Francisco de Aquino, Brasil  
Sivia Gelover, México  
Thâmara Martins Ismael de Sousa, Brasil  
Tiago Luis Gomes, Brasil  
Valderi Duarte Leite, Brasil  
Valéria Cristina Palmeira Zago, Brasil  
Victor Manuel Luna Pabello, México  
Viviane Trevisan, Brasil  
Wanderli Rogerio Moreira Leite, Brasil  
Wellington Cyro de Almeida Leite, Brasil