

XXV SEMANA DE LA FACULTAD DE *Arquitectura e Ingeniería*

Nombre de la actividad

Presentaciones Proyecto de Investigación
Ingeniería Ambiental

Curso

Proyecto de Investigación

Docentes

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Programa

Ingeniería Ambiental

Objetivos de la actividad

Sustentar los resultados finales de Proyecto de
Investigación de los estudiantes de Ingeniería
Ambiental

Productos a divulgar

Resúmenes de las presentaciones
desarrolladas por cada grupo



Evaluation of phosphorus solubilization efficiency with *Trichoderma* sp. and *Aspergillus* sp. in soils with contrasting mineralogy.

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Abstract: Phosphorus (P) is essential for plants and has low availability in soil. An alternative to meet this need is the use of fungi that solubilizes P. No emphasis has been placed on the influence of soil mineralogy. The purpose of this research was to evaluate the effect of soil mineralogy on the efficiency of P solubilization by *Aspergillus* sp., and *Trichoderma* sp. **Methods:** Two fungal was isolated and selected for their *in vitro* efficiency in solubilizing rock phosphate (RP). P solubilization analysis were performed by inoculating the fungal strain with and without RP on three type of soils (Andisol, Vertisol, Entisol) and the without soil (WS) as the control treatment. Molecular and phylogenetic analysis was performed using ITS1 and ITS4 universal primers. Analyses of variance (ANOVA) and multiple comparison tests (LSD All-Pairwise Comparisons Test) were performed to compare mean values for the different factors and variables analyzed ($p < 0.05$) using Statistic 8. **Results:** *Aspergillus awamori* presented a concentration of P in a solution of 5.5 mg L^{-1} in the WS/RP⁺ treatment; while *Trichoderma crassum* 7.2 mg L^{-1} in the Vertisol/RP⁺ treatment **Conclusions:** The efficiency of P solubilization depends on the mineralogy of the soil.

Keywords: Solubilization of RP, *Aspergillus* sp., *Trichoderma* sp., Vertisol, Entisol, Andisol, DNA.



Formulation and Evaluation of Biochar Encapsulation with Beneficial Microorganisms for Promoting Plant Growth

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Abstract: This research aimed to evaluate the effect of biochar combined with beneficial microorganisms on nutrient availability and the growth of Guinea grass, a high-value forage species in livestock production. Two formulations of biochar with *Bacillus megaterium* were developed: one encapsulated in a sodium alginate matrix and another manually granulated. To assess biosolubilization capacity, parameters such as pH change, electrical conductivity, and the proportion of solubilized biochar were measured. Results showed that *Bacillus megaterium* significantly reduced the pH of the medium, indicating the production of acidic compounds associated with nutrient release, and achieved the highest solubilization proportion compared to the control. In greenhouse trials, the encapsulated biochar treatment promoted greater plant height, leaf width, and biomass in Guinea grass, outperforming both the granulated biochar and the untreated control. Moreover, this treatment demonstrated a more stable response over time. The findings highlight the potential of using biochar in combination with beneficial microorganisms as a sustainable alternative to improve soil fertility and forage productivity, reducing the reliance on conventional chemical inputs in agricultural systems.

Keywords: Biochar - Plant growth - Encapsulated formulation - Microorganisms - Agricultural productivity - Sustainability.



Stabilization of a quarry sludge with calcium carbonate bioprecipitation induced by *Bacillus* spp.

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Abstract: Quarry sludge is a byproduct of aggregate mining with few alternatives for valorization. One potential method for achieving this is microbial-induced calcium carbonate precipitation, an enzymatic biological method that uses urease to catalyze the decomposition of urea into ammonium and carbon dioxide, forming crystals with calcium ions; these crystals improve soil properties. However, this process is limited by the soil's particle size and organic matter content, and by the limited control over ammonium production, a compound that is toxic in soil at high concentrations. The objective is to evaluate the conditions for calcium carbonate precipitation in quarry sludge using three strains of *Bacillus* spp., fed with urea, $\text{Ca}(\text{OH})_2$, and CaSO_4 ; pH, CFU, and total calcium variables were monitored at 3, 7, 14, 28, and 42 days. The results showed positive effects of adding calcium sources on bacterial growth and increasing pH. *Bacillus* spp. demonstrated high competitiveness, which favors crystal formation; a direct and positive relationship was identified between calcium addition, increased pH, and calcium precipitation over longer periods of time, due to increased calcium concentration. Treatment with *Bacillus Mycoides* #6 (C2) and calcium hydroxide on day 42 yielded the best results.

Keywords: Bioprecipitate, Ureolytic bacteria, Circular economy, Aggregate mining, By-product valorization.



Study of perceptions and expectations regarding the provision of cleaning services in solid waste management by merchants in the Manila neighborhood.

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Abstract: The research evaluated the perception and expectations of the merchants of the Manila neighborhood, Medellín, regarding the quality of the public sanitation service, with emphasis on solid waste management, through a qualitative and descriptive approach. The Manila neighborhood has undergone changes in its land use, going from being a residential sector to a mixed sector of commercial and tourist services. These changes have brought with them an increase in the generation of solid waste, which has generated problems in the disposal of waste for collection, collection schedules, visual impact, rodent problems, among others. To evaluate the quality of the service, initially a documentary review was carried out to determine the factors of compliance of the public sanitation services company. Subsequently, a survey based on the SERVQUAL model was applied to a representative sample of 67 users, determined by simple random sampling. The results reveal a service quality index (SQI) of -0.720, indicating a significant deficit in the perception of quality compared to expectations. The most critical dimensions identified were “tangible elements” and “reliability”, associated with obsolete equipment, inadequate infrastructure and lack of compliance with collection schedules. The increase in waste generation, driven by the neighborhood's transition to a commercial and tourist sector, aggravates problems such as the disposal of waste in the neighborhood

Keywords Appreciation; Quality; Population; Solid Waste; users.



Water quality analysis in some self-managed sources in Commune 1 of Medellín.

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Abstract:

The objective of this project was to analyze water security with emphasis on water quality in some sources in Comuna 1 of the District of Medellín, which use self-managed sources for domestic activities. Seven (7) water sources used by the community were identified and georeferenced. It was found that some of them could be related to infiltration water or runoff from sources.

Of these, four (4) sources were selected for analysis: La Avanzada rainwater catchment, La Avanzada community aqueduct, Manantial and Nacimiento Los Chorros, both in Barrio Popular 1. Microbiological variables (total and fecal coliforms (*E. coli*), fecal *Enterococcus*, *Pseudomonas* and *aeruginosa* and mesophiles) and physicochemical parameters (turbidity, alkalinity, pH and conductivity) were evaluated at six (6) times during the years 2024 and 2025. The results indicated that Manantial Popular 1 and Nacimiento Los Chorros comply with the physicochemical parameters, but the two sources in Barrio La Avanzada exceed the turbidity limits established by Resolution 2115 of 2007.

As for microbiological quality, all samples showed contamination, so the water is not suitable for human consumption. Finally, the results will be shared with the community along with recommendations for the safe use of the resource.

Keywords:

Water quality, fecal coliforms, total coliforms, physical-chemical analysis, Water Quality Indexes.



Analysis of Sustainability Indicators in Colombian Beverage, Agro-industrial, and Food Companies (2022–2023) According to GRI Standards

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Abstract: Sustainability reports are gaining increasing importance among companies, organizations, countries, and stakeholders as they seek to demonstrate their commitment to environmental, social, and governance (ESG) actions outlined in the United Nations 2030 Agenda for Sustainable Development Goals (SDGs). This study aims to examine the disclosure of environmental and social information in the sustainability reports from 2022–2023 issued by companies in the beverage, agro-industrial, and food sectors in Colombia, using the GRI Standards as a reference. To achieve this objective, several steps will be undertaken, including the identification of companies that publish sustainability reports in accordance with the GRI Standards and are listed in the Merco ranking under the category of Most Responsible Companies, as well as the review of each report to identify the most frequently reported indicators. Ultimately, this study seeks to identify the most common indicators in the sustainability reports of Colombian companies in the aforementioned sectors and to offer recommendations to enhance the understanding of the importance of disclosing environmental and social performance in such reports.

Keywords: Sustainability, Disclosure, Indicator, Sustainability Report, Environmental, Social.



Risk Assessment of Human Health and Environmental Hazards Associated with Gold Mining Environmental Liabilities (GMELs) in the Bajo Cauca Region of Antioquia.

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Abstract: The research project focuses on the categorization and prioritization of Gold Mining Environmental Liabilities (GMELs), specifically on tailings and their potential influence on the environment and human health in the municipalities of Nechí, El Bagre and Zaragoza, in the department of Antioquia, Colombia. Tailings dams, which are waste deposits generated during gold mining, represent a significant environmental risk due to the possible release of Potentially Toxic Elements (PTE) such as As, Cd, Cu, Zn, Mn, Pb and Cr into nearby soils and water sources. For risk categorization, the methodology of the Geological Survey of Spain described in the “Manual for risk assessment of decommissioned or abandoned extractive industry waste facilities” was applied, which considers the Probability Index (PI) and the Severity Index (SI) to estimate the Risk Index. Ninety-two soil samples collected at the three locations were analyzed, focusing on As, Cd, Pb and Cr concentrations. The results show that 72.83% of the samples exceed natural soil levels, with lead being the most critical element, with concentrations up to 50 times above the reference values. The municipality of El Bagre showed high levels of contamination, possibly due to its intense formal mining activity. Although 78.3% of the evaluated cases reflect a low risk level, constant monitoring is recommended to guide environmental management and public health protection actions.

Keywords: Geospatial analysis, risk analysis, potentially toxic elements, mine tailings.



Design and evaluation of a real-time data acquisition system for decision-making in an activated sludge reactor.

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Abstract: Improper wastewater management poses a risk to public health and the environment. Among secondary treatment systems, activated sludge stands out for its efficiency in degrading pollutants using biomass. However, the lack of real-time monitoring of key variables such as total suspended solids (TSS) and volatile suspended solids (VSS) can affect its operational performance. This study presents the design, construction, and evaluation of an indirect biomass sensing system to obtain real-time data and optimize the operation of an activated sludge reactor, based on nephelometric turbidity measurement using a white-light LED and a 90° light-dependent resistor (LDR) sensor. The reactor was redesigned to optimize data acquisition and improve aeration, mixing, and structural conditions for accurate data capture.. A waterproof housing was created to reduce light interference. Finally, tests were conducted with soil, anaerobic sludge, and aerobic sludge to compare the LDR sensor data with a laboratory turbidimeter; the anaerobic sludge was discarded due to interference from its strict operating conditions. Then, using only the aerobic sludge, the correlation between the LDR and TSS and VSS values was evaluated, obtaining accuracy of 95%. The LDR sensor proves to be an economical and reliable option for biomass monitoring, promoting efficient and sustainable water treatment.

Keywords: wastewater, activated sludge, biomass, turbidity, sensor.