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Book of Abstracts

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Contribution to numerical study of combined heat and moisture transfers in porous building multilayer walls made of local material in dry tropical climate

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Building materials, being porous media, are subject to heat and moisture transfer, when they are submitted to variables external temperature and relative humidity conditions. The moisture flow can degrade the materials thermal performances and then increase the need of energy to maintain the building interne comfort. In order to make a judicious choice of adapted materials to dry tropical environment, it's necessary to analyze and predict the hygrothermal behavior of available materials in presence of these flows. A mathematic model describing the combined heat and moisture transfer was implemented in COMSOL5.3a software to simulate the hygrothermal behavior of three type of local materials-based walls, such us cement blocks, cut lateritic block, and compressed earth block, all coated with cement mortar. To do this, these various walls were successively exposed to external static and cyclical temperature and relative humidity corresponding to general conditions of local climate. From this simulation, it appears that the compressed earth block-based wall gives the best hygrothermal comfort. In fact, under cyclical solicitation, its thermal inertia enables it to reduce the variation of internal temperature by 68% and 66% respectively in wet and dry period, and its hygric inertia reduce the variation of relative humidity by 70% and 68% respectively at wet and dry period. In addition, for the compressed earth blocks based walls, under static solicitation, the variation of internal temperature in 4,74℃ in wet period and 2.89℃ in dry period, i.e. -20.06% and -29.93% on average compared respectively to cement block and cut lateritic blocks based walls, and the relative humidity is 12.86% in dry periods and 7.93% in wet periods, i.e. -17.72% and -25.86% respectively compared to cement blocks and cut lateritic blocks based walls.

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ANALYSIS OF THE STABILITY OF TAILINGS DAMS IN A SAHELIAN CONTEXT: THE CASE OF THE SANBRADO MINE IN BURKINA FASO

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The SANBRADO mine tailings storage facility has been installed in a river, so we note a habitual presence of water on the south and south-east sides of the tailings storage facility. Also, the existence of power poles on the northeast side of the dam prevented the embankment from being sloped as originally planned.

The aim of this study is to carry out numerical modelling using Geostudio software to analyse the stability of the embankment in general, and to carry out electrical tomography to identify any fractures and cavities, and to check the state of the subsoil.

The electrical prospecting method used in this study is based on measuring the apparent resistivity

of the ground to the passage of an electric current. Numerical simulations were carried out using the SLOPE/W code.
The safety factor values were calculated using the Fellenius method, the simplified Bishop method and the Morgenstern method, all of which are based on the limit equilibrium method.
Diagonal profiles were used to obtain a cross-section of the dike. The overall resistivity values are low to medium. However, there are high resistivities in some areas. This variation in electrical resistivity across the embankment indicates a multi-layered structure of the fill and the nature of the materials used.

Key words: Stability, embankment, electrical tomography

3

The activity of metal ions impregnated on natural phosphates from Burkina Faso for the synthesis of chalcone in a green solvent.

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The Claisen-Schmidt condensation is one of the most important catalytic reactions for syntheses developed in the 20th century. Generally, this condensation is carried out with or without a toxic solvent in the presence of a catalyst. This research focused on the use of a green solvent (water) for the Claisen-Schmidt condensation reaction, improved by catalysts based on simple natural phosphate (PNc), natural phosphate impregnated with potassium (K- PN) or zinc (Zn-PN). The study highlighted the significant improvement in the catalytic activity of these catalysts in water. The optimal reaction conditions were also determined, taking into account factors such as quantity, reaction kinetics, solvent volume, reuse and the effect of the metal ions used. Additionally, the stability of these catalysts has been demonstrated across numerous reaction cycles, highlighting their reuse potential. The results showed that the catalysts developed are effective for the Claisen-Schmidt condensation reaction, under specific conditions in the presence of a green solvent (water).

Keywords: heterogeneous catalyst, phosphate, environment, green chemistry.

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Soil water dynamics under drip irrigation : potential water losses through deep drainage

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Due to water resources scarcity, reasonable water available management has become essential in arid and semi arid regions. Drip irrigation is increasingly used in irrigated agriculture because of its productivity and water savings. However, water may still be lost through deep percolation. In this work, HYDRUS software is used to simulate water movement coupled with heat transport in a sandy-textured soil column under four (04) low-pressure drip irrigation water treatments (two deficit 50%ETc, 75%ETc, one normal 100%ETc, and one surplus 150%ETc), in order to assess potential water losses through deep drainage over the 110-day cycle of an intermediate maize variety. The soil column is subject to atmospheric boundary conditions (minimum and maximum air temperatures,

relative humidity, global radiation, sunshine duration, and wind speed) and variable flux (representing the drip emitter) at its surface, zero flux of water and heat on its lateral side and free drainage at its bottom boundary. The results show that the deficit treatments of water, in particular 50%ETc, although causing losses, make it possible to reduce water losses by drainage. For a sandy soil, with a daily irrigation frequency, applying water at 50%ETc and 75%ETc considerably reduces water loss through deep drainage.
Keywords: Drip irrigation, Water dynamics, Free drainage

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Development and characterisation of clay nanoparticles for use in removing Cr(VI) from water.

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Background :
 Kaolinite is a lamellar clay with interesting properties due to its layered structure.
structure.
 Nano clays have more interesting properties than raw natural clays due to their large
because of their large specific surface areas. These nano clays are intended for use in
purification of wastewater contaminated by heavy metals.
 The tanning industry uses large quantities of chromium, and the wastewater it discharges is a source of pollution for the environment.
is a source of environmental pollution by chromium in all its forms.
forms.

Problematic :
The main objective of this project is to develop nano kaolinites from a natural clay rich in kaolinite and then use it to remove chromium (VI) from wastewater. Chromium (VI) is one of the most dangerous pollutants present in wastewater, generally originating from tanneries. Kaolinite, as a nano-structured material with a low surface charge, can offer advantages in the retention of anionic chromium (VI).

The research work will focus mainly on:
 Methods for producing nano kaolinites from a kaolinite-rich clay;
 Characterisation of the product obtained to ensure the clay's sheet structure: morphology
morphology, mineralogical composition and other properties will be assessed using the following
following characterisation techniques:
 XRD ;
 IR;
 SEM-EDX ;
 BET ;
 ICP.
 Evaluation of the effectiveness of nano kaolinites in the removal of chromium (VI) from wastewater.
To do this, certain parameters such as pH, contact time, dose of nano kaolinite

Expected results:
As a result of this work, we expect to obtain nano kaolinites with a sheet structure and a very large specific surface area that are highly effective in removing chromium (VI) from wastewater.

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Estimation of evaporation from the surface energy balance for soil in a tropical environment.

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Abstract. Nowadays, the estimation of the evaporative flow is a challenge for researchers, given its essential place in the energy and hydrological balance and its implication in the processes of effective and efficient management of water resources. Indeed, the precise quantification of the transfer of energy and mass during the evaporation of water from the soil is essential to improve the understanding of the hydrological cycle and for numerous applications in the fields of environment, agriculture and engineering. Drying of the soil under boundary radiation conditions results in the formation of a dry surface layer, which is accompanied by a shift in the position of a latent heat front from the surface to the subsurface. Thus, detailed study of evaporation dynamics in this near-surface active zone has been mainly limited to modeling, with few measurements available to test the models. The objective of our communication is to estimate the dynamics of the evaporative flow from the energy balance at the surface of an arid soil in the Sahelian zone under different scenarios. The modeling concerns the coupled transfers of liquid water, water vapor and heat is done for a sandy soil with little plant cover. This model is used to evaluate the energy balance at the soil surface and reported by the evaporative flow. This method makes it possible to dispense with very expensive devices for measuring evapotranspiration on agricultural soils such as Eddy covariance. The data used in this study were collected at a measuring station in Saaba, on the outskirts of Ouagadougou, Burkina Faso.

Keywords : evaporative flow, energy balance, soil surface, arid zones, water resources

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Geotechnical characterization of excavated soils for reuse as road embankments and subgrades

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In this paper, we present a geotechnical study of excavated soil from a road construction site in Ouagadougou. The excavated material is transported to dumps to make way for lateritic gravel from borrow sites. However, the increasing distance and scarcity of these sites, as well as the costs associated with transport and environmental impacts, are encouraging in-situ soil reuse after thorough geotechnical analysis. The first phase of this study, described here, focused on a physical analysis of the soil, including determination of solid particle density, methylene blue value, morphological analysis, Atterberg limits, Proctor characteristics, CBR and IPI bearing capacity indices, saturation permeability, and retention curve. The results enabled us to classify this soil as F2 material according to GTR 2023, indicating that it can be reused as road embankments, except in the event of heavy or moderate rainfall. Its use in its current state requires intense compaction for low-level embankments (≤ 5 m). However, due to the water-sensitivity of these soils due to the clay fraction they contain, treatment is often required for use in subgrades. These soils are generally treated in situ.

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Mathematical analysis and numerical modeling of mass transfer processes and density flows using the mixed finite element method.

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Saltwater intrusion occurs extensively in coastal zones, which are variably saturated porous media. Consequently, dissolved salts are the most common contaminants in freshwater in coastal aquifers, and this contamination stems from saltwater invasion, caused mainly by human activities due to heavy urbanization. To investigate methods of increasing fresh groundwater storage and preventing seawater encroachment, it is crucial to predict the location and movement of the saltwater interface. Saltwater intrusion problems are so complex that they generally cannot be solved analytically. Consequently, numerical methods are ideal tools for simulating and predicting results.
In this paper, a mixed finite element method based on a triangular mesh is developed to analyze the evolution of saltwater intrusion in coastal aquifer systems. The model formulation consists of a groundwater flow equation and a salt transport equation. Simulation results are compared with previously published solutions, where good agreement is observed.

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Exploratory analysis of long-term meteorological data from Burkina Faso: anomaly detection and management.

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Abstract:
The availability of quality data is essential for scientific decision-support programs. For a poor country like Burkina Faso, which has implemented a vast development program through agro-sylvo-pastoral growth poles, the availability of quality agro-climatic data is a prerequisite for all prediction and practice optimization methods that will guide professionals to a good return on their investment. Unfortunately, Burkina Faso's long-term meteorological data present significant gaps, with missing observations and outliers, compromising their reliability for climate modeling and forecasting. This study explores anomalies in meteorological variables using exploratory analysis and machine learning methods. We characterize missing data and apply statistical techniques such as correlation, regression, principal component analysis (PCA) and mutual information analysis (MIA) to 41-year time series from 10 synoptic stations. The results obtained serve as a basis for developing anomaly management strategies aimed at improving the quality of meteorological megadata in Burkina Faso.

Keywords: weather data, exploratory data analysis, anomalies, missing data, machine learning