CIERTE

INTERNATIONAL CONFERENCE ON RENEWABLE ENERGIES AND WATER TECHNOLOGIES

JANUARY 25-27, 2024
BUMS, CASABLANCA, MOROCCO

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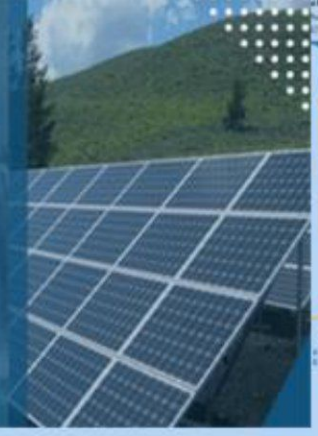

TOPICS

- RENEWABLE ENERGIES AND ENERGY EFFICIENCY
- WATER AND WATER STRESS MANAGEMENT
- GREEN TRANSITION AND SUSTAINABLE DEVELOPMENT

CIERTE 2024 book of Abstracts

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- ACCEPTED ARTICLES WILL BE PUBLISHED IN SCOPUS INDEXED JOURNALS AND BOOK

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Presentation

Hassan II University of Casablanca, in collaboration with the Association for Research and Development in Energy, Environment and Materials, and with the support of Hassan I University and Mohammed V University, is organizing the International Conference on Renewable Energy and Water Technology (CIERTE). The conference will take place from January 25 to 27, 2024, at the Mohamed Sekkat University Library (BUMS) in Casablanca, Morocco.

Energy and water are crucial domains addressed at the academic level, promoting responsible governance and transparency in these areas. CIERTE aims to be a cornerstone for scientific research and the transfer of new technologies and knowledge in these fields.

This event provides a valuable platform for economic actors, industrialists, decision-makers, NGOs, and national and international researchers from diverse countries, including Spain, Germany, Turkey, and Portugal. Participants can share best practices and experiences, learn about recent advancements and developments, and identify strategies for tackling various aspects of these two fundamental pillars of sustainable development.

A dedicated panel session titled "What synergy between the university, industrial, and associative environment for the promotion of low-carbon development and growth?" will feature discussions by distinguished professors and key experts.

Over 50 presentations will be presented and showcase scientific research on various conference topics, evaluated by a dedicated scientific committee.

Notably, around ten high-quality articles have already been accepted for publication in an indexed journal. Acceptance notifications have already been sent to the respective authors.

CIERTE promises certainly to be a dynamic and informative event fostering collaboration and knowledge exchange in the critical areas of renewable energy and water technology.

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ABSTRACTS

Topic 1

RENEWABLE ENERGIES AND ENERGY EFFICIENCY

Abstract 1.

ABONNER L'UTILISATION DU GAZ BUTANE AU MAROC : ETUDE ÉNERGÉTIQUE, ÉCONOMIQUE ET ÉCOLOGIQUE

Othmane Echarradi ***1 , Abdessamad Benlafkih 1, , Mounir Fahoume 1 , Abdelkader Hadjoudja 1,***

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La filière gazière au Maroc constitue un vrai fardeau pour les caisses du pays. Trouver solution à cette situation tarde à voir le jour en l'absence d'alternatives concrètes capables de combler un détachement total d'une source présente dans la quasi-totalité des foyers marocains et autres fermes d'élevage.

Cette transition pourrait être progressif ou soudaine selon les solutions mise à profit. Toutefois en vue des ambitions écologiques du Maroc en matière d'investissement en énergie renouvelables, la piste de l'électrification de cette source reste la plus plausible. Sur le plan environnementale cette métamorphose serait son aucun doute un vrai plus pour les objectifs à atteindre dans cette même perspective. En plus de déterminer la vraie portée écologique de cette manœuvre, les autres enjeux de cette étude sont d'éclairés l'opinion public intéressée par cette cause sur l'aspect économique, social, ainsi que les moyens mis à contribution pour irradier cette source d'énergie polluante et qui devra être mise de côté idéalement le plus tôt possible.

Mots clés: Filière gazière; alternatives énergétiques; transition énergétique ; électrification ; Ecologie ; Aspects économiques ; investissements ; objectifs environnementaux.

Abstract 2.

COMPARATIVE STUDY OF FOUR TYPES OF CLAY USED IN THE CERAMICS INDUSTRY: EFFECT OF FIRING TEMPERATURE ON THE PHYSICAL AND THERMAL PROPERTIES OF CLAY BRICKS

Walid Abouloifa 1, Mohammed Ettaki 2, , Sanaa Hayani Mounir 1,

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2 : Geosciences Semlalia Laboratory, Faculty of Sciences Semlalia, Cadi Ayyad University

The firing process has a direct and significant influence on the production cost of fired clay bricks. Physical properties (thermal conductivity, porosity, firing and drying shrinkage, density and loss on ignition) play an important role in determining the performance and durability of these bricks. The study of the effect of firing temperature on the physical properties of bricks involved four types of clay from three different geological sites. The distinct mineralogical composition of these clays shows a significant influence on the physical characteristics of the bricks. The bricks were fired at temperatures ranging from 850°C to 1050°C in 100°C increments. The impact of firing temperature on thermal conductivity, porosity, firing and drying shrinkage, density and loss on ignition was measured after each firing cycle. The results reveal that each type of clay has unique physical characteristics that influence the physical behavior of fired bricks. Brick thermal conductivity is influenced by the combined effect of clay type and firing temperature. This study has led to a better understanding of the relationship between firing temperature and the physical properties of clay bricks, facilitating decision-making in the ceramics industry.

Keywords: Firing Temperature; Ceramics; physical properties; Thermal conductivity.

Abstract 3.

CONTRIBUTION TO THE INFLUENCE OF SUNSPOTS ON SOLAR IRRADIANCE VARIABILITY DURING THE SOLAR CYCLE 24

Mohammed El Malki ***1, , Charaf Hajjaj 2, , Hamid Nebdi 1,***

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2 : Université Cadi Ayyad [Marrakech]

Solar irradiance is the fundamental driver of all climatic processes on Earth. Climate changes can be linked to variations in Total Solar Irradiance (TSI), the most important factor behind this variation being the number of sunspots.

In this study, we develop a link between experimental solar irradiance measurements and the influence of sunspots on daily solar irradiance variability. By using collected data during solar cycle 24 of solar instrumentation available at specialized observatories, we carried out a detailed statistical analysis of sunspots to assess their relationship to solar irradiance. Our results show a strong correlation between sunspot activity and variations in solar irradiance. Periods of intense sunspot activity were associated with an increase in solar irradiance, while periods of low sunspot activity showed a decrease in solar irradiance. By integrating these results into climate models, future climate forecasts can be improved by taking into account the influence of sunspots on solar irradiance variability. It will also provide a better understanding of the physical mechanisms governing the interactions between the sun and climate. Our contribution during the solar cycle 24 paves the way for further research to refine our knowledge of solar processes and better predict the Sun's effects on our planet in the future. These results have implications for solar energy research and climate modelling.

Keywords: Solar irradiance; Solar constant; solar variability

Abstract 4.

EFFECT OF TEMPERATURE VARIATION ON THERMAL PROPERTIES OF COMPRESSED WHITE SOIL-BASED BRICKS

Randa Bakari ***1, Abderrahim Samaouali 1, Karima Ouaazizi 1, Fatima Kanibou 1, Asmae Arbaoui 1***

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The determination of thermal properties of materials, carry significance in the construction industry given its considerable impact on advancing indoor comfort. Among sustainable materials, earthen materials, in particular have demonstrated excellent thermal performance compared to the conventional materials that harm the environment. The purpose of this experimental investigation is to characterize the thermal parameters, notably thermal conductivity, volumetric heat capacity and thermal diffusivity, of white earth bricks subjected to compaction with diverse masses (0, 250, 500 and 1000g), showing the influence of temperature alteration, varying gradually (20°C, 30°C, 40°C and 50°C) on these properties. The results revealed remarkable insights into the consequential effects of temperature variation on the examined thermal parameters. A decline of 9% of the thermal conductivity has been observed for the non-compacted samples, along with temperature increase from 20 to 50°C, while the samples subjected to 1000g of compaction, exhibited a substantial drop of 19%. A similar variation has been observed for the volumetric heat capacity, which have shown a decrease ranging from 6 to 8% after increasing the temperature from 20 to 50°C. Furthermore, the same phenomenon has been repeated for the thermal diffusivity measurements, where a remarkable reduction was shown in the thermal diffusivity values with the gradual temperature elevation. This result was notably evident in the specimens with 1000g of compaction. This study demonstrated an

enhancement in the soil-based bricks employed especially in the areas characterized by warm climates.

Keywords: Thermal conductivity; volumetric heat capacity; thermal diffusivity; white earth; compressed soil bricks

Abstract 5.

THERMOPHYSICAL CHARACTERIZATION OF COMPOSITE CLAY MATERIAL STABILIZED WITH ARGAN NUT SHELLS POWDER: EXPERIMENTAL CHARACTERIZATION

Karima Ouaazizi [1], ***Abderrahim Samaouali*** [1], , ***Fatima Kanibou*** [1], ***Randa Bakari*** [1], ***Asmae Arbaoui*** [1],

1 : Université Mohammed V de Rabat [Agdal]

This research focuses on evaluating the impact of integrating argan nut shells into compressed earth blocks (CEB) to promote the use of local resources, reduce construction expenses, and address housing shortages. Diverse samples were stabilized with varying proportions of argan nut shell powder, ranging from 5% to 30%. The thermal properties of the composite materials were experimentally measured using a thermal conductivity device (CT-meter) under dry conditions at a room temperature of 20°C. The results revealed a substantial decline in thermo-physical properties in bricks with 30% argan powder incorporation. Notably, there was a significant reduction of 56.5% in thermal conductivity, 47.41% in thermal diffusivity, and 40% in thermal effusivity. These findings underscore the potential of incorporating argan nut shells into CEB to enhance thermal insulation properties. This approach holds promise for sustainable construction practices, as it taps into local resources and has the potential to reduce overall building costs. This study contributes valuable insights into the development of eco-friendly construction materials, addressing both economic and environmental considerations.

Keywords: Red earth ; argan shells powder ; thermo ; physical properties.

Abstract 6.

EVALUATION OF PHOTOVOLTAIC SYSTEMS PERFORMANCE USING SATELLITES AND DRONES DIGITAL IMAGING

Karima Laaroussi [1, 2], , ***Assia Harkani*** [2], , ***Saloua Jemjami*** [3], , ***Tarik Benabdelouahab*** [4], , ***Abdellah El Aissaoui*** [2],

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Due to changing lifestyle and population growth, the demand for energy is increasing at an unprecedented rate, leading to an increase of greenhouse gas emissions caused by conventional energies. Renewable energies, more particularly photovoltaic energy have been frequently used following the strategy proposed by the Moroccan government.

Certainly, this technology is considered as an environmental solution but its suitability in the field still poses performance challenges. The evaluation of photovoltaic performance requires using remote sensing to gather data through various sensors and satellite images. It can be used to evaluate their general state by controlling solar irradiation, monitoring panel temperature, detecting module fouling and managing shadow vegetation.

However, satellite images cannot capture images at much closer distance. By contrast, drone imaging offers greater flexibility, with higher spatial resolution from different angles. In fact, the evaluation of

photovoltaic panels using drone thermal imagery enables individual panel dysfunctions to be detected, making it simple to resolve these problems in a short space of time.

This paper aims to present a review of remote sensing, comparing between two image capturing techniques (satellite images and drone) and providing an analysis of their advantages, drawbacks and limitations.

Keywords: remote sensing ; drone ; satellite imaging ; photovoltaic generator ; performance

Abstract 7.

INVESTIGATING THE THERMAL BEHAVIOR OF MICROENCAPSULATED PHASE CHANGE MATERIALS IN RECYCLED COTTON TEXTILES

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The use of phase change materials (PCM) for thermal energy storage is a novel strategy with enormous promise for reaching enhanced energy efficiency. In order to improve the energy efficiency of building envelopes, this study primarily looks into the incorporation of microencapsulated phase change materials (PCM) into recycled cotton textiles. The goal is to increase thermal comfort and lower energy consumption in buildings by making use of the latent heat that is released and/or absorbed during the phase transition process. Recycled cotton textile modified with PCM microcapsules have been developed as a result of the successful incorporation of the microcapsules into textile matrix via an acrylic binder. The efficiency of PCM microcapsules is assessed using thermogravimetric analysis (TGA) and differential scanning calorimetry (DSC). Thermal tests were used to examine the thermal behavior of PCM/textile composite. DSC analysis revealed that PCM microcapsules have a melting temperature of 25.25°C and a latent heat of 194.9 J/g. Regarding the PCM/recycled cotton composite, where PCM is in solid and liquid states, respectively, the thermal tests showed an increase in specific heat capacity and thermal conductivity. The research concludes that PCM microcapsules is an effective way for thermoregulating insulation textiles production for improved buildings energy efficiency.
Keywords: Phase Change Materials (PCMs) ; Thermal Energy Storage ; Recycled cotton textile ; Thermal Insulation Materials ; Energy Efficiency.

Abstract 8.

MPPT ALGORITHM AND CONTROL OF THE QZSI INVERTER USED FOR PV POWER SYSTEMS IN STANDALONE MODE

Essaid Jaoide ***1, Mbark Outazkrit 2, Faicel El Aamri 3, Abdelhadi Radouane 2, Azeddine Mouhsen 2***

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In response to rising fossil fuel costs, global governments prioritize green energy, notably advancing photovoltaic (PV) systems. Research focuses on power electronics converters to optimize the processing of recovered energy for efficient PV system operation. In this context, the quasi-Z-Source Inverter (qZSI) has emerged as a highly promising power electronic converter topology for PV

applications. This is attributed to its ability to effectuate a buck-boost conversion of the input voltage. Notably, the voltage boost and inversion processes are seamlessly executed within a single-stage inverter. The electrical power output of a PV module is contingent upon both solar irradiation levels and the temperature of the PV module. To maintain operation at the maximum power point (MPP) under diverse atmospheric conditions, a Maximum Power Point Tracking (MPPT) algorithm is employed. The prevalent approach for MPP tracking involves measuring both current and voltage of the PV module. In this paper, an MPPT method applied to a qZSI is proposed to track the maximum power of the PV generator operating in off-grid conditions. Additionally, the control strategy for the entire PV system is presented and designed. The proposed controls are tested and simulated using MATLAB/Simulink and Plecs software. The simulation results illustrate the practicability and validity of the proposed control scheme.

Keywords: MPPT algorithm; photovoltaic power ; quasi ; Z ; source inverter ; PI Control ; Standalone mode

Abstract 9.

NUMERICAL STUDY OF MIXED CONVECTION FLOWS AROUND SMALL-SCALE HEAT SINKS: APPLICATION TO THE COOLING OF ELECTRONIC COMPONENTS

***Fatima Zahra Laktaoui Amine* 1, Mustapha El Alami 1, Mariam Jadal 2, Elalami Semma 3**

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In this work, we present a numerical study of mixed convection flows around small-scale heat sinks. It is based on the Lattice Boltzmann Method (LBM) in Cascade for values of the Rayleigh number, in laminar regime, in the range and for a Reynolds value fixed at Re=1000. The study is carried out in a rectangular cavity of dimension H subjected to periodic thermal and dynamic boundary conditions on its side walls. Two heat sources of (L', l', H/2) with a hot temperature Tc are placed on the bottom wall of the cavity to simulate heat sinks. Fresh air (for cooling these heat sinks) is injected at a temperature Tf< Tc from the bottom of the cavity through two openings of width L''. The hot air is extracted through an opening in the upper horizontal wall 2L'' wide.
The preliminary results, presented here, are in the form of current lines, isothermal lines and thermal profiles in the range of the Rayleigh number considered. Heat transfer is studied in terms of the average Nusselt number calculated over the entire exchange surface of the two heat sources.

Keywords: Lattice Boltzmann ; Cascade ; Reynolds ; Rayleigh ; heat sink ; Mixed convection.

Abstract 10.

OPTICAL ANALYSIS OF GEOMETRY EFFECT ON A SOLAR COOKER BOX PERFORMANCE

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4 : Ecole Supérieure de Technologie Oujda

Solar cookers offer a sustainable and resource-efficient cooking solution, but their efficiency can be limited by various factors. This study investigated the impact of three different geometries - rectangular, trapezoidal, and triangular - on the incident irradiance on the absorber plate using ray tracing simulations. Simulations were conducted during a sunny day, and the flux distribution was particularly analyzed at 13h a critical time for assessing cooking efficiency. The optical efficiency of each cooker was then calculated based on the flux distribution at 13h. Significant variations in solar flux were observed with the triangular geometry demonstrating a higher average irradiance compared

to the other shapes. This optimal performance was driven by the triangular geometry's ability to minimize shadow areas within the cooker. These results provide valuable insights into the impact of geometry on solar cooker performance and inform the design of optimized cookers for improved **solar energy capture and cooking effectiveness.**

Keywords: Solar cooker ; flux ; irradiance ; simulation ; TracePro. ; ray tracing

Abstract 11.

SCAPS-1D SIMULATION OF 2-TERMINAL MONOLITHIC PEROVOSKITE/CISE TANDEM SOLAR CELL

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3 : LabSIPE, ENSAJ, Chouaib DOUKKALI University, El Jadida, Morroco
4 : LabSIPE, ENSAJ, Chouaib DOUKKALI University, El Jadida, Morroco

This study presents a comprehensive simulation of a two terminal tandem solar cell composed of a perovskite top cell and a copper indium selenide (CISe) bottom cell. The top cell, characterized by an absorber energy level of 1.5eV, exhibits an impressive photovoltaic performance under the global air mass spectrum AM1.5G, achieving an open-circuit voltage (Voc) of 1 V, a short-circuit current density (Jsc) of 21.62 mA/cm², a fill factor (FF) of 83,17 %, and an efficiency (η) of 19,17 %. Subsequently, the study explores the optimization of the CISe bottom cell, investigating the impact of varying CISe thickness and acceptor carrier density. Notably, the thickness variation within the range of 1 µm to 2 µm demonstrates minimal effects on the key photovoltaic parameters. However, varying the CISe acceptor density reveals a decrease of density of short circuit current. Finally, the study emphasizes the importance of achieving a current match condition in tandem solar cells, as demonstrated by the figure showing the current match at a CISe carrier concentration of 2.86 x 1017 cm-3. The tandem solar cell exhibits promising overall performance, with a Voc of 1.62 V, Jsc of 21.62 mA/cm², FF of 87.08 %, and η of 30.49%.

Keywords: CISe ; Perovskite ; Two Terminal ; Tandem ; Current Match ; Efficiency.

Abstract 12.

SPECTROSCOPIC AND DIELECTRIC ANALYSIS OF HETEROCYCLIC POLYMER CONTAINING N-VINYLCARBAZOLE UNITS: PREDICTING PROMISING PROPERTIES FOR ORGANIC SOLAR CELLS

Ouafae Ninis 1

1 : Abdelmalek Essaadi University

For decades, there has been significant interest in plastic electronics and flexible electronics. Driven by emerging processes such as Roll-to-Roll and inkjet printing routes, many conjugated polymers are targeted for deposition in devices with flexible substrates, benefiting from easy processing. These materials are extensively investigated as organic semiconducting materials.

While organic solar cells (OSCs) utilizing bulk heterojunction have achieved noteworthy solar-to-electrical power conversion efficiencies of 18%, recent studies have increasingly focused on organic electronics based on π-conjugated molecules. This shift in attention is driven by two key advantages over traditional semiconductors. Firstly, it enables the creation and deployment of devices on flexible and transparent substrates, thereby unlocking novel opportunities across various applications. Secondly, it presents a cost-effective alternative to inorganic semiconductors, enhancing its appeal for researchers.

Hence, this study highlights the spectroscopic and dielectric analyses conducted on copolymer based on assembly of two segments EDOT (3,4-Ethylene Di-Oxy-Thiophen) and VC (n-Vinyl-Carbazole). FTIR and Raman spectra provide a comprehensive fingerprint of the chemical bonds, enabling the identification of the studied compound. The frequency study reveals a Debye relaxation process occurring at frequencies around 1 kHz. The effects of temperature on both real and imaginary permittivities are examined across frequencies ranging from 50 Hz to 2 MHz. Various characteristic parameters related to dielectric relaxation phenomena are determined. The analysis of dielectric and curve data on a logarithmic frequency scale suggests a potential influence of the hopping model on the charge carrier mechanism.

Keywords: polymer ; solar energy ; dielectric properties

Abstract 13.

A PRACTICAL MODELING APPROACH FOR PHOTOVOLTAIC SOLAR CELLS WITH ONLY FOUR PARAMETERS

Sara Abdellaoui [1]***, Hassan Mharzi,***

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Due to the wide use of photovoltaic (PV) silicon solar cells, an accurate modeling must be provided to increase the efficiency of PV system design, indeed, designers of photovoltaic power converters, and developers of simulations of electrical circuits need a simple and accurate mathematical model that describes the actual behavior of PV cells / modules . This paper proposes a modeling approach for the three diode model of PV cell / module, the aim of this approach is to simplify the complex equations of the previously developed three-diode models, and by applying this approach only four parameters are required instead of seven or more parameters. To validate the accuracy of the proposed model, the model parameters will be calculated using an iterative method. The performance of this model will be evaluated against popular two-diode models.

Keywords: PV module ; Modeling approach ; Three diode model ; Model parameters ; Iterative method

Abstract 14

HYDROGEN STORAGE PROPERTIES OF PEROVSKITE-TYPE KMGH3 UNDER STRAIN EFFECT FROM FIRST-PRINCIPLES CALCULATIONS

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Hydrogen has become an energy carrier for the next technological, ecological and possibly environmental revolution in terms of energy. In the context of climate change, hydrogen appears to be an innovative solution for the production and storage of energy.

The objective of the hydrogen plan is to develop this sector and accelerate the energy transition in the territories. Hydrogen is highly explosive and storage is the most difficult step after its production. The aim of this work is to implement and use theoretical structural research techniques to explore the possibilities of metal alloys for storage of hydrogen, and to develop and characterise materials in the form of an alloy that absorbs hydrogen to form a solid metal hydride based on magnesium for storage. Our goal is also to find a suitable material for the storage of hydrogen, the subject is very innovative and we will try to do our best to advance in the field of green energy.

Finally, we will conclude our project with a method for modelling the effects of deformation on hydrogen storage.

Keywords: Storage ; hydrogen ; green energy ; materials

Abstract 15.

STRUCTURAL, ELECTRONIC AND OPTICAL PROPERTIES OF NOVEL DOUBLE PEROVSKITES RB2SN(BR1-UIU)6 (U = 0.25, 0.33, 0.42 AND 0.5) FOR PHOTOVOLTAIC APPLICATIONS: A DFT STUDY

Abdelkhalek El Rharib **1,** Abdelaziz Amine, Mimoun Zazoui, Yamina Mir

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The study focused on lead-free double perovskites, specifically Rb2Sn(Br1-uIu)6, with varying percentages of iodine substitution (u = 0.25, 0.33, 0.42, and 0.5). Ab-initio computational method is employed within the most accurate density functional theory (DFT). The investigation encompassed an analysis of their structural, electronic, supercell structure, and optical properties. The full potential linearized augmented plane wave with local orbital method (FP-LAPW) was employed, and the TB-mBJ exchange-correlation potential was utilized to assess optoelectronic characteristics. The lattice constant was determined using the generalized gradient approximation (GGA) method. These double perovskites, Rb2Sn(Br1-uIu)6, exhibited a substantial absorption coefficient (~ 105 cm-1) and a direct band gap ranging from 1.24 eV to 1.74 eV. This suggests their potential as promising candidates for future optical and photovoltaic devices. Furthermore, substituting bromine with iodine resulted in a reduced band gap, which makes them well suited to absorption in the visible region, so as to improve the photovoltaic properties of a double perovskite-based solar cell, and we find that Rb2SnBr4I2 is a better double perovskite applicable in the photovoltaic field with a maximum efficiency of 18.9% and fill factor FF of 88.3 %.

Keywords:

Abstract 16.

TOWARDS AEROGEL BLANKET FOR THERMAL INSULATION IN BUILDINGS - REVIEW

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Significant quantities of plastic are manufactured annually, yet only 10% of it is recycled globally. This research investigates different approaches for valorizing and recycling plastic waste into aerogel blankets, with the goal of providing thermal insulation for building envelopes. The building industry is confronted with issues such as excessive energy use and significant greenhouse gas emissions. The aerogel blanket emerges as the most energy-efficient material capable of addressing these concerns, allowing for ecologically acceptable building practices with reduced greenhouse gas emissions. The study highlights current advances in raw materials and manufacturing procedures used to create aerogel blankets, focusing on their excellent thermal and mechanical performance. Furthermore, this study reveals research gaps in the field, providing insights into areas that could be investigated further in future research attempts.

Keywords: aerogel blanket ; thermal insulation ; plastic recycling.

Abstract 17.

ENHANCING INGAN/GAN QUANTUM-WELL SOLAR CELLS IN GA POLARITY WITH PIEZO-PHOTOTRONIC EFFECTS: REVEALING THE INFLUENCE OF EXTERNAL STRESS

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In recent years, quantum well solar cells (QWSCs) have garnered significant interest. These configurations exhibit considerable improvement potential of the limited conversion efficiency of traditional solar cells, primarily because they address the substantial absorption losses inherent to such cells. Our paper focuses on numerical simulation and modeling of an innovative technique for enhancing the efficiency of quantum well solar cells with GaN/InGaN structure in Ga polarity with exploiting piezo-phototronic effects induced by external stress. Indeed, the piezoelectric charges present at GaN and InGaN interfaces play crucial roles in counterbalancing the piezoelectric charges generated inside InGaN wells by the lattice mismatch constraints. In this regard, our research demonstrates a significant improvement in short-circuit current, rising to 3.71 mA/cm² from 3.49 mA/cm² under the impact of hydrostatic pressure (P = 30 GPa). Moreover, this effect results in an impressive increase in efficiency of around 12.96%. These findings reveal the potential of piezo-phototronic effects as a new possibility for greater performance of quantum well GaN/InGaN solar cells. We believe that this research will help to the enhancement of optoelectronic properties of the GaN/InGaN quantum well structure for photovoltaic and optoelectronic applications.

Keywords: MQW InGaN/GaN solar cells ; Piezo ; phototronic effects ; Strain ; In content ; Hydrostatic pressure ; Photovoltaic properties.

Abstract 18.

FREQUENCY DOUBLING EMISSION THROUGH INTERSUBBAND TRANSITIONS IN GAAS/ALGAAS QUANTUM WELLS

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This work focuses on evaluating the potentiel of a GaAs stepped quantum well for frequency doubling, across an intersubband emission process, and on extending the unipolar optoelectronic devices for applications into the far infrared (FIR) and terahertz (THz) range. For this, we have calculated the conduction band electronic states for the AlxGa1-xAs/GaAs/ AlyGa1-yAs/AlxGa1-xAs stepped quantum well. The results show a singular behavior of the confined energies versus the step width. As a consequence, there is at least a crossing between two different transitions that occurs for specific geometries. As a consequence the equidistant two photon absorption is possible, which can enhance optical non linearities and leads to particular unipolar optoelectronic devices. Based on the calculations of each intersubband transition's optical momentum coupling and absorption coefficient, we have evaluated , each specific geometry's potential and particularly identified among these, the most promising for frequency doubling especially in the FIR and THz domain..

Keywords: Quantum well/ intersubband transition/Two photon absorption/ frequency doubling/ FIR and THz.

Abstract 19.

SYNTHESIS AND CHARACTERIZATION OF SPRAYED CU2MNSNS4 THIN FILMS FOR PHOTOVOLTAIC APPLICATIONS

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Thin films of Cu2MnSnS4 (CMnTS) were deposited on soda lime glass substrates via ultrasonic spray pyrolysis without sulfurization, utilizing varying molar concentrations of thiourea. The goal was to explore the impact of thiourea concentration on the properties of CMnTS films and identify the optimal

concentration for achieving pure CMnTS kesterite. The investigation determined that a thiourea concentration of 0.2 M yielded the most favorable conditions for depositing high-quality CMnTS thin films. The structural, optical, and electrical characteristics of these films were comprehensively examined using X-ray diffraction (XRD), Raman spectrometry, and UV–VIS absorption spectroscopy. Both XRD and Raman spectroscopy analyses confirmed the formation of the CMnTS stannite structure, exhibiting preferential orientation along the (112) direction. Additionally, XRD detected small peaks attributed to secondary phase, namely Cu2S . Optical assessments indicated a high absorption coefficient within the visible range (>104 cm−1), while the direct band gap decreased from 2.22 eV to 1.74 eV with decreasing thiourea concentration, potentially attributed to the presence of the secondary phase Cu2S in CMnTS. The four-point probe method was employed to measure electrical resistivity, revealing favorable properties that position the film as a promising material for photovoltaic solar cells based on the experimental results.

Keywords: CMnTS ; Ultrasonic spray pyrolysis ; Physical Properties

Abstract 20.

EFFECT OF ROTATIONAL SPEED ON PROPERTIES OF SOL-GEL SPIN COATED CU2FE0,5CO0,5SNS4 THIN FILMS FOR SOLAR CELL

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This work have studied the effect of rotational speed of deposition on structural, morphological, optical and electrical properties of the compound copper iron cobalt tin sulfide Cu2Fe0.5Co0.5SnS4 (CFCTS). The CFCTS thin films have been deposited on the glass substrate at different rotational speed by the easy and simple sol-gel spin coating technique without sulfurisation steep. The result of X-ray diffraction revealed the tetragonal phase with preferential orientation as (112). The morphological surface become homogenous and dense with increase of rotational speed. The elementary analysis determined the presence of the important element Cu, Fe, Co, Sn, S, so stoichiometry of CFCTS thin films improved with increased of rotational speed. The optical result showed that the CFCTS thin films have the high absorption coefficient and direct band gap. The optical band gap of CFCTS thin films decreased from 1.38 to 1.05 eV with the increase of rotational speed from 2500 to 4000 rpm due to quantum confinement effect. These results confirm that it is possible to use this CFCTS material as potential absorber in solar cells in order to generate renewable energy. Also, a very high conversion efficiency can be achieved under the ideal synthesis conditions for this material.

Keywords: Rotational speed ; sol ; gel ; CFCTS ; annealing ; properties

Abstract 21.

ELABORATION AND CHARACTERIZATION OF NANOCOMPOSITE FILMS

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The conversion of mechanical energy into electrical energy is a renewable form of energy. This form of energy is based on piezoelectric materials. There are several types of piezoelectric materials, including piezoelectric polymers such as PVDF, PLA, etc. These materials have good flexibility and interesting intrinsic properties. In this recent work, PLA/PZT nanocomposite films have been

elaborated by the solvent casting method. 0.1%,0. 5% and 1% of the PZT nanoparticles were inserted separately into the PLA polymer to study their influence on the properties of the polymer. afterward, they were characterized by XRD, FTIR, SEM, and TGA. The results have shown that the properties were influenced by the progressive addition of the inorganic PZT nanoparticles. XRD and FTIR show that the β - phase increases, while the α - phase decreases. TGA confirms the increase of degradation temperature in PLA/PZT(0.5%). The dielectric constant becomes significant with the addition of PZT. According to these results, PLA/PZT can be used in various applications such as energy harvesting and dielectric applications.
Keywords: solvent casting method; β phase; energy harvesting; nanocomposite films

Abstract 22.

ELABORATION AND CHARACTERIZATION OF SNSE ELABORATED BY ELECTRODEPOSITION

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The scientific community and researchers have been very interested in energy storage materials in recent years because of the growing global warming and depletion of nonrenewable resources over the last ten years. The continued depletion of nonrenewable resources presents a significant obstacle to the development of green energy conversion and energy storage in the modern world. Due to their potential use in a variety of device applications, including solar cells, rechargeable Li-ion batteries, electrochemical capacitors, and spintronics, nanomaterials are receiving a lot of attention these days. The current study presents tin selenide (SnSe), which was elaborated by the electrodeposition method. The obtained results were analyzed through techniques such as cyclic voltammetry and chronoamperometry, and the SnSe was characterized using techniques such as X-ray diffraction (XRD) and optical absorption measurements. The results of these analyses showed interesting properties of the elaborated layers, suggesting potential applications in various fields such as energy storage, electronics, etc.

Keywords: electrodeposition ; tin ; selenium ; cyclic voltammetry ; chronoamperometry energy gap.

Topic 2

WATER AND WATER STRESS MANAGEMENT

Abstract 23.

CARACTÉRISATION DES LIXIVIATS DE LA DÉCHARGE CONTRÔLÉE DE LA VILLE DE FÈS

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Les lixiviats contiennent différents types de matières organiques et inorganiques qui peuvent polluer les milieux aquatiques s'ils ne sont pas correctement traités. Le choix et l'efficacité des techniques de traitement dépendent des caractéristiques des lixiviats, ces caractéristiques changent d'une région à l'autre et en fonction du temps et des saisons. L'objectif de cette étude est la caractérisation des lixiviats de la décharge contrôlée de la ville de Fès, suite à la réalisation des tests de traitabilité de ce lixiviat en contrôlant les différents paramètres d'analyse. Pour pouvoir choisir la technique adaptée au type de lixiviat à traiter. Dans notre cas pour le lixiviats de la décharge contrôlée de la ville de Fès, les caractéristiques physico-chimiques sont réalisées concernant la DCO, la DBO5, la MES, l'Azote total et le Phosphore, ces caractéristiques montre la richesse des lixiviats en éléments nutritifs. Aussi, une forte présence d'éléments métalliques est détectée ce qui montre que les ordures ménagères sont mélangées avec les rejets industriels. La caractérisation des lixiviats de la décharge contrôlée de la ville de Fès a montré le potentiel de ce produit d'être valoriser.

Keywords: Lixiviat de décharge ; caractéristiques physico ; chimiques ; valoriser ; éléments nutritifs.

Abstract 24.

CHARACTERIZATION AND VALORIZATION OF RECYCLED TEXTILE WASTE: APPLICATION FOR TREATMENT OF WASTEWATER FROM THE TEXTILE INDUSTRY

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Wastewater from the textile industry is hazardous effluents containing toxic complex components that without appropriate treatment severely impact the environment; causing harmful effects to the aquatic ecosystems, as well as to human health. Many cleaning and recovery techniques have been applied in recent decades, from physical separation to chemical separation. Adsorption is described as a highly successful technology for removing contaminants from textile-effluents wastewater compared to other methods.

In this study, we are interested in the treatment of industrial dyes by recycled waste from an industry in Morocco. The first, the material was characterized by several methods, namely Fourier transform infrared spectroscopy (FTIR), scanning electron microscopy (SEM), fluorescence (FX), and X-ray diffraction (XRD).

The results show that the material is very rich in hydroxide and carbon chains, with variable and heterogeneous shapes. The textile waste exploited in this work gives promising cationic dye removal results, with a percentage of discoloration that can reach 98% in our experimental conditions and can replace expensive industrial adsorbents as well as natural materials and plants exploited in the adsorption of pollutants.

Keywords: Textile waste ; adsorption ; characterization ; XRD ; SEM ; FTIR ; wastewaters ; textile industry

Abstract 25.

ELIMINATION DES COLORANSTS DES REJETS LIQUIDES PAR ADSORPTION SUR DES FIBRES D'ORIGINE VEGETALES

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Le present travail consiste en l'évaluation de la capacité de trois fibres végétales, la Sciure de bois (SB), la fibre de Lif (fibrillum, FL) et la fibre de Filasse (FF) à adsorber des colorants solubles dans des solutions aqueuses. Pour cela le bleu de methylene (BM) a été choisi comme colorant, l'analyse chimique de ces trois fibres indique la richesse de ces dernieres en cellulose, Hémicellulose et en Lignine. Les analyses d'adsorption révèlent que le temps d'équilibre est fonction de la concentration initiale du colorant. L'équilibre s'établie au bout de 10min, 40 min et de 60 min pour des concentrations des solutions de BM à 4.12mg/L, à 8.25mg/L et à 16.50mg/L respectivement. Par contre, le taux d'adsorption est très peu influencé sur une gamme de pH allant de 3 à 10. La capacité maximale d'adsorption déterminée par le modèle mathématique de Langmuir est de 4.16 mg.g-1 pour SB, 77.52 mg.g-1 pour FL et 6.47 mg.g-1 pour FF. Alors que l'adsorption du Bleu de méthylène sur les trois fibres est décrite par le modèle pseudo-seconde-ordre.

Keywords: Sciure de bois ; Fibre de Lif (Fibrillum) ; Fibre de Filasse ; Adsorption ; Bleu de méthylène.

Abstract 26.

ADVANCED HARMONIZATION OF UV-VISIBLE SPECTROSCOPY WITH CUTTING-EDGE CHEMOMETRIC TECHNIQUES FOR SIMULTANEOUS ASSESSMENT OF KEY WATER QUALITY INDICATORS

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Our research introduces a sophisticated system merging spectrophotometric analysis and chemometric methods for the simultaneous estimation of nitrite, nitrate, and Total Organic Carbon (TOC) in water samples. This study highlights the critical need for precise water quality monitoring in the context of environmental health and public safety. We detail our innovative approach comprising three phases: firstly, the application of Recursive Feature Elimination with Support Vector Regression (RFE-SVR) for the strategic selection of the most informative input wavelengths. This step is pivotal in correlating specific wavelengths with our targeted water quality indicators. Secondly, we employ Multilayer Perceptron Regression (MLP) to effectively model the complex, non-linear relationships present in environmental data. Lastly, we conduct a thorough performance evaluation using key metrics such as R-squared values, Root Mean Square Error of Prediction (RMSEP), Mean Absolute Error (MAE), and cross-validation techniques. Our results exhibit outstanding predictive capabilities, as evidenced by high R2 values (0.9915, 0.9953, 0.9866) and low RMSEP and MAE values (RMSEP for nitrite: 0.092, nitrate: 0.068, TOC: 0.115; MAE for nitrite: 0.210, nitrate: 0.643, TOC: 0.091). The

integration of these advanced analytical techniques presents a robust and effective solution for water quality analysis, ensuring accurate prediction of nitrite, nitrate, and TOC levels. Our findings hold significant implications for environmental monitoring, offering a promising approach for future research and application in this critical field. This work lays the foundation for advanced water quality assessment, contributing to the broader goals of environmental sustainability and public health protection.

Keywords: Spectrophotometry; Chemometrics; Water Quality; Support vector regression; Recursive feature elimination; Multilayer perceptron

Abstract 27.

GESTION ET VALORISATION DES EAUX PLUVIALES PAR DES TECHNIQUES ALTERNATIVES, CAS DE LA ZONE1 DU CITÉ UNIVERSITAIRE DE SETTAT

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Notre recherche consiste à mobiliser un nouveau système de gestion et de valorisation des eaux pluviales en utilisant des techniques alternatives, visant à participer dans l'économie d'eau et dans la sécurisation de l'approvisionnement en eau potable, sans gaspillage.

A cet effet, notre étude a été mené pour objectif la collecte des eaux pluviales, le stockage, le traitement, et la distribution aux différents usagers et ce en respectant les normes en vigueur pour la réutilisation, en se basant sur ces techniques alternatives et en utilisant le logiciel de modélisation EPA SWMM5, afin d'optimiser le dimensionnement et la conception des ouvrages nécessaires.

Ainsi, on a procédé à une étude de cas, sur la zone 1 du cité universitaire de Settat au Maroc, d'une superficie de 6,56 Ha, avec une pluie intense de 42mm/h sur une durée de 30 min et une pluie annuelle moyenne de 372 mm/an, le résultat obtenu est très important avec un rendement allant jusqu'à 90%: soit la collecte d'eau de pluie de 334.8 litres/m2/an soit 21 963 m3/an, stocké au moment de pluie dans des réservoirs d'une capacité globale de 1336,20m3, et à réutiliser pour alimenter les chasses d'eau, l'irrigation des jardins et des espaces verts avoisinant le site d'étude sans utiliser l'eau potable, ainsi une économie de consommation d'eau potable, un gain significatif et une économie aussi sur l'investissement et sur l'exploitation des ouvrages pluviaux in site et hors site.

En conclusion, à l'intérieur d'une surface limitée, l'utilisation des techniques alternatives de gestion et de réutilisation des eaux pluviales conduit à une économie de plus de 50% d'eau potable, par conséquent, on espère apporter des solutions pour que, aussi bien l'homme que la terre agricole et les industries, pourront atténuer le stress hydrique, faire face à la pénurie et la rareté des ressources hydriques, sécuriser et économiser l'eau potable ainsi lutter contre le gaspillage dans l'avenir.

Mots-Clés : Gestion des Eaux pluviales ; Techniques alternatives ; Usagers d'Eau ; Collecte et Valorisation des Eaux Pluviales.

Abstract 28.

OPTIMIZATION OF DRINKING WATER TREATMENT: A SYNERGY OF QUALITY, ECONOMY AND SUSTAINABILITY

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In the context of the global water crisis, optimal management of water resources has become a top priority. This presentation focuses on the critical interrelationship between drinking water treatment, water quality and water economics. By exploring advanced water treatment techniques and their economic impact, we aim to demonstrate how optimizing water treatment can simultaneously improve drinking water quality and promote water conservation. We'll start by discussing the vital importance of drinking water quality and current challenges in water resource management. We will

then look at the different methods of water treatment, such as physical, chemical and biological treatments, assessing their effectiveness in improving drinking water quality. The presentation will also highlight how treatment processes can have an impact on overall water use and contribute to more economical management of water resources. We can see where innovations in water treatment can reduce water consumption and increase efficiency. This research aims to highlight the importance of an integrated approach to guaranteeing both drinking water quality and water conservation, with a view to sustainable management of water resources.

Keywords: drinking water treatment; water quality; water economy; water resource management; sustainability

Abstract 29.

PHYSICO-CHEMICAL, BACTERIOLOGICAL AND VIRULO PROPERTIES OF TREATED WASTEWATER AT HAD SOUALEM AND AÉROPORT MOHAMED V WWTPS AND COMPLIANCE WITH WHO AND NATIONAL STANDARDS FOR VARIOUS REUSES

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Wastewater management poses numerous environmental problems that are becoming a cause for concern for public health. To remedy this, it is advisable to set up wastewater treatment plants. Thus, our study is a preliminary study aimed at physico-chemical and bacteriological characterization of treated water from the Had Soualem and Aireport Mohamed V WWTPs.
To do this, we took samples of treated wastewater over a six-month period (January 2023-June 2023). These samples were subjected to physico-chemical and bacteriological analyses based on International, National and Rodier standards. The results indicate that, with the exception of total phosphorus (TP) whose concentrations range from 5.4±5 to 13.7±7/8mg/l, the other main pollution indicators are total nitrogen (NTK, 75.3±33 to 122. 3±40.6 mg/l), suspended solids (SS, 78±22.3 to323.2±260.3 mg/l), 5-day biochemical oxygen demand (BOD5, 68.3±17.7 to 105.7±80.2 mgO2/l) and chemical oxygen demand (COD, 102.2±45.6 to 545, 3±109.4 mgO2/l) exceed the guide values recommended by the Côte d'Ivoire government through the SIIC (inspection service for classified installations) for effluent discharge into the receiving environment. Analysis of effluent bacterial flora reveals that concentrations of fecal coliforms and fecal streptococci exceed the guideline values recommended by the WHO.

Keywords: Wastewater treatment plants; Purified wastewater ; Physicochemical Parameters ; Bacteriological Parameters ; Morocco.

Abstract 30.

MART WATER TELEMETER BASED ON INFRARED SENSING

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Water shortage becomes year after year a real-life threat. According to The **Worldwide Fund**[1], By 2025, two-thirds of the world's population may face water shortages.
An important amount of wasted clean water is due to the leaking distribution systems, furthermore, the manual way of collecting measuring water consumption can't detect efficiently those leaks.
Water agencies and distributors in most countries use traditional collection of measurements recorded on water meter meters. The collection agents use paper media to record the measurements, then they

must enter them in applications to make the calculation and generate the bills of the customers. In addition to the inability to detect leaks, the errors that the human factor can generate are important, that's why some manufacturers of water meters propose solutions that automate this whole process. As an example, we mention the industrial modules of the **Itron** brand which use pulse sensors[2] to be able to read the measurements from their water meters equipped with a target dedicated to this system. other solutions are based on cameras[3] to read the values displayed on the index displays of these water meters. The problem with the first solution is that it is proprietary, which means that a water distributor must use only this brand to be able to benefit from such a service, or worse, the distributor must change all the water meters already installed to replace them with new ones that support this service, which is very expensive. For the second solution, there is the problem of the accuracy of the readings in addition to the fact that such a system will prevent the manual reading of the values without forgetting the energy aspect...

Our solution consists in the realization of an autonomous connected device that is installed above the totalizers of the water meters. With its sensors oriented towards the totalizer, it can make the necessary measurements with precision. And with its LPWAN connectivity (Lora), it can communicate these measurements to the application server which records and analyses the data to detect leaks, as well as issuing invoices and allowing customers to track their consumption.
What distinguishes our solution is that it uses for the measurement, two infrared sensors under each node that are placed on the totalizer target (the red needle) using a mechanical system that allow us to move it freely in order to match the location of the target for any kind of water meter, which makes them compatible with the majority of existing meters on the market, in addition to that these sensors give us the possibility to detect the direction of rotation of the totalizer, which allows us to know the direction of the water flow and to detect potential frauds.
The nodes are based on an ultra-low power microcontroller equipped with all the necessary modules (RTC, Flash, Lora ...) which gives a compact solution and offering a significant autonomy and can be deployed either in urban or rural areas (thanks to Lora communication). The nodes periodically communicate the measurements to a Lora gateway which delivers them to the server that will record them for analysis.

Keywords: Water consumption monitoring; low power communication; infrared sensor; Wireless communication; Interface LORA ; Telemetry

Abstract 31.

ELIMINATION DU COLORANT BR46 PAR ADSORPTION SUR L'ARGILE DE SAFI À L'ÉTAT BRUTE PURIFIÉ, CARACTÉRISATION ET VALORISATION

Asmaa Bennani Karim, Rais Zakia, Taleb Moustapha, Zarry Meryem, Mohamed Tahiri, Mounir Badia

Située dans l'ouest du Maroc dans la région de Marrakech-Safi, La ville de Safi dispose de réserves importantes d'argiles utilisées principalement dans la production de poterie et l'industrie céramique.
Les rejets de l'industrie textile sont chargés en colorants [1]. Ces rejets présentent un véritable danger pour l'homme et son environnement en raison de leur stabilité et leur faible biodégradabilité [2]. L'élimination de ces colorants dans les eaux résiduaires s'avère nécessaire.
Dans ce travail de recherche, nous avons tenté l'utilisation de l'argile de Safi, à la dépollution des eaux. Nous avons mené une étude de caractérisation minéralogique et physico- chimique de cette matière. Cette argile, en tant qu'adsorbant, a été utilisée à l'état brut (sans traitement préalable, taille des particules < 80 µm) et à l'état purifié (taille des particules < 2 µm). A cet effet, nous nous sommes proposés d'étudier l'adsorption en système discontinu du colorant cationique BR46, très utilisé dans les industries textiles sur l'argile purifiée. En effet, Les résultats de la caractérisation ont montré que ce colorant est mieux fixé sur cette argile, vue sa constitution plus importante en fraction argileuse. L'effet de la concentration initiale en colorant, la masse de l'adsorbant ont été déterminés ; L'étude de la valorisation de l'argile brute en utilisant le NaCL et le CaCL2 a été réalisée.

Mots-clés : Argile purifiée ; Argile brute ; BR46 ; adsorption ; régime statique ; caractérisation ; valorisation.

Abstract 32.

SUSTAINABILITY IN INTEGRATED WATER RESOURCES MANAGEMENT: SYSTEMATIC LITERATURE REVIEW

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Morocco, like many developing countries, faces a major challenge in terms of managing water resources and combating floods and drought. Nowadays, the shortage of fresh water will experience an intensification and a significant geographical extension in the near future. The growing demand for water is confronted with a significant reduction in the supply of the resource due to the semi-arid to arid climatic context which reigns over most of the territory, marked by irregularity in water availability over time and over time. space as well as the intensive use of water in the agricultural sector which the first consumer of water (more than 85% of available water) is both responsible and victim of the lack of water.

In this regard, Morocco finds itself obliged to adapt to this new structural variable. To do this, it is necessary to go through integrated water resources management (IWRM), while adopting Nexus approaches which aim to ensure water, energy and food security with the aim of implementing integrative solutions capable of maximize synergies between the three “NEXUS A3E” approaches and minimize trade-offs, while simultaneously reducing environmental impacts, including water resources at temporal and spatial scales.

The objective of this article is to take stock of integrated water resources management and analyze **how NEXUS WEF approaches have actually been implemented in order to support sustainable water resources management?.**To answer the research question, we relied on a systematic review and documentary analysis on various databases (scopus, web of science, Jstor, scienceDirect) were explored with the following research equation: ("WATER RESOURCES") AND ("INTEGRATED MANAGEMENT") AND (SUSTAINABLE OR SUSTAINABILITY). Only journal articles published in English during the period 2010-2023 were included. Based on the PRISMA guidelines, 93 articles were selected. The results showed that the WEF Nexus is indeed very relevant in reducing pressures on the environment and water resources through integrated management and governance and, therefore, better efficiency in the use of resources implemented. However, technological improvements must be integrated into appropriate framework conditions, including policies, and with appropriate regulation and monitoring mechanisms. Only then can the benefits of the NEXUS approach materialize, without environmental or socio-economic impacts in other sectors or at other scales.

Mots-clés : Water resources, Integrated management, Sustainable developement, Demand water.

Abstract 33.

VALORISATION OF RAINWATER BY GROWING CHICKPEAS: EXPERIMENTATION IN PLANTAE

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Water and soil: land-related resources, agriculture, local science and life management activities, there foreshore important functions that need to be coordinated to ensure higher levels of commodities.
Irrigated agriculture, the sector that consumes the most water, today faces an urgent need to conserve it, or even limit it in the face of water scarcity and soil degradation. The global food crisis has led to violence in some countries, raising expectations for irrigated agriculture. In Morocco, the depletion of water resources and soil degradation are notable. These phenomena are due to the uncontrolled growth of urbanization and the development of agricultural and industrial activities. There is also an anarchic occupation of space, a maladjustment or even a lack of sanitation. The quality of these resources remains a growing concern for the national and international community. In addition, edible legumes occupy an important place in food systems agriculture, and play an important role in the development of the agricultural economy of many countries of the world because of the area they occupy.
The present work focuses on the study of the effect of rainwater collected from the FSDM on the cultivation of chickpeas, as well as the effect of the organic amend mint previously developed from organic waste within the LIMOME laboratory on the fertility of an arid soil poor in mineral elements. Chickpea cultivation was monitored by measuring vegetative growth parameters.
The results obtained showed compliance of rainwater quality with the irrigation standard, and a chickpea rise after 10 days compared to the control irrigated by drinking water whose first push took place after 25 days. We also found a significant increase in vegetative growth parameters and chickpea production in soil enriched by the amendment and irrigated with rainwater collected and conserved from the FSDM.
The treatment carried out allowed the recycling of collected water and the adaptation to the developed use. Our study could represent an interesting reflection to encourage stakeholders on better management of water resources.

Keywords: Soil; irrigation water ; organic amendment ; chickpeas ; crop monitoring

Abstract 34.

CHARACTERIZATION PHYSICO CHEMICAL AND EVALUATION THE PERFORMANCE OF A WASTEWATER TREATMENT PLANT TYPE NATURAL LAGOONING WITH ANAEROBIC DIGESTION OF THE CITY OF SKHIRAT MOROCCO

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During the last two decades, Morocco has made remarkable progress in the construction of urban and industrial wastewater treatment plants, reducing pollution caused by domestic and industrial effluent. However, Wastewater treatment plants (WWTPs), particularly those using natural lagoons with anaerobic digestion, such as the treatment plant in the city of Skhirat, can be subject to deficiencies that limit the efficiency of the treatment process over the operating period. The aim of our study is to monitor the treatment performance of the WWTP by determining the physical-chemical parameters and heavy metals at the exit of the WWTP, in comparison with Moroccan discharge standards. The results showed that all the physicochemical parameters of WWTP Skhirat, namely average temperature of 21.11°C, hydrogen potential (pH) of 7.9, electrical conductivity (EC) of 3,76 mS/cm, dissolved oxygen (O2) =13.17 mg/l, (BOD5)=90.06 mg O2/l, (COD) =173.42 mg O2/l, suspended solids

(SS) 23.8 mg/l, ammoniacal nitrogen (N-NH4+) 0.76 mg/l, (N-NO2-)=0. 7 mg/l, nitric nitrogen (N-NO3-) =0.15 mg/l, orthophosphates (PO43-) =0.82 mg/l, all in compliance with Moroccan rejection standards. In addition, the result showed that trace heavy metal parameters such as (Cu)=0.02 mg/l and (Zn)=0, 61 mg/l and (Ni) =0.02 mg/l conform to the Moroccan standard for rejection and reuse in irrigation. The performance of the WWTP in treating wastewater has allowed a reduction in physicochemical pollution indicators of the order of MES 94.7%, TKN 61.08%, COD 73.16% and BOD5 58.31%. Indeed, after treatment, wastewater from the Skhirat WWTP can be returned to the environment or reused for irrigating without any impact on the environment or crops in terms of physicochemical parameters and Heavy metals.

Keywords: wastewater ; WWTP ; anaerobic digestion ; COD ; BOD5 ; Heavy Metals.

Abstract 35.

RECYCLING OF EFFLUENTS FROM A HAEMODIALYSIS SERVICE: COMMENTS FROM A PUBLIC SERVICE LOCATED IN THE NORTH CENTER OF MOROCCO

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The human right to water is necessary to live in human dignity. This is a precondition to achieving other human rights. It is an essential and basic public service for the socio-economic development of each country. However, rapid progress in the process of urbanization cannot be separated from global resource support. Industrial development and demographic agglomeration have posed major challenges for regional governance of the water environment. In addition, the treatment of certain diseases, which have become frequent, such as renal insufficiency, requires large quantities of water. As a result, about 120 litres of water are purified, for each haemodialysis session and for each patient. Faced with a triple challenge, quantitative, qualitative and accessibility, and given that we are among the countries exposed to shortage water; we have developed into a Moroccan public haemodialysis service, a recycling program for its effluents. This program aims to re-use effluents in various fields such as irrigation and watering.

To reach our objective, we conducted physico-chemical and bacteriological analyses of the effluent water before and after treatment. This procedure was accomplished d by mixing the effluent haemodialysis service with the well water. The analyses were in accordance with Moroccan norms. Physico-chemical analysis was carried out to measure hydrogen potential (pH), temperature and electrical conductivity, determination of nitrates, nitrites, orthophosphates, chlorides and sulphates, For microbiological analysis, we performed a membrane filtration count of faecal coliforms, as well as a search for *Salmonella* and *Vibrio cholera*.

The results showed that we could not directly use the raw effluent for watering because the majority of the parameters tested were not compliant. However, after treatment of the effluents, all the microbiological and physico-chemical analyses, as well as the heavy metals analyses, showed compliance with the Moroccan standards concerning discharges intended for irrigation.

The treatment allowed us to recycle the evacuated water and adapt it to irrigation and watering. Our study could represent an interesting thought process to encourage stakeholders to better manage water resources.

Keywords: Center northern of Morocco; Effluents; feedback; haemodialysis ; public service ; recycling

Abstract 36.

ADSORPTION OF METHYLENE BLUE FROM TEXTILE INDUSTRIAL WASTEWATER USING FUNCTIONNALIZED TEXTILE FIBER WASTE

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Polyacrylonitrile Fibers (PANF) stand out as a predominant polymeric material extensively employed for wastewater purification in diverse industrial processes. Recognized for its commercial availability and cost-effectiveness, PANF possesses noteworthy mechanical strength and a substantial specific surface area [1]. In this study, we aimed to enhance the adsorption efficacy of waste PANF by functionalizing of nitrile groups. This modification was undertaken to create an efficient adsorbent capable of removing a variety of organic dyes, including anionic, cationic, and reactive dyes [2]. Building upon our prior investigation [3], which affirmed the adsorbent's competence in hexavalent chromium removal and explored its mechanical and thermal properties during the adsorption of organic dyes, the current research delves into evaluating the synthesized material's efficiency as an adsorbent for industrial organic dyes in aqueous solutions. Systematic variations in parameters such as pH, adsorbent mass, contact time, temperature, and initial concentration were conducted to assess their influence on removal efficiency. The obtained results were meticulously compared with the experimental plan. The findings underscore the profound impact of these parameters on removal efficiency, emphasizing the necessity for optimization studies to achieve optimal removal effectiveness. Kinetic modelling results indicate that chemisorption predominantly governs the adsorption rate, implicating forces and electron exchange between the adsorbent and adsorbate. The conducted studies provide substantial evidence supporting the assertion that adsorption occurs as a monolayer and exhibits homogeneity. Remarkably, the maximum adsorption capacity reaches approximately 99.7% for the cationic dye Methylene Blue. These outcomes substantiate the potential of the functionalized waste PANF as an adept and high-capacity adsorbent for the removal of industrial organic dyes from aqueous solutions, offering valuable insights for sustainable wastewater treatment strategies.

Keywords: polyacrylonitrile fiber ; textile ; organic dyes ; adsorbent ; wastewater

Abstract 37.

ADVANCED HARMONIZATION OF UV-VISIBLE SPECTROSCOPY WITH CUTTING-EDGE CHEMOMETRIC TECHNIQUES FOR SIMULTANEOUS ASSESSMENT OF KEY WATER QUALITY INDICATORS

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Our research introduces a sophisticated system merging spectrophotometric analysis and chemometric methods for the simultaneous estimation of nitrite, nitrate, and Total Organic Carbon (TOC) in water samples. This study highlights the critical need for precise water quality monitoring in the context of environmental health and public safety. We detail our innovative approach comprising three phases: firstly, the application of Recursive Feature Elimination with Support Vector Regression (RFE-SVR) for the strategic selection of the most informative input wavelengths. This step is pivotal in correlating specific wavelengths with our targeted water quality indicators. Secondly, we employ Multilayer Perceptron Regression (MLP) to effectively model the complex, non-linear relationships

present in environmental data. Lastly, we conduct a thorough performance evaluation using key metrics such as R-squared values, Root Mean Square Error of Prediction (RMSEP), Mean Absolute Error (MAE), and cross-validation techniques. Our results exhibit outstanding predictive capabilities, as evidenced by high R2 values (0.9915, 0.9953, 0.9866) and low RMSEP and MAE values (RMSEP for nitrite: 0.092, nitrate: 0.068, TOC: 0.115; MAE for nitrite: 0.210, nitrate: 0.643, TOC: 0.091). The integration of these advanced analytical techniques presents a robust and effective solution for water quality analysis, ensuring accurate prediction of nitrite, nitrate, and TOC levels. Our findings hold significant implications for environmental monitoring, offering a promising approach for future research and application in this critical field. This work lays the foundation for advanced water quality assessment, contributing to the broader goals of environmental sustainability and public health protection.

Abstract 38.

FUTURE CHANGES IN SURFACE RUNOFF DUE TO CLIMATE VARIABILITY IN THE BOUREGREG BASIN BY INTEGRATING REGIONAL CLIMATE MODEL OUTPUT DATA IN THE GR2M HYDROLOGICAL MODEL

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Watershed hydrology is facing significant challenges due to climate change. This study aimed to evaluate the impact of future climate change on surface runoff in the Bouregreg catchment. The Rural Genius Model (GR2M), combined with the outputs from the CNRM-CM5 climate model, was used to project monthly streamflow in the 2040s (2031-2050), comparing it with the reference period of 1982-2001 under medium (RCP4.5) and high (RCP8.5) emission scenarios. The methodology encompassed three main steps: (1) projecting future trends of various climate parameters using the regional climate model; (2) calibrating and validating the hydrological model; and (3) predicting potential runoff in the 2040s. The results showed inevitable climatic changes in the Bouregreg catchment under the Representative Concentration Pathways (RCP). Mean temperatures were projected to increase by 1.32 °C and 1.69 °C, potential evapotranspiration (PET) to rise by 5.38 mm and 6.27 mm, and precipitation to decrease by 33.74% and 40.20% under RPC4.5 and RCP8.5, respectively. These changes would lead to an annual decrease in streamflow of 44.63% for RCP4.5 and 64.30% for RCP8.5 by the 2040s compared to 1982–2001. The study's insights can be invaluable for decision-makers in developing effective strategies to manage and safeguard water resources in the Bouregreg catchment.

Keywords: Bouregreg catchment ; Climate change ; RCPs ; Climate model ; GR2M model ; Surface runoff

Abstract 39.

THERMODYNAMIC PROPERTIES DATA OF TERNARY SYSTEM KBR-KH2PO4-H2O AT 298.15 K

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The OCP Group located in Morocco in Africa is one of the biggest producers of phosphates and fertilizers in the world and delivers products to more than 165 clients on five continents, such as Ammonium and Di-Ammonium Phosphate, Sodium Phosphate, and others with added micronutrients (Potassium-Calcium-Nitrogen) that are designed to effectively feed degraded soil. OCP has launched a new strategy in Africa called "Green Africa" to transform African agriculture and make it a platform for

food production. Therefore, with the aim of developing new fertilizers and increasing the yield of soils and agriculture, we are interested in this work to study the influence of electrolyte on fertilizer Phosphate such KBr-KH2PO4-H2O. This system was investigated with our developed hygrometric method at 298.15 K. The thermodynamic parameters of the studied system such the water activity and osmotic coefficient are determined by measuring the relative humidity at various total molalities from 0.2 mol.kg-1 to about saturation, and for different ionic-strength fractions *y* of KH2PO4 (*y*=*I*KBr/(*I*KH2PO4+*I*KBr)) of 0, 1/4, 1/3, 1/2, 2/3, 3/4 and 1. The obtained measurements are compared tofour models such the Dinane (ECA),Lin et al., Robinson and Stokes (RS), and Leitzke-Stoughton (LS II) equations. The solubilities of KBr and KH2PO4 in their aqueous mixture are also measured at 298.15 K. The solid state was characterized using Powder X-Ray Diffraction (XRD). The PSC model was used to correlate the results and to predict the solute activity coefficients, excess Gibbs energy, and solubilities of the components in the mixture.

Keywords: Water activity ; Osmotic and Activity coefficient ; Excess Gibbs energy ; Solubility ; Pitzer ; Simonson ; Clegg model

Topic 3

GREEN TRANSITION AND SUSTAINABLE DEVELOPMENT

Abstract 40.

DESALINATION OF ANCHOVY RESIDUES AND THEIR MIXTURE WITH SOYBEAN MEAL FOR THE PRODUCTION OF POULTRY FEED: OPTIMIZATION OF WASTE ASSOCIATIONS THROUGH RESPONSE SURFACE METHODOLOGY (RSM)

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Salted anchovy bones are a non-recyclable waste product that contains high levels of salt. However, they also contain valuable minerals such as calcium, phosphorus, potassium, magnesium, and nitrogen. This study aimed to find a cost-effective method to desalinate anchovy bones while preserving their nutritional value, and to repurpose the desalinated bones as a raw material for poultry feed. Through various tests, we were able to reduce the salt content of the anchovy bones from 15.4% to 4.7% using a 50%/50% mixture of tap water, and from 15.4% to 3.7% using a mixture of tap water and soybean meal in a 30/70% ratio. Combining soybean meal with desalted anchovy bones resulted in a nutritional composition comparable to that found in poultry feed, while also reducing the salt content. The response surface method (RSM) was employed to determine the optimal proportions of desalted anchovy bones (70-90%) and soybean meal (10-30%) and to study the variables affecting the concentrations of NaCl, Ca, P, Ash, and TNM. The results revealed the influence of desalted anchovy bone and soybean meal percentages on these concentrations. This study demonstrates that the method used provides an ideal approach for understanding the interactions between input parameters (% DAR, % SM) and output parameters (NaCl, Ca, P, Ash, and TNM), and shows promising results for the desalination of anchovy bones using a soybean meal cake as well as the feasibility of creating poultry feed.

Keywords: Salted anchovy bones ; Poultry feed ; Soybean meal ; Response surface methodology.

Abstract 41.

ECOLOGICAL BUILDING MATERIALS BASED ON MIXTURES OF DEMOLITION WASTE, RECOVERED PUMICE STONE AND MARBLE SLUDGE'S WASTE: ELABORATION AND CHARACTERIZATION

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In Morocco, the construction sector is a major source of greenhouse gases. According to the local development company (SDL) Casa Environment, around 9.5 million tons of inert waste litter the various districts of the city of Casablanca [1], their transport to landfill generates significant additional costs and contributes significantly to global warming, with huge quantities of CO 2 emissions [2]. Added to this waste are those generated by the textile industry. While this industry contributes by 15% Morocco's GDP [3], it also generates large quantities of various liquid and solid wastes, we take a look at pumice stone which is used in blue Jean washing. Thirdly, marble factories also generate large quantities of marble powder from the cutting of marble blocks. The recovery of these wastes is thus becoming a major environmental challenge. However, despite the relevance and topicality of the subject, the field of research into the recovery of demolition and industrial wastes is still new to Moroccan research centers. This study is a contribution to the valorization of waste as a substitute for

normalized aggregates and fines in the manufacture of environmentally-friendly building materials. Our main objective is to study the effects of substituting natural aggregates with recycled aggregates of demolition waste, pumice and marble on the mechanical, thermal and durability properties of conventional building materials such as concrete and bricks. We are also studying the behavior of marble powder and finely ground demolition waste fines as cement substitutes with the addition of limestone. These properties include compressive, flexural and tensile strength, carbonation, permeability, and resistance to sulfate attack, among others. Initial results indicate that the mechanical properties of materials made with variable rates of these wastes combined with cement or cement-marble or cement- fine of demolition waste as binder are very interesting and can contribute to the reuse of these wastes in the industrial manufacture of sustainable ecological materials and resource saving. This process will help to reduce the carbon footprint of the construction sector.
Keywords: Concrete waste ; pumice stone waste ; marble waste ; mechanical properties ; durability ; ecological materials ; footprint of building sector

Abstract 42.

LA VALORISATION DU BIOGAZ : UNE SOLUTION INNOVANTE POUR UNE ÉNERGIE RENOUVELABLE POLYVALENTE ET DURABLE

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La valorisation du biogaz pour l'évaporation forcée est une approche innovante qui permet d'utiliser le biogaz issu de la décomposition des déchets organique pour alimenter des systèmes d'évaporation forcée. Cette approche consiste à produire de l'énergie thermique à partir du chauffage de l'eau en utilisant la chaleur dégagée lors de la combustion du biogaz.

L'utilisation du biogaz comme source de chaleur dans ce processus évite le recours aux combustibles fossiles ou à d'autres sources d'énergie traditionnelles, ce qui contribue à réduire les émissions de gaz à effet de serre.

Dans ce contexte, nous avons mis en place un pilote d'évaporation forcée au niveau de la décharge contrôlée de Meknès, en vue de valoriser le biogaz produit pour réduire le volume des lixiviats, qui constitue un défi majeur pour la commune de Meknès.

Cette étude a été réalisée en hiver (février 2023), lorsque l'évaporation naturelle des lixiviats est insuffisante par rapport à l'été. L'objectif était donc de garantir une évaporation élevée et stable tout au long de l'année.

La qualité et le volume du biogaz sont mesurés quotidiennement. En moyenne, un volume de 6,67 m^3 de biogaz contenant 45 % de CH_4 est brûlé pendant 6 heures pour chauffer 5 litres d'eau. Ainsi, La vapeur chaude produite, atteignant une température de 98 °C, est acheminée à l'aide d'un serpentin en cuivre de 3 mètres de longueur, qui est immergé dans une petite bassine ronde de 40 cm de diamètre et 15 cm de hauteur contenant 3 litres de lixiviats. Ce test a permis d'augmenter la température des lixiviats à 43 °C, entraînant une évaporation moyenne de 30 %.

Des analyses physico-chimiques sont réalisées à la fin de chaque test d'évaporation. La conductivité a augmenté de 33,5 40mS/cm, le pH passe de 7,1 à 7,4 et la concentration en NH_4^+ est augmenté de 2 à 2,5mg/l.
En conclusion, l'utilisation du biogaz dans le processus d'évaporation forcée offre une opportunité prometteuse pour une utilisation durable des ressources et la production d'énergie renouvelable. Cela permet de combiner l'élimination des déchets organiques, la réduction des émissions de gaz à effet de serre et la production d'énergie utile. Malgré les défis techniques associés, cette approche présente

un potentiel significatif pour contribuer à la transition vers une économie verte et à faible émission de carbone.

Keywords : Biogaz ; GES ; Energies renouvelables ; Valorisation ; Evaporation forcée

Abstract 43.

INDICATEURS CLÉS POUR OPTIMISER LA PERFORMANCE DU SYSTÈME MANAGEMENT ENVIRONNEMENTAL : CAS D'UNE SOCIÉTÉ DE TRAVAUX PUBLIC (MAROC)

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Actuellement, la prise en compte des problèmes environnementaux est devenue un enjeu stratégique pour les entreprises et surtout à caractère industrielles, la plupart de ces entités ont adopté de nouvelles pratiques en matière de protection de l'environnement.

La performance environnementale est un sujet d'actualité, il représente les résultats mesurables liés au management des aspects environnementaux, la performance environnementale n'existe que si elle peut être mesurée, ainsi l'évaluation de la performance environnementale nécessite la mise en œuvre d'outils plus ou moins innovants, ces derniers permettaient aux dirigeants d'évaluer le niveau de performance environnementale et ‘identifier les points éventuels à améliorer.

Le Système de Management Environnemental (SME) désigne les méthodes de gestion et d'organisation environnementale d'une entreprise. C'est une démarche qui reste encore aujourd'hui innovante, car elle vise à prendre en compte de façon systématique l'impact des activités de l'entreprise sur l'environnement, à évaluer cet impact et à le réduire. Elle consiste donc à intégrer l'environnement dans la gestion et la stratégie de l'entreprise. Le Management Environnemental s'inscrit donc dans une perspective de développement durable : il implique une interdépendance entre développement économique et qualité de l'environnement. Dans le domaine de l'environnement, la gestion des entreprises est soumise à des pressions réglementaires et institutionnelles auxquelles les entreprises peuvent difficilement se soustraire sans remettre en cause leur légitimité. Le système de management environnemental basé sur la norme ISO 14001 est une réponse à toutes ces pressions. La présente étude, portant sur l'amélioration du SME, a été effectuée dans une société de travaux publics (Maroc) qui s'est engagée dans la démarche de certification conformément à la norme ISO 14001 Version 2015 dans un souci de prouver son engagement environnemental à ses différents partenaires et clients et ce afin de garantir un entourage sain et salubre.

Dans la pratique, ce travail constitue une contribution à l'amélioration de la performance environnementale de cette entreprise par l'identification, l'évaluation et l'atténuation des risques et des aspects environnementaux liés à ces activités et ce dans le but de réduire l'impact de ses processus de production et de ses produits sur l'environnement.

Keywords : SME ; ISO 14001 ; Evaluation de la Performane Environnementale ; Exigences réglementaires ; Amélioration continu

Abstract 44.

NATURAL WOOL AS A FIRE-RESISTANT MATERIAL; TECHNICAL SAFETY TEXTILE

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Wool, a natural protein fiber, contains keratin, which is known for its flame-resistant properties. The fibrous structure of wool, coupled with its high moisture content and self-extinguishing capabilities, contributes to its excellent fire-resistant properties. Numerous research studies have focused on using naturally derived materials, like keratin, to enhance the flame retardancy of textiles. In this context, wool powder presents a potential alternative to synthetic flame-retardant materials. This alternative approach aligns with the growing demand for environmentally friendly and sustainable flame-retardant solutions, as wool powder offers a biodegradable and renewable option compared to conventional flame-retardants. The discourse on wool powder as a flame retardant highlights its potential significance in the fields of materials science and fire safety, warranting further investigation into its effectiveness and application in diverse contexts such as textiles and upholstery.

Keywords : wool powder ; flame ; retardant ; fire safety ; sustainable materials

Abstract 45.

RECOVERY AND RECYCLING OF CONCRETE AND ITS CONTRIBUTION RATE TO DECARBONATION OF BUILDING SECTOR

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In Morocco, the construction sector ranks among the major sources of greenhouse gases in the atmosphere; Cement produces carbon dioxide in limestone calcination furnaces (1 ton of CO2 emitted for 1 ton of cement produced); The transport of raw materials (sand from beaches, rivers and quarries) to construction sites, and demolition and construction waste to public landfills requires transport by large trucks (1 8x4 truck emitted 2.64 Kg per liter of diesel consumed).
The objective of our project is to reduce the carbon footprint of the construction sector by recovering demolition and construction site waste after collection, sorting, crushing , grinding and sieving ; séparation each extracted part and testing its conformity with suitable and appropriate materials.
For example, the very fine micronized by-product has proven its ability to substitute up to 20% of new cement. The remaining fractions will be used to manufacture plasters, mortars, ecological bricks, decorative gravel, sewage pipe beds, ... etc.
The contribution of this waste in the substitution of new materials is very provident. First, this waste ensures the sustainability of raw materials, the saving of resources and drastically reduces the carbon footprint since production or transport energy is spared and the preservation of natural resources is preserved.
Casablanca produces annually staggering quantities of inert waste from construction sites and demolitions for renovation (About 300 - 500 thousand tons/year since the year 2000). This represents a share of 15-25% of energy needs and a carbon footprint estimated at 150,000 to 250,000 tons of carnic gases avoided in the atmosphere annually.
We will present in detail the main results of our research work and also describe the specific properties of each material developed.

Keywords: Demolition and construction waste ; Recovery and recycling of inert waste ; Energy saving ; Decarbonization ; Construction sector in Morocco.

Abstract 46.

ROSA CANINA AQUEOUS EXTRACT: CHEMICAL CHARACTERIZATION AND GREEN SYNTHESIS OF SILVER AND COPPER NANOPARTICLES

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The term "nanoparticles" (example: silver, copper) suggests a "Nano" particle with a size range of 1 nm to 100 nm. These particles can be categorized into many classes according to their characteristics, sizes, or shapes. Metal nanoparticles can be synthesized using a variety of techniques, including chemical, electrochemical, and radiation approaches. Nevertheless, chemical processes frequently yield hazardous compounds that could have unfavorable side effects in medicinal applications. Since green chemistry can reduce or eliminate the usage of dangerous materials, it is thought to be a superior option. Due to their affordability and environmental friendliness, aqueous extracts of medicinal plants are currently being used to synthesize nanomaterials.
In the current work, we synthesized copper and silver nanoparticles from the seeds of the Moroccan medicinal plant *Rosa canina*, and we measured their antibacterial and antioxidant properties against three strains of bacteria at varying concentrations. Based on SEM, zeta sizer, UV, and IFTR studies, the resulting nanoparticles are spherical in shape and range in size from 50 to 100 nm. The larger concentration of silver nanoparticles (10 mM) demonstrated a noteworthy antibacterial action, according to the results. Indeed, a potent antimicrobial effect was reported against *Staphylococcus aureus* and *Escherichia coli*. After copper nanoparticles, the activity of the silver nanoparticles was on par with or greater than that of the conventional antibiotics. These results suggest that silver nanoparticles synthesis using *Rosa canina* aqueous extract can be used as an effective growth inhibitor of various microorganisms, making them applicable to diverse medical devices and antimicrobial control systems.
Keywords: Green chemistry ; Silver nanoparticles ; Antibacterial activity ; Rosa canina.

Abstract 47.

THERMAL PROPERTIES OF COMPRESSED EARTH BRICKS PRODUCED WITH PENNISETUM ALOPECUROIDES FIBERS

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In most studies, scientists have focused on the thermal and mechanical impact of natural fibers on compressed earth bricks. This article addresses, for the first time, the characterization of the thermal transport properties of materials composed of clay and waste fibers from Pennisetum alopecuroides (PA). Eco-composites were developed by incorporating different proportions of the fiber, ranging from 0.5% to 4.5% by weight of the soil, to assess their thermal behavior and apparent density. The results indicate that PA fiber has a positive effect on the thermal properties of earth blocks.
Keywords: Pennisetum alopecuroides ; Eco ; composites ; clay

Abstract 48.

MECHANICAL AND THERMAL ANALYSIS OF COMPACT BLOCKS FABRICATED FROM CLAY STABILIZED WITH WOOD ASHES OR CRUSHED WASTE FROM TRADITIONAL POTTERY

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The primary objective of this research is to enhance the thermal and energetic properties of construction materials, with a specific focus on meeting the heating and cooling requirements outlined in the Moroccan thermal building regulations (RTCM 2015). The investigation explores the potential integration of wood ashes or crushed waste from traditional pottery into the formulation of environmentally friendly bricks.

Laboratory-scale experiments were conducted on various mixtures to identify the optimal dosage for achieving ideal thermal characteristics in brick blocks. The proportions of wood ashes and crushed pottery waste were varied from 0% to 50% relative to the total mass of the dry mixture. Using clay samples, brick blocks and cylindrical specimens measuring 5 cm in diameter and 10 cm in height were created. The optimal dosage of wood ashes was determined to be 5% in combination with the clay. The inclusion of crushed pottery waste enhanced the absorption properties of these blocks, with the highest thermal resistance values observed at a 20% dosage of pottery waste.
By replacing 5% of the clay with wood ashes or 20% with crushed pottery waste, environmentally friendly blocks were successfully produced, exhibiting a notable increase in thermal resistance comparable to traditional building materials. Furthermore, a simulation study was conducted to analyze the dynamic thermal behavior of a room with a single thermal zone, assessing the impact of the introduced building material on heating and cooling loads in different Moroccan climate zones, namely the humid climate of Agadir (zone 1) and the dry climate of Marrakech (zone 5).
The numerical comparisons revealed that the studied composite material aligns with the thermal regulation requirements outlined in the Moroccan building code (RTCM 2015). This signifies the potential of the introduced material as an energy-efficient alternative, showcasing promising results in meeting the demands of sustainable construction practices in Morocco.
Keywords : Ecologic building material ; Clay ; Thermo ; physical characterizations ; Simulation study

Abstract 49.

THERMAL-OXIDATIVE AGEING AND LIFETIME PREDICTION OF THE HIGH-DENSITY POLYETHYLENE PIPES

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Polyethylene (PE) pipes are widely used in drinking water distribution networks around the world. In-depth research into the ageing of PE pipes is imperative to ensure their successful use. The study of

the ageing of these products is based on the analysis of the kinetics and mechanisms of failure during prolonged exposure to external factors. Understanding polymer degradation mechanisms is crucial for developing stabilisation strategies and predicting lifetimes based on accelerated artificial ageing tests. The aim of this article is to detail the methodology used to predict the service life of high-density polyethylene (HDPE) pipes. Reliable predictions of the service life of underground HDPE pipes must be based on a thorough understanding of the failure mechanisms and on more reliable extrapolation procedures, allowing the transition from relatively short-term test data to long-term service environments.

Keywords : High density polyethylene (HDPE) ; lifetime ; prediction ; ageing

Abstract 50.

THERMO-PHYSICAL CHARACTERIZATION OF A CEMENTITIOUS COMPOSITE MATERIAL FOR SUSTAINABLE CONSTRUCTION

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Energy efficiency in buildings is becoming increasingly important given the potential it has in terms of reducing consumption and complying with the principles of sustainable development. The design of energy-efficient materials therefore aims to provide the building with considerable energy performance by complying with safety standards and promoting better thermal comfort.

Currently, physical and chemical improvements of construction materials are the most common treatment methods used worldwide. Moreover, the global production of plastics reached a record of 320 million tons in 2015, which is equivalent to 10.1 t per second. Given the value of the thermal conductivity coefficient of plastics, which is between 0.15 and 0.30 W/m.K the introduction of plastic waste into construction materials is a way to improve the thermal behavior and be an innovative solution to recycle plastics. Besides, cement is recognized as a hydraulic binder, which in contact with water, and following a succession of chemical reactions, hardens and retains its resistance afterwards. Its importance in construction is based on its presence in the composition of all the materials used: concrete, breeze block, mortar, etc. As a result, improving the energy performance of this essential material means improving the energy performance of the building as a whole.
The present work consists of the design and chemical and thermodynamic characterization of an elaborate material intended for sustainable construction. The results show an improvement in its thermal performance depending on the presence rate of plastic. The addition of recycled plastic to the initial material decreases the thermal conductivity of the composite as the rate of recycled plastic increases.

Keywords : : Plastic waste ; cement ; energy efficiency ; thermal conductivity ; heat capacity.

Abstract 51.

CARVACROL, CAMPHOR, AND LINALOOL / AL (111) INTERACTION MODELLED USING DFT, MONTE CARLO, AND MOLECULAR DYNAMICS METHODS

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Corrosion poses a significant challenge in various industrial sectors, impacting the functionality of different materials, including aluminum. Aluminium, which constitutes approximately 8% of the Earth's crust by mass, is the most abundant metal available. Its affordability and mechanical properties make it an essential component in industries such as aerospace and marine transportation.

Aluminium alloys possess greater stability due to the formation of a protective oxide-hydroxide film on their surface. This film acts as a barrier against corrosion by covering the entire surface of the metal. It prevents the movement of electrons produced during metal oxidation from reaching the oxide surface. However, this protection is compromised if there are any defects or dissolution of the oxide film.

Exposure to marine environments leads to alloy cracking and intergranular exfoliation in aluminum. Chloride ions have distinct characteristics that enable them to penetrate through the oxide film and form soluble complexes. Pitting and crevice corrosion are regarded as crucial types of corrosion for aluminium alloys in seawater.

One method used to enhance resistance against corrosion in aluminium alloys is through corrosion inhibitors. These inhibitors offer a simple and cost-effective means of protecting metals from corrosion. They are typically organic or inorganic substances added at low concentrations within corrosive environments to inhibit or slow down metal corrosion.

Organic compounds interact with metal surfaces due to active sites like heteroatoms with lone pairs of electrons (O, S, and N), aromatic rings, azomethine linkage, and planarity within their molecular structure, allowing them to adhere effectively to the metal surface.

While synthetic compounds exhibit excellent potential for inhibiting corrosion, they also present high levels of toxicity to both humans and the environment. Natural-based inhibitors derived from substances found in nature offer an alternative solution that is biodegradable and non-toxic. Recent research has increasingly focused on these eco-friendly inhibitors, known as green inhibitors.

Numerous bio-organic families containing alkaloids, phenolic compounds, and terpenes have demonstrated significant effectiveness in reducing corrosion.

Researchers have examined three primary compounds from different essential oils to study their ability to inhibit corrosion and understand the adsorption process. Carvacrol, a monoterpene, represents the main component of essential oils derived from Hop Cones, Origanum vulgare, and Origanum elongatum. Linalool, a terpene alcohol, is the predominant compound found in the essential oil from Hyssopus officinalis.

Quantum chemistry is a suitable method for studying corrosion inhibition processes and establishing significant correlations between compound efficiency and various semi-empirical corrosion inhibition properties.

This study focuses on the electronic structure and reactivity of three organic compounds (carvacrol, camphor, and linalool) as potential inhibitors of aluminum corrosion. The study employs topological analysis of the electron localization function (ELF), Monte Carlo simulations, and density functional theory (DFT) calculations to evaluate how these inhibitors interact with the aluminum surface.

Analysis of ELF reveals different synaptic orders in the valence basins, which are crucial for understanding the electronic structure of the inhibitors and their complexes with the metal. Furthermore, global reactivity indices such as dipole moment, electronegativity, and nucleophilicity are investigated to predict whether these inhibitors can provide protective characteristics when adsorbed onto aluminum surfaces.

The findings indicate that carvacrol and camphor have higher dipole moments and nucleophilicity indices compared to linalool. This suggests a stronger tendency for these compounds to donate electrons to the metal surface, which is advantageous for corrosion protection. Moreover, bonding energies between inhibitor molecules and the Al(111) surface, as well as local reactivity descriptors identifying electrophilic and nucleophilic sites on inhibitors, are explored.

Based on quantum chemical descriptor values, carvacrol exhibits easier interaction with aluminium than camphor or linalool molecules. Additionally, analysis of atomic net charges shows that oxygen

atoms in all three inhibitor molecules carry a negative charge. This site is generally considered more reactive as an electron donor.
Positively charged carbon atoms are likely to bind with metallic surface atoms. According to local reactivity indices, O20, O15, and C2 sites linked to carvacrol, camphor, and linalool, respectively, provide electrons during adsorption.
Keywords: DFT ; Corrosion inhibition ; hydrochloric acid ; Aluminum ; Monte Carlo simulation ; Essential oil

Abstract 52.

FIRST-PRINCIPLES COMPUTATIONAL STUDY OF DOUBLE PEROVSKITE STRUCTURE AS MATERIAL FOR SOLID-STATE SODIUM BATTERIES

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Recent decades have seen immense developments in lithium-ion battery technologies, which will be greatly beneficial for electric vehicles, portable electronics, and other large-scale energy storage applications. However, new technologies are being driven forward by the growing demand for lithium batteries and the necessity to transition to large-scale energy storage systems. An encouraging alternative for lithium –ion batteries in energy storage is sodium-ion batteries. Due to their low cost and abundant supply of sodium resources, they represent a viable and economical option for power systems.
In this work, a double perovskite type Na1.5La1.5TeO6 has been studied as electrolyte for solid-state sodium batteries because of its great specific capacity and stable cycle performance. The structural and electronic properties have been investigated through first principles calculations using the full potential linearized augmented plane waves (FP-LAPW) approach. The results of the electronic density of states and the band structure reveal that Na1.5La1.5TeO6 is a direct band gap semiconductor, and the calculation of the voltage suggests that this material has the potential to serve as a favorable option for a solid electrolyte in sodium batteries.
Keywords: First principles calculations ; Band gap ; Electronic properties ; Sodium ion batteries

Abstract 53.

ENHANCING THERMAL PROPERTIES OF CONSTRUCTION AND DEMOLITION DEBRIS VIA MARBLE POWDER BY-PRODUCT ADDITION AND SINTERING

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The unprecedented growth in construction and demolition activities worldwide has led to a substantial increase in the generation of debris, presenting significant challenges for environmental sustainability. Hence The increasing global emphasis on sustainable development has prompted a growing interest in recycling construction and demolition debris (C&D debris) as a means of minimizing environmental impact and promoting resource efficiency.
This study aims to provide a comprehensive analysis of the recycling practices applied to demolition debris, focusing on reutilizing debris to create a construction material.
In this study, we examined the influence of sintering on the thermal behavior of debris and marble byproduct. Furthermore, we explored the ramifications of incorporating marble byproduct into construction and demolition debris concerning thermal conductivity, specific heat, thermal diffusivity, and thermal effusivity. Our study aims to elucidate the nuanced thermal characteristics resulting from

sintering and to rigorously evaluate the impact of marble byproduct addition across a spectrum of thermal parameters. This comprehensive analysis, augmented by the use of the CT-Meter—an apparatus developed by the SCTB, compliant with the standard (NF EN 993-15:2005)—seeks to deepen our understanding of the intricate thermal properties inherent in the composite material.
The research ultimately seeks to promote the widespread adoption of recycling practices in the demolition sector, fostering a more circular economy and reducing the overall environmental footprint of construction activities.
Keywords: Debris ; marble byproduct ; thermal conductivity ; specific heat ; thermal diffusivity ; and thermal effusivity.

Abstract 54.

USE OF METAKAOLIN AND FIRED BRICK WASTE IN GEOPOLYMER PRODUCTION FOR SUSTAINABLE CONSTRUCTION

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Global interest to develop durable building materials with low CO2 emissions makes geopolymer materials a friendly alternative to conventional construction materials. In this context, this study presents an experimental investigation into the properties of geopolymer binders prepared using metakaolin (MK) and red clay brick waste (RBW). A series of mixes with varying contents of RBW up to 100% as metakaolin replacement was prepared to assess several properties, such as, water absorption, compressive strength, thermal conductivity, and fire resistance. The experimental outputs signified that 30% RBW replacement exhibited good mechanical properties and superior thermal insulation compared to conventional cement, with lower thermal conductivity values and good fire resistance. Therefore, there is great potential for transforming red brick waste into a readily available aluminosilicate resource for use in geopolymer materials.

Keywords: Clay brick waste ; Recycling ; Metakaolin ; Geopolymer ; Building materials.

Abstract 55.

THERMODYNAMIC ACTIVITY OF AMMONIUM SUPERPHOSPHATE IN AQUEOUS SOLUTIONS AT 333.15 K

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Mineral fertilizers, including phosphate, fertilizers play an essential role in achieving optimal agricultural productivity with high quality and yield. Phosphorus, alongside nitrogen (N) and potassium (K), is a fundamental element for plant life and is widely abundant in nature. Extensive global research on fertilization has emphasized the crucial significance of phosphorus in the mineral nutrition of plants. The efficient utilization of phosphorus maximizes the benefits derived from nitrogen fertilization, which is pivotal for plant growth and development [1].
Gaining knowledge about the thermodynamic properties of superphosphate fertilizers is of great importance for comprehending the underlying physicochemical processes and equilibrium in aqueous solutions [2]. The primary objective is to develop and investigate the structural characterization of an ammonium superphosphate salt. The thermodynamic properties of salt in aqueous solutions were studied across a range of concentrations, from dilute to saturated solutions, at a temperature of 333.15 K. Experimental water activities were determined using the hygrometric method [3].

Additionally, the relevant properties, such as osmotic and activity coefficients, were evaluated using ion interaction models that were specifically developed for this purpose.
Keywords: Ammonium Superphosphate ; fertilizers ; water activity ; hygrometric method ; thermodynamic