

International Conference on
Ceramics and Geomaterials
in Central Africa



Yaounde | Cameroon | Nov 28 – Dec 01 2023

Book of Abstracts

Volume I

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International Conference on Ceramics and Geomaterials in Central Africa – CGCA-01
YAOUNDE, Cameroon, November 28 – December 01, 2023

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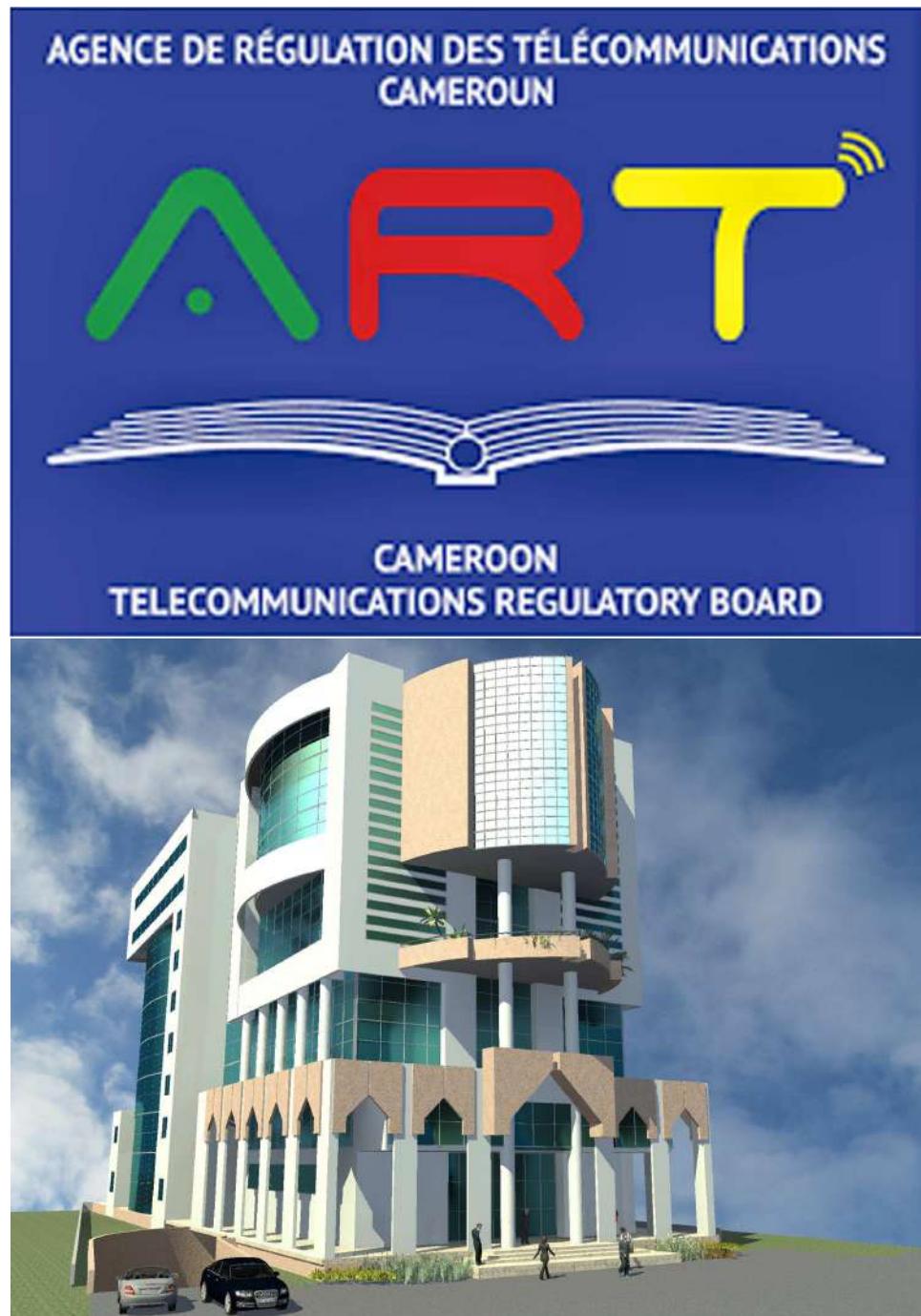
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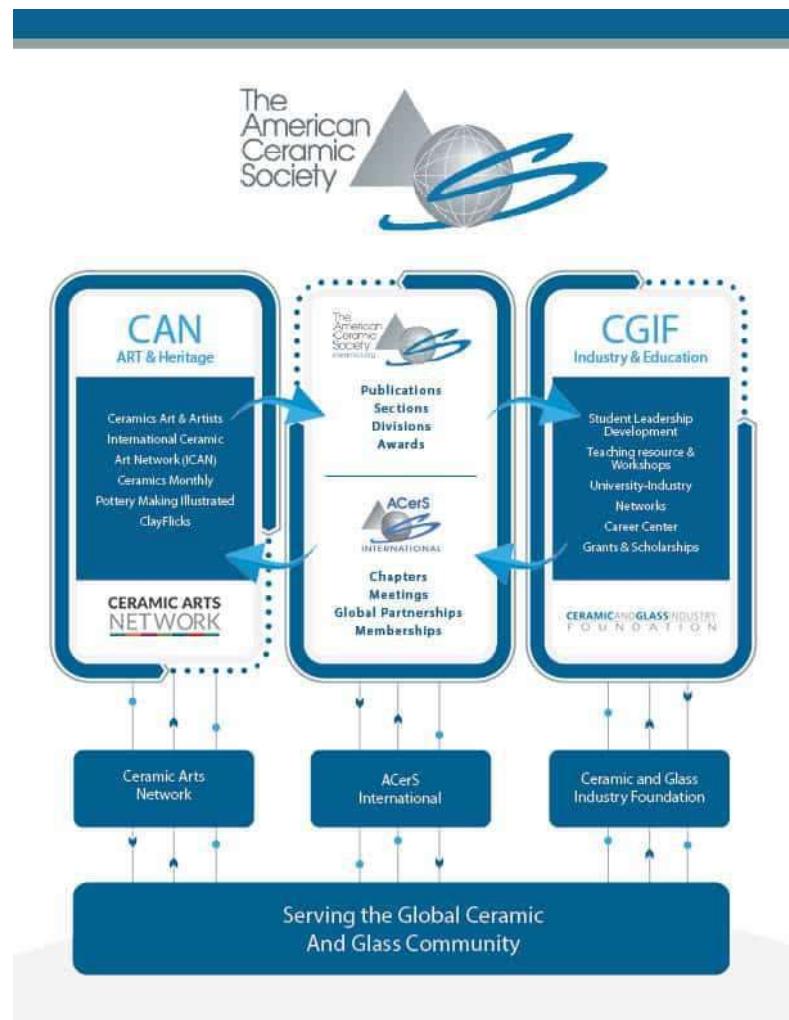
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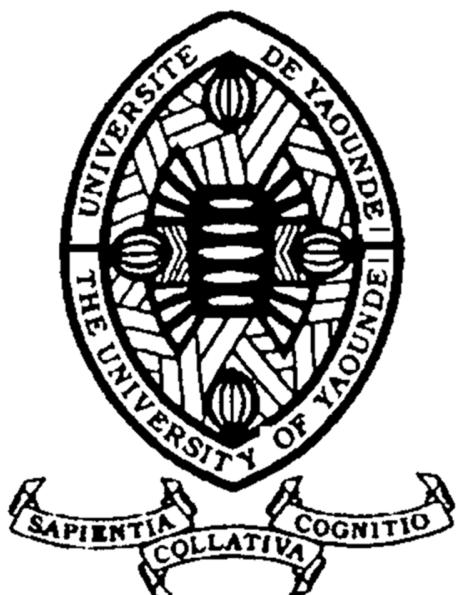
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Table

Plenary conferences		1
Keynotes lectures		6
ST1	Geomaterials: prospections and characterization	25
ST2	Ceramics and geomaterials processing	32
ST3	Sintering and consolidation mechanisms	46
ST4	Characterization, Structure–Properties correlation	55
ST5	Low carbon materials, Environmentally Friendly Materials and Sustainability	62
ST6	Waste valorisation and recycling	71
ST7	Porous ceramics	82
ST8	Properties of use and Industrial applications	90
ST9	Modelling and Artificial intelligence for materials science	96
Posters	All cessions	104

Plenary conferences

Please check the appropriate contribution: Oral or Poster

DECARBONATION OF THE CERAMIC INDUSTRY

BLANCHART Philippe ¹

¹ Univ. Limoges, CNRS, IRCEr, UMR 7315, F-87000 Limoges, France

Abstract

Energy consumption and contributions to climate change of the construction sector can be reduced by decisions taken at the design stage of buildings. Improvements are mainly achieved in the manufacturing stage of materials and in the construction of buildings. To ascertain the actual contribution to climate change, studies need to be carried out from a long-term building life-cycle perspective. Particular attention needs to be paid to the environmental impact of the manufacture of building materials and the impact of building operation over the entire life cycle. To achieve these objectives, it is necessary to select materials whose lifespan exceeds the life of the buildings, and to optimize the design of the constructions.

Today's building materials, such as ceramics and concrete, have a proven lifespan of over 150 years. This longevity reduces the annual environmental impact of their manufacture. However, atmospheric emissions from the manufacture of ceramics and cement are still significant. For example, annual atmospheric emissions from the ceramics industry in the EU are 20 Mt of CO₂.

We describe various technical solutions for mitigating the climatic effects of the industrial ceramics production, making it more sustainable. Examples of European policy directions are described, sharply reducing atmospheric emissions before 2050 and reviewing possible responses: - what are the main sources of carbon emissions from the ceramics industry; - what benefits will the industry derive from adopting low-carbon technologies; - which manufacturing processes will be most impacted and which industrial problems will need to be overcome.

We show that environmental and energy issues are not limited to the manufacturing stages alone, but are also determined by the directions chosen by countries to supply sufficient quantities of decarbonized energy from a broad distribution network.

Keywords: industrial ceramic, building materials, decarbonation.

¹ Corresponding author : BLANCHART Philippe, philippe.blanchart@unilim.fr
November 28 – December 1, 2023, Yaoundé

Please check the appropriate contribution:

Keynote

INAUGURAL LECTURE: TITLE: ARTIFICIAL INTELLIGENCE: STATE OF THE ART, APPLICATIONS, AND IMPACT

NANA ENGO¹

¹ Département de physique,, Faculté des Sciences, Université de Yaoundé I, P.O. Box 812,
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Abstract

Artificial intelligence (AI) has become an integral part of our lives, with applications ranging from healthcare and safety to finance, business, and entertainment. The world-renowned AI research group at the University of Yaoundé I is at the forefront of this interdisciplinary field. In his inaugural lecture, Professor Nana Engo delves into the cutting-edge AI research that he and his colleagues are currently undertaking. Their work focuses on machine learning, data mining, quantum neural networks, and image analysis. Professor Engo emphasizes the significant impact and successful applications of their AI techniques and tools in solving a variety of real-world problems, including those in biology, agriculture, and material sciences.

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Please check the appropriate contribution: Oral or Poster

ULTRA-HIGH TEMPERATURE CERAMICS FOR ENERGY APPLICATIONS

William Fahrenholtz¹

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130 Straumanis-James Hall, Rolla, MO 65409 United States

Abstract

Ultra-high temperature ceramics are a class of materials that are proposed for use in conditions that are beyond the capabilities of existing materials. Desired future capabilities such as concentrated solar power and nuclear fusion expose materials to extreme temperatures, heat fluxes, and neutron irradiation levels. Historic research identified transition metal boride, carbide, and nitride ceramics as candidates for use at temperatures of 2000°C or higher. Recent results from our laboratory have addressed fundamental structure-property relationships at elevated temperatures, explored fusion welding, and examined solute distributions in boride ceramics. The presentation will also discuss thermodynamic aspects of the formation of carbide-based ultra-high temperature ceramics and vacancy ordering in zirconium carbide. Finally, emerging research trends will be presented.

Keywords: no more than 6 (times New Roman, font size 11).

References: no more than 6 (times New Roman, font size 10).

Please check the appropriate contribution: **Keynote**

TRICALCIUM PHOSPHATE-DIOPSID CERAMICS FOR BONE REGENERATION

CARMEN Baudín and PILAR Pena

Instituto de Cerámica y Vidrio, CSIC (ICV-CSIC), Kelsen 5, 28049 Madrid, Spain

Abstract

Bone-associated diseases due to aging, traumas, congenital defects or surgical removal of tumors are one of the most important current public health problems being bone the second most commonly transplanted tissue worldwide. Synthetic biomaterials might avoid the immunological and disease risks associated to biological grafts. Thus, one of the main subjects of materials science is the research on artificial materials for bone tissue therapies. The most successful bioceramics for bone regeneration are calcium orthophosphates (CaPO₄-based, CPs). When dealing with large defects and/or load bearing applications, the use of engineered structures combining resorbable scaffolds, cells and/or reactive agents as growth factors or antibiotics -tissue engineering constructs (TEC)- has been proposed. In the ideal case, these structures would facilitate host cells to deposit extracellular matrix (ECM) and replace the scaffold structure over time. The challenge is materials with adequate biological and mechanical behaviors. Multiphase ceramics in the pseudobinary system tricalcium phosphate-diopside (TCP, Ca₃(PO₄)₂-D, CaMg(SiO₃)₂) are among the most appropriate responses to such a challenge.

In the Phase Equilibrium Diagrams research group of the Institute of Ceramics and Glass (Instituto de Cerámica y Vidrio, CSIC), we have developed solid-state sintered TCP-D based bioceramics of variable microstructure and suitable biological and mechanical properties.

After a brief discussion on bone properties and the requirements of biomaterials for bone substitution and repair, the development of polycrystalline bioceramics in the pseudobinary system TCP-D is addressed. The tailoring of the microstructures to improve their mechanical and biological behaviors and their potential to constitute walls of scaffolds for bone regeneration is analyzed. Different composites are discussed focusing the relationships between the microstructure and the mechanical behavior. Last, our main results on the biological behavior of optimized microstructures seeded with human mesenchymal stem cells (hASCs) are described.

Keywords: Bioceramics, bone regeneration, scaffolds, mechanical behavior, tricalcium phosphate, diopside

November 28 – December 1, 2023, Yaoundé

Keynote lectures

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TRICALCIUM PHOSPHATE-DIOPSID CERAMICS FOR BONE REGENERATION

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Keywords: Bioceramics, bone regeneration, scaffolds, mechanical behavior, tricalcium phosphate, diopside

November 28 – December 1, 2023, Yaoundé

Please check the appropriate contribution: Oral or Poster

Contribution aux Enseignements des Géomatériaux dans les Sciences de la Terre : Cas des Argiles de Libreville au Gabon

Jean-Eudes BOULINGUI¹

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Résumé : La problématique de l'adéquation formation-emploi et de la plus-value dans les sciences de la terre suscite un vif intérêt parmi les professionnels cherchant à améliorer le système éducatif de leur pays. Les politiques publiques répondent à cette question en prenant en compte les réalités sociopolitiques et économiques propres à chaque territoire, afin de proposer des orientations pour le modèle d'enseignement envisagé.

La valorisation des matières premières minérales des ressources du sol et du sous-sol des pays africains, en particulier les géomatériaux tels que les argiles au Gabon, est essentielle pour diversifier les enseignements des géosciences en fonction des substances utiles. Ces géomatériaux, notamment les argiles, peuvent être d'une grande utilité dans la recherche de solutions pour le problème du déficit en logements au Gabon.

Pour cela, il est important de contextualiser et d'intégrer la connaissance de ces substances dans l'élaboration des parcours d'enseignement en Sciences de la Terre, que ce soit au niveau Licence, Master ou Doctorat. Une étude sur les argiles de Libreville (Boulingui, 2015) utilisant la diffraction aux rayons X et des analyses chimiques, montre qu'elles sont principalement composées de kaolinite et d'illite. Leur teneur moyenne en kaolinite (14,99 %) et en illite (30,03 %) les rend aptes à être utilisées dans la fabrication de produits en terre crue et cuite pour le bâtiment. Cependant, leur applicabilité en République Gabonaise doit être examinée.

Cette recherche soulève des questions sur l'applicabilité de ces argiles en République Gabonaise et sur la manière dont les géomatériaux peuvent être intégrés dans les programmes de formation en Sciences de la Terre pour constituer d'importantes ressources minérales destinées à la fabrication de produits.

L'intérêt de cette étude réside dans la démonstration que les géomatériaux enseignés dans les sciences de la terre, en tant que science pour l'ingénieur, sont des substances utiles susceptibles de favoriser la production de biens et de services.

Mots-clés : Géomatériaux, Sciences de la Terre, Argiles, Plus-value, Gabon.

References:

Boulingui J.-E. (2015). Inventaire des ressources en argiles du Gabon et leurs utilisations conventionnelles ou non dans les régions de Libreville et de Tchibanga. Thèse de Doctorat. Université de Lorraine - Université de Yaoundé1, p.245.

ETUDE ARCHEOMETRIQUE DES CERAMIQUES ISSUES DES SITES ARCHEOLOGIQUES DU CAMEROUN : TECHNOLOGIE ET PROVENANCE.

Keynote

EPOSSI NTAH – KROLL Zoila Luz

Département des Arts et Archéologie, Faculté des Arts Lettres et Sciences Humaines, Université de Yaoundé 1

L'archéométrie est une discipline basée sur l'application des techniques analytiques des sciences exactes à l'étude des vestiges archéologiques et du patrimoine culturel. Elle répond aux questions relatives à leur âge, leurs techniques de production, leur provenance, leur fonction et leur altération - conservation. Ces réponses contribuent à la compréhension de l'histoire de ces vestiges et à la conservation du patrimoine culturel matériel. Cette approche interdisciplinaire s'est développée dans le monde autour des années 60. Au Cameroun, la nécessité d'impliquer les sciences exactes en archéologie a été posée par Cheik Anta Diop en 1986 lors du Premier Colloque International sur l'Archéologie Camerounaise au Palais des Congrès de Yaoundé. De 1986 à nos jours beaucoup de progrès ont été faits. Mais, la nécessité de la collaboration entre les archéologues et les différents domaines des sciences exactes se pose toujours. A cet effet, la première Journée d'Archéométrie ayant pour thème « *les sciences exactes au cœur de l'art et l'archéologie* » s'est tenue le 26 Juillet 2023 à la Faculté des Arts et Lettres de l'Université de Yaoundé 1. Le but de cette activité était d'une part, de renforcer la collaboration entre les spécialistes des sciences humaines et ceux des sciences exactes, et d'autre part de vulgariser l'approche interdisciplinaire dans l'étude du patrimoine culturel camerounais. Dans le cadre de ce Premier Colloque International sur les Céramiques et Géomatériaux en Afrique Centrale, les résultats de la recherche archéométrique sur les céramiques archéologiques de quelques régions du Cameroun seront présentés. Le travail consiste à faire une caractérisation chimique et minéralogique des céramiques afin de déterminer les différents traitements de leurs pâtes, leurs paramètres de cuisson, la nature de leur matière première et leur provenance. Les méthodes analytiques utilisées sont la fluorescence des rayons X, la diffraction des Rayons X, la spectroscopie infrarouge, les analyses thermiques et le microscope optique polarisant.

Please check the appropriate contribution: Oral

INFLUENCE DES TOURTEAUX DE KARITE SUR LES PROPRIETES MECANIQUE, HYDRIQUE ET THERMIQUE DE BLOCS DE TERRE ARGILEUSE STABILISÉS AVEC 5% DE CIMENT

KOUAME Niamien Alfred¹, MEITE Namory¹, AMON Lydie¹, **GOURE DOUBI Bi Irié Hervé²**, KOUAKOU Lébé Prisca Marie-Sandrine¹, TOGNONVI Monique², MANOUAN Wedjers Max Robin³, KONAN Koffi Léon¹

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Abstract

Ce travail s'inscrit dans le cadre général de l'élaboration d'éco-matériaux de construction à base d'argile comme alternative aux parpaings de ciment dans le contexte actuel de développement durable. Il vise d'une part, à étudier les propriétés physico-chimique et géotechnique de trois argiles locales et d'autre part, à déterminer les propriétés hydrique, mécanique et thermique de Blocs de Terre Comprimée (BTC), incorporant des tourteaux de karité élaborés à partir de ces argiles et stabilisés avec 5% de ciment. Pour ce faire, trois matières premières argileuses notées F, K de classe A2 et Y de classe A3 constituées essentiellement de kaolinite, de quartz, de micas et de phases ferriques ainsi que les tourteaux de karité (TK) constitués majoritairement de lignine (32%) ; de cellulose (28%) et d'hémicellulose (19%) ont été utilisés. Plusieurs formulations de BTC avec différentes compositions en pourcentage massique d'argile, de tourteaux de karité (0 à 10%) et 5% de ciment ont été élaborées puis caractérisées.

Les résultats de cette étude ont montré une légère augmentation de l'absorption totale d'eau des BTC, attribuée au caractère hydrophile de la cellulose [1] contenue dans les tourteaux de karité. Une augmentation des résistances mécaniques a été observée avec l'ajout de 5% de ciment du fait de la formation de silicates de calcium hydratés (CSH). L'incorporation des tourteaux de karité dans la matrice argilo-cimentaire a induit la diminution des résistances mécaniques, ce qui résulte généralement de l'augmentation de la porosité du matériau composite [2]. Une diminution de la conductivité thermique de 25 ; 16 et 22% respectivement pour les formulations avec les argiles F ; K et Y a été observée. Cela serait lié au caractère isolant de la cellulose des tourteaux et par la création de pores dans la matrice. L'ensemble des résultats de l'étude a montré que l'utilisation de ces matériaux pour des murs non porteurs, exige des teneurs en tourteaux de karité de 4% pour les formulations avec l'argile F contre 6% pour les formulations avec les échantillons K et Y.

Keywords: éco-matériau, BTC, tourteaux de karité, propriétés hydrique, mécanique et thermique

References: no more than 6 (times New Roman, font size 10).

- [1] Weng, C.-H., Deng-Fong, L., et Pen-Chi, C. 2003. Utilization of sludge as brick materials. Advances in environmental research 7 (3): 679–685.
- [2] Laborel-Preneron, A., Aubert, J.-E., Magniont, C., Tribout, C., et Bertron, A. 2016. Plant aggregates and fibers in earth construction materials: A review. Construction and Building Materials, 111, 719–734.

Please check the appropriate contribution: Oral or Poster

Powder mixing and grinding processes with controlled viscosity

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Abstract

Ceramics are prepared from inorganic raw materials in the form of powder grains. During sintering, as a result of the action of the diffusion mechanisms of the solid-state material, the grains weld together, the porosity between grains is eliminated and the material densifies. The raw materials therefore have a direct influence on the final properties of the ceramics. In order to adapt these properties, it will be necessary to be able either to select raw materials with the desired characteristics, or to adapt them in order to have powders with "good" characteristics. It is generally accepted that the initial powders used for technical ceramics, both in the laboratory and in industry, should:

- have a high chemical purity often exceeding 99%. Care must be taken to limit the pollution generated by the adaptation processes, particularly grinding;
- be fine. This can lead to a reduction of sintering temperature and time. Thus, micron and submicron sizes will be sought;
- be homogeneous and well dispersed, without the presence of aggregates or agglomerates.

A first major technological step in the manufacture of a ceramic is the mixing and grinding of the raw materials, or calcinated powders, in order to adapt the powders to the desired characteristics. This stage can be carried out in a dry or wet environment. After a reminder of the main theoretical considerations on the dispersion of mineral powders in slurries, we'll present several studies of the mixing and grinding of powders on applications of ceramics [1]. In any case, we have been able to show that it is essential in a preliminary phase to grinding to try to disperse the slurries as well as possible in order to eliminate flocculates and agglomerates, to obtain a slurry that is sufficiently fluid to be able to undertake the grinding stage with good efficiency and those by jointly playing on the control of the pH of the slurry and/or the addition of dispersant. Rheology then proves to be an extremely effective tool for the ceramist.

Then, during the grinding process, care must also be taken to maintain constant slurry dispersion conditions (by controlling the slurry and adjusting the pH or adding dispersant) to maintain good grinding efficiency, to avoid reagglomeration when shear stresses decrease (either at the exit of the continuous mill or when the mill is stopped) or to simply avoid strong agglomeration during grinding.

It is then possible to obtain very homogeneous powder mixtures with fine grains (nanometric size) which will be more reactive and can lead to the formation of pure phase when this is generally difficult to obtain, better sinterability, nanometric microstructures in the context of subsequent rapid sintering (flash, SPS or microwave sintering...).

The prospects of the approach we have undertaken in the laboratory (control of the dispersion conditions, then grinding with high energy mills) are applicable to all ceramic compositions.

References: [1] Houivet, D., Bernard, J., 2021. Powder Mixing and Grinding Processes for Ceramics, in: Pomeroy, M. (Ed.), Encyclopedia of Materials: Technical Ceramics and Glasses. Elsevier, Oxford, pp. 112–135. <https://doi.org/10.1016/B978-0-12-818542-1.00109-0>

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Please check the appropriate contribution: Oral or Poster

CIRCULAR APPROACHES FOR WASTE BASED GEOPOLYMER FEEDSTOCKS

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Abstract

Geopolymer cements exhibit high-strength properties while producing ~60% lower CO₂ emissions compared with Portland cement manufacture. Much of this offset has been achieved by the use of waste based materials like Fly Ash and GGBS. These pozzolanic materials are becoming increasingly scarce and expensive limiting the expansion of these low carbon alternatives.

A number of new waste derived materials have been identified for use as Geopolymer feedstocks including historic slags, dredgings, bottom ashes, waste clays and mine tailings. This paper reviews these alternative waste based feedstocks and their role within a circular economy. The chemical composition and properties of these materials, as well as the factors that affect the performance of geopolymer cements made from them are compared. Key factors are shown to be the Si and Al presence and ratio and the availability of alkaline cations (Na⁺, K⁺, Ca⁺²). A number of deleterious components common in these alternative wastes are identified including presence of organic matter and chlorides.

A case study evaluating the use of treated municipal soil waste from construction sites is presented utilising filter cake produced in Teesside (UK). A digital Taguchi design matrix was established to identify significant variables in the final geopolymer UCS, this included soil chemistry, water content and alkali components. The maximum UCS recorded across all geopolymer mixtures was 25 MPa.

The paper concludes that alternative, circular waste based feedstocks have the potential to be used to produce high-performance geopolymer cements. However, further research is needed to pre-treat these materials and to develop cost-effective, consistent and scalable production methods.



Figure 1 - >50,000 tons of soil waste (filter cake) per annum is processed at the plant in Teesside UK.

Keywords: Geopolymer cement, waste materials, filter cake, circular, concrete.

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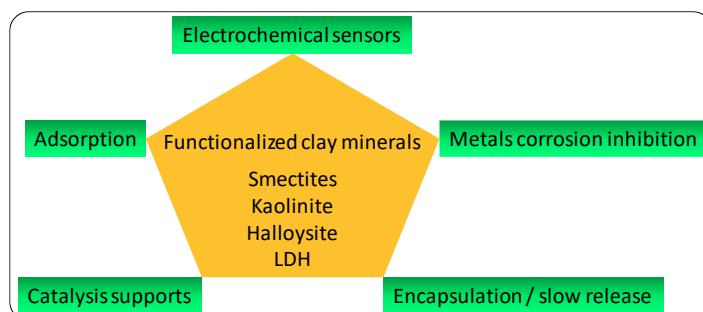
Clay minerals modification and environmental applications

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Abstract

Clay minerals are natural occurring materials, produced following complex geological processes. Clay minerals are very abundant on earth and are found as large or small deposits with variable accessibility.^{1,2} Cameroon, a central Africa country possess large clay minerals deposits, still under-exploited. In materials chemistry, clay minerals offer significant potential as they are generally structured materials with good thermal and chemical stability. Moreover, their surface chemical functionalities allow their coupling (by grafting or intercalation) with multiple chemical species to afford robust, stable and more efficient hybrid materials.³



Scheme 1. Clay minerals used in LEAGEM and application domains.

At the *Laboratoire d'Électrochimie Analytique et Génie des Matériaux* (LEAGEM) of the University of Yaoundé I, our research team have been interested for several years by layered clay minerals, because of their abundance in country and their interesting physico-chemical properties. The choice of modification strategies applied to these clay minerals (smectites, kaolinite and halloysite) is conditioned by the targeted applications. These hybrid clay minerals (Scheme 1) are thus characterized and applied amongst other for the development of electrochemical sensors, water treatment by adsorption, catalysts synthesis, metals corrosion inhibitors formulation and vesicles dedicated to the encapsulation of several organic compounds.

Keywords: Clay minerals, grafting, intercalation, environment preservation.

References: no more than 6 (times New Roman, font size 10).

- 1- A. Ito; R. Wagai, *Sci. Data* **2017**, *4*, 1–11.
- 2- G.I.E. Ekosse, *Appl. Clay Sci.* **2010**, *50*, 212–236.
- 3- G.K. Dedzo, C. Detellier, *Adv. Funct. Mater.*, **2018**, *28*, 1703845.

Low-carbon materials, the case of compressed earth blocks stabilized with optimized lime-calcined clay cement (OLC2)

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Abstract

The 2022 global status report for buildings and construction pointed that, In 2021, materials used in the construction accounted for about 9% of overall energy-related CO₂ emission. Hence, the need to decarbonize the sector. In the present study, an optimized lime-calcined clay (OLC2) cement was elaborated, characterized and applied in the stabilization of compressed earth blocks for building. Raw materials for the cement were kaolin rich clay, hydrated lime and sodium hydroxide. The percentage of lime in the binder varied between 20% and 30%. Compressive strength in standard mortar at 28 days attained almost 20 MPa. The optimized cement with 75% calcined clay and 25% hydrated lime contributed to reduce for about 58% CO₂ emission due to raw materials firing and for about 40% the firing temperature of raw materials compared to ordinary Portland cement. When the OLC2 was used as stabilizer for compressed lateritic soil, in which water–solid (laterite and binder) and laterite–binder ratios varied, respectively, from 0.12 to 0.20 and 4 to 9. Sodium hydroxide (NaOH) was added as a chemical activator in the mixture. The NaOH–binder ratio varies from 0.02 to 0.04. The average effect of each component of the mixture on compressive strength, water absorption and apparent density of compressed laterite after 7 or 28 days of conservation at 40 ± 1 °C in an atmosphere saturated with water vapour was evaluated. Results showed compressive strengths of blocks at 28 days more than the double of 4MPa recommended by the Cameroonian standard NC 102-114: 2002-06. The increase of water–solid (laterite and binder) ratio showed a maximum compressive strength at water–solid ratio of 0.16. At this ratio, minimum water absorption and maximum apparent density were obtained. The effective proportion of sodium hydroxide was less than 3%. using kaolin rich clay, hydrated lime and sodium hydroxide as raw materials for cement formulation. Lateritic soil was used for compressed blocks manufacturing.. Performant compressed earth block with 9MPa compressive strength were obtained with 8-10% OLC2 as stabilizer, higher than 4MPa recommended by the Cameroonian standard

The percentage of lime in the binder varied between 20% and 30%. The binder was used as a stabilizer in compressed lateritic soil in which water–solid (laterite and binder) and laterite–binder ratios vary, respectively, from 0.12 to 0.20 and 4 to 9. Sodium hydroxide (NaOH) was added as a chemical activator in the mixture. The NaOH–binder ratio varies from 0.02 to 0.04. The average effect of each component of the mixture on compressive strength, water absorption and apparent density of compressed laterite after 7 or 28 days of conservation at 40 ± 1 °C in an atmosphere saturated with water vapour was evaluated. Results showed compressive strengths of blocks at 28 days more than the double of 4MPa recommended by the Cameroonian standard NC 102-114: 2002-06.

Please check the appropriate contribution: Oral or Poster

CLAY MINERALS: FROM THE EARTH TO THE TABLE

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ABSTRACT

"Clay minerals: from the earth to the table" is a research program carry out at the Center for Research on Art and Technology of Materials (CERATEM) at the Fine Art Institute of Foumban - IFAF, University of Dschang (Cameroon). The objective of the program is to identify, analyse and evaluate the suitability of local clayey materials and other development minerals as ceramic raw materials for artisanal or industrial production and for sustainable development through the whole chain value. For this purpose, a multi-disciplinary and pluri-analytical method approach is used for the development of a data base on raw materials for table ware, ceramic construction materials and refractory bricks.

The data base includes field studies (identification, sampling, and mapping), laboratory assessment (granulometry, mineralogy, geochemistry, geotechnical properties) and technical end use properties (ceramic properties, fabric design, and prototyping). Kaolinitic clay is the main mineral component of the studied materials. It is associated to quartz. Illite, smectite, feldspar and iron mineral as hematite are accessories. Thus, the data base indicates that most studied samples are suitable for ceramic production.

Selected clays from four deposits around Foumban (Njindare, Koutaba, Bangourain and Mayouom) are used for training of the undergraduate and master's students of the Institute as well as for building capacity of local artisans in the domains of pottery and fired bricks production. Local cultural heritage elements are used for design and decoration of ceramic table ware prototypes. Socio-anthropological and market studies indicate that clay minerals from Foumban and its vicinity are suitable for pottery, bricks, floor and roofing tiles. Some deposits present opportunity for small and medium scale ceramic factories for local development.

It is concluded that the sticky earth which dirty our shoes when we are walking in the swampy zone is of great importance for local economy. It is on our wall (fire bricks), our floor (floor tiles), our roof (roofing tiles), and on our table (table wares).

Key words: Clays; Cameroon; data base; ceramic production.

CLAY MATERIALS FOR CERAMICS IN CAMEROON: THE STATE-OF-THE-ART

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ABSTRACT: The aim of this paper is to take stock of known deposits and indices of clays in Cameroon. After a brief history of the use of clays in Cameroon, their characteristics and some application trials in ceramics for each region are presented. Most of the major clay deposits are sedimentary, alluvial or residual, and some are of hydrothermal origin. The main clay deposits around Douala, the economic capital, are at Bomkoul, Bonendale, Loungahe, Dizangue and Missole. Around Yaoundé, Cameroon's political capital, there are lateritic deposits (Nkolbisson (29.000 m³/ha), Zoatoupsi – Mbarkomo (39.000 à 48.000 m³/ha), Etoug-Egbe (32.000 à 39.000 m³/ha) and Ongot (38.000 m³/ha)) and alluvial clay deposits, including 3 pockets at Nanga-Eboko, 1 at Mbanjock, 1 at Nachtigal and 2 at Ebebda. The total volume is around 2 million m³, with a cumulative operating life (6,000 tonnes/year) of 9 centuries. In the West Cameroon region, the major sites are Lembo, Balengou, Bana, Ndianse (Bangwa), Meka'a (Dschang), Mayouom, Koutaba, Bangouren, Njindare, Koupare-Nkouandep. At Lembo, road trenches more than 50 m high reveal clays of hydrothermal origin made up of kaolinite-halloysite (60-85 wt%) + illite + quartz + hematite + anatase ± rutile ± orthose ± sanidine ± magnetite ± maghemite ± goethite ± Ba-Al-Fe-phosphates ± carbonates ± sulphates. The clays at Bana are montmorillonite accompanied by kaolinite, mica, quartz, anatase, cristobalite, K-feldspars and heulandite. Cation exchange capacity (CEC) varies between 50 and 60 meq/100 g and specific surface area between 50 and 60 m²/g. At Mayouom, sandy kaolin and non-sandy kaolin are produced by the hydrothermal transformation of mylonitic gneisses and magmatic dykes respectively. Mineralogical compositions include kaolinite (85-75% and 58-44%), quartz (7-2%), illite/muscovite (7-2%), anatase (1-4%), traces of haematite and Ba-Sr hydroxyapatite. Given the high percentage of kaolinite (>85%), and the low iron mineral content (<1.5%), Mayouom kaolin can be used as a raw material for white-firing ceramics. Exploration indicates more than 22 million tonnes of clay. Mining at a rate of 2,000 tonnes/year will take more than 30 years. The South-West region has a rich clay subsoil. The sedimentary type is probably the most important, followed by alluvial clays; although these are still in the prospective domain, their potential is enormous. In the North-West Region, the Ndop plain is the site of colluvial, alluvial and floodplain deposits (1150-1200 m altitude). Auger drilling at Bamessing and Bamunka revealed mineable clays over 5m thick. The technological properties (900 to 1100°C) (metallic sound, water absorption, loss on ignition, linear shrinkage, apparent density, flexural strength) amply demonstrate their suitability for the manufacture of ceramic products. In the Adamaua, North and Far North regions, the clays are red soils and vertisols. The "red soils" are found on hills, between 408 and 600-900 m, and the associated piedmonts. Vertisols take over on gentle slopes (below 10%). Occasionally, "red soils" alternate with Vertisols and young soils, depending on the topography and external drainage. Red soils are rich in iron (Fe₂O₃: 15.6-18.5

wt%), silica and alumina (39-41 wt% and 29.6-27 wt%, respectively), while loss on ignition is 11 ± 0.5 wt%. The chemical and mineralogical compositions of the red soils of North Cameroon are similar to those of the raw materials used in the formulation of terracotta and fired bricks. Vertisols are rich in SiO_2 (60-75 wt%) CaO (1-3 wt%) and poor in Al_2O_3 (7-15 wt%) Fe_2O_3 (1.7-5 wt%) and loss on ignition (5-12 wt%). Vertisols consist mainly of smectites (68.35-72.81%) associated with illite (10.71-14.47%), kaolinite (8.03-11.88%) and traces of quartz and feldspar. On firing (750-1150°C), apparent density, linear shrinkage and compressive strength are within the norm for tiles and fine ceramics, and for formulations for brown or red monoporosa, Cottoforte and "Grès rouge". In conclusion, Cameroon has numerous clay deposits. Their genesis is controlled by geological processes (meteoric or hydrothermal alteration, marine or continental sedimentation), climate (equatorial, tropical and sub desert) and geomorphology.

Key words: Cameroon, Regions, Clay deposits, Ceramics.

RESUME : L'objectif de cette communication est de recenser les indices et les gisements d'argiles connus, les études sur la caractérisation parfois suivie de quelques essais d'application en céramique. Après un aperçu sur l'évolution des études de valorisation des argiles au Cameroun, des résultats spécifiques sont présentés par centre d'intérêt et en fonction des types de gisements. La plupart des grands gisements d'argiles sont sédimentaires, alluvionnaires ou résiduelles, certaines argiles sont d'origine hydrothermale. Les principaux gisements d'argiles des environs de Douala, capitale économique, sont ceux de Bomkoul, Bonendale, Loungahe, Dizangue et Missole. Autour de Yaoundé, la capitale politique du Cameroun, il existe des gisements latéritiques (Nkolbisson (29.000 m³/ha), Zoatoupsi-Mbankomo (39.000 à 48.000 m³/ha), Etoug-Egbe (32.000 à 39.000 m³/ha) et Ongot (38.000 m³/ha)) et des gisements d'argiles alluvionnaires dont 3 poches à Nanga-Eboko, 1 à Mbanjock, 1 à Nachtigal et 2 à Ebebda. Le volume total s'élève à environ 2 millions m³ et une durée d'exploitation (6000 tonnes/an) cumulée de 9 siècles. Dans la Région de l'Ouest du Cameroun, les sites importants sont : Lembo, Balengou, Bana, Ndianse (Bangwa), Meka'a (Dschang), Mayouom, Koutaba, Bangouren, Njindare, Koupare-Nkouandep. A Lembo, des tranchées routières de plus de 50 m de hauteur révèlent des argiles d'origine hydrothermale constituées de kaolinite-halloysite (60-85 wt%) + illite + quartz + hématite + anatase ± rutile ± orthose ± sanidine ± magnétite ± maghemite ± goethite ± Ba-Al-Fe-phosphates ± carbonates ± sulfates. Les argiles (DRX, FTIR, ATD/ATG et MEB) de Bana sont de la montmorillonite qu'accompagnent la kaolinite, mica, quartz, anatase, cristobalite, K-feldspaths et heulandite. La capacité d'échange cationique (CEC) varie entre 50 et 60 meq/100 g et une surface spécifique comprise entre 50 et 60 m²/g. A Mayouom, il existe du kaolin sableux et du kaolin non sableux issu, respectivement, de la transformation hydrothermale des gneiss mylonitiques et des dykes magmatiques. Les compositions minéralogiques comprennent la kaolinite (85-75% et 58-44%), quartz

(7-2%), illite/muscovite (7-2%), anatase 1-4%), des traces d'hématite et d'hydroxyapatite de baryum et de strontium. Vu le pourcentage élevé de kaolinite ($> 85\%$), et la faible teneur en minéral de fer ($< 1,5\%$), le kaolin de Mayouom peut être utilisé comme matière première des céramiques cuisant blanc. L'exploration indique plus de 22 millions de tonnes d'argiles. L'exploitation au rythme de 2000 tonnes/an s'étendra sur plus de 30 ans. La Région du Sud-Ouest possède un sous-sol bien fourni en argiles. Le type sédimentaire est vraisemblablement le plus important, suivi des argiles alluvionnaires ; bien que celles-ci restent du domaine de la prospective, leurs potentialités sont énormes. Dans la Région du Nord-Ouest, la plaine de Ndop est le site des dépôts colluviaux, alluviaux et des plaines d'inondation (1150-1200 m d'altitude). Les sondages à la tarière à Bamessing et Bamunka ont révélé des argiles exploitables de plus de 5 m de puissance. Les propriétés technologiques (900 à 1100°C) (son métallique, absorption d'eau, perte au feu, retrait linéaire, densité apparente, résistance à la flexion) démontrent amplement leur aptitude à la fabrication des produits céramiques. Dans les régions de l'Adamaoua, Nord et Extrême-Nord, les argiles sont des sols rouges et des vertisols. Les "sols rouges" sont observés dans deux situations géomorphologiques différentes (collines à relief très accidenté, entre 408 et 600-900 m, et les piedmonts associés). Les vertisols prennent le relai sur les pentes faibles (inférieures à 10%). Parfois, les "sols rouges" alternent avec des vertisols et des sols peu évolués en fonction de la topographie et du drainage externe. Les sols rouges sont riches en fer (Fe_2O_3 : 15.6-18.5 wt%), celles de silice et alumine s'élèvent à 39-41 wt% et 29.6-27 wt%, respectivement tandis que la perte au feu est 11 ±0.5 wt%. Les compositions chimiques et minéralogiques des sols rouges du Nord Cameroun sont similaires à celles des matières premières utilisées pour la formulation des terres et briques cuites. Les vertisols sont riches en SiO_2 (60-75 wt%) CaO (1-3 wt%) et pauvres Al_2O_3 (7-15 wt%) Fe_2O_3 (1.7-5 wt%) et perte au feu (5-12 wt%). Les vertisols sont constitués principalement de smectites (68,35 à 72,81%) associée à l'illite (10,71 à 14,47%), à la kaolinite (8,03 à 11,88%) et des traces quartz et feldspath. A la cuisson (750-1150°C), la densité apparente, le retrait linéaire et la résistance à la compression sont dans la norme des carreaux et de la céramique fine, des formulations pour *monoporosa brun ou rouge*, *Cottoforte* et « *Grès rouge* ». En conclusion, le Cameroun dispose de nombreux gisements d'argiles d'espèces différentes. Leurs genèses sont contrôlées par les processus géologiques (altérations météorique ou hydrothermale, sédimentation marine ou continentale), le climat (équatorial, tropical et sahélien) et la géomorphologie.

Mots clés : Cameroun, Régions, Gisements d'argiles, Céramiques.

Please check the appropriate contribution: Oral or Poster

WASTE MATERIALS FOR THE REMOVAL OF EMERGING CONTAMINANTS IN WASTEWATER: A VIABLE ALTERNATIVE FOR DEVELOPING COUNTRIES

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Abstract

Environmental pollution is a significant concern for public health because of the adverse effects of toxins on humans and other living organisms (Bai and Acharya, 2019). Waterway pollution results from the production, disposal or human use of pharmaceuticals. The environmental exposure of pharmaceuticals generally occurs through, amongst others, manufacturing units, hospital effluents, and land application (Roy and Roy, 2022). Conventional wastewater treatment methods include various physical, chemical and biological processes the results of which can be limited because of high investment cost or, in some cases, due to poor treatment efficiency. There is an urgent need to look for a solution that can effectively reduce the negative impacts humans have on the environment. A pragmatic shift is ongoing in waste material management and wastewater treatment technology due to the large amount of waste production worldwide and the necessity for cheap adsorbents to reduce wastewater treatment costs (Hossain et al., 2020). Developments in the circular economy and energy recovery from waste materials is another fast-growing concept for promoting sustainability and a greener environment. This communication will review some of the endeavors to integrate the concept of wastewater treatment by waste materials (agricultural residue, industrial and municipal waste, organic and inorganic sources) and the used waste adsorbents for value-added products through further treatment. In addition, it summarized the potential valuable products such as regenerated adsorbents utilizing waste adsorbent. The major emerging contaminants, the diverse waste materials as potential adsorbent candidates and conversion processes from waste into adsorbents will be reviewed. Further, the joined applications of this findings as well as the commercial window offered to accumulate waste materials for large scale applications in Africa will be discussed. The outcome of this communication will be the promotion of the use of waste into wastewater treatment which may improve waste management and boost the circular economy in development countries.

Keywords: waste management, wastewater treatment, waste material adsorbents, emerging contaminants, circular economy, sustainable development goals.

References

- Bai X. and Acharya K., 2019. Removal of seven endocrine disruption chemicals (EDCs) from municipal wastewater effluents by a freshwater green alga. *Environ Pollut* 247:534-540.
- Hossain N., Bhuiyan M. A., Pramanik B. K., Nizamuddin S., Griffin G., 2020. Waste materials for wastewater treatment and waste adsorbents for biofuel and cement supplement applications: A critical review. *Journal of Cleaner Production* 255: 120261.
- Roy B. and Roy A., 2022. Removal of pharmaceutical from wastewater using nanomaterials. In: Removal of refractory pollutants from wastewater treatment plants. CRC Press, Taylor & Francis Group, Boca Raton, London, New York. 563 Pages.

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Please check the appropriate contribution: * Oral or Poster

FORMULATION OF MIXED EMULSION/SUSPENSION SYSTEMS FOR THE PREPARATION OF CERAMICS WITH ARCHITECTURED POROSITY

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Abstract

In a context of ecological transition and more particularly of energy saving or water filtration, ceramic materials whose microstructure includes a multiscale architectural porosity can be a solution to current problems of thermal insulation or drinking water.

Foams (figure 1) or emulsion-based systems are suitable for achieving a final porosity rate higher than 60%vol.[1-2]. The size and shape distribution of the porosity then depends on those of the air bubbles or oil droplets before shaping. It is therefore essential to control the physicochemistry of the interfaces in the formulations which consist of liquid phases, gases, ceramic grains and additives (surfactants, binders, plasticizers, dispersants) and which are also influenced by the technique of shearing and mixing.

This presentation has to show how to formulate and characterize these systems to adapt them to shaping processes such as microextrusion and to diversify porosity templates. For this, the rheological and electrokinetic properties of the suspensions as well as specific observation techniques by optical microscopy have to make it possible to establish the link between formulation and microstructure of the components.

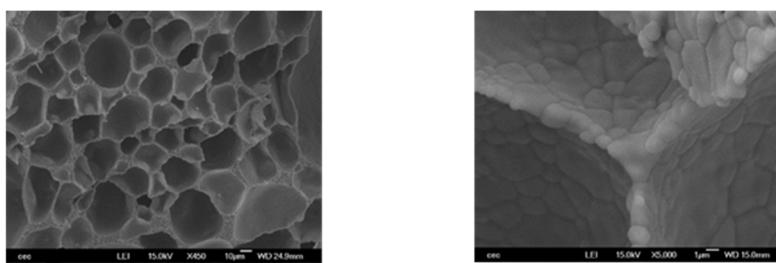


Figure 1 SEM pictures of the alumina foam microstructure

Keywords: porous ceramic, foam, emulsion

References:

- J. Am. Ceram. Soc., 89 [6] 1771–1789 (2006)
Colloids and Surfaces A, 585, 20 January 2020, 124156

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Please check the appropriate contribution:

Keynote

ARTIFICIAL INTELLIGENCE METHODS AND APPLICATIONS

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Abstract

Data stored in many systems could be exploited in the decision making process. Researchers have developed many approaches/algorithms in order to extract knowledge from the data. Among these approaches, symbolic approaches which integrate domain knowledge in the data exploitation process, and Machine Learning approaches, which in the absence of knowledge find from data better parameters of the model able to consume the data. Machine Learning algorithms have been applied in many domains included medicine, bank, insurance, chemistry, This talk mainly focuses on the Machine Learning models, going from the data to the model evaluation. These models involve learning rules from data. They use an algorithm to uncover patterns in a dataset that predict an outcome or property of policy interest. The main idea of these approaches will be presented, their advantages and their limits will also be presented. This talk will also present some AI application in diverse domains.

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THEME

**GEORESSOURCES POUR LES CERAMIQUES : TRANSITION ENERGETIQUE,
POTABILISATION DES EAUX, ET DIGITALISATION**

Keynote sur les latérites par YONGUE FOUATEU Rose

RESUME

Latérites et sols latéritiques : géoressources de la zone intertropicale

Les latérites sont des formations d'altération épaisses, développées sous des climats chauds et humides pendant de longues périodes de temps. Identifiées depuis le 19^{ème} siècle, ces formations géologiques exogènes ont fait l'objet de nombreuses études émaillées de controverses au fil du temps. Considérés comme « matériaux durs naturels superficiels utilisés comme briques » au début du 19^{ème} siècle, puis comme « produits d'altération généralement formés sous les conditions tropicales, riches en fer et en aluminium, et durs ou sujets à durcissement suite à l'exposition alternée à l'humidité et à la sécheresse » au milieu du 20^{ème} siècle, il est désormais admis depuis la fin du siècle dernier que latérite ne se limite pas aux matériaux indurés mais comprend toutes sortes de produits d'altération tropicale. Ainsi, le terme « latérite » pris dans son sens le plus large, c'est-à-dire en tant que produits d'altération intense composés du point de vue minéralogique des oxydes, oxyhydroxydes ou hydroxydes de fer (goethite, hématite), d'aluminium (gibbsite, boehmite), d'argile (kaolinite) et de quartz, regroupe les bauxites, les cuirasses ferrugineuses et ou alumineuses (bauxites), matériaux nodulaires, carapaces, et s'étend aux formations ou horizons qui font partie des sols ferrallitiques rouges ou jaunes, sols ferrugineux tropicaux et autres formations telles que les horizons tachetés kaolinitiques, non indurées mais couramment associées aux formations ferrugineuses indurées. Les latérites ont une grande répartition latitudinale ; elles occupent plus du tiers des surfaces immergées et sont très largement répandues dans la zone intertropicale puisqu'elles se forment, de nos jours, à la faveur d'un climat relativement chaud et humide, mais peuvent se trouver préservées, à des latitudes plus élevées, témoins de climats chauds passés et/ou de la dérive des continents. Ces couvertures latéritiques épaisses au-dessus d'une grande variété de roches ont une morphologie très diversifiée, mais présentant généralement 3 horizons majeurs : i) zone d'altération, à la base (saprolite grossière ou arène, saprolite fine) caractérisée par la dissolution incongruente des minéraux primaires et par le lessivage de la plupart des matières solubles; ii) une zone d'accumulation, située dans la partie médiane, montrant généralement des accumulations indurées de fer ou d'aluminium, soit continues (cuirasses) soit discontinues (nODULES) qui correspondent à une réorganisation du matériel d'origine et à une accumulation absolue de fer et d'aluminium cristallisés sous forme de divers oxydes, hydroxydes oxyhydroxydes et aussi de la kaolinite; et (iii) une zone meuble, non indurée, située dans la partie supérieure du profil marquée par une accumulation relative des minéraux primaires comme le quartz, et des minéraux secondaires comme la kaolinite et les oxyhydroxydes, résultant soit de la dissolution, soit de la dégradation et du démantèlement des matériaux. Produits d'altération principalement formés par un enrichissement résiduel en fer et aluminium, les différences géochimiques entre les latérites ferrugineuses et les bauxites, sont liées à l'intensité des conditions climatiques contrôlant une lixiviation et un lessivage de plus en plus importants, avec un marquage spécifique des éléments traces et des terres rares en relation avec le type de roches mères. Ainsi, les latérites peuvent être enrichies d'autres

éléments chimiques comme Ni, Co, Nb , Sc et/ou les éléments du groupe du platine (EGP). L'exploration par l'approche cartographique des terrains latéritiques couplant SIG , imagerie satellitaire et caractéristiques pétrologiques favorise actuellement une meilleure estimation de ces géoresources . Avec les progrès scientifiques de ce 21^{ème} siècle, des études récentes ont permis d'aborder les contraintes temporelles de la formation des latérites et les relier aux variations paléoclimatiques ou paléoenvironnementales. Terre agricole, matériau de construction, source de minerai, les latérites sont utilisées à diverses fins tout au long de l'histoire dans les activités anthropiques (construction, conceptions architecturales spécifiques, routes...). Le développement des recherches, l'amélioration des techniques analytiques existantes, et l'apparition de nouvelles techniques mettent en lumière certaines inconnues, et ouvrent de nouvelles perspectives. non seulement pour des sources potentielles de certains métaux critiques dans les latérites, mais des informations sur les méthodes de traitement et métallurgiques appropriées. Aussi, les nouvelles tendances dans la production de géopolymères à base de matériau latéritique s'élaborent, tout comme les études de la capacité d'absorption de fluorure, phosphore et des métaux lourds par ces géomatériaux sont en cours en vue de leur utilisation efficace et durable.

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ABSTRACT

Laterites and lateritic soils: georesources of the intertropical zone

Laterites are thick weathering formations, developed in hot and humid climates for long periods of time. Identified since the 19th century, these exogenous geological formations have been the subject of numerous studies fraught with controversy over time. Considered "hard surface natural materials used as bricks" at the beginning of the 19th century, then "products of weathering generally formed under tropical conditions, rich in iron and aluminum, and hard or subject to hardening following alternating exposure to humidity and drought" in the middle of the 20th century, it has now been accepted since the end of the last century that laterite is not limited to hard materials but includes all kinds of tropical weathering products. Thus, the term "laterite" taken in its broadest sense, that is to say as products of intense weathering composed from the mineralogical point of view of oxides, oxyhydroxides or hydroxides of iron (goethite, hematite), aluminum (gibbsite, boehmite), clay (kaolinite) and quartz, includes bauxites, ferruginous and or aluminous "cuirasses" (bauxites), nodular materials, "carapaces", and extends to formations or horizons which are part of red or yellow ferrallitic soils, tropical ferruginous soils and other formations such as mottled kaolinitic horizons, not indurated but commonly associated with indurated iron formations. Laterites have a large latitudinal distribution; they occupy more than a third of the submerged surfaces and are very widespread in the intertropical zone since they are formed, nowadays, in favor of a relatively hot and humid climate, but can be preserved, at higher latitudes, witnesses of past warm climates and/or continental drift. These thick lateritic covers above a wide variety of rocks have a very diversified morphology, but generally presenting 3 major horizons: i) zone of alteration, at the base (coarse saprolite or arene, fine saprolite) characterized by the incongruent dissolution of primary minerals and by leaching of most soluble matter; ii) an accumulation zone, located in the middle part, generally showing indurated accumulations of iron or aluminum, either continuous ("cuirasses") or discontinuous (nodules) which corresponds to a reorganization of the original material and an absolute accumulation of iron and aluminum crystallized in the

form of various oxides, hydroxides oxyhydroxides and also kaolinite; and(iii) a loose, non-indurated zone located in the upper part of the profile marked by a relative accumulation of primary minerals such as quartz, and secondary minerals such as kaolinite and oxyhydroxides, resulting either from dissolution or from degradation and dismantling of materials. Alteration products mainly formed by a residual enrichment in iron and aluminium, the geochemical differences between ferruginous laterites and bauxites are linked to the intensity of the climatic conditions controlling increasingly effective leaching and leaching, with marking specific trace elements and rare earths in relation to the types of source (parent) rocks. Thus, laterites can be enriched with other chemical elements such as Ni, Co, Nb, Sc and/or platinum group elements (PGE). Exploration by the cartographic approach of lateritic terrains coupling GIS, satellite imagery and petrological characteristics currently favors a better estimation of these georesources. With the scientific progress of this 21st century, recent studies have made it possible to address the temporal constraints of laterite formation and link them to paleoclimatic or paleoenvironmental variations. Agricultural land, building material, source of ore, laterites have been used for various purposes throughout history in human activities (construction, specific architectural designs, roads...). The development of research, the improvement of existing analytical techniques, and the appearance of new techniques highlight certain unknowns, and open up new perspectives. not only for potential sources of some critical metals in laterites, but information on appropriate processing and metallurgical methods. Also, new trends in the production of geopolymers based on lateritic material are being developed, just as studies of the absorption capacity of fluoride, phosphorus and heavy metals by these geomaterials are in progress with a view to their efficient and sustainable use.

ST1. Geomaterials: prospections and characterization

Please check the appropriate contribution:

Oral

or

Poster

GEOTECHNICAL PROPERTIES OF SAND-ASPHALT FOR USE IN ROAD BASE LAYER INSTEAD OF CONVENTIONAL MATERIALS

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Abstract

The study of the geotechnical properties of sand-asphalt for use in road base layer instead of conventional materials, for low to moderate traffic volume, is based on standardized laboratory tests. Sand samples were taken from Kayar, Darou Alpha and Keur Morry (Thies region, Senegal). Identification tests (particle size distribution and sand equivalent) made it possible to select Kayar and Darou Alpha sands which have respective sand equivalent (SE) values of 92 % and 62 %. These values are higher than the minimum required (40 %), for sand-asphalt, with different 35/50 bitumen dosages. The results of the Hubbard-Field test carried out showed that Darou Alpha sands are suitable, with an optimum binder content of 7 %. The stability at 18 °C, at dry conditions, is 2 732 kg and is greater than the minimum required value (2 300 kg). The immersion/compression ratio is 85 % and is greater than the minimum required limit (75 %). Water absorption reaches 5.4 % and remains below the maximum required limit (7 %). The volumetric swelling is 2.6 % and is below the maximum required limit (5 %). The compactness is 84 % and is acceptable because it exceeds the minimum required limit (80 %). A flexible pavement designed with the Alizé^{©3} software gives deformation values lower than the permissible values. The pavement structure that is placed on a PF3 subgrade (SETRA-LCPC, 1994) is therefore correctly sized to support a traffic of 150 heavy vehicles per day for a service life of 15 years. This roadway structure, which is devoid of a foundation layer, includes a 23 cm thick sand-asphalt base layer on which rests a 5 cm thick asphalt concrete.

Keywords: sand-asphalt, sand, Hubbard-Field test, Kayar, Darou Alpha, Keur Morry.

References:

- CEBTP (1980). Guide pratique de dimensionnement des chaussées pour les pays tropicaux. Ministère de la coopération française, 117 pages.
- Chauvin J.J. (1987). Les sables, guide pratique d'utilisation routière, ISTED, Paris, 76 pages.
- LCPC-SETRA (1994). Conception et dimensionnement des chaussées. Paris, 260 pages.

Please check the appropriate contribution: Oral or Poster

STABILITE THERMIQUE DES POLYMERES INORGANIQUES PHOSPHATES OBTENUS A BASE DE SCORIES VOLCANIQUES

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RESUME :

Le présent travail a pour but d'évaluer la stabilité thermique des polymères inorganiques phosphatés obtenus à partir d'une poudre de scorie volcanique (MaJ ou Mbo) et d'une SAA (Solution Activatrice Acide) de rapport molaire P_2O_5 / H_2O égal à 12% et un prétraitement de la pâte fraîche à 60 °C pendant 24 heures dans une étuve. Les polymère obtenu MaJ_{60} ou Mbo_{60} obtenus, laissés maturés pendant 28 jours ont ensuite subi des traitements thermiques à 200, 300, 500, 750 et 1000 °C avec une vitesse de montée en température de 5 °C/min et un temps de séjour de 2h. Les différents produits de cuisson ont été caractérisés par appréciation de l'aspect visuel, détermination de la composition minéralogique et microstructurale. D'autres propriétés comme la résistance en compression et le pourcentage d'absorption en eau de ces produits de cuisson ont également pu être évaluées. Nous avons pu observer une augmentation du taux d'absorption d'eau ainsi qu'une chute de la résistance à la compression des polymères MaJ_{60} thermiquement traités au-delà de 500°C qui gonflent, présentant en outre des craquelures et des fissures. Les polymères Mbo_{60} présentent quant à eux après une transition vitreuse au-delà de 750 °C, une surface compacte, un pourcentage d'absorption d'eau presque inexistant, et une augmentation de la résistance à la compression.

Mots clés : Polymères inorganiques phosphatés ; Scories volcaniques ; Phase vitreuse ; Résistance à la compression ; Cristallisation.

References:

- Davidovits J.**, Geopolymers: Ceramic-like inorganic polymers. *Journal of Ceramic Science and Technology* 08 [3] (2017) 335-350.
- Djobo Y J N, Elimbi A, Stephan D.** Phase and dimensional stability of volcanic ash-based phosphate inorganic polymers at elevated temperatures. *SN Applied Sciences* (2020) 2:828 <https://doi.org/10.1007/s42452-020-2616-4>
- Elimbi A, Tchakoute H K, Njopwouo D.** Effects of calcination temperature of kaolinite clays on the properties of geopolymers cements. *Construction and Building Material.* 25 (2011) 2805-2812. <https://doi:10.1016/j.conbuildmat.2010.12.055>.
- Le-ping L, Xue-min C, Shu-heng Q, Jun-li Y, Zhang L.** Preparation of phosphoric acid-based porous geopolymers. *Applied Clay Science.* 50 (2010) 600–603. doi:10.1016/j.clay.2010.10.004.
- HOU Y., WANG D., ZHOU W., LU H., WANG L.** Effect of Activator and Curing Mode on Fly Ash-based Geopolymers. *Journal of Wuhan University of Technolotgy-Mater. Sci. Ed.* Oct.2009. DOI 10.1007/s11595-009-5711-3

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Please check the appropriate contribution: Oral or Poster

PHYSICOCHEMICAL, MINERALOGICAL AND CERAMIC PROPERTIES OF CLAY MATERIALS FROM THE EASTERN PART OF THE DOUALA SUB-BASIN, CAMEROON.

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Abstract

With the aim of valorizing the clay raw material for the manufacture of earth bricks, a study was carried out on clay materials in the eastern part of the Douala sub-basin. This work focused on material characterization and geotechnical testing, with a view to resolving the problem of the vulnerability of earth bricks in a hot, humid region such as Douala. Mineralogical and geochemical characterization and geotechnical testing methods were investigated. Mineralogical results showed that clay materials are kaolinitic in nature (45.3% and 69.2%). The abundance of kaolinite in the sub-basin clays has been reported in previous work [1,2]. Geochemically, the clays are dominated by oxides of silicon (22.21 - 71.31%), aluminum (12.59 - 23.98%) and iron (1.07 - 17.76%). The results of geotechnical analyses have shown that, in general, loss on ignition is between 6.82% and 12.09%. The clay fraction is the most important (77%), followed by the silty fraction (15%) and the sandy fraction (8%). After briquette firing, the fired products have acceptable technological properties, with a metallic sound and good cohesion between 1000 and 1100°C. Their colors vary slightly from red to reddish-brown. Apparent density values vary from 2.57 to 3.69g/cm³, water absorption of the materials studied varies between 15.32 and 25.48 N%, shrinkage is from 2.62 to 4.27% and compressive strength is from 4.41 to 7.72 MPa. In view of these various observed characteristics, the clay materials of the Douala sub-basin are potentially suitable for the production of bricks and other ceramic products.

Key words: Subbasin, mineralogical characterization, bricks, ceramics

References:

1. Kankao, O. O., Ngon Ngon, G. F., Mbog, M. B., Tehna, N., Bayiga, E. C., Mbai, J. S., Etame, J., 2022. Mineralogical, Geochemical Characterization and Physicochemical Properties of Kaolinitic Clays of the Eastern Part of the Douala Sub-Basin, Cameroon, Central Africa. Appl. Sci., 12, 9143. <https://doi.org/10.3390/app12189143>.
2. Bukalo, N.N., Ekosse, G.E., Odiyo, J.O., Ogola, J.S., 2018. Mineralogical characteristics of cretaceous-tertiary kaolins of the Douala sub-basin, Cameroon. J. Afr. Earth Sci. 141, 130-147. <https://doi.org/10.1016/j.jafrearsci.2018.02.010>.

Please check the appropriate contribution: Oral or Poster

POTENTIALITES DES FORMATIONS SUPERFICIELLES DE MAROUA (EXTREME-NORD CAMEROUN) POUR LA PRODUCTION DES MATERIAUX DE CONSTRUCTION

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Abstract

Les propriétés physico-chimiques et minéralogiques des formations superficielles de Maroua et environs ont été étudiées en vue de leur utilisation comme matière première pour la production des matériaux de construction. Ainsi, les travaux de terrain ont permis de faire la description des profils et une estimation optimale des épaisseurs des matériaux argileux. Il ressort que les argiles de Maroua et environs présentent des couleurs variant du brun au jaune et au rouge. Les matériaux argileux ont une structure polyédrique moyenne et une épaisseur de 2 à 6 m. Les caractères physiques, minéralogiques et géochimiques des argiles de Maroua ont été déterminés au moyen des techniques telles que la granulométrie, les limites d'Atterberg, la DRX, la FTIR, l'ATG-ATD, la FRX. Du point de vue granulométrique, les argiles de Maroua et environs sont des sols fins et ont des compositions comparables à celles utilisées pour la production des briques pleines, des briques perforées. Elles sont peu plastiques, présentent une extrusion maximale acceptable au moulage et pourraient être utilisées pour produire des briques et des poteries. Leur minéralogie montre en phase argileuse la smectite, la kaolinite et l'illite auxquelles sont associés les minéraux non argileux comme le quartz, les feldspaths, le rutile, la calcite, accessoirement l'hématite et l'amphibole. L'analyse FTIR révèle une mauvaise cristallinité de la kaolinite et le caractère ferrifère de la smectite. Du point de vue géochimique ces argiles silico-alumino-ferriques ont de très faibles proportions en alcalins, alcalinoterreux et en TiO₂. Cette composition chimique permet de classer les matériaux argileux de Maroua comme étant des argiles banales mais aussi leur confère une bonne aptitude pour la production des grès rouges.

Keywords: argile, caractérisation, minéralogie, matériau de construction, Cameroun .

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November 28 – December 1, 2023, Yaoundé

Oral**Design and characterization of Cameroonian pegmatite-calcined clay binary mortars via geopolymmerization****Achile Nana^{a,b,c*}, Elie Kamseu^{b,d}, Sanjay Kumar^c, Cristina Leonelli^d**^aResearch Unit of Noxious Chemistry and Environmental Engineering, University of Dschang, Faculty of Science, Department of Chemistry, P.O. Box 67, Dschang, Cameroon^bLocal Materials Promotion Authority, MINRESI/MIPROMALO, P.O. Box 2396, Yaoundé, Cameroon^cCSIR-National Metallurgical Laboratory, Jamshedpur 831 007, India^dDepartment of Engineering “Enzo Ferrari”, University of Modena and Reggio Emilia, Via Vivarelli, 10, 41125 Modena, Italy*Corresponding author: e-mail: achilenana@yahoo.fr**Abstract**

In this work, geopolymers binders obtained from a mixture of Cameroonian pegmatite and type 1/1 calcined clays at different proportions (10-30 wt%) were used for the formulation of mortars. The kinetic parameters of the reactivity of the pegmatite mixed with different calcined clays in alkaline medium were evaluated via heat of reaction data measured at isothermal conduction calorimeter (ICC) at 27 °C for the first 24h. The different products obtained were characterized by means of mechanical flexural and compressive resistances (dry and wet), physical properties, FTIR, XRD and SEM. The results showed that the compressive strength values vary with the type and fraction of calcined clays. The highest values were achieved with mortars containing 30 wt% of the different calcined clays, ranging from approximate 25 to 35 MPa in dry conditions. The flexural strength values of the mortars increase also with the incorporation of calcined clay and vary from 1.0 to 4.5 MPa. After 72 h of immersion of these samples in water, they lost less than 60% of their mechanical performance. The water absorption rate of the mortars decreases with the incorporation of calcined clays and ranges from 7.5 to 13.8%. FT-IR indicated the reactivity of pegmatite during the geopolymmerization process while SEM micrographs exhibited a better cohesion between the aggregates and the binder. The above-mentioned pegmatite-calcined clay mortars appear to be a suitable candidate for engineering applications.

Keywords: Feldspathic minerals, Pegmatite, Calcined clay, Kinetic reactions, Geopolymer Mortars.

Oral

EVALUATION DE L'APTITUDE A LA CONFECTIION DES BRIQUES DE TERRE DES ARGILES LATERITIQUES ET DES MATERIAUX DE TERMITIERES EN ZONE DE PLATEAU (ADAMAOUA-CAMEROUN)

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Résumé

La présente étude a pour but d'effectuer une étude comparative de l'aptitude à la confection des briques des argiles latéritiques et de matériaux modifiés par les termites (termitière). Après une description macroscopique des matériaux, les échantillons prélevés ont été l'objet d'étude géotechnique à travers la réalisation des essais d'identification et, la détermination des paramètres hydriques et les essais mécaniques avant et après cuisson à 850, 950 et 1050 °C. Les résultats obtenus montrent que les matériaux des termitières sont plus plastiques (27 – 31 %), plus argileux (37,95 – 53,91 %) que les argiles latéritiques. Les matériaux de termitières (absorption d'eau < 25%, résistance à la flexion (> 2 MPa) sont aptes pour la confection des briques denses quelle que soit la température de cuisson malgré leurs propriétés physiques médiocre (retrait élevé 2 – 6 % et fissures). Les argiles latéritiques ne se prêtent à la fabrication des briques que pour une température de cuisson de l'ordre de 950°C. Cette aptitude est confirmée par des valeurs de résistance à la compression supérieures à 5 MPa. Les valeurs des paramètres céramiques et mécaniques des matériaux étudiés baissent pour une température de cuisson de 1050 °C. Une faible température est nécessaire pour la cuisson de ces matériaux. Les matériaux des termitières présentent de meilleures caractéristiques pour une utilisation dans l'industrie du bâtiment comparés aux argiles latéritiques. L'activité biologique des termites aurait un effet bénéfique sur les propriétés des matériaux utilisés dans l'industrie du bâtiment.

Mots clés : Argiles latéritiques, Termitières, Briques de terre, Cuisson, Adamaoua Cameroun

References:

- Souza Santos P. (1989). Ciência e tecnologia de argilas. São Paulo, EDUSP.
- Kessoum Adamou J-M., Ntouala R.F.D., Ndome E.E., Nanga Bineli M.T., Ngo'o Ze A., Hamadjida Gouban., Onana V.L., 2023. Mineralogical, geochemical, and geotechnical features of lateritic soils from termite mounds in two contrasting savannah areas (central Cameroon) as raw materials for brick making. *Heliyon* 9 e17257.
- Ntouala RFD., Onana VL., Kamgang V., & Ekodeck, GE. (2016). Mineralogical, geochemical and mechanical characterization of the Ayos (East-Cameroon) lateritic and alluvial clayey mixtures : Suitability for building application. *Journal of Building Engineering*, 5, 50 – 56.
- Onana VL., Ntouala RFD., Mbey JA., Ngo'o Ze A., Kabeyene KV., & Ekodeck GE. (2019). Mineralogy and preliminary assessment of the potential uses of alluvial clays from Batouri (Eastern-Cameroon). *Ceramica* 65, 407 – 415.

ST2. Ceramics and geomaterials processing

Please check the appropriate contribution: Oral or Poster

EFFICIENT FRAGMENTATION OF MINERAL RAW MATERIALS - IMPACT OF EXPERIMENTAL PARAMETERS

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Abstract

The fragmentation of mineral raw materials is the first step and an integral part of ceramic manufacturing processes.

This work deals with the impact of grinding parameters on the particle size distribution obtained, while using apparatus with grinding media, rotating around a vertical axis (planetary ball mill, attritor, Emax, etc.).

First, some rules of grinding will be stated. Then, concrete cases are presented, such as grinding of sand (Figure 1) mica, alumina, hydroxyapatite etc. Through these examples, the impact of some parameters on the final particle size distribution, such as the characteristics of the grinding media (shape, size, nature), the rotation speed or the rate of filling, is studied and illustrated.

By optimizing these parameters, the grinding times are considerably reduced, energy is saved, the grinding media is less worn and the desired particle size distributions are obtained.

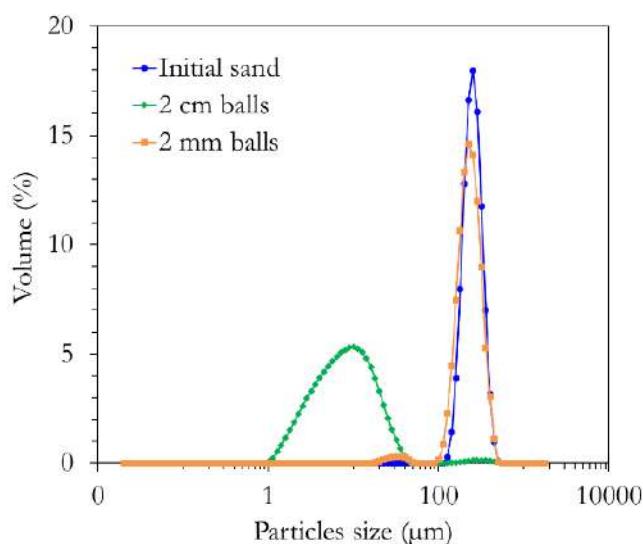


Figure 1. Impact of ball size on sand grinding. Planetary ball milling. 400 rpm. 30 min

Keywords: Grinding. Ceramic. Alumina. Sand. Planetary ball mill. EMAX

Please check the appropriate contribution:

Oral

or

Poster

OPTIMISATION DES PARAMETRES DE SYNTHESE D'UN COMPOSITE GEOPOLYMERE/OXYDE FER : APPLICATION A LA DETECTION DES IONS Pb²⁺ EN SOLUTION AQUEUSE

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Résumé

La présence du plomb dans les eaux de consommation cause de multiples dégâts sur la santé¹, il est donc important de développer des moyens d'identification et/ou de contrôle peu onéreux et performants de ce polluant. C'est ainsi que, les méthodes électrochimiques, compte tenu des avantages qu'elles offrent, sont très sollicitées^{1,2}. Les ciments géopolymères sont listés parmi les modifiants d'électrodes utilisés pour améliorer les performances d'électrodes classiques. Leur microstructure³ et leur applicabilité en électroanalyse dépendent de plusieurs paramètres dont les effets combinés sont difficiles à élucider. Dans ce travail, un plan d'expérience composite centré orthogonal a permis d'évaluer l'effet de l'oxyde de fer (*x*), du temps de durcissement (*y*) et l'effet combiné de (*x*) et (*y*) sur les propriétés électroanalytiques des géopolymères. Les formulations proposées par le logiciel ont été synthétisées en milieu acide phosphorique à partir de métakaolin et de l'oxyde de fer puis exploitées pour élaborer des capteurs électrochimiques appliqués à la détection des ions Pb²⁺ (10⁻⁶M). Les caractérisations physico chimiques ont montré la formation des réseaux géopolymères ainsi que l'effet de Fe₂O₃ dans la microstructure de ces matériaux. Les courants enregistrés à partir de chaque formulation, ont été utilisés comme réponses dans le plan d'expérience généré. Le modèle mathématique choisi montre que l'évolution des courants de pics est décrite à 95% en fonction des paramètres étudiés. Le coefficient de régression (R²) est très proche de 1, ce qui explique une forte relation linéaire entre les réponses expérimentales et celles prédictes par le modèle. Ce résultat est confirmé par la représentation graphique des réponses expérimentales en fonction de celles prédictes par le modèle, qui montre une bonne correspondance entre les valeurs expérimentales et prédictes. Le diagramme des résidus en fonction des réponses prédictes ne laisse apparaître aucune relation entre les valeurs prédictes par le modèle et les résidus. Les points semblent être disposés aléatoirement indiquant ainsi que les variances sont constantes et qu'aucune donnée n'est absurde. Cela signifie également que le modèle nous avons établi explique bien les résultats expérimentaux et nous permet donc de confirmer l'adéquation de celui-ci. Les résultats obtenus ont permis d'établir l'équation mathématique du modèle $I(\mu\text{A}) = 33,4849 - 1,8163x + 5,2547y - 0,1710xy + 0,04882x^2 - 0,08099y^2$. La formulation optimale GA_{opt} obtenue en 0,16 jours environ et contenant 17,0782% de Fe₂O₃, a une estimation de 98,71% entre la valeur prédictive du courant de pic et celle expérimentale.

Mots clés: Géopolymère acide, composite, oxyde de fer, plan d'expérience, électroanalyse.

Références:

1. Pengou, M. et al, *Journal of Solid State Electrochemistry* **25**, 1183–1195 (2021).
2. Ngassa, G. B., Tonle, I. K., Walcarius, A. & Ngameni, E., *Applied clay science* **99**, 297–305 (2014).
3. Celierier, H., Jouin, J., Mathivet, V., Tessier-Doyen, N. & Rossignol, S., *Journal of Non-Crystalline Solids* **493**, 94–98 (2018).

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Please check the appropriate contribution: Oral or Poster

Preparation and characterization of foamed concrete using a foaming agent and local mineral resources from Burkina Faso

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Abstract

Lightweight-foamed concretes (LFC) were formulated from cement, natural sand, and foam from a foaming agent with densities of 600 and 700 kg/m³. The identified mineral phases in the cement are alite, belite, celite, ferrite, calcite, and gypsum. The obtained foamed concretes have a porosity varying from 29.17 to 37.14 vol%, a thermal conductivity below 0.2 W/m.K, and a mechanical strength greater than 2 MPa. At 28 days setting, the relative quantities of crystalline and amorphous phases were identified by XRD and DTA/TG. These techniques allowed to show the importance of the carbonation process and hydrated phases formation on the macroscopic strength increase. The microstructural characterization by image analyses evidences that when the density decreases, growth of both crystalline and amorphous phases in the bubble walls during setting is a mean of compensating the role of density in strength.

Keywords: Foamed concretes, Thermal conductivity, Porosity, Foaming agent, Mechanical strength

References

- [1] Qasim S. Khan, M. Neaz Sheikh, Timothy J. McCarthy, Mehdi Robati, Mark Allen, Experimental investigation on foam concrete without and with recycled glass powder: a sustainable solution for future construction, Construct. Build. Mater. 201 (2019) 369–379, <https://doi.org/10.1016/j.conbuildmat.2018.12.178>.
- [2] O. Gencel, T. Bilir, Z. Bademler, T.A. Ozbakkaloglu, Detailed review on foam concrete composites: ingredients, properties, and microstructure, Appl. Sci. 12 (2022) 5752, <https://doi.org/10.3390/app12115752>.
- [3] Y.H. Mugahed Amran, Nima Farzadnia, A.A. Abang Ali, Properties and applications of foamed concrete; a review, Construct. Build. Mater. 101 (2015) 990–1005, <https://doi.org/10.1016/j.conbuildmat.2015.10.112>.
- [4] Marcin Koztowski, Marta Kadela, Mechanical characterization of lightweight foamed concrete, Adv. Mater. Sci. Eng. (2018) 1–8, <https://doi.org/10.1155/2018/6801258>.
- [5] E.K. Kunhanandan Nambiar, K. Ramamurthy, Air-void characterisation of foam concrete, Cement Concr. Res. 37 (2007) 221–230, <https://doi.org/10.1016/j.cemconres.2006.10.009>.

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Please check the appropriate contribution: Oral or Poster

Influence of alumina on the compressive strengths and microstructural properties of the acid-based geopolymers from calcined indurated laterite and metakaolin

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Abstract

The main objective of this work is to investigate the influence of alumina on the compressive strengths and microstructural properties of the acid-based geopolymers using calcined indurated laterite and metakaolin. These raw materials have been replaced by 0, 5, 10, 15 and 20 mass% of calcined bauxite. Phosphoric acid with molarity 10 M was used as a chemical reagent. The compressive strengths of the acid-based geopolymers increase with increasing the calcined bauxite content. Those from the substitution of calcined laterite by calcined bauxite are ranging from 21.45 to 47.95 MPa and higher compared to those from metakaolin (12.55 and 21.97 MPa). TG and DSC curves of all acid-based geopolymers indicate the decomposition of AlPO₄.H₂O at between 230 and 248 °C to an amorphous phase. In addition to this mineral, those from calcined laterite show the transformation of amorphous FePO₄.2H₂O at in the range 451–788 °C to the crystalline FePO₄. The micrography images of the acid-based geopolymers indicate the formation of dense amorphous geopolymer matrices. It was found that the alumina incorporated in the acid-based geopolymers increases the compressive strengths. The presence of hematite in the calcined laterite leads to the formation of amorphous FePO₄.2H₂O which could contribute to enhancing exponentially the compressive strengths of the acid-based geopolymers.

Keywords: Laterite, Metakaolin, Bauxite, geopolymers, AlPO₄.H₂O, FePO₄.2H₂O.

References

- [1] Bewa, C.N., Tchakout'e, H.K., Banenzou'e, C., Cakanou, L., Mbakop, T.T., Kamseu, E., Rüscher, C.H., 2020. Acid-based geopolymers using waste fired brick and different metakaolins as raw materials. Appl. Clay Sci. 198, 105813.
- [2] Riyap, H.I., Tazune, F.K., Fotio, D., Tchakout'e, H.K., Nanseu-Njiki, C.P., Rüscher, C.H., 2021. The Coexistence of the poly(phospho-siloxo) networks and calcium phosphates on the compressive strengths of the acid-based geopolymers obtained at room temperature. J. Inorg. Organomet. Polym. Mater. 2021 <https://doi.org/10.1007/s10904-021-01949-8>.
- [3] Tchakout'e, H.K., Rüscher, C.H., Kamseu, E., Andreola, F., Leonelli, C., 2017. Influence of the molar concentration of phosphoric acid solution on the properties of metakaolin-phosphate-based geopolymer cements. Appl. Clay Sci. 147, 184–194.

Please check the appropriate contribution: Oral or Poster

VARIABILITY, CLASSIFICATION AND MECHANICAL PROPERTIES OF LATERITIC SOILS IN BURKINA FASO

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Abstract

Lateritic soils are soils available in tropical countries and use as pavement building materials. It results from the bedrock's weathering under many factors. It is in particular the geology, the climate and the topography that contribute to the formation of their soils, and then to give a variety of them. Many African countries, as Burkina Faso, located in the tropical area, has as essential soils of construction: the lateritic soils. However, their use in roads design and construction constitute a main problem. Basing on a large literature review on the use of lateritic soils in pavement engineering and on an analysis of samples from Burkina Faso, this communication presents the variability of some geotechnical parameters of lateritic soils and propose an approach for their classification. It appears that there is a low variability of lateritic soils, which mean that the geo-climatic factors have less influence on them at the scale of the country. Nevertheless, it can be highlighted tree groups of lateritic soils, varying from fine grained to coarse grained lateritic soils. In view of the results of the different analysis and on the characterization of lateritic soils according to other parameters as their crushability, an approach is proposed for the classification of lateritic soils and for their better use in road design and construction.

Keywords: Lateritic soils, variability, classification and properties

References:

- Buchanan, Francis Hamilton. 1807. A journey from Madras through the countries of Mysore, Canara, and Malabar, performed under the orders of the most noble the marquis Wellesley, governor general of India... Vol. 1. Cadell.
- Garc a-Gaines, Ruben A., et Susan Frankenstein. 2015. « USCS and the USDA Soil Classification System: Development of a Mapping Scheme ». Engineer research and development center Hanover nh cold regions Research and Engineering Lab.
- Gidigasu, M. D. 1972. « Mode of formation and geotechnical characteristics of laterite materials of Ghana in relation to soil forming factors ». Engineering Geology 6 (2): 79–150.
- Ndaye, M. 2013. « Contribution à l'étude de sols latéritiques du Sénégal et du Brésil ». Sénégal et France : Université Paris-Est et Université Cheikh Anta Diop de Dakar. HAL.
- Paige-Green, P. 2015. « A review of specifications for lateritic materials for low volume roads ». Transportation Geotechnics 5: 86-98.

Please check the appropriate contribution: Oral or Poster

Mineralogical and physico-chemical characterizations of clay from Allou Kagne (Senegal)

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Abstract

There is interest in exploiting and developing natural resources, particularly deposits of natural clays. Senegal has several clay minerals deposits for which chemical and mineralogical compositions have been studied insufficiently. Some of these natural materials are nowadays used in pottery and ceramics. To extend applications, a better basic knowledge is required and, for this objective, the raw clay and separated < 2µm clay fraction from Allou Kagne (Senegal) were subjected to chemical and mineralogical studies. Several techniques including X-ray diffraction (XRD), thermal analysis (TG-DTA), Fourier transform infrared spectroscopy (FTIR), scanning electron microscopy (SEM), N₂ adsorption-desorption isotherms, cation exchange capacity (CEC) measurements have been performed for materials characterization. It was found that the raw clay and the separated clay fraction consist of a mineral mixture in which palygorskite is the main component.

Keywords: Palygorskite , chemical characterization, mineral characterization, clay minerals.

- [1]- H Jianhua., L YuanFa & W Xingguo: Influence of differently modified palygorskite in the immobilization of a lipase. *Journal of Molecular Catalysis Enzymatic*; **55**, 2008, 49-54.
- [2]- S Caillère: Minéralogie des argiles, Tome I et II, *Ed. Masson*, 1982
- [3]- S Akyuz & T Akyuz: Study on the interaction of nicotinamide with sepiolite, loughlinite and palygorskite by IR spectroscopy. *J. Mol. Struct.*; **744-747**, 2005, 47-52.
- [4]- Y X Liu., W W Dai., T Wang., Y Tao: Superficial performance and pore structure of palygorskite treated by hydrochloric acid. *J. Cent. South Univ. Technol.*; **13**, 2006, 451-455.

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Please check the appropriate contribution: Oral or Poster

Raw earth bricks amended with cement and kenaf fibres : microstructure and physico-mechanical properties

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Abstract

A recent publication in our laboratory has showed that small cement amount addition in adobes elaborated with raw clayey material permit to obtain building materials with technological properties that meet standards for construction [1]. The present work investigates the influence of kenaf fibers (up to 1wt. %) and their length (1.5 and 3 cm) on the microstructure, physical and mechanical properties of adobes stabilized with 2wt. % cement elaborated with this raw material in order to improve their thermal conductivity and breaking behavior. It appears from this new study that kenaf fibers addition improves physical and mechanical properties comparing to adobes stabilized with only 2wt. % cement. This result is due to the strong adhesion of kenaf fibers with the clayey matrix because of their roughness and also to the non-propagation of cracks in the clayey matrix [2,3]. The effect is very much felt on the thermal conductivity due mainly to the presence of cellulose contained in the fibers which have an insulating character. Development of important internal porosity explains also this result. Manufactured adobes have the elasto-plastic behavior because of high tensile strength of kenaf. Considering of these properties, elaborated adobes are suitable for habitats construction in tropical climate.

Keywords: Kenaf fibers, Cement, Microstructure, Physico-Mechanical Properties, Breaking Behavior, Thermal Comfort

[1] K. Dao, M. Ouédraogo, Y. Millogo, J-E. Aubert, M. Gomina. Thermal, hydric and mechanical behaviours of adobes stabilized with cement. Construction and Building Materials 158, 2018; 84-96.

[2] Y. Millogo, J.C. Morel, J. Emmanuel Aubert et G. Khosrow. Experimental analysis of Pressed Adobe Blocks reinforced with Hibiscus cannabinus fibers. Construction and Building Materials 52, 2014. 71-78.

[3] A. Kumar, B.S. Walia et J. Mohan. Compressive strength of fiber reinforced highly compressible clay. Construction and Building Materials 20, 2006. 1063–1068.

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Please check the appropriate contribution: Oral or Post

TITLE: TRONA AS LOCAL SOURCE OF ALKALI IN THE PRODUCTION OF ECOLOGICAL BINDER

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Abstract

Portland cement, is presented as the most used material for building construction, however with the global warning potential and climate change, cement cannot be continuously considered as the ideal solution. The aim of this study is to synthesize new alternative binder using trona (sodium carbonate ore) as local alkali source and sodium hydroxide, laterite, volcanic ash, rice husk ash as solid precursors. To achieve this aim, sodium carbonate and sodium hydroxide solution were prepared at 10M, followed by the mixture with precursors (laterite and volcanic ash). The compressive strength will be performe at day 14 and day 28. Some analytical methods are FT-Infrared Spectroscopy, X-ray Diffraction, X-ray Fluorescence, Environmental scanning electron microscope ESEM-EDS. The expected results for the mechanical test evaluation are as follows, the sample prepared with sodium hydroxide may present high strength (18 MPa at 14 days and 25 MPa at 28 days) compared to those with sodium carbonate ore solution (10 MPa at 14 days and 12 MPa at 28 days) and the reaction may be more effective in volcanic ash than laterite, the concentration of 10M of activating solution favours the dissolution of ions into precursors. The results may confirm that, the use of ecological cement appeared promising construction material.

Keywords: Alkali, Trona, Binder

References

- Ben, M.I., Hamdi, N., Srasra, E., 2018. The suitability of thermally activated red illite/kaolinitic clay as raw material for geopolymers binders. J. mater. Environ. Sci., vol 9, issue 3, page 946-954.
- Cong, M., Bin, Z., Shenglai, G., Guangcheng, L., Youjun, X. 2019. Properties and characterization of green one-part geopolymers activated by composite activators. Journal of Cleaner Production 220, 188-199.
- Sibel, G., Umit, A., 2016. Assessment of soda ash calcination treatment of Turkish trona ore. E3S Web of conferences, 01013.

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Oral

Effect of an organic compared with a mineral fluxing agent on the characteristics of kaolinite clay-based stoneware ceramics.

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Abstract

Stoneware ceramics are used in construction, sanitaryware and even environmental protection [1]. In order to improve their properties and lower their production temperature, several authors have used different sources of flux [2,3]. The present study is focused on the influence of cocoa cortex ash (CCA) compared with syenite (SY), and the effect of mixing these two fluxes on the technological characteristics of stoneware ceramics. To this end, mixtures in mass proportions of 90/10, 80/20 and 70/30 of the clay powders (EB) and each flux were made by uniaxial pressing and the codes C10, C20 and C30 were assigned to the EB+CCA samples and S10, S20 and S30 to EB+SY. Thereafter, both fluxes were mixed with clay in mass proportions of 90/5/5; 80/10/10; 90/2.5/7.5 and 90/7.5/2.5. All formulations were sintered at 1100°C. Technological properties (water absorption (Abs), bulk density (BD), flexural strength (FS)) were determined. The results show that for the EB+SY mixture, S30 has appreciable properties (Abs: 3.87%; BD: 2.37 g/Cm³ and FS: 29.6 MPa); while for EB+CCA, C10 has interesting properties (Abs: 2%, BD: 2.41 g/Cm³ and FS: 32 MPa). According to ISO 13006, C10 has the characteristics of vitrified stoneware and S30 those of semi-vitrified stoneware [4]. The results of partial substitution of CCA by SY show that sample 80/10/10 has more advantageous properties (Abs: 1%; BD: 2.45 g/Cm³ and FS: 41.43 MPa).

Keywords: kaolinite clay, fluxing agent, stoneware ceramics, technological properties.

References:

- [1] Fragassa C. (2015), Limits in application of international standards to innovative ceramic solutions. *International Journal for Quality Research*, (9) 279–298.
- [2] Njindam O.R., Njoya D., Mache J.R., Mouafon M., Messan A., Njopwouo D. (2018), Effect of glass powder on the technological properties and microstructure of clay mixture for porcelain stoneware tiles manufacture. *Construction and Building Material*, (170) 512-519.
- [3] Ndzana E. J. A., Njoya D., Elimbi A., Ranaivoarivo G. V., Lecomte-Nana G., Nzeukou A. N., Njopwouo D. (2019), Cocoa Cortex Ashes as Fluxing Additive for Vitrified Ceramic Making from Alluvial Clay. *Journal of Materials Science and Chemical Engineering*, (7) 24-39.
- [4] Dondi M., Raimondo M., Zanelli C. (2014), Clays and bodies for ceramic tiles: Reappraisal and technological classification. *Applied clay Science*, (96) 91-109.

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Please check the appropriate contribution: Oral or Poster

EFFECTS OF IRON MINERALS ON THE COMPRESSIVE STRENGTHS AND MICROSTRUCTURAL PROPERTIES OF METAKAOLIN-BASED GEOPOLYMER MATERIALS

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Abstract: The current study aims to investigate the influence of iron minerals on the amorphous phase content, compressive strengths and the microstructural properties of the geopolymer materials. Geopolymer materials were prepared by the substitution of metakaolin by 10 and 20 wt.% of each iron mineral sample. Sodium waterglass from rice husk ash was used as a hardener and metakaolin was used as an aluminosilicate source. The X-ray patterns show that the iron minerals denoted FR and FB are associated with hematite and magnetite, respectively. FY contains goethite together with a significant content of kaolinite and quartz. It is observed in the XRD patterns and FTIR absorption spectra that the additions hematite, magnetite and goethite remain largely unreacted in the geopolymer binder. The compressive strengths of the related geopolymer composites show some significant variations indicating certain effects for mechanical stability obtained: 10 wt.% replacement of metakaolin by hematite increased the compressive strength from 51.1 to 55.5 MPa, while 20 wt.% hematite caused a decrease to 44.9 MPa. Furthermore, 10 and 20 wt.% replacement with FB revealed decreased values 47.0 and 40.3 MPa, respectively. It was also found that 10 and 20 wt.% of FY caused lower values of 30.9 and 39.1 MPa, respectively. The micrographs of geopolymer materials present some voids and cracks. The denser matrix is related to a superior gel formation producing a better glue between the crystalline additions. The unsubstituted geopolymer sample provides with about 50% the highest X-ray-amorphous content, whereas the substituted samples range between 35 and 45% indicating systematically smaller gel contents without any clear trend with the compressive strength variation, however. The strength dependencies reveal more complex interaction between the gel and crystalline additions.

Keywords: Hematite; Magnetite; Goethite; Metakaolin; Geopolymer materials; Gels

Reference: Li, X.; Wang, P.; Guo, Z.; Qin, J.; Liang, K. Effect of $\text{Fe}^{2+}/\text{Fe}^{3+}$ on high-strength ceramsite prepared by sintering geopolymers using iron ore tailings. *Ceram. Inter.* **2022**, *48*, 5681–5688.

Please check the appropriate contribution: Oral or Poster

EFFECTS OF CURING CYCLES ON DEVELOPING STRENGTH AND MICROSTRUCTURE OF GOETHITE-RICH ALUMINOSILICATE (CORRODED LATERITE) BASED GEOPOLYMER COMPOSITES

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Abstract

The present work carried out the influence of curing cycles on the performance of laterite-based geopolymer composites. To do so, the products were obtained by altering laterite with 15, 20, and 25 wt% of rice husk ash (RHA). Alkaline solution in a constant solid/liquid ratio of 0.35 was added together with fine and coarse aggregates (representing equal and double weight of laterite, respectively). The obtained matrices were treated in three curing cycles before characterization: room temperature curing (RTC), oven curing at 80°C (OTC) and controlled humidity steam curing at 80°C (STC). The mechanical tests carried out at 28 days give the following maximum values for each curing mode: 16.40, 28.82 and 56.41 MPa for RTC, OTC, and STC modes respectively. Means that when samples are submitted in a moisture-controlled environment, the end products are more stable, less porous and resistant [1]. Regarding the physical properties, the results show that the maximum value of open porosity is 11.62% corresponding to a matrix that was cured at room temperature without rice husk ash added, while the minimum value of 7% corresponds to a matrix that was cured under controlled humidity and containing 20% rice husk ash. The lower percentages could be either due to formation of iron silicate minerals from silica and iron compounds resulting in an improvement of structure [2]. The optimum and minimum absorption values are 2.70 and 4.60% respectively for the OTC and RTC curing modes. As for bulk densities, the optimum value is 2.64 g cm⁻³ for the matrix having 15% rice husk ash and the minimum value is 2.33 g cm⁻³ for a matrix having 20% rice husk ash, for OTC and STC curing modes respectively. The appropriate curing type for laterite-based geopolymer is when the humidity is controlled.

Keywords: Laterite, Curing cycles, Quarry sand dust, Rice husk ash, Mechanical properties, Microstructure,

References: [1] D. Dimas, I. Giannopoulou, D. Panias, Polymerization in sodium silicate solutions: a fundamental process in geopolymers technology, *J. Mater. Sci.* 44 (14) (2009) 3719–3730.

[2] R.C. Kaze, L.M. Beleuk ` a Moungam, M. Cannio, R. Rosa, E. Kamseu, U.C. Melo, C. Leonelli, Microstructure and engineering properties of Fe₂O₃ (FeO)-Al₂O₃-SiO₂ based geopolymers composites, *J. Clean. Prod.* 199 (2018) 849–859.

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Valorisation de trois matières premières dans la formulation de matériaux réfractaires

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Résumé :

Au Burkina Faso, une quantité importante de matériaux réfractaires tels que les creusets et les coupelles sont importés par les sociétés minières et les laboratoires. Ces matériaux sont utilisés dans le processus de traitement des minéraux. L'élaboration des creusets réfractaires à base de matières premières locales pourrait contribuer à la résolution de ce problème d'importation. Pour cela, deux argiles et du sable naturel prélevés au Burkina Faso ont été caractérisés, et les résultats ont montré que ces matières premières peuvent être utilisées dans le domaine des céramiques réfractaires. L'une des argiles a une teneur plus élevée en kaolinite et l'autre en fondant. Des creusets ont été élaborés par la suite par pressage de mélanges proportionnels de ces matières premières, puis frittés à 1200 °C. Les matériaux cuits à 1200°C présentent une microstructure composite granulaire typique où des grains de quartz sont intégrés dans la phase de matrice argileuse. Sous charge à haute température, le comportement du matériau est influencé par la nature de la phase de la matrice argileuse qui fond progressivement à haute température et la proportion en argile fondant.

Cette étude montre que la production locale de creusets réfractaires à partir d'argiles kaoliniques du Burkina Faso est possible. Ces creusets ont une grande résistance mécanique, une bonne résistance aux produits chimiques et résistent aux chocs thermiques. Ils sont prêts à être employés dans des conditions corrosives et à des températures atteignant 1173,6°C sous charge.

Mots clés : argile, mullite, réfractaire

Please check the appropriate contribution: Oral or Poster

Investigation of the properties of metakaolin-based geopolymers materials using ferrisilicates as additives synthesized in sodium hydroxide solution or distilled water

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Abstract

The main target of this work is to investigate the behaviour of ferrisilicates synthesised from hematite and two silica sources such as rice husk ash and silica fume on the compressive strengths of geopolymers cements. Ferrisilicates were synthesised in a sodium hydroxide with molarity 2M and others were prepared using distilled water as a solvent. The molar ratio $\text{Fe}_2\text{O}_3/\text{SiO}_2$ contained in the ferrisilicates was set at 0.2. Metakaolin and sodium silicate solution ($\text{SiO}_2/\text{Na}_2\text{O}=1.6$) were used as aluminosilicate and hardener, respectively. In addition, the compressive strengths of the geopolymers materials were measured. The results obtained show that the compressive strength of the control geopolymer cement is 53.34 MPa. Those from ferrisilicates prepared in the alkaline solution using rice husk ash and silica fume are 71.91 and 77.72 MPa, respectively. Whereas, the compressive strengths of the geopolymers materials from ferrisilicates prepared in distilled water using rice husk ash and silica fume are 74.13 and 44.73 MPa, respectively. It was observed that the maximum compressive strength of 77.72 MPa was achieved in the presence of ferrisilicate FNS. The minimum compressive strength of 43.73 MPa was achieved when the ferrisilicate FS was incorporated into the metakaolin.

Keywords: Hematite; Silica sources; Ferrisilicates; Geopolymer composite; Compressive strength.

References: Kaze, R.; Beleuk à Moungam, L.; Cannio, M.; Rosa, R.; Kamseu, E.; Chinje, U.; Leonelli, C. Microstructure and engineering properties of $\text{Fe}_2\text{O}_3(\text{FeO})-\text{Al}_2\text{O}_3-\text{SiO}_2$ based geopolymers composites. *J. Clean. Prod.* 2018, 199, 849–859.

Tchakouté, H.K.; Rüscher, C.H.; Djobo, J.N.Y.; Kenne, B.B.D.; Njopwouo, D. Influence of gibbsite and quartz in kaolin on the properties of metakaolin-based geopolymers cements. *Appl. Clay Sci.* 2015, 107, 188–194.

ST3. Sintering and consolidation mechanisms

Please check the appropriate contribution: Oral or Poster

INVESTIGATION OF THE INFLUENCE OF IRON CONCENTRATION ONTO THE SINTERING BEHAVIOR OF PHYLLOSILICATE

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Abstract

Ecological transition have been at the center of many issues over the years. The ceramic industry needs to follow environmental developments towards a "competitive low-carbon economy by 2050" and achieve carbon neutrality in order to match the "European Green Deal" [1].

Phyllosilicates are included in the formulation of silicates ceramics whereby the firing step is performed within "natural gas" kilns at industrial scale. Alternatives for thermal treatment, such as the use of biogas, green hydrogen or electricity based furnaces should be considered. These changes in the sintering environment can significantly affect the transformation kinetics by changing the surrounding atmosphere and heat transfer patterns. Therfore, the challenge of the present study is to understand the effects of such modifications, especially on physical and chemical transformations together with the structural reorganization of clays.

This works focuses on two types of clays: kaolinitic and illitic clays [2]. Kaolinite is a 1:1 clay mineral where the unit sheet results from the superposition of an octahedral layer and a tetrahedral layer. Illite is a 2:1 clay mineral where the unit sheet results from the superposition of a central octahedral layer and two external layers with potassium ions in the interlayer space. Two models clays were chosen for this study: a kaolin noted "CR" that was provided by Imerys company, and an illite noted "ABM" that was provided by Argiles du Bassin Méditerranéen company.

The understanding of the transformations and interactions of kaolinite or illite with secondary phases is a key point to control the physical and chemical properties of related materials. According to details from Ellingham diagram and the compositions of most silicate ceramics and biogas, the influence of impurities such as iron oxide is studied [3]. To this end, controlled additions of iron oxide were performed up to 10 wt.%. The thermal behavior of these compounds is investigated using different thermal cycles under controlled atmosphere. In situ DTA/TG and ex situ XRD, SEM and TEM analyses were performed to implement the knowledge in line with the phase transformations and interactions of kaolinite or illite with iron oxide. In general, the presence of nanosized iron oxides, tends to promote the earlier mullite crystallization and flux occurrence.

Keywords: phyllosilicates, sintering, biogas, fluxing oxides, Ellingham diagram

References: [1] Furszyfer Del Rio D., Sovacool B., Foley A., Griffiths A., Bazilian M., Kim J., Rooney D., Decarbonizing the ceramics industry: A systematic and critical review of policy options, developments and sociotechnical systems, Renewable and Sustainable Energy Reviews, 157 (2022) 112081
[2] F. Bergaya, F. Teng, G. Lagaly, Handbook of clay science, Elsevier, 2006
[3] G. Lecomte-Nana, J.-P. Bonnet, N. Soro, Influence of iron onto the structural reorganization process during the sintering of kaolins, Journal of the European Ceramic Society, 33(4) (2013) 661-668

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Please check the appropriate contribution: Oral or Poster

Effects of feldspar addition on ceramic properties of alluvial clays from Bamendou-Balessing (West Cameroon)

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Abstract

The present study focuses on the use of feldspars from Batié granites (West-Cameroon) as a fluxing agent in fired clay bricks, in order to reduce the energy cost of brick manufacture. Four alluvial clays were collected in the field using an auger and the feldspar sample was collected by hammering. Mineralogical (XRD) and geochemical (XRF) analyses of alluvial clays and feldspar samples were carried out. Brick samples of 160×40×40 mm with different proportions of feldspar (0%, 5%, 10%, 15%, 20%, and 25%) were made and fired at 850 °C, 950 °C, 1000 °C, 1050 °C and 1100 °C. Physico-mechanical tests (sound, linear shrinkage, water absorption, bulk density, compressive strength) were done on fired specimens.

The XRF chemical composition of the feldspar reveals, alongside silica (65 wt. %), significant proportion of alumina (18.71 wt. %), potassium and sodium oxides considered as fluxing agents ($K_2O + Na_2O = 14$ wt. %). Orthoclase and albite are essentials feldspar minerals. The alluvial clays are composed of clay minerals dominated by kaolinite with variable contents of illite and vermiculite. The non-clay mineral phases are quartz associated with variable proportions of K-feldspar, gibbsite and goethite. Geochemical analysis shows that clay material consists of: SiO_2 , Al_2O_3 , Fe_2O_3 , TiO_2 , P_2O_5 , MgO , CaO and K_2O . Fired specimens displayed metallic sound, accentuated with temperature and the increase in feldspar. All Fired specimens displayed reddish yellow (5YR 7/6) color. With increase in feldspar, linear shrinkage increased with temperature. Bulk density and compressive strength increase with temperature and feldspar. The compressive strength (10–17 MPa) of fired specimens meet the standard of traditional ceramics requirements. It was observed that brick formulations with 0% of feldspar fired between 950 and 1000 °C are similar to those of 10 and 20% of feldspar fired at 850 °C.

Keywords: alluvial clay, feldspar, firing specimens, bricks, characterization.

Please check the appropriate contribution: Oral

Enhancing the crystallization phenomena and strength of porcelain stoneware: the role of CaO

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Abstract

Limestone was used to modify the fluxing action of two potash feldspars (a pure potash feldspar and a soda-potash feldspar) labeled P and C, respectively, in the formulation of porcelain stoneware based on Cameroonian raw materials. The effect of limestone addition (0–10 mass%) was investigated in the range of sintering temperature between 1125 and 1300 °C. Characterization of sintered samples including thermal behavior (DTA, TG and dilatometry test), phase evolution, densification parameters, flexural strength, morphology as well as pores structure was investigated in details. The maximum flexural strength (138 MPa) was obtained at 1175 °C with P series (7 mass% addition of limestone) and at 1200 °C (122 MPa) for C series. The maximum density ($\approx 3.1 \text{ g cm}^{-3}$) and lower water absorption ($\approx 0\%$) were obtained at 1200 °C. Mullite and anorthite were identified as main crystalline phases. Starting from 1175 °C and mostly at 1200 °C, the two series compositions (with 7 mass% addition) presented a self-glazing phenomenon which gave them significant brightness and high aesthetic quality; these properties were achieved only at 1300 °C for reference samples with no lime addition (P0 and C0). A proper addition of limestone (3–7 mass%) with potash feldspar significantly reduced the sintering temperature (~ 150 °C) and allowed producing high strength (122–138 MPa), low energy and sustainable porcelain stoneware.

Keywords : Porcelain stoneware · Tiles · Crystallization · Limestone · Sintering

References

1. Dondi M, Ercolani G, Melandri C, Mingazzini C, Marsigli M. The chemical composition of porcelain stoneware tiles and its influence on microstructural and mechanical properties. Int Ceram Rev. 1999;48(2):75–83.
2. Tchakoute Bakop T, Tene Fongang RT, Melo UC, Kamseu E, Miselli P, Leonelli C. Sintering behavior of two porcelainized stoneware compositions using pegmatite and nepheline syenite minerals. J Therm Anal Calorim. 2013;114:113–23

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November 28 – December 1, 2023, Yaoundé

Please check the appropriate contribution: Oral

Influence of CaO/Al₂O₃ molar ratio of synthetic calcium aluminate hydrates on the microstructural properties and compressive strengths of metakaolin-based geopolymers cements

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Abstract

The aim of this work is to study the behavior of synthetic calcium aluminate hydrate (CAH) on the microstructural properties and compressive strengths of metakaolin-based geopolymers cements. CAH and calcium hydroxide (CH) were used as additives. They were obtained from sources of calcium (chicken eggshells) and alumina (bauxite). CAH were synthesized with CaO/Al₂O₃ molar ratios equal to 0.4, 0.6, 0.8, 1.0 and 1.2 and denoted CA04, CA06, CA08, CA10 and CA12, respectively. Sodium silicate solution from rice husk ash containing a SiO₂/Na₂O molar ratio equal to 1.6 was used as hardener. Geopolymer cements were obtained by substituting metakaolin by 0 and 10 wt% of different calcium aluminate hydrates (CA04, CA06, CA08, CA10 and CA12) and calcium hydroxide. Raw materials, calcium aluminate hydrates, calcium hydroxide and geopolymers cements were characterized by means of thermal analysis (ATG/DSC), X-ray powder diffractometry, Fourier transform infrared spectroscopy, scanning electron microscopy and compressive strength measurements. X-ray diffractograms of CAH show amorphous calcium aluminate hydrate and alumina. They also show reflection peaks of alumina and calcium aluminum oxide hydrate. The one from calcium hydroxide shows reflection peaks of calcium hydroxide (Portlandite). Microstructures of geopolymers cements are homogeneous, compact and dense. However, geopolymers cements using calcium hydroxide (GCH) and CA12 (GCA12) as additives have spongy calcium-rich areas and pores in their microstructures, respectively. Compressive strengths increased from 48.86 to 63.59 MPa (30 %) when the CaO/Al₂O₃ molar ratio of CAH increased from 0.0 to 0.4. They decrease from 63.59 to 32.76 MPa (48.5 %) when the CaO/Al₂O₃ molar ratio of CAH increases from 0.4 to 1.2. The highest drop in compressive strength (54.8 %) occurs when calcium hydroxide is used as additive. It was found that, CaO/Al₂O₃ molar ratio of calcium aluminate hydrates to use in order to produce metakaolin-based geopolymers with best compressive strengths is 0.4.

Keywords: Metakaolins, Calcium aluminate hydrate, Geopolymer cements, Compressive strengths, Microstructures.

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Please check the appropriate contribution: Oral or Poster

Porcelain stoneware tiles based on clays mixture and waste glass powder: Effect of soaking time

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Abstract

The effect of soaking time on the firing behavior of porcelain stoneware tiles based on clay mixture and waste glass powder was studied. Mixture was prepared and fired at 1150 °C. During firing, raw mixture was subjected to various soaking times: 30, 60, 90 and 120 minutes. The technological properties (linear shrinkage, water absorption, bulk density and flexural strength) of the fired bodies were investigated, and microstructure changes were carried out by X-ray diffraction and SEM. The results demonstrated that physico-mechanical properties of ceramic samples are significantly affected by soaking time. For a soaking time of 30 minutes, products satisfied the ISO 13006 standard condition for porcelain stoneware wall and floor tiles: Water absorption value is lower (0.07%) and mechanical strength value is higher (44.4 MPa) in comparison with other samples. Prolonged soaking time is useless and undesirable due to its negative effect (bloating) on the products physical and mechanical performance. The XRD patterns indicated the presence of mullite, cristobalite, enstatite, anorthite, hematite and quartz as the main crystalline phases. Furthermore, the SEM images of tiles fired at 1150 °C and during 30 min displays a very close texture and dense microstructure.

Keywords: Soaking time, waste glass powder, bloating.

References:

- J.S. Lu , Y. Li, C. Zou, Z. Liu, C. Wang, Effect of sintering additives on the densification, crystallization and flexural strength of sintered glass-ceramics from waste granite powder, Materials Chemistry and Physics 216 (2018) 1-7.
- E. El-Fadaly, Characterization of porcelain stoneware tiles based on solid ceramic wastes, Int. J. Sci. Res. 4 (2015) 602-608.
- J.M. Pérez, M. Romeron, Microstructure and technological properties of porcelain stoneware tiles moulded at different pressures and thicknesses, Ceram. Int. 40 (2014) 1365-1377.

Please check the appropriate contribution:

Oral

or

Poster

EFFECT OF BAUXITE CONTENT AND TEMPERATURE ON THE PROPERTIES OF ANODE BAKING FURNACE REFRactories

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Abstract

Two raw materials namely bauxite (Ba) from Minim-Martap in the Adamaua Region and clay (MY1) from Mayouom - Foumban Ouest Region, all both in Cameroon, have been used in this study to design the most suitable refractory bricks for an anode baking furnace. Ba and My1 were crushed and calcined at 1500°C into crucibles. Five batches are made from calcined bauxite (CBa) alone and from the mixture of calcined bauxite CBa and both calcined and raw clays (CMY1 and MY1) in such a way to obtain 70% and 80% alumina refractory bricks. They have been pressed into small bars (6 × 5 × 60 mm) and fired at 1400, 1500 and 1600°C. The bulk density (BD), the apparent porosity (AP) and the water absorption (WA) of the sintered samples were determined using the water displacement method (Archimedes method). While raising the temperature from 1400 to 1600°C, the water absorption decreased from 20 to 3 wt.%, the porosity went from 31 to 11wt.%, and the bulk density varied from 2.01 to 3.36 g.cm⁻³ but the shrinkage increased from 3 to 10 % respectively. As the temperature increased, the modulus of rupture (MOR), measured using the three-point bending method on an INSTRON universal testing machine with a support span of 40 mm and a displacement rate of 5 mm/min, increased from 13 to 93 MPa. The elastic behavior (EMod) of ceramic samples, studied using the ultrasonic technique with transducers of 10 MHz, also increased from 19 to 182 GPa with the temperature. Corundum and Mullite are the major minerals and are well crystallized as revealed in the diffractograms. SEM images with different magnifications showed dense and compacted products. Finally, dense and mature bauxite ceramics have been obtained at 1600 °C with improved properties to increase the service lifetime of anode baking furnaces and therefore to maximize the production of the aluminum industry.

Keywords: Refractory, Bricks, Anode, Furnace

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Please check the appropriate contribution: Oral or Poster

STUDY OF BEHAVIOR IN THE CHEMICALS ATTACK OF A PORCELAIN FORMULATED FROM LOCAL RAW MATERIALS FROM BURKINA FASO

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Abstract

This work evaluates the resistance to chemical attack of a porcelain formulated from local raw materials from Burkina Faso for their validation in real use. A kaolinitic clay, a pegmatite and sand were used for the formulation of porcelain tiles. Samples were shaped by casting into porous molds and sintered at a temperature of 1240 °C. The average heating rate is 10 °C/min up to the final temperature. These porcelains were immersed to a depth of 25 mm in test solutions and kept closed at 20 °C for 12 days. Six concentrations of test solutions were prepared to perform these tests: ammonium chloride (100 g/L); hydrochloric acid (3% and 18% by volume); lactic acid (5% by volume); citric acid (100 g/L) and alkali KOH (30 g/L and 100 g/L). The test showed that these porcelains are resistant to chemical attacks with insignificant mass variations ranging from -0,03–0,05 w%. The results obtained qualify the porcelains for industrial and real use.

Keywords: chemical attack, chemica resistance, porcelain and raw materials.

References:

- [1] International Organization for Standardization EN ISO 10545–13. Ceramic tiles, determination of chemical resistance. (2015).
- [2] International Organization for Standardization EN ISO 10545–4, Ceramic tiles - Part 4: Determination of modulus of rupture and breaking strength. (2019).
- [3] Sawadogo, Y., Sawadogo, M., Ouédraogo, M., Seynou, M., Lecomte-Nana, G., Blanchart, P., Gomina, M. and Zerbo, L. Optimization of Contents of Three Raw Clay Materials in Formulation of a Porcelain. Journal of Materials Science and Chemical Engineering, 10, 41–58. (2022). <https://doi.org/10.4236/msce.2022.101003>
- [4] International Organization for Standardization Norme ISO 10545–3, Ceramic floor and wall tiles – Test method, Part 3: Determination of water absorption, apparent porosity, apparent relative and bulk density. (2018).
- [5] Moustapha Sawadogo, Issiaka Sanou, Yéri Dah, Boubacar Traoré, Youssouf Sawadogo, Drissa Samaké, Cheick Dembelé, Lamine Zerbo, Mohamed Seynou. Résistance aux chocs thermiques et aux attaques chimiques de briques réfractaires à base d'argile kaolinitique et de sable. Journal de la Société Ouest-Africaine de Chimie (2021), 050: 50 – 56

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Please check the appropriate contribution: Oral or Poster

VALORIZATION OF CLAYS OF CENTRAL AFRICAN REPUBLIC: OPTIMIZATION OF FORMULATIONS REGARDING THE PROPERTIES OF USE AND THE SINTERING BEHAVIOR

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Abstract

Two clay materials from Central African Republic NZ2 and KO, were subjected to physicochemical, thermal, and mineralogical characterizations in order to identify their appropriate fields of use. The results show that these clays are kaolinic-illitic raw materials suitable for to be used for the manufacture of silicate ceramics. The properties of clay-based products shaped by unidirectional pressing and sintered in the range 900 to 1200°C were studied. The results obtained showed that the thermal conductivity values of materials produced between 900 and 1100°C are within the range of values permitted for terracotta materials (bricks, tiles). However, NZ2 clay exhibited weaker mechanical properties than KO clay due to its low densification. Given the high quartz content of NZ2 clay (59.8 mass%), quantities of 10 and 20 mass% NZ2 were added to KO, which has a high kaolinite content (69.7 mass%) and low content quartz (7.68 mass%), in order to study its effect on the thermal conductivity (λ) and compressive strength (σ) of the materials produced. NZ2 could also be used as a non-fluxing component. The thermal conductivity values obtained varied very little with the addition of NZ2 compared with those obtained without. However, an increase of around 13% in compressive strength is observed when 10 mass% of NZ2 is mixed with KO and sintered at 1000 °C. Above a sintering temperature of 1000°C, the addition of NZ2 at a rate equal to or greater than 10 mass% has a detrimental effect on the final properties of fired products. The addition of 10 or 20 mass% of NZ2 in KO resulted in a decrease in thermal conductivity from $1.16 \pm 0.03 \text{ W.m}^{-1}.\text{K}^{-1}$ (without addition at 1100°C) to $0.95 \pm 0.03 \text{ W.m}^{-1}.\text{K}^{-1}$, after firing at 1100°C. In general, λ and σ decrease with increasing NZ2 content. These results highlight the non-fluxing role of this clay, which contains a very high silica content (mass ratio $\text{SiO}_2/\text{Al}_2\text{O}_3 = 5.94$). This suggests that a mixture of 90 mass% KO and 10 mass% NZ2 is of interest, to guarantee the properties required for use in terracotta products.

Keywords: clay materials, kaolinite and illite, consolidation, flux, quartz, properties of use.

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ST4. Characterization, Structure–Properties correlation

Please check the appropriate contribution:

Oral

Heterostructuring in modern ceramic materials: A good strategy for improving their energy conversion properties.

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Abstract

One of the current global challenges is to find renewable, low-carbon, and clean substitutes for fossil fuels. Hydrogen (H_2) can be seen as the ideal energy carrier for the future to change the global energy structure. As water is an abundant source, large-scale production of pure hydrogen from water electrolysis using a suitable modern ceramic catalyst seems to be a good alternative to steam reforming [1]. The building of the heterostructure material seems to be a very good strategy to prepare an excellent catalyst material. Indeed, at the interface of two components, a spontaneous electron transfer activated by the heterostructure can modify the electronic state of the surface and improve the catalytic performance. In addition, the lattice strain and electron injection at the interface can tune the catalytic activity. It has also been reported that the heterostructure can significantly increase the number of active sites for catalytic activity [2]. In this work we are developing two heterostructures based modern ceramic materials including 2D titanium carbo-oxide and molybdenum disulfide in one hand and in other hand 2D vanadium carbide and cobalt based metal organic framework. The full characterizations using XRD, Raman, SEM, HRTEM and XPS confirm the effective formation of the heterostructures. Their applications in energy conversion, namely, Hydrogen Evolution Reactions, demonstrate the superiority of the heterostructuring, highlighting therefore the powerful of this strategy to boost the properties of a given materials.

Keywords: Heterostructuring, 2D materials, MXenes, Energy conversion, Hydrogen Evolution Reaction.

References:

- [1] Singla M. K., Nijhawan P., Oberoi A. S. (2021), Hydrogen fuel and fuel cell technology for cleaner future: a review. *Environ. Sci. Pollut. Res. Int.* (28) 15607– 15626
- [2] Zheng D., Yu L., Liu W., Dai X., Niu X., Fu W., Shi W., Wu F., Cao X. (2021), Structural advantages and enhancement strategies of heterostructure water-splitting electrocatalysts. *Cell Rep. Phys. Sci.* (2), 100443

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Please check the appropriate contribution:

Oral

or

Poster

Compressive Strengths and Microstructural Properties of Geopolymeric Materials Arising from the Addition of Semi-Crystalline Alumina to Silica-rich Aluminosilicate Sources

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Abstract

This work aims to investigate the behaviour of the semi-crystalline alumina added to the aluminosilicates rich in amorphous and crystalline silica during the geopolymerization. Waste fired brick and metakaolin used in this work are rich in amorphous silica and quartz, respectively. Bauxite calcined at 600 °C was used as a semi-crystalline alumina source. The calcined product was added to each aluminosilicate with mass ratios calcined bauxite/metakaolin or calcined bauxite/waste fired brick equals 0, 0.1, 0.2, 0.3 and 0.4. Geopolymer pastes were obtained by adding sodium waterglass to each composition. The hardened pastes were cured at room temperature for 28 days before characterization. The compressive strengths of the geopolymer materials when the mass ratios of calcined bauxite/metakaolin are ranging from 0 to 0.3 increase from 36.33 to 55.09 MPa and drop from 55.09 to 43.19 MPa when that mass ratios increase from 0.3 to 0.4. Whereas those from waste fired brick decrease from 47.81 to 19.91 MPa with increasing the mass ratios. The spectra of the energy dispersive X-ray analysis of geopolymer materials from metakaolin and the one from waste fired brick without addition indicate the formation of Si-rich geopolymer networks. Whereas the one from waste fired brick after the addition of semi-crystalline alumina are mainly composed of Al-rich geopolymer structures. It can be concluded that the semi-crystalline alumina added to the metakaolin spread in the network of the final products while this alumina does not react with amorphous silica contained in the structure of waste fired brick during the geopolymerization.

Keywords: Amorphous silica. Quartz. Semi-crystalline alumina. Metakaolin. Waste fired brick. Geopolymer materials

REFERENCES

- [1] Hamed I. Riyap¹ · Charles Banenzoué³ · Hervé Kouamo Tchakouté^{1,2} · Charles N. P. Nanseu¹ · Claus H. Rüscher². Etude comparative des propriétés mécaniques et microstructurales des matériaux géopolymères en utilisant les metakaolins et les rebus de briques comme sources d'aluminosilicates. Journal of the Korean Ceramic Society 58 (2020) 236- 247.

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Microstructure and mechanical properties of laterite-based geopolymers and OPC concretes: Influence of the type of aggregates

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Abstract

The present study focuses on the production of geopolymers concretes using calcined laterite and an activator solution at 750°C, with various coarse aggregates such as basalt, granite, and volcanic scoria. The physical and mechanical properties of the resulting concretes were characterized and compared to those of ordinary Portland cement (OPC). The study utilized XRD, FTIR, optical microscopy, and SEM analysis to evaluate characteristics of raw materials and concretes. The 28-day flexural and compressive strengths of laterite-based geopolymers range between 13.88-14.81 MPa and 102.58-139.16 MPa, respectively, which are comparable to OPC concretes. The laterite-based geopolymers were denser and exhibited higher water absorption and porosity values. SEM analysis revealed that the concretes made with volcanic scoria aggregates exhibited a more compact and dense microstructure due to additional geopolymerisation reactions and the formation of an aluminosilicate gel. Overall, laterite-based geopolymers show promising properties for engineering applications.

Keywords: Laterite, aggregates, geopolymers concretes, mechanical properties, microstructures.

References:

Kaze, Rodrigue Cyriaque, Jean Noel Yankwa Djobo, Achile Nana, Herve Kouamo, Elie Kamseu, Uphie Chinje Melo, Cristina Leonelli, and Hubert Rahier. 2018. “Effect of Silicate Modulus on the Setting, Mechanical Strength and Microstructure of Iron-Rich Aluminosilicate (Laterite) Based-Geopolymer Cured at Room Temperature.” *Ceramics International* 44 (17): 21442–50. <https://doi.org/10.1016/j.ceramint.2018.08.205>.

Sontia, M. J. V., C. R. Kaze, A. Adesina, N. G. J. Deutou, Y. N. J. Djobo, N. P. Lemougna, T. Alomaryri, E. Kamseu, M. U. Chinje, and T. T. Tamo. 2022. “Influence of Thermal Activation and Silica Modulus on the Properties of Clayey-Lateritic Based Geopolymer Binders Cured at Room Temperature.” *Silicon*, 18p. <https://doi.org/10.1007/s12633-021-01566-7>.

Sontia, M. J. V., R. C. Kaze, G. J. Deutou, P. Venyite, A. Nana, E. Kamseu, U. Chinje, and T. T. Tamo. 2021. “Evaluation of Performances of Volcanic-Ash-Laterite Based Blended Geopolymer Concretes: Mechanical Properties and Durability.” *Journal of Building Engineering* 34 (August 2019): 12p. <https://doi.org/10.1016/j.jobe.2020.101935>.

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ÉVALUATION GEOTECHNIQUE DES GRAVELEUX LATÉRITIQUES DE BALENG (OUEST-CAMEROUN COMME COUCHE DE CHAUSSEES ROUTIERES.

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Résumé

Cette étude menée dans la localité de Baleng porte sur la caractérisation géotechnique et la valorisation des graveleux latéritiques en technique routière. Pour ce faire, une méthodologie de travail partant des travaux de terrain aux analyses de laboratoire a été mise en place. Les travaux de terrains ont consisté en la localisation, la description des profils de sols et au prélèvement des échantillons remaniés. Les échantillons prélevés ont fait l'objet d'une identification complète. Du point de vue pédologique, il s'agit de graves limono-argileuses de couleur rouge et rouge clair (5R5/8 et 7.5R6/8). Les analyses physiques montrent que les teneurs en eau sont de 15, 2 % et 10,6 % ; les indices de plasticité (Ip) de 22,4 % et 17,9 % les particules fines de 30,1 % et 11 % respectivement pour les sols sur basaltes et granitoïdes. Ces sols appartiennent aux classes des graviers et sables avec fins (B6) et aux sous-groupes A-2-7 dont les indices de groupe varient de zéro (0) à deux (2). Les valeurs de densité sèche et de teneur en eau à l'optimum Proctor sont respectivement de 1,98 - 2,03 T/m³ et de 16,2 – 14,2 %. Un indice CBR supérieur à 30 (34 et 43) montre que ces sols, de classe de portance S5, peuvent être employés comme couche de fondation. Le module de Young des différents sols est 1118,01 et 1904,76 MPa respectivement pour les sols développés sur basalte et ceux développés sur granitoïde. Au regard des différents résultats obtenus, ces sols peuvent être employés à l'état naturel dans la construction des routes en terre, en plus d'être utilisable comme couches de formes et fondations des chaussées revêtues.

Mots clés : Baleng, latérites, basalte, granitoïde, propriétés géotechniques, chaussées.

References:

- CEBTP (1984) Guide pratique de dimensionnement des chaussées des pays tropicaux, Ministère de la coopération de la république française, 155 p.
- NF P94-078 (1997) Indice CBR après Immersion-Indice CBR Immédiat- Indice portant Immédiat, Sols : Reconnaissance et essais, 12 p
- NF P94-093 (1999). Détermination des références de compactage d'un matériau, Essai Proctor normal-Essai Proctor modifié, Sols : Reconnaissance et essais, 20p
- Onana VL, Ngo'o Ze A, Medjo Eko R, Ntouala RFD, Nanga Bineli MT, Ngono Owoudou B, Ekodeck GE (2017) Geological identification, geotechnical and mechanical characterization of charnockite-derived lateritic gravels from Southern Cameroon for road construction purposes, Transportation Geotechnics. 10, 3, PP 5-46

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Please check the appropriate contribution:

Oral

or

Poster

Complexes d'intercalation de quelques kaolinites désordonnées et d'urée

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Résumé

Le développement des matériaux composites renouvelables à faible impact environnemental exige l'utilisation de composants biocompatibles ou biodégradables. Dans le cas des nanocomposites polymère-argile, les grandes surfaces spécifiques associées à la forme lamellaire des argiles leurs confèrent une place prépondérante parmi les charges explorées. C'est le cas des smectites dont la capacité d'exfoliation assure leur bonne dispersion dans la matrice polymérique[1]. Bien que très répandues, les kaolinites restent très peu utilisées à cause de leur forte cohésion interne. L'exfoliation/délamination par intercalation est une voie très prometteuse pour l'expansion de leurs feuillets[2]. Les travaux sur les kaolinites ont démontré que les plus cristallines étaient les moins cohésives[3] et que leur intercalation avec le diméthylsulfoxyde (DMSO) sera favorisé par une bonne cristallinité[2]. Ainsi dans l'optique de contribuer à l'identification des causes cristallochimiques pouvant justifier les différences d'intercalation de l'urée dans des kaolinites désordonnées, cette étude se focalise dans son intercalation au sein de la kaolinite. Pour cette étude, quatre (04) échantillons de kaolinites sont l'objet d'intercalation par l'urée. L'influence de la cristallinité est analysée en utilisant l'indice d'Hinckley, le facteur P0, le facteur R2 et le *slope ratio*. L'Infra-Rouge à Transformée de Fourier est utilisé pour la mise en évidence de l'intercalation. Les taux d'intercalation démontrent une disparité de degré d'intercalation linéaire avec la cristallinité.

Mots-clés : kaolinite, Cristallinité, intercalation, Composites, molécules polaires.

Références

- [1] P. C. LeBaron, Z. Wang, et T. J. Pinnavaia, « Polymer-layered silicate nanocomposites: an overview », *Applied Clay Science*, vol. 15, p. 11-29, 1999, doi: [https://doi.org/10.1016/S0169-1317\(99\)00017-4](https://doi.org/10.1016/S0169-1317(99)00017-4).
- [2] J. A. Mbey, J. M. Siéwé, C. J. N. Sabouang, A. Razafitianamaharavo, S. Kong, et F. Thomas, « DMSO Intercalation in Selected Kaolinites: Influence of the Crystallinity », *chemengineering*, vol. 4, p. 66, 2020, doi: [10.3390/chemengineering4040066](https://doi.org/10.3390/chemengineering4040066).
- [3] H. W. Van Der Marel et P. Krohmer, « O-H Stretching Vibrations in Kaolinite, and Related Minerals », *contribution to mineralogy and petrology*, vol. 22, p. 73-82, 1969, doi: <https://doi.org/10.1007/BF00388013>.

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Veuillez vérifier la contribution appropriée : Oral

TITRE : Caractérisation des phosphates du gisement de Kodjari au Burkina Faso pour une utilisation en agriculture

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Résumé

Des échantillons de phosphorites provenant de différentes occurrences de gisements de Kodjari, Burkina Faso, ont été étudiés. Ce sont des phosphorites à grains fins avec de petites quantités d'argile. Les analyses chimiques par XRF indiquent une teneur en CaO de 35,98 à 41,33 % en masse et une teneur en masse de P₂O₅ de 26,85 à 30,75 %. Les diagrammes XRD et leur raffinement de Rietveld par le logiciel MAUD, montrent que les phases principales sont le Carbonate-Fluorapatite (Francolite), l'Hydroxyapatite et l'alpha-Quartz. Ces techniques indiquent que les minéraux identifiés coexistent avec des phases mineures que sont la Wavellite et la Maricite. De petites quantités de phyllosilicates, la smectite et l'illite, sont également détectées. Les analyses FTIR valident davantage l'identification des phases minérales. Ils montrent des bandes typiques des groupes phosphates dans les structures. Des bandes des groupes carbonates sont également détectées et une bande est corrélée avec la présence de F structurel dans la Francolite. Les intensités relatives de certaines bandes des liaisons P-O sont liées à l'indice de cristallinité des principaux minéraux phosphatés. Les valeurs de l'indice de cristallinité sont légèrement supérieures aux valeurs moyennes, ce qui est corrélé à la substitution partielle des groupes carbonate dans les sites cristallographiques de phosphates et à la présence d'ions fluor structuraux. L'importance économique des gisements de Kodjari pour la fertilisation des sols en agriculture est reconnue, et ils ont fait l'objet de travaux successifs de cartographie et de prospection. Cependant, l'indice de cristallinité moyen est un inconvénient car il réduit la cinétique d'assimilation du phosphore dans les sols agricoles, nécessitant des recherches complémentaires.

Mots-clés : phosphate, phosphorite, Rietveld, cristallinité, Kodjari, agriculture, Burkina Faso

Références :

- Satoshi N., Simpore S., Barro A., Dambinga J., Monrawee F., Takashi K., Fujio N., 2020. Kodjari Phosphate Rock pour la production de riz pluvial de plaine dans la savane soudanaise, Burkina Faso. *Trop. Agr. Développer.* 64(2):97 – 106.
 Lutterotti, L. (2010). Ajustement total du motif pour la détermination combinée taille-déformation-contrainte-texture en diffraction de couche mince, *Nucl. Instrum. B*, 268, 334-340.
 Hellenbrandt, M. (2004). The Inorganic Crystal Structure Database (ICSD) – Present and Future, *Crystallogr.* 10, 17-22.
 Shemesh A., 1990. Cristallinité et diagenèse des apatites sédimentaires. Département des isotopes, Institut Weizmann des sciences, Rehovot 76100, Israël.

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ST5. Low carbon materials, Environmentally Friendly Materials and Sustainability

Quantification de l'acide oléanolique dans *Launaea taraxacifolia* et activité larvicide contre les vecteurs du paludisme

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Résumé

La gestion des gites larvaires est l'une des mesures utilisées pour prévenir le paludisme. Pour une lutte préventive et écologiquement rentable, le recours aux bio-larvicides élaborés à base d'extraits actifs de végétaux serait un atout pour le contrôle des vecteurs du paludisme notamment *Anopheles gambiae*. Le progrès de la pharmacognosie a révélé les avantages de plusieurs composés phytochimiques à effets thérapeutiques très riches et variés. Parmi ces derniers, l'acide oléanolique (AO) est assez remarquable du fait de ses diverses et multiples propriétés dont la plus part sont mises en évidence avec les feuilles de *Launaea taraxacifolia*. Après un fractionnement liquide-liquide avec différents solvants organiques de l'extrait hydro-méthanol de *Launaea taraxacifolia*, nous avons obtenu trois fractions nommées Fhex (fraction hexane), FDCM (fraction dichlorométhane) et FHM (fraction hydro-méthanol) qui ont été testées sur des larves d'*Anopheles gambiae* de troisième stade. La Fhex s'est révélée la plus active avec des LC₅₀ de 120,11 ppm et 69,50 ppm respectivement en 24h et 48h de contact. Ensuite, nous avons développé une méthode de Chromatographie Liquide à Haute Performance Ultra-Violet (CLHP / UV) pour apprécier la quantité de l'acide oléanolique présente dans les fractions Fhex et FDCM qui ont donné respectivement 0,46% et 0,23%.

Mots clés: Paludisme, *Launaea taraxacifolia*, Acide oléanolique, Activité larvicide.

Please check the appropriate contribution: Oral

PHYSICAL PROPERTIES AND MICROSTRUCTURES OF POLY(PHOSPHO-SILOXO) AND POLY(SIALATE-SILOXO) NETWORKS FROM TWO METAKAOLINS)

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Abstract

The aim of this investigation is to compare the properties of poly(phospho-siloxo) and poly(sialate-siloxo) networks. Commercial sodium waterglass and sodium waterglass from rice husk ash were used as alkaline reagents and phosphoric acid with molarities 8 and 10 M was used as acid reagents. Local metakaolin and commercial ones containing 0.99 and 0.0% of Fe_2O_3 , respectively, were used as aluminosilicate sources. The physical properties of the prepared poly(phospho-siloxo) and poly(sialate-siloxo) networks were monitored by measuring the apparent and absolute density. The microstructures were assessed by scanning electron microscopy and mercury intrusion porosimetry. The engineering property was checked by the determination of their compressive strengths. The results indicated that the apparent densities of poly(phospho-siloxo) and poly(sialate-siloxo) networks are in the ranges 1.918-2.177 and 1.814-1.959 g/cm³, respectively, while their absolute densities are not significantly different. Their compressive strengths are ranging from 14.21 to 30.03 and 50.22 to 75.77 MPa, respectively. The average pore diameters of the specimens from acid reagents are between 30.0 and 83.9 nm whereas those from alkaline reagents are between 8.3 and 14.8 nm. The log differential intrusion versus pore size diameters showed that the obtained products using acid and alkaline solutions are ranging from 6,000 to 110,000 nm and 5.59 to 13.84 nm, respectively. This indicates that poly(phospho-siloxo) and poly(sialate-siloxo) network are macroporous and mesoporous materials, respectively. It was found that the chemical and mineralogical compositions and the degree of the purity of the aluminosilicate source could significantly affect the physical properties and microstructures of poly(phospho-siloxo) network.

Keywords : Metakaolins, Sodium waterglass, Phosphoric acid, Poly(sialate-siloxo), Poly(phospho-siloxo).

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Low-carbon materials, the case of compressed earth blocks stabilized with optimized lime-calcined clay cement (OLC2)

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Abstract

The 2022 global status report for buildings and construction pointed that, In 2021, materials used in the construction accounted for about 9% of overall energy-related CO₂ emission. Hence, the need to decarbonize the sector. In the present study, an optimized lime-calcined clay (OLC2) cement was elaborated, characterized and applied in the stabilization of compressed earth blocks for building. Raw materials for the cement were kaolin rich clay, hydrated lime and sodium hydroxide. The percentage of lime in the binder varied between 20% and 30%. Compressive strength in standard mortar at 28 days attained almost 20 MPa. The optimized cement with 75% calcined clay and 25% hydrated lime contributed to reduce for about 58% CO₂ emission due to raw materials firing and for about 40% the firing temperature of raw materials compared to ordinary Portland cement. When the OLC2 was used as stabilizer for compressed lateritic soil, in which water–solid (laterite and binder) and laterite–binder ratios varied, respectively, from 0.12 to 0.20 and 4 to 9. Sodium hydroxide (NaOH) was added as a chemical activator in the mixture. The NaOH–binder ratio varies from 0.02 to 0.04. The average effect of each component of the mixture on compressive strength, water absorption and apparent density of compressed laterite after 7 or 28 days of conservation at 40 ± 1 °C in an atmosphere saturated with water vapour was evaluated. Results showed compressive strengths of blocks at 28 days more than the double of 4MPa recommended by the Cameroonian standard NC 102-114: 2002-06. The increase of water–solid (laterite and binder) ratio showed a maximum compressive strength at water–solid ratio of 0.16. At this ratio, minimum water absorption and maximum apparent density were obtained. The effective proportion of sodium hydroxide was less than 3%. using kaolin rich clay, hydrated lime and sodium hydroxide as raw materials for cement formulation. Lateritic soil was used for compressed blocks manufacturing.. Performant compressed earth block with 9MPa compressive strength were obtained with 8-10% OLC2 as stabilizer, higher than 4MPa recommended by the Cameroonian standard

The percentage of lime in the binder varied between 20% and 30%. The binder was used as a stabilizer in compressed lateritic soil in which water–solid (laterite and binder) and laterite–binder ratios vary, respectively, from 0.12 to 0.20 and 4 to 9. Sodium hydroxide (NaOH) was added as a chemical activator in the mixture. The NaOH–binder ratio varies from 0.02 to 0.04. The average effect of each component of the mixture on compressive strength, water absorption and apparent density of compressed laterite after 7 or 28 days of conservation at 40 ± 1 °C in an atmosphere saturated with water vapour was evaluated. Results showed compressive strengths of blocks at 28 days more than the double of 4MPa recommended by the Cameroonian standard NC 102-114: 2002-06.

Please check the appropriate contribution: Oral or Poster

Effect of the addition of iron oxide on the formation and microstructure of ye'elimité

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Abstract

Among the new less carbon-intensive and environmentally friendly binders are Calcium Sulfoaluminate Cements (CSA). The ye'elimité represents the main and characteristic phase of CSA clinker.

This work details the protocol for the solid-state synthesis of ye'elimité containing increasing quantities of iron ($\text{Ca}_4\text{Al}_{(6-2x)}\text{Fe}_{2x}\text{SO}_{16}$) and their impact on the microstructure. The presence of iron favors the formation of ye'elimité and stabilizes its cubic polymorph at the expense of the orthorhombic. The incorporation of iron in ye'elimité structure is complete when $x < 0.12$. Beyond this composition, the ferritic phase appears as a minor phase. At the level of the microstructure, a clear distinction between the grains of calcium aluminates and the grains of ye'elimité was observed. The presence of iron favors the formation of an iron-rich liquid phase, which leads to the growth of ye'elimité grains by material diffusion mechanisms and increases the conversion rate of alumina and calcium aluminates in ye'elimité phase.

Keywords: Calcium sulfoaluminate cements, Ye'elimité, Iron, Polymorph, Microstructure

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1. Please check the appropriate contribution: **Oral****Investigation of the calcined halloysite content on reactivity and rheological behaviour of Limestone Calcined Clay Cement (LC³)**

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Abstract

LC³ represents one of the most promising solutions for high-performance blended cement with a much-reduced clinker concentration and the potential for global adoption. Therefore, understanding its fresh properties of these low carbon materials is important to guarantee requested performances throughout its use. This study examines the impact of calcined halloysite clay content on reactivity, setting time and rheological behavior of limestone calcined clay cements (LC3-30 and LC3-50) containing 30 and 50% CEM I, using CEM I as reference binder. The halloysite clay is from Balengou in Cameroon and the limestone arises from Figuil. This halloysite was previously calcined at 700°C. The raw materials (CEM I, calcined halloysite and limestone) and hardened products were characterized using FX, XRD, TG/DTA and FTIR. While the setting time, rheology and kinetic reaction were assessed using ICC, Vicat apparatus and rheometer. The compressive and flexural strength were recorded on samples cured at 28 days. The synthesized samples developed the interesting properties that could find application in engineering buildings.

Keywords: CEM I, Calcined halloysite, Limestone, Kinetic reaction, Rheology, setting time, Mechanical properties,

Please check the appropriate contribution:**X Oral****or****Poster**

Formulation of a geopolymmer grout from Callovo-Oxfordian argillite for radioactive waste disposal

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Abstract

This study is a part of the project of high and intermediate level radioactive waste disposal (Cigéo project for Centre Industriel de stockage GEOlogique). The construction of the disposal facility will be conducted underground in the Callovo-Oxfordian argillite layer. This will lead to the excavation of millions of tons of argillites. To use and to recycle these large quantities of excavated argillites is one of the challenges of the Cigéo project. Among the materials developed from aluminosilicate sources, geopolymers can be a way to use the excavated argillites. One of the possible uses within the Cigéo project could be the formulation of a grout to be injected at the interface between the high-level radioactive waste vaults and the host rock. Geopolymers materials results from the activation of an aluminosilicate source, at ambient temperature, using an alkaline silicate solution. The requirements for the expected geopolymers grout are to display a viscosity ≤ 5 Pa.s, a working time of between 6 and 24 hours and a pH value ≥ 12 after setting. The aim of this work is to develop an injectable geopolymers grout and study its evolution with time, at 20°C and 80°C.

Different aluminosilicate sources were used, such as an industrial metakaolin and Callovo-Oxfordian argillite calcined at 650°C. Two potassium silicate solutions were used. Six formulations satisfying the above criteria were selected and characterized by structural and chemical analyses such as X-ray diffraction, Fourier transform infrared spectroscopy and thermogravimetric analysis.

The results show that, after setting, there is no evolution after few days at room temperature, while a curing period at higher temperature induced structural changes. At 80°C, there would be a different dissolution/reactivity of the aluminosilicate species, leading to a different structural network compared to room temperature preparation and curing. These more reactive species lead to the formation of a geopolymers network characterized by a different amorphous phase compared to the same materials stored at 20°C.

Keywords: Geopolymer, Radioactive waste, storage, grout, argillite.

Please check the appropriate contribution: Oral

SYNTHESIS, CHARACTERISATION, AND AGRICULTURAL APPLICATION OF GLAUCONITE-AMMONIUM DIHYDROGEN PHOSPHATE NANOCOMPOSITES: ADVANCING ENVIRONMENTALLY FRIENDLY FERTILISERS

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Abstract

In this research, the synthesis of glauconite with ammonium dihydrogen phosphate (ADP) nanocomposites, in a ratio of 9:1, is investigated via chemical and mechanochemical means. Analytical methodologies employed in this study encompass X-ray diffraction analysis, scanning electron microscopy combined with energy-dispersive X-ray spectroscopy, high-resolution transmission electron microscopy, Fourier transform infrared spectroscopy, and differential thermal analysis, augmented with a quadrupole mass spectrometer. The resultant nanocomposites retain the layered structure characteristic of glauconite. Specific glauconite unit structures have experienced a thickening attributed to the modest intercalation of nitrogen (in the form of ammonium) into the interlayer spaces. A differentiation is observed in the nanocomposites procured through chemical techniques, displaying preserved spheroidal, granular, or pelletised mineral constituents. These globular and micro-aggregate particles are enveloped in a thin film of adsorbed ADP within the nanocomposites. The mechanochemical method facilitates a marginal elevation in the percentage of adsorbed (up to 3.2%) and intercalated (up to 6.0%) nutrients compared to the chemical approaches. The chemical preparation of nanocomposites results in a composition of glauconite (90%), adsorbed (1.8–3.6%), and intercalated (3.0–3.7%) ADP constituents. Utilising a potassium-infused clay mineral as an inhibitory agent, controlled-release nitrogen, phosphorus, and potassium (NPK) nanocomposite fertilisers were successfully fabricated. Anticipated targeted and regulated nutrient dispersal, such as phosphate, ammonium, and potassium, is facilitated by diverse nutrient forms located on the surface, within micropores, and in the interlayer space of glauconite. This assertion is corroborated by the observed incremental dynamics of ammonium, nitrate, potassium, and phosphate release from the formulated nanocomposites. The distinct properties of these nanocomposites hold promise for enhancing plant growth and maturation when utilised as soil fertilisers.

The authors gratefully acknowledge the financial support provided by Russian Science Foundation through the research project № 22-77-10002.

Keywords: Glauconite; Ammonium dihydrogen phosphate; Controlled-release fertiliser; Eco-friendly nanocomposites; Activation; Agriculture

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Please check the appropriate contribution: Oral or Poster

TITLE: Plant fiber-inorganic binder based composite board and their correlation with building insulation properties: state-of-the art and perspectives

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Abstract :

Inorganic binders play an important role in determining the performance of plant-fiber composites. This study reviews the literature on inorganic binder-plant fiber composites board with emphasis on their thermal and mechanical properties for buildings. Inorganic binder-based composites reinforced with plant fibers for insulation are classified as part of the bio-based materials family. Factors such as raw materials, supplementary materials, material structure and processing can modify their insulating properties, with consequent effects on building comfort. Various macro-properties of the material - density, porosity, thermal resistance, thermal conductivity, permeability, thickness, etc. - are closely linked to its insulating properties [1-4]. General rules for optimizing the performance of composites based on inorganic binders reinforced with natural fibers will be defined in this study, facilitating the rational design and application of these materials. Trends in future research are also discussed.

Keywords: composites, inorganic binders, plant fibers, insulation, environmental impact and buildings

References:

1. Marie Viel. Développement de composites bio-sourcés destinés à l'isolation des bâtiments. Matériaux. Université Rennes 1, 2018. Français. ffNNT : 2018REN1S122ff. fftel-02377632ff
2. E. Mansour, C. Loxton, R.M. Elias, G.A. Ormondroyd. Évaluation des incidences sur la santé liée à la transformation et à l'utilisation de produits d'isolation en laine naturelle Environ. Int., 73 (2014), pp. 402 412, 10.1016/j.envint.2014.08.004
3. Al-Homoud, Dr MS. Performance characteristics and practical applications of common building thermal insulation materials. Building and Environment. 1 mars 2005; 40 (3):353-366.
4. Valentin Colson. Panneaux composites bio-sourcés destinés à l'isolation des bâtiments : caractérisation des ressources et procédé de production. Matériaux composites et construction. Université Rennes 1, 2019. Français. ffNNT : 2019REN1S031ff. fftel-03738039.

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ST6. Waste valorisation and recycling

Effet du remplacement partiel des scories volcaniques par les résidus de poudre de fer sur les propriétés des polymères inorganiques phosphatés.

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Résumé :

Cette étude se focalise sur l'effet du remplacement partiel des scories volcaniques par les déchets de poudres de fer lors de la synthèse des polymères inorganiques phosphatés (PIPs) à base de scories volcaniques. Pour le faire, 0, 5, 10, 15 et 20 % des résidus d'un composite riche en fer ont substitué celles de deux échantillons de scories volcaniques dénommés MaJ et Mbo. Par la suite, l'ensemble des poudres a été mélangé par le biais d'une solution H_3PO_4 (6M) selon un rapport massique Liquide / Solide égal à 0,45. Les matières premières ont été caractérisées par XRF, BET, XRD and IRTF. En plus de ces techniques de caractérisations, les produits de synthèse obtenus ont également été caractérisés par Microscopie Optique. Les propriétés des spécimens âgés de 28 jours ont été évaluées par détermination de la résistance à la compression, la masse volumique, le pourcentage d'absorption d'eau et la porosité. Les résultats obtenus montrent que l'augmentation des déchets de poudre de fer entraîne la diminution de la résistance à compression et de la masse volumique et parallèlement, une augmentation de la porosité et du taux d'absorption d'eau. Associé aux analyses BET, l'observation des micrographes optiques montre que pour un remplacement partiel de 10% de la poudre de scories (Mbo) par les déchets de poudre de fer entraîne une augmentation de la surface spécifique des produits de synthèse et une présence accrue des vides au sein des spécimens à base de Mbo. Par contre, pour la même teneur, l'on observe une occupation des pores au sein des spécimens à base de MaJ. L'ensemble de ces résultats montre que les déchets de poudres de fer entraînent une expansion des volumes de pores dans nos matériaux et les fragilisent. Par conséquent, peuvent être utilisées comme agent porogène lors de la synthèse des PIPs poreux pour le traitement des effluents.

Mots clés : Résidus de poudre de fer, Polymères inorganiques phosphatés, Scories volcaniques, Agent porogène, Effluents.

Please check the appropriate contribution:

Oral

or

Poster

Caractérisation de cendre de biomasse agricole : perspective de valorisation des ressources locales dans les matériaux de construction

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Résumé

La production du ciment ne cesse de croître. Cela entraîne jusqu'environ 23 % des émissions totales de CO₂ dans l'industrie de la construction [1]. Afin de diminuer ces émissions, l'accent est mis sur l'utilisation des sous-produits industriels tels les cendres volantes, le laitier, la fumée de silice en tant que matériaux pour le remplacement partiel du ciment [2]. Certaines biomasses agricoles riches en silice sont pratiquement non valorisées avec une grande quantité incinérée à l'air libre. Cela constitue un défi environnemental majeur [2] [3]. Ce travail est focalisé sur la caractérisation de cendre de balle de riz comme matériau cimentaire supplémentaire. Pour ce faire, la cendre a été préparée à l'aide d'un pyrolyseur traditionnel. Les analyses physiques et chimiques montrent que la cendre obtenue contient plus de 90 % de silice sous forme amorphe. L'analyse structurale a révélé la présence des bandes 1054 et 797 cm⁻¹ caractéristiques des liaisons Si-O de la silice. Les cendres riches en silice amorphe sont très prometteuses pour d'éventuelle application dans les matériaux de construction, car il réagit avec les produits chimiques du ciment et augmente la résistance du béton [4]. Ces résultats montrent que la cendre obtenue peut, non seulement être utilisée comme matériaux pouzzolaniques naturels, mais aussi comme substitut potentiel au ciment.

Mots clés : cendre ; valorisation ; matériaux de construction.

Reference

- [1] H. Huang, X. Gao, H. Wang, et H. Ye, « Influence of rice husk ash on strength and permeability of ultra-high performance concrete », Constr. Build. Mater., vol. 149, p. 621-628, sept. 2017, doi: 10.1016/j.conbuildmat.2017.05.155 .
- [2] V. Charitha, V. S. Athira, V. Jittin, A. Bahurudeen, et P. Nanthagopalan, « Use of different agro-waste ashes in concrete for effective upcycling of locally available resources », Constr. Build. Mater., vol. 285, p. 122851, mai 2021, doi: 10.1016/j.conbuildmat.2021.122851.
- [3] GIZ, « Partnership Ready Côte d'Ivoire : Gestion et recyclage des déchets organiques ». 2020. [En ligne]. Disponible sur : https://www.giz.de/en/downloads/GBN_Sector%20Brief_CIV_Bioabfall_FR_Web.pdf
- [4] R. A. Bakar, R. Yahya, et S. N. Gan, « Production of High Purity Amorphous Silica from Rice Husk », Procedia Chem., vol. 19, p. 189-195, 2016, doi: 10.1016/j.proche.2016.03.092.

Please check the appropriate contribution:

Oral

or

Poster

Utilisation des déchets d'équipements électriques et électroniques dans la confection des mortiers. Le cas des verres.

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Abstract

Chaque année des millions de tonnes de Déchets d'Equipements Electriques et Electroniques (DEEE) sont produits dans le monde. En 2019 c'est environ 53,6 millions de tonnes métriques qui sont collectés, soit 7,3 Kg / habitant. Seulement 17,35% soit 9,3 Mt de cette production étaient valorisés [1]. D'après les projections de la Réglementation Européenne, elle dépassera 74 Mt en 2030 si le rythme actuel de production reste maintenu (2 Mt/an). Dans les pays en voie de développement comme la Côte d'Ivoire, la fraction non métallique (verres et plastiques) est incinérée à l'air libre provoquant des problèmes environnementaux et sanitaires[2]. Dans la présente étude nous proposons une nouvelle alternative écologique consistant à utiliser les verres des DEEE dans les travaux du génie civil comme liant et agrégats fins. Les résultats obtenus démontrent que l'ajout de la poudre de verre dégrade légèrement les propriétés physiques comme les résistances à la flexion et à la compression du mortier, et l'ajout d'une certaine quantité de cendre de la balle de riz occasionne leur amélioration. Les temps de prise, la surface spécifique et autres propriétés physico-chimiques montrent une très bonne tendance. Ils indiquent aussi l'utilité de la granulométrie et du taux d'incorporation comme facteur très important. Lorsque la granulométrie de la poudre de verre est égale à 40 µm et le taux d'incorporation entre 10 et 30% renforcée par 10% de cendre de la balle de riz on obtient de très bonnes performances proches au mortier témoin. En conclusion nous retenons que l'utilisation des DEEE dans les travaux du génie civil est une méthode écologique et durable.

Keywords: E-Déchets, Mortier, Poudre de verre, Ecologie

References:

- [1] K. McMahon, C. Uchendu, et C. Fitzpatrick, « Quantifying used electrical and electronic equipment exported from Ireland to West Africa in roll-on roll-off vehicles », *Resources, Conservation and Recycling*, vol. 164, p. 105177, janv. 2021, doi: 10.1016/j.resconrec.2020.105177.
- [2] J.-M. Davis, G. Akese, et Y. Garb, « Beyond the pollution haven hypothesis: Where and why do e-waste hubs emerge and what does this mean for policies and interventions? », *Geoforum*, vol. 98, p. 36-45, janv. 2019, doi: 10.1016/j.geoforum.2018.09.020.

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November 28 – December 1, 2023, Yaoundé

Please check the appropriate contribution: **Oral****or** **Poster**

Analyse multicritères des composants des pavés écologiques à base de déchets plastiques et de verre, et de renforts granulaires

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Résumé

La transformation des déchets plastiques en une ressource dans les applications de la construction constitue une opportunité pour la protection de l'environnement, la préservation des ressources naturelles et la réduction des phénomènes de pollution. On peut citer les pavés de revêtement routier, mais malheureusement ils ne résistent pas toujours aux contraintes appliquées, d'où des affaissements et des effondrements. De l'analyse des causes par la courbe de Pareto, il ressort que 74,47% des causes de cet effondrement sont du fait d'une mauvaise formulation des mélanges et un mauvais choix des matières premières du composite. Un choix optimal donc des constituants et un mélange adéquat du composite sont à implémenter. L'application du logiciel SUPERDECISION a permis de ressortir deux matériaux composants favorables que sont le verre et les gravillons dans la production de composite pour des pavés. En rajoutant des déchets plastiques de type PEBD, collectés, nettoyés et broyés sous forme de granulats, nous obtenons une résistance à la compression de 7 MPa avec gravillons et 8 MPa avec le déchet de verre qui restent en dessous des recommandations de la norme NF EN 1339 ($R_c \geq 20 \text{ MPa}$) pour les trafics de type T5. La meilleure composition de fabrication du pavé écologique est donc (PET/PP/PEBD) + sable + verre (50/12,5/37,5). L'analyse de ces résultats montre que l'influence des matières premières et l'utilisation des pavés écologiques doivent donc être adaptées aux sollicitations qu'elles sont capables de supporter.

Keywords: Analyse multicritères, Propriétés, Pavés écologiques, Valorisation, Environnement.

References:

- 1) Hemwadee Thongchua "Preliminary Investigation of Crushed Rock-Based Geopolymer for Road Applications Preliminary Investigation of Crushed Rock-Based Geopolymer for Road Applications" Key Engineering Materials" Vol. 841, pp 161-165 doi:10.4028/www.scientific.net/KEM.841.161,2020;
- 2) N. Dorbane, B. Guendouzi et A. Mezig, «Recovery of plastic waste, an opportunity for sustainable local development. Empirical reference to the wilaya of Tizi-Ouzou,» *Journal of North African Economies*, pp. 33-50, 2021;
- 3) D. Saifoullah, A. L. Pahimi, A. Gové et J. D. Housseini, « valorisation des déchets plastiques dans la production des matériaux de construction : cas des pavés dans la ville de Garoua (Nord- Cameroun) » *American Journal of Innovative Research and Applied Sciences*, pp. 215-221, 2020 ;
- 4) B. M. Abdelatif et B. Houria, « Contribution à l'élaboration d'un béton de sable, à base du sable de dune et déchets plastiques » 2022 ;
- 5) M. R. et E.-H. Hadjer, « Préparation d'une nouvelle génération de pavé à base de plastique et de sable » Blida, 2021.

Traitemen~~t~~**t**t des lixiviat**s** par les graines de *Moringa oleifera* : cas de la décharge de Koubia (Niamey-Niger)

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Résumé

L'une des conséquences de la présence des déchets est la production des lixiviat**s**, une eau usée souvent plus chargée que l'eau usée proprement dite. Dans le souci de répondre aux questions environnementales, notre étude a pour objectif de valoriser un biomatériau dans le traitement des lixiviat**s** produits au niveau de la décharge de Koubia (Niamey). Les essais de traitements des lixiviat**s** ont été effectués par coagulation avec des biomatériaux à base de graines de *Moringa oleifera*. Le traitement a été fait avec les graines de *Moringa Oleifera* utilisées sous trois formes : poudre, poudre calcinée et mélange poudre et poudre calcinée. Les paramètres pH, Conductivité, turbidité, matière organique et éléments traces métalliques ont été analysés avant et après l'opération de traitement. Nous avons obtenu un taux d'abattement de 98% pour la matière organique et de 99% pour la turbidité et la plupart des éléments traces métalliques. Le pH et les conductivités électriques n'ont subi que de légères variations au cours des différents traitements. Nos résultats sont encourageants et devraient être utilisés pour le traitement à grande échelle des lixiviat**s** produits au niveau de toutes les décharges de la ville de Niamey.

Mots clés: décharge de Koubia, lixiviat**s**, coagulation, graines de Moringa.

Please check the appropriate contribution:

Oral or Poster

Characterization of cementitious composite materials based on calcined clay activated by silicate from rice husk ash and Ingessil silicate- activator: Sodium hydroxide (NaOH)

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Abstract

The ever-increasing cost of cement and its production of harmful carbon dioxide (CO₂) has led development actors to continuously search for less environmentally polluting and low-cost binders. Hence the interest in the valorisation of agricultural resources through the production of different binders such as silicate for the elaboration of geopolymers at low manufacturing temperatures (<750°C). In this study, Ingessil industrial silicate and rice husk ash silicate were used as pozzolan raw materials to prepare geopolymers with sodium hydroxide as activator at a concentration of 12 M. Two types of samples were developed: geopolymer mortars based on Ingessil silicate and geopolymer concretes based on Ingessil industrial silicate and rice husk ash silicate. Sand and gravel were used as fine and coarse aggregates for the production of geopolymer concretes. They were represented 80% of the mass of the geopolymer concretes according to the standards of elaboration. The porosity values obtained were of the order of 30%, i.e. water absorption values of about 18%, apparent specific weight of about 5 g/cm³ and bulk density of about 1.7 g/cm³. The mechanical values of BGAC-RHA samples are higher than those of BGAC-I. The physico-chemical properties of geopolymer concretes were similar.



Illustration: Geopolymer mortars and concretes.

Keywords: Clay, rice husk ash, geopolymer binder, composite materials, physico-chemical properties.

References:

- [1] Metekong J.V.S., Kaze C.R., Deutou J.G., Venyite P., Nana A., Kamseu E., Melo U.C., Tatietse T.T., 2021, Evaluation of performances of volcanic-ash-laterite based blended geopolymer concretes: Mechanical properties and durability. *Journal of Building Engineering*, Vol. 34, 101935, <https://doi.org/10.1016/j.jobe.2020.101935>.
- [2] Rangan, B. V. 2010. Fly ash-based geopolymer concrete. *Proceedings of the International Workshop on Geopolymer Cement and Concrete*, pp. 68–106. <https://doi.org/10.1007/s10853-006-0523-8>.

Please check the appropriate contribution: **Oral****or** **Poster**

Development of calcium sulfoaluminate cement from rich-alumina bauxite and marble wastes: physico-chemical and microstructural characterization

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Abstract

This work discusses the effect of rich-alumina bauxite on the mineralogical composition of calcium sulfoaluminate (CSA) clinker cement on their performances. After preparation of different local raw materials (alumina and bauxite), they were mixed with 15 wt% of commercial gypsum and pressed at 2 MPa. The obtained pellets were thermally treated to produce clinker which is used to synthesize the CSA cement. Many analysis such as X-ray fluorescence (XRF), Fourier transform infrared spectroscopy (FTIR) DSC-TGA and X-ray diffraction (XRD) were done on raw materials and X-ray diffraction, Fourier transform infrared spectroscopy, ICC, S.E.M and physico-mechanical tests on the obtained products. ICC analysis of the powder of clinker cement showed that the reactions are strongly affected by gypsum content [1-3]. XRD results revealed that clinker and cement present a strong intensity of ye'elinite as main mineral phase [4]. Also, the hydrated cement exhibited ettringite and monosulfate as new phases formed [5]. The compressive strength of hydrated cement reached ~21 and 28 MPa after 1 and 28 days of curing, respectively. From aforementioned results, these local materials can be used to produce high strength cement materials at early ages which allows their use in engineering and building applications.

Keywords: calcium sulfoaluminate cement, rich-alumina bauxite, Mintom limestone, gypsum, physico-chemical, microstructural properties

References: no more than 6 (times New Roman, font size 10).

- [1] Winnefeld F, Lothenbach B (2010) Hydration of calcium sulphoaluminate cements—experimental findings and thermodynamic modelling. *Cem Concr Res* 40:1239–1247
- [2] Lan W, Glasser FP (1996) Hydration of calcium sulphoaluminate cements. *Adv Cem Res* 8:127–134
- [3] Zhang L, Glasser FP (2002) Hydration of calcium sulphoaluminate ce
- [4] I.A. Chen, M.C.G. Juenger, Synthesis and hydration of calcium sulfoaluminate-belite cements with varied phase compositions, *J. Mater. Sci.* 46 (2011) 2568-2577.
- [5] A. Cuesta, Hydration mechanisms of two polymorphs of synthetic ye'elinite, *Cem. Concr. Res.* 63 (2014) 127–136

Please check the appropriate contribution: Oral or Poster

Preparation of low-cost nano and microcomposites from chicken eggshell, nano-silica and rice husk ash and their utilisations as additives for producing geopolymers materials

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Abstract

This work aims to prepare the low-cost nanocomposite and microcomposite with lower molar ratio CaO/SiO₂ (0.4). Nano-silica, rice husk ash and calcined chicken eggshell have been used as silica and calcium sources. Metakaolin has been separately replaced by 0, 10 and 20 wt% of each composite in order to study their behaviour on the properties of geopolymers cements. The chemical reagent used is a sodium waterglass from rice husk ash. The specific surface area of nano-silica and rice husk ash were 54.40 and 4.08 m²/g, respectively. The cumulative specific intruded volumes of the control geopolymers, the ones containing 10 wt% of microcomposite and 10 wt% of nanocomposite are 119.71, 89.92 and 110.49 mm³/g, respectively. The compressive strength of the control specimen is around 64.02 MPa. The one using 10 wt% of microcomposite was 68.97 MPa. It drops to 42.88 MPa when metakaolin was replaced by 20 wt% of microcomposite. Whereas the one using 10 wt% of nanocomposite was 30.03 MPa and it decreases to 26.05 MPa when metakaolin was substituted by 20 wt% of the nanocomposite. It can be concluded that 10 wt% of microcomposite could be mixed to metakaolin for strength development and nanocomposite does not recommend to use as an additive for producing high strength of geopolymers cements.

Keywords: Metakaolin, Microcomposite, Nanocomposite, Sodium waterglass, Geopolymer cements.

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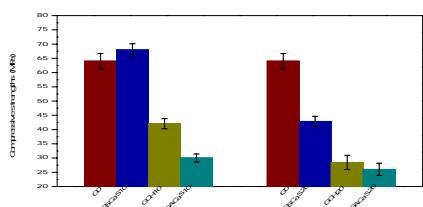


Fig. 1. Compressive strengths of metakaolin-based geopolymers cements.

Mabah DET, Tchakouté HK, Fotio D, Rüscher CH, Kamseu E, Bignozzi MC, Leonelli C. Influence of the molar ratios CaO/SiO₂ contained in the sustainable microcomposites on the mechanical and microstructural properties of (Ca, Na)-poly(sialate-siloxo) networks. Mater Chem Phys 238 (2019) 121928.

November 28 – December 1, 2023, Yaoundé

Please check the appropriate contribution: Oral or Poster

Formulation by a composite plane of a membrane from the combination of sand, plastic and porogen: application to the retention of water from septic tanks

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Abstract

Plastic waste is increasing everyday due urbanization, population growth and in turn pollutes the environment. These wastes are considered to be a big problem due to its very low biodegradability and presence in large quantities. A large amount of plastic which is being brought by human activities are discarded or burned which leads to the contamination of environment and air. Therefore, finding alternative methods of disposing waste by using kindly approaches are becoming a major research issue. In this research, polyethylene terephthalate waste is using as a binder by burning and mixed with sand and sodium carbonate to investigate the possibility to produce composite material with plastic sand filter, and study the effect of sand, polyethylene terephthalate waste and porogen with different design mix ratio on the properties of product. An experimental design plan was adopted to formulate the materials. To fabricate this material, the melt moulding/particulate leaching technique was used, in which the components are mixed in their respective proportions, moulded, melted and afterwards leached to remove the porogen. We obtained an optimum of 31.0711% porosity for the optimum mixture containing proportions of 0.5, 0.25 and 0.25 plastic sand and porogen respectively. An improved melt/moulding particulate leaching technique was used to improve the permeability and reduce pore sizes of the optimum. This technique involved using a saturated solution of porogen instead of using the porogen in particulate form. Microbial cut off efficacy of the material was evaluated, in which microbiological analyses were used to enumerate the number of microbes in a lake water sample before and after filtration through the porous material. The results of viable cell counting showed that the material eliminated 92.6% of the water microbes analysed.

Keywords: Plastic waste, polyethylene terephthalate, properties, composite material, porogen, experimental design plan

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Please check the appropriate contribution: **Oral****or** **Poster**

Development of calcium sulfoaluminate cement from rich-alumina bauxite and marble wastes: physico-chemical and microstructural characterization

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Abstract

This work discusses the effect of rich-alumina bauxite on the mineralogical composition of calcium sulfoaluminate (CSA) clinker cement on their performances. After preparation of different local raw materials (alumina and bauxite), they were mixed with 15 wt% of commercial gypsum and pressed at 2 MPa. The obtained pellets were thermally treated to produce clinker which is used to synthesize the CSA cement. Many analysis such as X-ray fluorescence (XRF), Fourier transform infrared spectroscopy (FTIR) DSC-TGA and X-ray diffraction (XRD) were done on raw materials and X-ray diffraction, Fourier transform infrared spectroscopy, ICC, S.E.M and physico-mechanical tests on the obtained products. ICC analysis of the powder of clinker cement showed that the reactions are strongly affected by gypsum content [1-3]. XRD results revealed that clinker and cement present a strong intensity of ye'elinite as main mineral phase [4]. Also, the hydrated cement exhibited ettringite and monosulfate as new phases formed [5]. The compressive strength of hydrated cement reached ~21 and 28 MPa after 1 and 28 days of curing, respectively. From aforementioned results, these local materials can be used to produce high strength cement materials at early ages which allows their use in engineering and building applications.

Keywords: calcium sulfoaluminate cement, rich-alumina bauxite, Mintom limestone, gypsum, physico-chemical, microstructural properties

References: no more than 6 (times New Roman, font size 10).

- [1] Winnefeld F, Lothenbach B (2010) Hydration of calcium sulphoaluminate cements—experimental findings and thermodynamic modelling. *Cem Concr Res* 40:1239–1247
- [2] Lan W, Glasser FP (1996) Hydration of calcium sulphoaluminate cements. *Adv Cem Res* 8:127–134
- [3] Zhang L, Glasser FP (2002) Hydration of calcium sulphoaluminate ce
- [4] I.A. Chen, M.C.G. Juenger, Synthesis and hydration of calcium sulfoaluminate-belite cements with varied phase compositions, *J. Mater. Sci.* 46 (2011) 2568-2577.
- [5] A. Cuesta, Hydration mechanisms of two polymorphs of synthetic ye'elinite, *Cem. Concr. Res.* 63 (2014) 127–136

ST7. Porous ceramics

Please check the appropriate contribution:

Oral

or

Poster

Microfiltration ceramic membranes from Cameroonian in Allophane rich soils and husked rice: physico-mechanical, chemical characterization and application to the treatment of drinking water

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Abstract

The presence of particles in drinking water and their resistance to several disposal methods is a major problem in Cameroon. The work presented in this manuscript focused on the synthesis of a ceramic membrane based on allophane rich soils for effective microfiltration in the clarification of drinking water. This work focused on the assessment of the suitability of allophane rich soils and rice hulls for the domestic treatment of drinking water. Rice hulls from the city of Yagoua have been used as a blowing agent. Several formulations have been produced with different allophane and husk rice proportions (60-40, 70-30, 80-20 and 90-10%) and at a sintering temperature of 1200 °C. The originality of this membrane lies in its monolayer structure which is at the same time the support layer and the active layer for microfiltration. The filters were characterized, the filtration tests were carried out. Chemical analysis of the raw materials revealed a high level of essential minerals. The thermal analysis made it possible to stop the heat treatment at 1200°C. Textural analysis of the membranes revealed that the formulated membranes had pore volumes between 30 and 43%. These characteristics are consistent with microfiltration. SEM carried out on the surface and in cross section of the membranes revealed that the pores are uniformly distributed over the entire surface and interconnected in depth. The membranes have been subjected to good mechanical and chemical resistance. These membranes can therefore be used effectively for microfiltration assisted by transmembrane pressure. We obtain a minimum flow rate of 17.43 mL/hour and a final turbidity of 7.65 NTU. This value is close to the quality limits of drinking water according to the standard of the French government which fixes the turbidity of tap water less than or equal to 2 NTU while UNICEF fixes this standard at 5 NTU.

Keywords: Allophane rich soil; Ceramic membrane; microfiltration; Suspended matter; Consumption of water.

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Please check the appropriate contribution:

Oral or Poster

Performances of laterite-based geopolymers matrice filters on the Bacteriological filtration of contaminated groundwater and microstructure

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Abstract

In this study Rice husk ash (RHA) obtained from rice husk an agricultural waste product is used to produce the laterite based geopolymers matrices. Five different water sources were analysed and passed through the laterite based geopolymers matrices filters (LBGMF). Bacteriological analysis was used to assess the efficiency of the LBGMF. The filters were obtained by altering laterite with different percentages of RHA as 0, 10, 20, 30, 40wt%. Samples were cured at 80 ° C for 24 and 48 h and measured at 2, 7, and 28 days for various tests while others were cured at ambient temperature and measured at 28 days. The results of XRD, FI-IR, ESEM, and MIP investigations were used to establish the effective stability of the laterite based geopolymers matrices filters for water filtration. Best results were obtained at 28 days of curing for compressive and flexural strength, water absorption, bulk density and apparent porosity. Bacteriological parameters (faecal streptococci, faecal coliforms, Escherichia coli) were measured in a contaminated groundwater samples at the inlet and outlet of the laterite based geopolymers matrices filters with two trials assessment. Results demonstrates that the LBGMF produced, contained both mesopores and macropores and with the mesopores suitable for water filtration. These pores were efficient in reducing coliform bacterial present in a highly polluted ground water.

Keywords: Laterite/RHA, Groundwater, Bacteriological analysis, Filtration, Mesopores, microstructure

[1] K.N. Palansooriya, Y. Yang, Y.Fai Tsang, B. Sarkar, D. Hou, X. Cao, E. Meers, J. Rinklebe, K. Kimj, Y.S.Ok, Occurrence of contaminants in drinking water sources and the potential of biochar for water quality improvement: a review, Taylor and Francis, 2019, <https://doi.org/10.1080/10643389.2019.1629803>.

[2] P. Rajshree, A. Dilshad, P. Balkundae, S. Kausley, C. Malhotra, Development of low cost point-of-use(POU) interventions for instant decontamination of drinking water in developing countries, J.Water Resour.Eng.(2020), <https://doi.org/10.1016/j.jwpe.2021.102280>.

[3] J.R. Njimou, D.B. Tambe, A.S. Nana, S.A. Maicaneanu, A.A. Noujep, A. Tallab, N. G. Elambo, Sequential treatment of municipal wastewater and valorization of filtering media, J. Chem. Eng. Trans. 86 (2021) 661–666,<https://doi.org/10.3303/cet2186111>.

Please check the appropriate contribution: Oral or Poster

Effect of palm kernel shells and mango seed coats in the kaolinite clay based ceramic membranes: Application for the wastewater treatment from breweries in Cameroon.

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Abstract

Environmental pollution occurs through wastewater discharges from processing industries. These waters must require better treatment before being discharged into the environment. A good treatment of these waters also meets the daily needs of man. The brewing industries contribute to the various wastewater discharges which are favorable to environment pollution. Thus, it is therefore necessary to develop effective technologies at low cost for the treatment of these waters. This work has enabled us to develop ceramic membranes based on kaolinite clay (NJB), palm kernel shells (PKS) and the mango seed coats (MSC). The formulation of (85% NJB + 15% PKS), (85% NJB + 15% MSC) and (85% NJB + 7,5 PKS + 7,5 MSC) respectively for M3, M8, M13 membranes, gave us a porosity ranging from 51 to 53 %, an important permeability and a good chemical resistance (less than 1% corrosion) in an acid medium (H_2SO_4) at 1M and in a basic NaOH medium at pH =13. The M8 membrane shows the best values of the physico-chemical parameters of wastewater such as MES (from 169 mg/L to 20 mg/L), turbidity (from 107 NTU to 10 NTU), pH (from 10,79 to 8,04), electrical conductivity (from 18182 μ s/Cm to 2,06 μ s/Cm), DCO (from 700 mgO₂/L to 14 mgO₂/L), DBO₅ (from 250 mgO₂/L to 06 mgO₂/L) and the retention of the different ions: Na (from 10,9 mg/L to 0,7 mg/L), Cl⁻ (from 10,9 μ g/L to 0,7 μ g/L), PO₄²⁻ (from 4810 mg/L to 919 mg/L), NO₃⁻ (from 10,9 mg/L to 3,5 mg/L). The wastewater treatment from breweries in Cameroon with these members contributed to the reduction of pollutants by 95%.

Keywords: Clay, Porogene agents, Membrane, Pollution, Wastewater, Treatment.

References

- Falizi, N.J., Hacıfazlıoğlu, M.C., Parlar, İ., Kabay, N., Pek, T.Ö., Yüksel, M., 2018. Evaluation of MBR treated industrial wastewater quality before and after desalination by NF and RO processes for agricultural reuse. J. Water Process Eng. 22, 103–108. doi : 10.1016/j.jwpe.2018.01.015
- Gagnaire, J., Moulin, P., Marrot, B., 2008. Bioréacteurs à membranes : un intérêt grandissant. Eau Ind. Nuis. 64–74.

Please check the appropriate contribution: Oral or Poster

Ceramic membranes based on kaolinite, bentonite clays and limestone for bacteria removal

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The membrane supports were made from kaolinitic and bentonite clay and limestone harvested respectively in the locality of Mayouom (West, Cameroon), Sabga (North-West, Cameroon) and Figuil (North, Cameroon). Nineteen formulations were made with 10% bentonite and limestone, the rate of which varies between 0-20% (natural and pre-sintered). These mixtures obtained were shaped into parallelepipedal and cylindrical specimens which were subjected to a heat treatment of 1150° C., at a heating rate of 2° C/min with two hours (2h) of soaking time. To characterize the ceramic membranes obtained, the following analyzes were performed: Color, mercury intrusion porosimetry (MIP), flexural strength, permeability, linear shrinkage, water absorption, density, mass loss, chemical stability and bacterial retention capacity. The results obtained show that after firing, the specimens have retained their initial shape but have a new color (pinkish white) which depends on the composition of the mixture. The addition of limestone in the manufacture of membranes increases the size of the pores, the porosity and therefore the permeability but to the detriment of the performance of bacterial retention. Among the various compositions studied, the membrane containing 7% natural limestone showed the best performance, with 100% of bacterial retention and a maximum water permeability of 566 L.h⁻¹.m⁻². bar⁻¹. These novel low-cost microfiltration membranes are expected to have potential applications in water treatment and domestic applications. The membrane containing 83% kaolin, 10% bentonite and 7% natural limestone is therefore the most optimal membrane.

Keywords: microfiltration; ceramic membranes; natural resources; Escherichia coli; Staphylococcus aureus

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Rhéologie des pâtes pour impression 3D de biocomposites à matrice plâtre renforcés de fibres courtes état de l'art et perspectives

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Résumé

La rhéométrie a pour but d'appliquer une contrainte connue et de mesurer la (vitesse de) déformation résultante, ou inversement d'appliquer une (vitesse de) déformation et de mesurer la contrainte résultante. L'étude de l'écoulement des pâtes de plâtre armés de fibres met en évidence l'existence de différents régimes d'écoulements et les travaux de A.D.O.BETENE[1] ont non seulement montré l'existence de nouveaux régimes mais aussi leurs dépendances à la nature des fibres , de leur fraction volumique , rapport d'aspect mais aussi de la composition de leur microstructure. Les céramiques imprimées en 3D par projection de liant, sont limitées à une utilisation d'isolation. Cette isolation est le plus souvent phonique du fait de leur porosité prononcée , l'incompatibilité de certains renforts a été associée à celles-ci en raison des traitements thermiques et de la natures des liants destinés à consolider les grains de poudres céramique. C.Thibault et al [2] ont imprimé un matériau bio-sourcé constitué de fibres courtes de celluloses naturelles, les filaments de 200mm de longueur suivant une vitesse linéaire comprise entre 3mm. s^{-1} et 5mm. s^{-1} à environ 20cm au-dessus de la surface d'impression. Les pâtes imprimées sont comprimées dans un rhéomètre à des vitesses (taux) de déformation comprises entre 0.1 et 1 s^{-1} . Les résultats obtenus sont des courbes qui se superposent et se conforment à celles de la littérature ([2]).

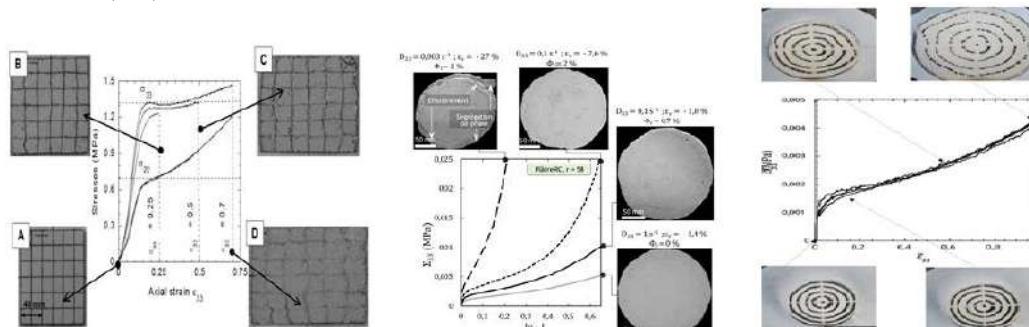


Figure 1 : Courbes contrainte-déformation ($\sigma_{33} - \epsilon_{33}$) typiques d'essais de décompression simple lubrifiée réalisés sur des échantillons de pâte de polymères, de plâtre renforcé de fibres, de ciment

L'examen de la littérature actuelle confirme la capacité des techniques de modélisation à prédire le type de défaillance structurelle dans le processus d'impression, y compris les défaillances à l'extrusion des matériaux, à une ou plusieurs couches, et à l'échelle de la structure entière, micro structure (segregation de particule, prise en compte et analyse de la couche lubrifiante), échelle du filament (continuité lors du dépôt, arrêt du fait de la couche lubrifiant) et de la structure (interface, flambement).

Mots clefs : plâtres armés de fibres, compression lubrifiée, régimes d'écoulement,

[1] A.D.O. BETENE, Rhéologie des pâtes de plâtre armé de fibres, Congrès des Jeunes Chercheurs en Mécanique (Méca-J), du 24 au 27 août 2021

[2] C. Thibaut, A fibrous cellulose paste formulation to manufacture structural parts using 3D printing by extrusion. <https://www.sciencedirect.com/science/article/pii/S014486171930089X>

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Please check the appropriate contribution:

Oral

or

Poster

Membrane céramique à base de kaolin et de balle de riz: Optimisation par la méthodologie de surface de réponse (MSR) et de l'analyse de l'interdépendance des réponses

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Abstract

Les membranes céramiques sont fabriquées en faisant des mélanges contenant des matériaux qui interagissent à haute température pour donner un produit final dont certaines caractéristiques peuvent être corrélées (porosité, résistance, perméabilité, etc.). La fabrication des membranes aux propriétés optimales passerait ainsi par la prise en compte des interactions entre les constituants du mélange et l'analyse des interdépendances entre les caractéristiques de ces membranes. Dans cette étude, les points précédents ont été étudiés en utilisant trois matériaux, une argile non plastique de Mayouom (MY3), une argile plastique de Koutaba (KG) et les balles de riz (BR). Dix membranes, conformément au *simplex centroid design* ont été confectionnées pour étudier les interactions entre les constituants. Pour ces membranes élaborées, la résistance varie de 4 à 8 MPa ; le taux de porosité varie de 28,1 à 40 %, la perméabilité va de 95 à 898 L.h⁻¹.m⁻².bar⁻¹ et le diamètre hydraulique varie entre 2,35 et 5,64 µm. Les modèles mathématiques décrivant les caractéristiques précédentes ont montré de fortes interactions entre les constituants du mélange (MY3, KG et BR), et ont permis de mettre en évidence des liens entre la porosité et la résistance, et entre la porosité, le diamètre hydraulique et la perméabilité hydraulique. Ces liens ont montré que le diamètre hydraulique est plus influent que la porosité sur la perméabilité. La prise en compte de ces résultats a permis de trouver un mélange optimum constitué de 83 % de MY3 ; 15 % KG et 2 % BR. Ses caractéristiques sont : 8,1 MPa de résistance ; 30 % de porosité et 675 L.h⁻¹.m⁻².bar⁻¹ de perméabilité et un diamètre hydraulique de 0,08 µm.

Keywords: Argile kaolinitique, plan d'expérience, simplex centroid design, membrane céramiques

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Please check the appropriate contribution:

Oral

or

Poster

Caractérisation de quelques propriétés thermo-physiques et mécaniques du béton moussé au Burkina Faso

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Abstract

Le Burkina Faso est un pays à climat tropical chaud et sec qui n'échappe pas au problème énergétique. Nous remarquons qu'au Burkina Faso, les constructions des habitats avec des briques en parpaing augmentent grâce à sa forte résistance mécanique malgré sa faible inertie thermique. Des économies pourraient être réalisées si leur comportement thermique était pris en compte. Ainsi notre objectif consiste à déterminer les propriétés thermo-physiques et mécaniques du béton moussé nouvellement produit au Burkina Faso. Une série de tests a été réalisée avec plusieurs échantillons en utilisant un dispositif de compression et celui de PUNDIT pour les essais mécaniques. L'appareil DESPROTHERM a été utilisé pour les essais thermiques. Les résultats des essais réalisés montrent que les masses volumiques des échantillons analysés varient de 600 à 930 kg/m³. La conductivité thermique du béton moussé étudié en fonction de la masse volumique est comprise entre 0,05 à 0,20 W/m.K. Les résultats des essais mécaniques montrent que la résistance à la compression du béton moussé en fonction de la masse volumique part de 1,2 à 3,4 MPa et ceux du module dynamique d'Young analysé varie de 1,18 à 3,1 GPa. Au regard de ces résultats nous pouvons dire que le béton moussé présente des caractéristiques thermiques et des propriétés mécaniques acceptables, d'où un bon isolant pour la construction des bâtiments au Burkina Faso.

Mots clés : béton moussé, résistance à la compression, conductivité thermique, module dynamique d'Young, masse volumique.

References:

- [1] A. J. Hamad, "Materials, Production, Properties and Application of Aerated Lightweight Concrete: Review," *Int. J. Mater. Sci. Eng.*, vol. 2, no. 2, pp. 152–157, 2014.
- [2] M. Kozlowski and M. Kadel, "Mechanical Characterization of Lightweight Foamed Concrete," *Adv. Mater. Sci. Eng.*, vol. 2018, p. 1–8. <https://doi.org/10.1155/2018/6801258>.
- [3] N. V. Kumar, C. Arunkumar, and S. S. Senthil, "Experimental Study on Mechanical and Thermal Behavior of Foamed Concrete," *Sci. DirectMaterials Today Proc.*, vol. 5, no. 2, pp. 8753–8760, 2018.
- [4] M. A. O. MYDIN, "Lightweight Foamed Concrete (LFC) thermal and mechanical properties at elevated temperatures and its application to composite walling system content," p. 281, 2010.
- [5] S. Wei, C. Yiqiang, Z. Yunsheng, and M. R. Jones, "Characterization and simulation of microstructure and thermal properties of foamed concrete," *Constr. Build. Mater.*, vol. 47, p. 1278–1291. <http://dx.doi.org/10.1016/j.conbuildmat>, 2013.

November 28 – December 1, 2023, Yaoundé

ST8. Properties of use and Industrial applications

Please check the appropriate contribution: Oral or Poster

A State-of-the-Art Review on the Evolution of Geopolymer Application in Water and Wastewater Treatment

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Abstract

The fundamental necessities of life are surrounded around clean water and a clean environment. Nevertheless, there is a challenge of management of these resources due to the huge amount of novel pollutants being emitted caused by an escalation of populace, urbanization, and industrialization. In so doing, viable approaches must be applied to ameliorate water and environmental resources, to address societal challenges [1]. Different methods have been applied to acquire clean wastewater through treatment process using different materials which has proven quite costly and unsustainable, e.g activated carbon, electrolysis etc. within the last few decades, geopolymer has emerged as the most innovative, sustainable, durable and affordable material means of wastewater treatment, which is also eco-friendly [2]. The interest in this material has kept growing because their raw materials are readily available, they can be produced through a simple geopolymerization process at low temperatures, low energy with little or no greenhouse gas emission, hence a low carbon footprint [3]. They also exhibit excellent physical and chemical stability, ion exchange, dielectric characteristic etc. their application in wastewater treatment as adsorbent and membranes [4, 5] has evolved from the use of geopolymer composite as powders to the current use in the porous form both as powders and block form, due to their incorporation of waste within these pores. For this reason, the aim of this review is to comprehend the performance evolution of geopolymer composite to pervious/porous geopolymer in the application of wastewater treatment in the elimination of heavy metals, dye, nutrients etc, as adsorbents, membranes, photo-catalyst etc, with the view of reducing environmental pollution.

Key words: Geopolymer, Wastewater, wastewater treatment, adsorbent, membranes, heavy metals, nutrients removal.

References

- [1] Azimi A., Azari A., Rezakazemi M., Ansarpour M. (2017) Removal of Heavy Metals from Industrial Wastewaters: A Review. ChemBioEng Reviews 4:37-59. DOI: doi:10.1002/cben.201600010.
- [2] Sefiu Abolaji Rasaki, Zhang Bingxue, Rohiverth Guarecuco, Tiju Thomas, Yang Minghui, Geopolymer for use in heavy metals adsorption, and advanced oxidative processes: a critical review, Journal of Cleaner Production (2018), doi: 10.1016/j.jclepro.2018.12.145
- [3] Luhar, I.; Luhar, S.; Abdullah, M.M.A.B.; Razak, R.A.; Vizureanu, P.; Sandu, A.V.; Matasaru, P.-D. A State-of-the-Art Review on Innovative Geopolymer Composites Designed for Water and Wastewater Treatment. Materials 2021, 14, 7456. <https://doi.org/10.3390/ma14237456>
- [4] Tan, T.H., Mo, K.H., Ling, T.C., Lai, S.H., 2020. Current development of geopolymer as alternative adsorbent for heavy metal removal. Environ. Technol. Inno. 18, 100684. <https://doi.org/10.1016/j.eti.2020.100684>.
- [5] Bai, C., Colombo, P., 2018. Processing, properties and applications of highly porous geopolymers: a review. Ceram. Int. 44, 16103e16118. <https://doi.org/10.1016/j.ceramint.2018.05.219>.

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MINERALOGICAL, GEOCHEMICAL AND ADSORPTIVE PROPERTIES OF CLAY MATERIALS FROM JAPOMA AND ITS SURROUNDINGS, DOUALA CAMEROON.

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Abstract

The locality of Japoma is located between coordinates 9°50' - 9°60" longitude East and 3°10' - 4°10', in the Douala sub-basin, Cameroon coast. This study consisted in carrying out a mineralogical, geochemical and adsorbent characterization of the clay materials in order to determine whether these clays represent a significant adsorbent cover capable of trapping the various pollutants observed in this environment. Field work (description and sampling) and laboratory work (mineralogy, geochemistry and electrochemistry) were carried out. Field results revealed five clay facies: light grey, dark grey, purplish, mottled and yellow. These materials are available in thicknesses of up to 8 m [1]. Kaolinite (45.3 and 69.2%) and illite (2.4 and 10.2%) are the main secondary mineral phases, while quartz (20.5 and 40.8%) is the main impurity in the clay materials. Oxides of silicon (22.21 - 71.31%), aluminum (12.59 - 23.98%) and iron (1.07 - 17.76%) are in the majority and similar to the results of previous work in the sub-basin [2]. Adsorption tests on cadmium revealed significant results. The contact time varied between 10 and 60 minutes, the maximum pH was 5, the average mass dose was around 15 mg and cadmium adsorption increased linearly with the concentration gradient of the cadmium solution, with an adsorption yield varying between 93.4 and 97.1%. The clay materials in and around Japoma are potential adsorbent soils, providing a barrier layer for the protection of groundwater overexploited by the local population.

Key words: Japoma, mineralogy, electrochemistry, adsorption, cadmium

References:

1. Babechuk, M.G., Widdowson, M., Kamber, B.S., 2014. Quantifying chemical intensity and trace element relcasC Irom two contrasting profiles, Decan Traps, India. Chemical Geology. 365: 56-75.
2. Lu, S., Wang, S., Chen, Y., 2015. Paleopedogenesis of red paleosols in Yunnan Plateau, southwestern China: Pedogenical, geochemical and mineralogical evidences and paleoenvironmental implication. Paleogeography, Paleoclimatology, Paleoecology. 420: 35-48.
3. Ndzié Mvindi, A. T., Onana, V. L., Ngo Ze, A. O., Ohandja, H. N., & Ekodeck, G. E. 2017. Influence of hydromorphic conditions in the variability of geotechnical parameters of gneiss-derived lateritic gravels in a savannah tropical humid area (Centre Cameroon), for road construction purposes. Transportation Geotechnics, 12, 70-84.

Please check the appropriate contribution: Oral or Poster

**PROPOSITION DES ELEMENTS DE DECORATION POUR ARCHITECTURE
D'INTERIEURE A PARTIR DES GEORESSOURCES LOCALES
ET DES ELEMENTS DU PATRIMOINE CULTUREL IMMATERIEL :
EXEMPLE DES MOZAÏQUES MURALES ET DES POTS DE FLEUR**

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Les ressources locales naturelles (argile, sable, pouzzolane, métaux, pierres, granulats, bois et fibres végétales entre autres) sont généralement utilisées comme matière d'œuvre ou support d'œuvre pour des créations artistiques. Aussi, l'exploration des ressources locales immatérielles à l'exemple des danses patrimoniales, des us et coutumes, des savoir-faire artisanaux et certaines techniques séculaires permet d'envisager leur exploitation dans les pratiques artistiques contemporaines. Cependant, les connaissances scientifiques et technologiques sur ces matériaux locaux et les ressources locales immatérielles sont en général parcellaires et même parfois inexistantes. Ceci a pour corolaire la sous-exploitation et l'absence de contribution efficiente au développement, plus particulièrement dans la création artistique et l'industrie culturelle.

Ce travail est une contribution à la valorisation des ressources locales matérielles (agiles et sable) et immatérielles (us et coutumes) dans la proposition des éléments de décoration pour l'architecture d'intérieur. Ainsi, les symboliques de la panthère d'une part et du tissu traditionnel Ndop d'autre part, dans la société traditionnelle chez les Bamiléké de l'Ouest Cameroun, sont explorées pour proposer des éléments décoratifs en céramique à base de minéraux de développement comme l'argile, le sable et la pouzzolane pour l'achalandage de l'espace intérieur.

L'étude sémiologique de ces deux éléments culturels, l'application des techniques de création contemporaines classique et les principes décoratifs, ont permis de proposer plusieurs modèles de pots de fleur et de mosaïques. Les prototypes qui nous ont semblés plus intéressants et facilement reproductibles ont été développés en utilisant comme matières d'œuvres les argiles et les sables pouzzolaniques locaux et en respectant le protocole de production d'une œuvre céramique. Ces prototypes sont proposés pour la décoration des Halls d'hôtel, lieux d'accueil et de rencontre qui favorisent l'expression artistique et la diversité culturelle.

Mots-clés : Ressources matérielles et immatérielles, création contemporaine, décoration.

Please check the appropriate contribution: Oral or Poster

Mechanical Properties and chemical stability of Roof Tiles: a mixture of Cathode-Ray Tube (CRT) waste glass and Allophane rich soil fired at different temperatures.

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Abstract

The use of Cathode-Ray Tube (CRT) wastes as fluxing agent in replacement of Feldspar contribute to reduce the energy necessary to sintering fired ceramic. In this work, the effect of CRT waste glasses and allophane on the physico-mechanical properties and chemical stability has been investigated. Commercial tile and roof are the vitrified ceramic that are composed of clay, feldspar, and quartz. The manufacturing of theses ceramic products requires high temperature sintering at least at 1250°C that result in high energy costs a great quantity of thermal energy is consumed in the firing stage. The aim of this work is to produce ceramic tile with low energy consumption and that have good physicochemical and mechanical properties. The raw materials were characterized in terms of mineralogical and chemical composition. Different mixtures with various amounts of glass were prepared and fired in the temperature range of 700–950°C, for 4h. The influences of waste glass content on the technological properties (linear shrinkage, water absorption, bulk density and flexural strength) were determined. Microstructural analysis of the fired samples was carried out by X-Ray Diffraction and SEM. The experimental results revealed that Raw materials have good fluxing properties which were improved with firing. Mechanical and physical tests such as Linear shrinkage, water absorption, open porosity, bulk density, flexural strength, loss on ignition, chemical stability and leaching were used to evaluated the behaviour of ceramic bodies at sintering temperatures of 700°C, 750°C, 850°C and 950°C respectively. The results showed that best physico-mechanical properties were obtained at 850°C with 30% CRT waste glass added while water absorption drastically reduced from 16 to 7%, porosity fell from 27 to 10.41% and flexural strength increased from 5.98 to 20.26MPa. This improved behaviour observed around 850°C can be attributed to better glassy phase formation.

Key works: allophone rich soil, CRT waste glass, chemical stability, mechanical properties, and tiles.

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Please check the appropriate contribution: **Oral**

or

 Poster

GEORESOURCES ET DEVELOPPEMENT DURABLE EN AFRIQUE D'HIER A AUJOURD'HUI : CETTE COMBINAISON EST-ELLE POSSIBLE ?

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Résumé :

En Afrique depuis la nuit des temps, les africains exploitaient le sol à des fins utilitaires. Ils s'en servaient pour faire des pots, des ustensiles, des briques, des pavés ...et toutes sortes de choses. Ce secteur est donc une opportunité d'affaire pour l'Afrique. Cependant, le problème qui se présente, est que l'exploitation de ces ressources ne respectaient pas toujours des règles environnementales. Ce qui débouche sur des pollutions des eaux, des érosions, destruction forestière ...Par conséquent, les populations de certaines zones de l'Afrique sont menacées par cette destruction environnementale du fait de l'amenuisement des ressources alimentaires vitales. Dès lors, Quel est l'impact de la géoresource sur la sécurité écologique, alimentaire et économique de l'Afrique ? L'objectif de l'étude vise à mettre l'accent sur les bienfaits et effets néfastes de la géoresource en Afrique. L'étude a permis de voir que la géoresource est certes un domaine pourvoyeur d'emploi mais demeure un frein à la souveraineté alimentaire ... C'est une étude qualitative. Ainsi la mobilisation de la documentation, s'est faite grâce aux sources, orales, écrites et audio-visuelles. Pour les sources orales, nous avons procédé à la technique des enquêtes directs et à la méthode de la retranscription des interviews. Concernant, les sources écrites et audio-visuelles, c'est l'idée de la confrontation des écrits de façon objective qui s'est réalisée. Mieux, il était important de synthétiser les faits historiques en tenant compte du cadre spatio-temporel. L'analyse de l'étude s'articule autour de deux axes : le dynamisme de géoresource, les difficultés de celle-ci pour l'Afrique.

Mots clés : Afrique, géoresource, opportunité, souveraineté alimentaire, règles environnementales

ST9. Modelling and Artificial intelligence for materials science

Please check the appropriate contribution:

Oral

or

Poster

ENSEMBLE LEARNING FOR PREDICTING THE COMPRESSIVE STRENGTH OF HIGH-PERFORMANCE CONCRETES

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Abstract

Machine learning models are promising for predicting key concrete properties such as compressive strength, flexural strength, tensile strength, etc, and thus speeding up design. However, existing models such as decision trees, linear regression... have limitations in terms of accuracy and generalization performance. This study presents an artificial intelligence method for predicting the mechanical strength of high-performance concretes (HPCs) based on data generated locally at the MIPROMALO laboratory for a total of 1,000 samples. The proposed method is ensemble learning, which relies on combining the predictions of several basic models such as neural networks, decision trees... to obtain more accurate predictions. The idea behind ensemble learning is that by aggregating the predictions of several models, the final prediction can be more robust and reliable than that of any individual model. The proposed model can be used to study the impact of different mix design variables on the mechanical strength of HPCs.

Keywords: Machine learning, Compressive strength, Artificial intelligence, High performance concretes (HPCs), Ensemble learning.

Please check the appropriate contribution: Oral or Poster

Optimisation of concrete performance using the particle packing concept based on the modified empirical mathematical model of Andreasen and Andersen.

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Abstract

In this work, high-performance concretes were developed by achieving optimal particle conditioning. By optimising the aggregate particle size distribution, the compaction density can increase, which could decrease the void rate between particles (Sun Yung et al., 2018). The modified mathematical model developed by Andreasen and Andersen was used to determine the particle size distribution for dense matrix packing (Andreasen & Andersen, 1930). The aim of this project was to optimise aggregate particle mixes using local materials for the production of high-performance concrete. The aggregates were collected from a local quarry and divided into three main classes according to their respective minimum and maximum diameter (0.05 / 1mm ; 0.1 / 2mm and 0.25 / 4mm). The modified Andreasen and Andersen model was used to write a computer program using Matlab software to generate the granular distribution curves. The curves thus obtained theoretically were used in turn to highlight the different sub-classes of granular materials for the design of dense particle packaging. Portland cement type CEM I 42.5 was used as a cementitious binder at a percentage of 20 % by mass for the formulation of the concrete specimens. A wide range of specimens was made according to the distribution coefficient q (2-30). The water/cement ratio was set at 0.5. Tests of apparent density (ASTM C 29) and water absorption coefficient (NF P 18-554) were carried out on the granular subclasses defined beforehand. Scanning electron microscopy and compressive strengths on cylindrical concrete specimens measuring 11cm in diameter and 22 cm in height (11 × 22cm) were determined at 28 days. The results obtained show that the water absorption coefficient varies between 1.01 and 14.62% depending on the granular class studied. As for the mechanical measurements, the results revealed that the optimum curve obtained is the one with good grain densification (low porosity) and more effective particle packing characterised by high compressive strength.

Keywords : High-performance concrete; optimisation; particle packing; Matlab software; granular distributions.

References

- Andreasen A.H.M., Andersen J ; Ueber die Beziehungen zwischen Kornabstufungen und Zwischenraum in Produkten aus losen Körnern (mit einigen Experimenten), Kolloid-Zeitschrift 50 (1930) 217–228.
- Sun Y, Wang Z, Gao Q, Liu C ; A new mixture design methodology based on the Packing Density Theory for high performance concrete in bridge engineering. Construction and Building Materials 182 (2018) 80–93.

Please check the appropriate contribution: Oral or Poster

NEW INSIGHTS INTO THE APPLICATION OF MACHINE LEARNING IN PREDICTING PROPERTIES OF CALCINED CLAY CEMENTS

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Abstract

In recent years, the construction industry has been witnessing a significant shift towards sustainable and environmentally friendly building materials. Calcined clay cements (CCCs) have emerged as a promising alternative to traditional Portland cement due to their lower carbon footprint and improved durability. However, the complex nature of CCCs and the need for accurate property predictions present challenges in their widespread adoption. Machine learning (ML) has proven to be a powerful tool in various scientific and engineering fields, and its application in materials science has opened new possibilities for predicting material properties. This oral presentation aims to explore the latest insights into the application of machine learning techniques in predicting the properties of calcined clay cements. The core of the presentation will revolve around the innovative use of machine learning algorithms in predicting the properties of CCCs. By leveraging large datasets of experimental data, ML techniques can identify hidden patterns and correlations, leading to accurate predictions of material behavior. Various ML models, such as regression, decision trees, support vector machines, and neural networks, will be discussed in the context of their application to CCCs. Finally, the presentation will showcase case studies and research findings where machine learning models have successfully predicted CCC properties. These findings illustrate the potential of ML in optimizing CCC formulations, designing tailored mixtures, and ultimately improving the overall performance and sustainability of construction materials.

Keywords: artificial intelligence, machine learning, calcined clay cement, compressive strength

References:

El Khessaimi et al., (2023). Machine learning-based prediction of compressive strength for limestone calcined clay cements. Journal of Building Engineering, 107062.

El Khessaimi et al., The effectiveness of data augmentation in compressive strength prediction of calcined clay cements using linear regression learning. 2023. [hal-04166948](https://hal.archives-ouvertes.fr/hal-04166948)

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Please check the appropriate contribution: Oral

Elaboration and characterization of kaolinitic clays and cassava peel-based ceramic membranes using simplex centroid design

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Abstract

The efficiency of ceramic membranes is giving them increasing importance in filtration processes for eliminating pollutants and making water drinkable. It is therefore important to develop membranes with optimum properties in order to increase their efficiency. This involves controlling and understanding the various effects and interactions between the constituents of the mixture (clay, pore-forming agents, etc.) and the firing parameters (temperature, time, heating rate, etc.). This work therefore reports on the evolution of the physical and mechanical properties of ceramic membranes as a function of the constituents of the mixture, sintering and, above all, their interactions. The experimental field was defined by the augmented simplex centroid design (ASCD) mixing planes coupled with temperature as the firing parameter. The raw materials were characterised by chemical analysis, TG/DTA, XRD and FTIR spectroscopy. In the formulations, the percentage of KG kaolinitic clay, which is plastic, varied from 15 to 35%, EB clay, which is non-plastic, varied from 65 to 85%, while the cassava skins used as a pore-forming agent varied from 0 to 20%. The membranes were fired at 900°C and 1100°C and characterised by XRD, SEM, flexural strength, porosity and permeability. Experimental results showed that, the strength of the membranes varied from 1.19 to 14.44 MPa; porosity from 19.02 to 44.38%; and permeability from 57.04 to 1721.85 L.h⁻¹.m⁻².bar⁻¹. The mathematical models showed very strong interactions between the firing temperature and the constituents of the mix, demonstrating the importance of considering the firing parameters and adapting them to the different percentages of the constituents. Optimisation of these properties resulted in a compromise zone comprising 65% EB, 24.79% KG and 10.21% PM. The optimum membrane has the following characteristics: 10.10MPa strength, 32.13% porosity and 675.85 L.h⁻¹.m⁻².bar⁻¹ permeability, with an overall satisfaction rate of 93.44%.

Keywords: Kaolinitic clays, cassava peels, experiments design, ceramic membranes, optimization

Please check the appropriate contribution: Oral or Poster

Optimization of geopolymmer concrete produced from laterite and pozzolan using the simplex centroid mixture design method

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Abstract

Lateritic soils are commonly used in the production of geopolymmer concretes. But these laterites are mostly reactive when subjected to temperature greater than 400°C for activation of the amorphous phase. The energy required calcination is high and hence less sustainable. Hence research is been done on the substitution of laterite with other solid precursor. The main aim of the work is to strike a balance among workability, compressive strength, durability, economic efficiency and sustainability of geopolymmer concretes based laterite and pozzolan as aluminosilicate sources. In this work, the optimum paste had 50% calcined laterite, 50% pozzolan and alkaline solution with a solid-liquid ratio of 0.7. The ratio of the paste, fine aggregate and coarse aggregate was optimized using the simplex centroid method based on the compressive strength property of the various concrete obtained. The results showed values of compressive strength ranging between 20MPa to 40MPa. The optimum value of 39.2 MPa was obtained with 40% of paste, 30% of fine aggregate and 30% of coarse aggregate. The trend decreased as the we varied to about 60% of pozzolan. Further rheological properties analysis will be done. Also, optimum sample have been exposed under the action of natural climatic conditions to observe its effect on the sample within a period of six months.

Keywords: laterite, pozzolan, concrete, physico chemical analysis, simplex centroid design, optimization

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Please check the appropriate contribution:

Oral

or

Poster

Explicabilite des réseaux de neurones pour la prédition de la resistance mecanique du beton haute pression base sur les facteurs optimaux

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Résumé

Durant la dernière décennie, les réseaux de neurones profonds ont démontré des résultats assez impressionnantes pour la résolution des problèmes dans des domaines variés. Connus également sous le nom de réseaux de neurones artificiels (ANN), ils sont considérés comme des boîtes noires à cause du fait qu'il est difficile d'interpréter ou d'expliquer les prédictions obtenues. Une méthode basée sur les facteurs booléens appelé Using Boolean Factors for The Construction of an artificial Neural Network permettant de définir l'architecture des réseaux de neurones précédemment proposés dans la littérature. Ainsi qu'une des méthodes d'Explicabilité appelé Layerwise Relevance Propagation a fourni des explications intéressantes pour la compréhension des caractéristiques des entrées qui ont été les plus pertinentes pour les réseaux de neurones dans leurs processus de prédictions. Cette méthode s'applique différemment en fonction du type de réseaux de neurones, ici nous proposons d'utiliser les facteurs optimaux pour définir l'architecture de notre réseaux de neurones, utiliser la méthode LRP pour déterminer les caractéristiques qui ont été utilisés par le modèle pour la prédition de la résistance à la compression du béton de haute performance. La base de données contenant 1500 observations a été obtenue dans le laboratoire de la MIPROMALO au Cameroun. Les résultats obtenus donne de bons résultats en indiquant les variables qui ont le plus impacté la sortie du réseau(la prédition).

Keywords: Réseau de neurones artificiel, Resistance à la compression, BHP; Facteurs booléens, Explicabilité

Please check the appropriate contribution: Oral or Poster

Automatic selection of attributes based on porosity-hygroscopy correlations of geopolymers matrix.

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Abstract

Geopolymer matrix have major advantages for thermal comfort. For a given matrix, it is important to predict its hygroscopic capacity in order to know how the material will behave in the phenomenon being studied. There are several variables that influence this hygroscopic capacity. It is therefore important to know which variables are the most significant. In this paper we present an implementation of a hybrid T-MOFS-S-GA variable selection algorithm, combining the advantages of filter and wrapper methods. This machine learning algorithm approach is used to reduce the size of the feature set by automatically selecting the most important ones. A dataset of 1000 observations obtained at the laboratory of MIPROMALO is used for the experiments and the results are promising.

Keywords: Geopolymer matrix, Machine learning , feature selection, porosity, hygroscopy

Posters

Quantification de l'acide oléanolique dans *Launaea taraxacifolia* et activité larvicide contre les vecteurs du paludisme

Ahouansou C. A., Tokoudagba J. M, Assanhou A. G., Hounguè U., Houngbemè A. G., Mèdégan Fagla S. R. et Gbaguidi A. F.

Résumé

La gestion des gites larvaires est l'une des mesures utilisées pour prévenir le paludisme. Pour une lutte préventive et écologiquement rentable, le recours aux bio-larvicides élaborés à base d'extraits actifs de végétaux serait un atout pour le contrôle des vecteurs du paludisme notamment *Anopheles gambiae*. Le progrès de la pharmacognosie a révélé les avantages de plusieurs composés phytochimiques à effets thérapeutiques très riches et variés. Parmi ces derniers, l'acide oléanolique (AO) est assez remarquable du fait de ses diverses et multiples propriétés dont la plus part sont mises en évidence avec les feuilles de *Launaea taraxacifolia*. Après un fractionnement liquide-liquide avec différents solvants organiques de l'extrait hydro-méthanol de *Launaea taraxacifolia*, nous avons obtenu trois fractions nommées Fhex (fraction hexane), FDCM (fraction dichlorométhane) et FHM (fraction hydro-méthanol) qui ont été testées sur des larves d'*Anopheles gambiae* de troisième stade. La Fhex s'est révélée la plus active avec des LC₅₀ de 120,11 ppm et 69,50 ppm respectivement en 24h et 48h de contact. Ensuite, nous avons développé une méthode de Chromatographie Liquide à Haute Performance Ultra-Violet (CLHP / UV) pour apprécier la quantité de l'acide oléanolique présente dans les fractions Fhex et FDCM qui ont donné respectivement 0,46% et 0,23%.

Mots clés: Paludisme, *Launaea taraxacifolia*, Acide oléanolique, Activité larvicide.

Please check the appropriate contribution:

Oral

or

Poster

TITLE: ELABORATION DE FILTRES CÉRAMIQUES ET APPLICATION EN FILTRATION

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Abstract

La pollution chimique de l'eau, la surexploitation des eaux souterraines en raison d'une démographie galopante sont des facteurs entrainant le manque d'eau de consommation dans le monde (**Amon et al, 2017**). La valorisation des eaux de surface devient donc une nécessité. Cependant, ces eaux de surface sont souvent polluées. Plusieurs des procédés de traitement (**Errais,2011**) utilisés pour produire des eaux potables sont coûteux. L'utilisation de filtres céramiques poreux à base d'argiles locales pourrait être une alternative moins chère pour la filtration de ces eaux à la maison. La présente étude vise à évaluer les capacités filtrantes de matériaux céramiques poreux pour le traitement des eaux de surface. Ces matériaux, fabriqués à partir d'argiles locales (référencées D et Y) et de la farine de maïs, puis consolidés par traitement thermique à 1000 °C (**Amon et al, 2017**), ont été utilisées pour filtrer les eaux de la lagune d'Aghien, au sud de la Côte d'Ivoire. Les deux argiles utilisées sont constituées majoritairement de 29,92% de kaolinite, 55,95% de quartz, de 13,6% d'illite pour l'argile D et de 41,9% de kaolinite, de 42,41% de quartz, de 10,65% d'illite et 4,25% de goethite pour l'argile Y. Les filtres élaborés ont été caractérisés par diverses techniques expérimentales. La microscopie électronique à balayage a mis en évidence un réseau de pores interconnectés dans le matériau. La porosimétrie au mercure a révélé que le diamètre des pores est majoritairement de 1 µm. Les filtres céramiques élaborés avec 75% D + 25% F et 75% Y + 25% F ont respectivement une porosité ouverte de 52,8% et 50,6%. Par contre, ceux élaborés avec 50% D + 50% F et 50% Y + 50% F ont respectivement une porosité ouverte de 66,6% et 68,2% proche de celle du filtre céramique de référence (66,5%) (**Amon, 2019**). Les surfaces spécifiques des filtres élaborés sont largement plus élevées que celle du filtre de référence (2,1 m²/g). L'utilisation de ces matériaux céramiques poreux dans la filtration des eaux brutes de la lagune Aghien a permis de montrer qu'ils jouent tous un rôle de barrière physique aux particules dont la taille est supérieure au diamètre des pores. Toutefois le filtre céramique Y50 s'est révélé être le filtre le plus performant (**Amon et al, 2020**).

Mots clés : Argiles ; filtres céramiques ; porosité ; farine de maïs.

REFERENCES :

Lydie Nina Amon ; Léon Koffi Konan; Hervé Goure-Doubi; Jonas Yapi Yao Andji; Julien Kalpy Coulibaly; Samuel Oyetola ,(2017) ; Physico-chemical and structural properties of clay-based ceramic filters from Côte d'Ivoire, J. Soc. Ouest-Afr. Chim.(2017), 044 : 70 – 77

Errais E., (2011) ; Réactivité de surface d'argiles naturelles. Etude de l'adsorption de colorants anioniques. Thèse de Doctorat, Université de Strasbourg.

Amon L.N. (2019) ; Contribution à l'étude des propriétés physico - chimiques des eaux de la lagune Aghien et évaluation des capacités filtrantes d'un matériau céramique poreux à base d'argile locale. Thèse de Doctorat, Université Félix Houphouët Boigny.

Lydie Nina Amon; Léon Koffi Konan; Lébé Prisca M.-S. Kouakou ; Hervé Gouré Doubi; Julien Kalpy Coulibaly; Yao Jonas Andji-Yapi; Samuel Oyetola, (2020) ; Surface Water Filtration Using Porous Clay-Based Ceramic Materials in Côte d'Ivoire

Please check the appropriate contribution: Oral or Poster X

TITLE : Amélioration des propriétés technologiques et mécaniques d'une argile moins plastique (argile de Ntokou) à partir d'une argile très plastique (argile de Dongou), extraites en République du Congo

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Abstract

L'objectif général de ce travail est d'améliorer les propriétés technologiques et mécaniques de l'argile Ntokou à partir d'argile Dongou. Deux formulations sont obtenues : F1 (90% d'argile de Ntokou et 10% d'argile de Dongou) et F2 (50% d'argile de Ntokou et 50% d'argile de Dongou). La granulométrie du mélange est déterminée par tamisage humide et séimentométrie. Les limites d'Atterberg sont déterminées à partir de l'appareil de Casagrande. Les résultats cohérents sont trouvés en mesurant le retrait linéaire, l'absorption d'eau et la résistance à la rupture, après cuisson des éprouvettes. Les diffractogrammes des produits céramiques sont déterminés, suivant les températures 1100 et 1150°C. Nous avons noté une valeur assez élevée de la résistance à la rupture (11,97 MPa), un taux d'absorption d'eau de 6,82% et un retrait de 4,53% à 1150°C pour la formulation F2 par rapport à la formulation F1, à la même température, où la résistance à la rupture est de 9 MPa, le taux d'absorption est de 10,03% et le retrait est de 2,85%. La microscopie électronique à balayage a montré la présence d'une porosité interconnectée et l'absence des oxydes alcalins et alcalino-terreux : ce qui donne un frittage en flux visqueux.

Keywords: Argile, déterminé, propriétés technologiques et mécaniques.

References:

AFNOR, NF P94-056, 1996. Sols : reconnaissance et essais-Analyse granulométrique des sols-méthode par tamisage sec après lavage.

Brindley G. and Brown G., 1980. Crystal structures of clay minerals and their X-Ray identification 5, 411-438.

Elimbi, A., Founyape S. and Njopwouo D., 2004. Effets de la température de cuisson sur la composition minéralogique et les propriétés physiques et mécaniques de deux matériaux du gisement argileux de Bakong. Ann. Chim. Sci. Mat., 29(2): 67-77.

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MINERALOGICAL AND PETROGRAPHIC STUDY ON ARCHAEOLOGICAL PIPES FROM NDITAM / CAMEROON.

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Eleven fragments of pipes which belong to the period 1487-1603 AD collected in the archaeological site from Ndoram (Tikar plain of Cameroon) were characterized by using X-ray diffraction (XRD) and polarized optical microscope (POM). The aim of the study is to determine some technological features and the origin of the pipes.

Macroscopically, the samples are cylindrical but show different shape and colour. Two of them present a reddish colour of the external surface whereas the others are grey and/ or black coloured. Three mineralogical groups were distinguished from X-ray diffraction analyses. Group 1 is composed of seven pipes and contains quartz, kaolinite, biotite, feldspar. Group 2 (three samples) is characterized by quartz, biotite, feldspar. Group 3 (one sample) presents kaolinite, quartz and feldspar. Hornblende and brookite were also detected as accessory minerals in some samples. The petrographic analysis agrees with the mineralogy determined by XRD. All the ceramics are characterized by the presence of quartz, feldspar, and phyllosilicates, which constitute the aplastic inclusions, in a matrix that varies from red to black. These aplastic inclusions appear poorly sorted in all the ceramics. Quartz is the main phase and appears polycrystalline and monocrystalline with straight and undulose extinction. Feldspar is mainly constituted by microcline and plagioclase characterized by their twinning aspect. Among phyllosilicates, biotite is prevailing whereas muscovite is sporadic. Grains of amphibole (brown hornblende) showing colourful interference colors and small grains of rutile are also observed in some samples. The pores are homogeneously distributed in the matrix and are mostly elongated. Some differences with the mineralogy identified by XRD are due to the detection limit of this last technique or the sizes of these crystals being too low to be observed under POM. From the technological point of view, most of the pipes were fired below 800°C due to the presence of phyllosilicates in their matrix. The firing atmosphere varied from reducing to oxidizing conditions. Based on the geological setting of the region and the mineralogical and petrographic results obtained, a local provenance of the pipes is suggested.

Key words: Ndoram, pipes, mineralogy, petrography, technology, provenance

Please check the appropriate contribution: Oral or X Poster

Geopolymers for antennas and absorbing materials application

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Abstract

Innovative dielectric materials based on geopolymers represent a cost-efficient and eco-friendly alternative to current materials used in electronics and electric engineering applications. Increasing interest has been drawn in recent years to the dielectric properties of geopolymers. It was previously shown that such geopolymer-based antennas can properly operate in a frequency band ranging from 300 MHz to 3 GHz. However, at later ages, they are dependent on the porosity and the density of the geopolymer. Different additives have also been added to geopolymer matrix to stabilize the properties. Geopolymers also represent an alternative for the design of broadband antennas and absorbing materials.

The objective of this work is to develop new geopolymer-based composites with dielectric properties suitable for these applications, keeping acceptable mechanical and thermal properties. For this purpose, different formulations based on metakaolin, alkaline solutions and additives were tested. The validation criterion was to have ϵ and $\tan \delta$ values between 2 and 3.3 GHz.

For antenna type materials, the type of metakaolin used had low effect on the dielectric characteristics, while the nature of the activating alkaline solution had a significant influence. For the absorbing materials, a non-ionic surfactant, a 12% carbon content with 75% pure graphite and mineral fibers were selected. The tests as a function of the humidity showed a reversibility of the dielectric properties. In addition, the usage properties (mechanical, thermal and temperature resistance) revealed that certain compositions could be retained.

Keywords: Geopolymer, Antenna, Absorbing materials, Eco-friendly.

Please check the appropriate contribution: Oral or Poster

ETUDE SUR LA STABILISATION DES SOLS AVEC LA CHAUX : APPLICATION AUX SOLS SEDIMENTAIRES

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RESUME

L'objectif de cette étude est de stabiliser un sol sédimentaire avec la chaux. Les essais réalisés sont : les essais de mesures des caractéristiques physiques, les essais d'identification, les essais mécaniques et de dureté. Pour les essais mécaniques et en optant pour les dosages en chaux de 2%, 4%, 6%, et 8%, la résistance maximale en compression obtenue à 28 jours est de 4.91MPa, avec une résistance à la flexion de 1,47MPa pour un dosage en chaux de 8%. Les résultats obtenus montrent que le dosage à 8% de chaux est optimal. Pour l'absorption d'eau, les éprouvettes sans un mélange de chaux se dissolvent au bout de quelques minutes, tandis que les éprouvettes de terre stabilisées à la chaux ne se dissolvent et ne présentent pas de défauts. De plus, on constate que lorsque la teneur en chaux augmente, l'absorption d'eau diminue. L'essai de dureté sur les éprouvettes stabilisées à 8% de chaux a permis d'obtenir un retrait de 214,14µm/m. L'intérêt de ce travail est de pouvoir renforcer avec la chaux la résistance en compression des sols de fondations des ouvrages de génie civil qui sont soumis à des charges de compression de façon permanente.

Mots clés : chaux, sols, stabilisation, flexion, absorption, traitements.

REFERENCES BIBLIOGRAPHIQUES

- [1] Thi-Thanh-Hang Nguyen " Stabilisation des sols traités à la chaux et leur comportement au gel". Thèse de Doctorat soutenue à l'Université Paris-Est.
- [2] M. Kergoët " Exemple d'étude de traitement pour déterminer l'emploi d'un sol en couche de forme " bulletin des laboratoires des ponts et chaussées, N°231, pp. 19-24, ref 4361,2001
- [3] M. Amin Boumehraz, M. Mellas, F. Boucetta, N. Elhouda Meghaichi, M. Chebah, "Comportement mécanique du schiste traité par des ajouts du ciment et de la chaux" Revue Nature et Technologie, N° ISSN : 1112-9778-
EISSN : 2437-0312, pp.1-10, 2020
- [4] Z. Belabbaci, " Stabilisation des sols gonflants ", thème soutenu à l'université Aboubeker Belkaid Tlemcen, p.185, 2014.

Please check the appropriate contribution: Oral Poster

TITLE: Characterization of a geopolymers based on calcined laterite substituted for oyster shell powder

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Abstract

This work aims to characterize a geopolymers obtained by calcined laterite and oyster shell powder. To achieve this, we took the raw laterite at SOA in the city of Yaoundé, this sample was first dried in the open air, before being put in an oven at 105°C, then calcined at 500°C and the oyster shells were extracted at Mouanko, in Sanaga-Maritime, then washed and dried in an oven at 105°C, before being calcined at 20°C for 2 hours. These samples were characterized by determining their chemical and mineralogical compositions, particle size distribution, density, their thermal analyses, then used for the synthesis of geopolymers, analysis techniques such as X-ray diffractometry on shell powder of oysters and laterites, thermal and gravimetric analysis, were used to elucidate the time and degree of calcination of the two samples, revolution of linear shrinkage, time of start and end of setting as well as resistance to compression of the synthesized binder pastes. The results obtained show that oyster shells are rich in CaCO and contain crystalline phases, while laterite is rich in silica, iron (FeCO) and alumina (AlO). The geopolymers, in laterite + 0% oyster shell formulations, have their onset times of between 125 and 168 min and its compressive strength is around 47 MPa at 28 days. The peak of resistance is observed around 15% with a setting time which increases with the addition of oyster shells. This resistance begins to decrease again at 25% substitution despite the observed incease in the start and end of setting time. This study shows that the addition of 15% of oyster shell increases the compressive strength of geopolymers based on calcined laterite, but also leads to a considerable drop in the linear shrinkage and the rate of absorption. Beyond this last percentage of adjuvant, the compressive strength decreases drastically and concomitantly, the star of setting time undergoes a increase

Keywords: Geopolymer, Laterte, Oyster shells, Activating solution

References:

- [1] Yoon H., Park S., Lee K., Park J., « Oyster shell as substitute for aggregate in mortar », Waste Manage Research 22, (2004) p 158–170.
- [2]. Davidovits J., Geopolymer Chemistry and Applications, second edition, Institut Géopolymère, Paris, 2008.
- [3]. J. Davidovits, Synthetic mineral polymer compound of the silico-aluminates family and preparation process, 1985, molded articles containing such polymer compound and production process thereof, Patent n° EP 0 066 571 B1.

November 28 , 2023, Yaoundé

Please check the appropriate contribution: Oral or Poster

Effectiveness of composite ceramic filters in arsenic removal from borehole water

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In recent decades, porous silicate ceramics have attracted great interest in water filtration and purification through economical systems with low environmental impact [2,3]. In order to obtain silicate ceramic filters of high, interconnected and controlled porosity, in this study, peanut shell residues from agriculture were crushed and then incorporated into the clay matrix. The clay raw material KOR and peanut shell powder (PCA) come from Burkina Faso. Activated carbon prepared from Peanut shell has been combined with ceramic filters to form composite ceramic filters to improve their contaminant retention capacity. These composite filters have been applied in water treatment for arsenic removal. Physico-chemical analyses of these raw materials indicated that KOR clay is kaolino-illitic and that PCA powder contains cellulosic groups. The mixtures of KOR clay with 20 or 25% PCA were shaped by uniaxial pressing with a load of 50 MPa. The filters were fired at 900 and 1100 °C with for 1 hour in order to study the effect of temperature. The sintered materials were formed of amorphous and mullitic phases, respectively. The materials obtained have high porosity which varies between 60 and 75% and the diametrical compression is above 0.15 MPa. The crystallization of the phases at 1100 °C causes the increase of the permeability from 7934 to 25478 L/h.m².bar. The filtration tests showed an arsenic removal rate could reach 95% and the contaminant concentration after filtration is below the limit value of 10 µg.L⁻¹.

Keywords: Filtration ; Ceramics ; Removal rate ; Diametrical compression

References:

- H. Zouaoui, G.L. Lecomte-Nana, M. Krichen, J. Bouaziz, Structure, microstructure and mechanical features of ceramic products of clay and non-plastic clay mixtures from Tunisia, Applied Clay Science, 2017, vol. 135, p. 112-118.
- M. Ben Hamden, G. Lecomte-Nana, J. Bouaziz, Design and characterization of a cost-effective cermet membrane : implementation in paper mill wastewater treatment, Desalination and Water Treatment, 2019, vol. 147, p. 73–82.
- M. Mouafon, D. Njoya, M. Hajjaji, A. Njoya, G. Lecomte-Nana, D. Njopwouo, Effect of porogenic agent type and firing temperatures on properties of low-cost microfiltration membranes from kaolin, Transactions of the Indian Ceramic Society, Transactions of the Indian Ceramic Society, 2020, vol. 79, 1, p. 1-12

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Please check the appropriate contribution: Oral or Poster

Les Ressources Minérales à Talc de la Dola au Gabon

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Résumé : Les ressources minérales de la ceinture orogénique néoprotérozoïque de l'Ouest Congo, affleurant à Fougamou dans le département de Tsamba Magotsi, se présentent sous la forme de talcschistes. Dans cette étude, un échantillon prélevé sur un affleurement constitué de sable fin blanc a été soumis à une caractérisation fine visant à identifier les minéraux associés au talc. Les méthodes analytiques utilisées comprennent la diffraction des rayons X sur roche totale, les analyses chimiques (majeures et traces), la spectroscopie infrarouge à transmission et réflexion diffuse, ainsi que la microscopie électronique à balayage. Les lames pétrographiques observées au microscope optique révèlent la présence de cavités.

Les résultats de cette étude mettent en évidence que le talc et le quartz sont les phases minérales prépondérantes dans le matériau (Boulingui, 2015). Les calculs des teneurs massiques des différentes phases minérales dans le matériau ont permis de définir les proportions accessibles aux industriels pour des usages spécifiques liés aux gisements à talcschistes connus dans le synclinal de la Nyanga. Les proportions retenues sont de 8 % pour le talc et de 90 % pour le quartz.

En se basant sur ces résultats, il est suggéré que les matériaux minéraux à talcschistes de la région de Dola pourraient être favorables à des applications dans la fabrication de grès cérame non émaillé, utilisé pour le revêtement des sols et des murs.

Mots clés : Application, Talc, Dola, Minéraux, Grès cérame.

References:

Boulingui J.-E. (2015). Inventaire des ressources en argiles du Gabon et leurs utilisations conventionnelles ou non dans les régions de Libreville et de Tchibanga. Thèse de Doctorat. Université de Lorraine - Université de Yaoundé1, p.245.

Please check the appropriate contribution: Poster

ECO-FRIENDLY ENHANCING AGRICULTURAL SOIL FERTILITY: AN EXPLORATION AND APPLICATION OF GLAUCONITE FROM THE PHOSPHORITE DEPOSIT WASTE

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Abstract

This paper examines glauconite extracted from the mining waste of the Egorevsk phosphorite deposit. The objective of this research is an in-depth investigation into the mineralogical and chemical composition of the glauconite-bearing waste rock. The study also scrutinises waste beneficiation and the mineral's morphological, structural, and chemical attributes to appraise its prospective application for enhancing agricultural soil fertility.

Glauconite is distinguished by its globular and granular grains, along with its high level of maturity. The analysis showed that this glauconite has a relatively high concentration of potassium (K_2O 6.1-9.0%) and exhibits a peak of the main basal reflection at 10.2 Å. Mature glauconite usually contains about 2-5% smectite. Apatite inclusions, which are almost constantly present in glauconite grains, play an important role in the composition of the obtained concentrate. Apatite contains high concentrations of phosphorus, which is one of the key macronutrients for plant growth. Thus, the presence of apatite inclusions in glauconite concentrate ensures the availability of phosphorus to plants, contributing to their healthy growth and development. Laboratory experiments in an agricultural context have revealed a favourable impact on plant growth, attributable to using both glauconite-bearing waste rock and glauconite concentrate as mineral fertilisers. The yield of common oats (*Avena sativa*) increased by 3.5% and 6.3% after adding the bulk sample and glauconite concentrate, respectively.

The research findings endorse the potential utilisation of glauconite from the residues of the Egorevsk deposit within the agricultural industry, serving as a mineral additive that increases soil fertility and escalates crop yields.

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Keywords: glauconite; phosphorites; beneficiation; potassium fertilisers; waste rock.

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Please check the appropriate contribution: Poster

CHEMICAL INTERCALATION OF ZINC INTO HALLOYSITE NANOTUBES: FORMULATION OF NANOCOMPOSITES FOR CONTROLLED-RELEASE FERTILISATION

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Abstract

This research focuses on unveiling the outcomes derived from the formulation of nanocomposites, constituted by a mineral inhibitor and a micronutrient filler, aimed at their prospective application as slow-release fertilisers. Halloysite nanotubes perform the inhibitory role, while zinc sulfate is the filler. The study intended to trigger the chemical intercalation of zinc into the macro-, meso-, and micro-pores of halloysite nanotubes.

Three distinct nanocomposites were achieved by preparing them in zinc sulfate solutions at 2, 20, and 40 mol% concentrations. These were subsequently labelled as Hly-7Å-Zn2, Hly-7Å-Zn20, and Hly-7Å-Zn40, respectively. The process of encapsulating zinc sulfate within halloysite nanotubes was scrutinised using various techniques, including X-ray diffraction analysis, transmission electron spectroscopy, infrared spectroscopy, and scanning electron microscopy with an energy-dispersive spectrometer.

Interestingly, the basic mineral parameters did not exhibit any substantial modifications when treated with a zinc solution at a concentration of 2 mol%. The subtle intercalation of zinc into the micro-porous space of the halloysite was corroborated by a marginal increase in its interplanar distance from 7.2 to 7.4 Å. As the reacted solution's concentration was amplified, the average nanotube diameter expanded from 96 nm to 129 nm, indicating that the macro-porous 'site' of the nanotubes had been effectively filled.

The peak retained content of adsorbed zinc on the nanotube surface reached 1.4 wt%. The research suggests that the novel approach of activating halloysite with zinc solution is feasible and holds future promise for developing precision fertilisers. These could demonstrate enhanced resistance to being washed away by rain or irrigation water due to the morphology of the nanotubes and the absorption of zinc into the macro-, meso-, and micro-porous spaces.

The authors gratefully acknowledge the financial support provided by Tomsk Polytechnic University grant Priority-2030-NIP/EB-112-375-2023.

Keywords: halloysite; nanotubes; zinc sulfate; nanocomposites; targeted delivery; controlled fertilisers.

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Please check the appropriate contribution: Oral or Poster

EGG-DERIVED POROUS PLASMA MODIFIED CLAY COMPOSITE FOR WASTEWATER REMEDIATION

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Abstract

This study focuses on the development of ecological and economical adsorbents from kaolinite and eggshells by calcination and glidarc plasma methods for the application in the removal of dyes in aqueous solutions. In this context, the adsorbent was prepared by mixing kaolinite and eggshells, i.e. ESC material with a mass ratio 3:1 (3 kaolinite for 1 eggshells). The latter was then calcined at 800 °C and treated by the sliding of plasma process (ESC-800/PL). The resulting materials were characterized by pH measurement at zero charge's point (pHPCN), Fourier Transformed Infrared spectroscopy (FTIR), X-ray diffraction (XRD), thermogravimetric analysis (TGA/DTG), nitrogen physisorption. The preparation gives porous platelet agglomerates resulting from the transformation of kaolinite, thereby increasing their internal specific surface area and capacity to retain pollutants. This granular distribution is kept stable by partial pozzolanic reactions avoiding deagglomeration. The specific surface area and total pore volume increased from $14 \text{ m}^2 \cdot \text{g}^{-1}$ to $89 \text{ m}^2 \cdot \text{g}^{-1}$ and $0.049 \text{ cm}^3 \cdot \text{g}^{-1}$ to $0.061 \text{ cm}^3 \cdot \text{g}^{-1}$ respectively leading to an enhanced removal efficiency of Fast Green (FG) and Orange G (OG) dyes from polluted water. At 298 K, the maximum adsorption capacity values were 32.34 and 14.78 mg.g^{-1} for OG and FG respectively. The experimental data were successfully adjusted to pseudo-first-order kinetic and Liu isotherm model. This work demonstrates that the conversion of waste materials into adsorbents has a double environmental benefit for both improving waste management and protecting the environment.

Keywords: Kaolinite, eggshells, pozzolanic reactions, glidarc plasma, adsorption

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Please check the appropriate contribution:

■ Poster

Etude des propriétés physiques et chimiques d'un bioplastique renforcé à la fibre de coco et/ou au métakaolin

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Abstract

L'utilisation croissante des matières plastiques issues de la pétrochimie a une incidence sur l'environnement car la grande majorité de ces déchets plastiques n'est pas biodégradable [1]. Par ailleurs, l'incinération de ces déchets est très polluante. En effet, ils libèrent des quantités importantes de dioxyde de carbone et d'autres gaz toxiques nocifs pour l'environnement et la santé humaine [2]. Il est donc nécessaire de développer des biopolymères biodégradables comme alternative aux polymères synthétiques. Dans ce contexte, compte tenu des propriétés de l'amidon [3], des matériaux argileux [4] et des fibres de coco [5], ce travail a pour but d'élaborer des films bioplastiques à base d'amidon de manioc avec une ou deux charges naturelles (fibre de coco et métakaolin). Différentes analyses ont été effectuées sur les biocomposites telles que: l'analyse chimique par EDS (Energy-Dispersive X-ray Spectroscopy), la microscopie électronique à balayage (MEB) et la résistance thermique. Les résultats obtenus montrent que le métakaolin se disperse relativement mieux que les fibres de coco dans les bioplastiques. Les bioplastiques sont tous constitués de silice (SiO_2); ce qui est un atout pour la diffusion de chaleur. A 150 °C, tous les films plastiques sont partiellement carbonisés à l'exception du film plastique BPK_T (Bioplastique renforcé avec le métakaolin). Cela suggère que l'argile constitue une barrière à la diffusion de la chaleur. L'incorporation des charges naturelles accélère la biodégradation des bioplastiques.

Keywords: bioplastiques, métakaolin, biodégradabilité, résistance thermique.

References:

- [1] Méité N., Konan K.L., Tognonvi M.T., Doubi B.I.H.G., Gomina M., et al. (2021). Carbohydrate Polymers, 254, pp.117322.
- [2] Belyamani, I. (2012). University of Jean Monnet, St Etienne, France. Retrieved from <https://tel.archives-ouvertes.fr/tel-00702749>
- [3] Tyagi V. & Bhattacharya B. (2019). MOJ Food Process Technol., 7(4), 128–130.
- [4] Islam H.B.M.Z., Susan M.A.B.H. & Imran A.B. (2020). ACS Omega, 5(28), 17543-17552.
- [5] Food and Agriculture Organization, (2022), Fibres du futur. (fibredecoco-fao.org)

Please check the appropriate contribution: Oral or Poster

Physico-chemical, mineralogical and thermal characteristics of raw clay materials used by local artisans to produce fired clay bricks in Sudano-Saharan area of Cameroon.

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Abstract

Clay materials used for the production of fired bricks in the Sudano-Sahelian zone of Cameroon (North and Far North Regions) were characterized to evaluate their suitability for the production of fired bricks. Four (04) samples of raw materials, namely MPB, MPD, MPG and MPZ, were taken from the major fired brick production sites (Guizigare, Zaktingling, Dablak and Bakara). Geotechnical analyses of these samples reveal that these materials exhibit average clay mineral contents and plasticity limits. X-ray diffraction (XRD), X-ray fluorescence (XRF), Fourier Transform Infrared spectrometry (FTIR) and thermal (DSC/TG) analyses show the presence of quartz, feldspar (Ca-Na-K) and several clay minerals such as montmorillonite, kaolinite and illite [1,2,3]. Oxides contents range from 61-79% SiO₂, 10-17% Al₂O₃ and 2-6% Fe₂O₃. The low content of Fe₂O₃ coupled with the presence of the alkalis MgO+CaO+Na₂O+K₂O ($\leq 8.4\%$) place these raw clay materials in the range of materials suitable for the production of fired bricks [1, 2].

Keywords: clay materials, mineralogy, suitability, fired bricks.

References:

- [1] Yanne, E., Oumarou, A.A., Nde, B.D. and Danwe, R. (2018) Physico-Chemical and Mineralogical Characterization of Two Clay Materials of the Far North Region of Cameroon (Makabaye, Maroua). Advances in Materials Physics and Chemistry, 8, 378 386. <https://doi.org/10.4236/ampc.2018.89025>
- [2] Tsozué D., Nzeukou Nzeugang A., Mache J. R., Loweh S., Fagel N. (2017) Mineralogical, physico-chemical and technological characterization of clays from Maroua (Far-North, Cameroon) for use in ceramic bricks production. Journal of Building Engineering, 11, 17–24. <http://dx.doi.org/10.1016/j.jobe.2017.03.008>
- [3] Ntah - Kroll, Z. L E., Ossima, A., Mache, J. R. (2022) Mineralogical characterization of ethnographic ceramics from Bankim (Adamawa, Cameroon/ West Central Africa). TESSITURAS V10 N1 JAN-JUN 2022, Pelotas, RS

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EFFECT OF BOVINE BONE ON PHYSICAL PROPERTIES OF POROUS CERAMICS INTENDED FOR WATER FILTRATION

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At the global scale, 25% of the world's population lives in areas where water is physically scarce [1,2], and over one billion people live where water is economically scarce, or places where water is available in rivers and aquifers, but the infrastructure is lacking to make this water available to people [1]. In developing countries like Cameroon, the water treatment system is not secure, and most people do not have access to drinking or tap water. In order to satisfy their water needs, they generally used imported filters based on synthetic oxides such as alumina, mullite or cordierite membranes. Consequently, the high cost of production of such filters combined with the increase of marketing cost, tend to significantly limit their accessibility. In order to contribute to drinking water supply, the present work aims to produce and characterize high-performance and more affordable porous ceramics that can be used as filtration membranes. They are developed from kaolin clays (MY3 and KG) from West Cameroon [3] as main components and from bovine bone (OB) as pore-forming and fluxing agents [4]. Various proportions of agents ranging from 0 to 25wt.% have been investigated. Disc-shaped ceramic samples have been unidirectionally pressed under 12 MPa. The as-obtained samples were oven-dried at 40°C for 48h and 100°C for 24h, and then sintered at 1000°C and 1150°C for 2h. Different physical properties of the as-sintered porous ceramics were characterized: porosity and pore size measurements, mechanical resistance through 3points bending tests, BET specific surface area and identification of phases with XRD analyses. The results obtained showed an improvement of the mechanical properties with increasing OB content which is due to the reduction of pore volume faction. The open porosity varies between 35.40% (25% OB) and 45.82% (0% OB) whereas the flexural strength goes from 10.5±0.5 MPa to 2.1±0.5 MPa respectively. The average pore size ranges between 0.09 µm (0% OB) and 0.04 µm (25% OB), thus these membranes are suitable for micro and ultrafiltration applications. Physical properties (pH value, conductivity, turbidity, etc.) of filtrates obtained are in agreement with international and French standards. This study is part of a sustainable, responsible and multidisciplinary approach (recovering waste and local raw materials, depolluting water).

Keywords: kaolinitic clay, bovine bone, porous ceramics, mechanical properties, filtration

- [1] I. C. Escobar and A. I. Schafer, Ustainable water for the future: water recycling versus desalination., Elservier., vol. 2. Amsterdam: Elservier, 2010.
- [2] A. M. Khalil and A. I. Schäfer (2020) Cross-linked β -cyclodextrin nanofiber composite membrane for steroid hormone micropollutant removal from water, J. Memb. Sci., doi: <https://doi.org/10.1016/j.memsci.2020.118228>.
- [3] A. Njoya et al. (2006), Genesis of Mayouom kaolin deposit (western Cameroon), Appl. Clay Sci., 32, 125-140.
- [4] N. Saffaj et al. (2013), New bio ceramic support membrane from animal bone, J. Microbiol. Biotechnol. Res., 3, 1–6.

Please check the appropriate contribution:

Oral or Poster

DESIGN, MANUFACTURE AND EVALUATION OF HIGH PERFORMANCE WOOD FUEL IMPROVED COOK STOVES FROM GEORESOURCES AND BIOSOURCED MATERIALS

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ABSTRACT

Climate resilience is an important world challenge since many decades. As the primary use of wood fuel in the developing world is for cooking, it seems natural to establish mechanisms to make the combustion and transferal of heat from wood more efficient, thereby reducing the consumption and demand for wood. Based on recent studies on the technology of biomass cooking stoves and according to Clean Cooking Alliance (2022), there are many advantages for climate, nature and communities to the use of improved cooking stoves for cooking and warming. Replacing open fires or inefficient stoves with improved stoves both increases efficiency of fuel use and reduces pollution. It avoids emissions from forest degradation and slows deforestation, improves health, saves families money, and empowers women and girls by limiting time spent collecting firewood thus, enabling sustainable rural livelihoods. However, high performance wood fuel improved cook stove is a difficult task, especially for Central Africa where this technology is still less developed.

This work deals with conception, manufacture and thermal efficiency evaluation of wood burning fuel improved cook stoves using development minerals as common clays, kaolin and pozzolana (volcanic ash), and biosourced materials as wood sawdust and rice husks. These materials were selected and composed according to their insulation properties in order to have the better formulation for stoves. Following the Rocket Stove Design Principles, four wood fuel cook stove prototypes were proposed: two basic low cost ceramic monolayer stoves including one with insulated combustion chamber by adding porogene component (saw dust or rice husk) and two multilayer stoves with ceramic inner, metallic clad and pozzolanic mortar isolation. Based on Water Boiling Test and compared to three-stone open fire, our stoves performed thermal efficiency of 27-35 % and about 40-50 % fuel savings, enabling these stoves to save a minimum of 2.5 tons of CO₂ emissions annually.

The high performances fulfill the international standards of appropriated wood fuel improved cook stoves. It is concluded that the dissemination of these products will significantly reduce the wood fuel consumption and there for, contribute to climate resilience especially for Central Africa countries.

Key words: local materials, improved cook stoves, climate resilience

Please check the appropriate contribution: Oral or Poster

Study of the effects of artificial pozzolan obtained from rice husk ash on the hydraulic properties of Portland cement

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Abstract

In the present study, investigations were conducted on the possibility of using rice husk ash from Ndop as complementary cementitious materials. The rice husk ashes were calcined at 700°C then ground and sieved at 100µm. They underwent chemical analysis by infrared spectroscopy (FTIR) and by X-ray fluorescence and mineralogical by X-ray diffraction (XRD). The formulation of pastes and mortar were made by partially replacing portland cement with rice husk ash in varying percentages of 0%, 10%, 15%, 20%, 25% and 30%. The fresh pastes were tested to determine the initial and final setting time, the hardened mortars were characterized to have physico-mechanical properties. The results show that the initial and final setting time increased with the addition of CBR, which therefore played the role of setting retarder in the mixtures. The shrinkage of hardened mortars increased with CBR. The rate of water absorption and the apparent density of the specimens decreased when the percentage of addition of CBR increased in the mortars. The mortars presented good mechanical resistances except those containing 25% and 30% of CBR, the phenomenon of dilution caused by the partial replacement of the cement was responsible for the fall of the resistances with the addition of CBR it thus appears that the ashes rice husks can play a role in making portland cement.

Keywords: artificial pozzolan, Cement Portland, rice husk ash, calcination

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Please check the appropriate contribution: Oral or Poster

TITLE: Digital simulation of the fatigue behavior of flexible pavements using the finite element method with Cast3m sofware

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Abstract

The bad setting in work of the layers of pavements, the increase of the traffic and the authorized loads as well as the abundance of the precipitations constitute the main reasons the fatigue of the flexible pavements. But the action of the tires (braking), of the chemicals the garbage (garbage, urines...) and the ageing of the materials is not to disregard. As well as the heap of the plastic distortions of the layers of materials non bound. This survey enters in the global objective of the maintenance of the infrastructures, notably to predict and to warn the apparition of the potential messes being able to long-term to drive to an overtaking of the state limits of served or to a total or partial ruin of the work. A modelling and a calculation by the method of the elements finished are done, where the physical model takes in account a portion of pavement composed of a foundation layer according to the law of behavior elastic plastic Cam-Clay, a layer of basis constituted of the consolidated material and according to the model of FatSin (Fatigue Sinusoidal). The layer of rolling is a concrete bituminous models by a law viscoelastic. An imposed displacement is applied step-by- step on the layer of rolling, following a curve sinusoidal to reproduce the cyclic solicitation. The results descended of the simulations show that the behavior of the basis layer influences the global behavior of the pavement strongly in fatigue.

Key words: Shod, fatigue, simulation

November 28 , 2023, Yaoundé

Please check the appropriate contribution: Oral Poster

Geotechnical, physico-chemical and mineralogical characteristics of vertisols from the Far North (Cameroon): Potential valorization in the elaboration of low-carbon stabilized materials

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ABSTRACT

With the aim of contributing to the knowledge of georesources in the Sudano-Sahelian zone of Cameroon, with a view to their valorization, the vertisols of the localities of Yagoua (SY1), Djidoma (SDj) and Doubangou (SDo) in the Far North Region were the subject of this study. This study focused on geotechnical, physico-chemical and mineralogical analyses. Geotechnically, these materials are not very plastic for SY1 (Ip: 3.7) and SDo (Ip :6.4) and plastic for SDj (Ip :20.7), and have very low organic matter contents (< 1.5%) [1]. Determination of their swelling indices shows that these vertisols vary from slightly to moderately swelling (GI: 32-59%). Nitrogen adsorption by these samples exhibited specific surface areas of the order of 11.0 m²/g for SY1 and SDo and 1.3 m²/g for SDj. Chemical analysis revealed values of (58 - 78%) SiO₂, (8 -18%) Al₂O₃ and (1-6%) Fe₂O₃. X-ray diffraction (XRD), X-ray fluorescence spectrometry (XRF), Fourier Transform Infrared spectrometry (FTIR) and thermal analysis (DSC/TGA) showed that the vertisol samples consisted mainly of montmorillonite, kaolinite and illite as clay minerals and quartz, feldspars, goethite and anatase as accessory minerals [2].

Keywords: Vertisols, mineralogy, organic matter, swelling index

References:

- 1- Tsozué D., Nzeukou Nzeugang A., Mache J. R., Loweh S., Fagel N. (2017) Mineralogical, physico-chemical and technological characterization of clays from Maroua (Far-North, Cameroon) for use in ceramic bricks production. *Journal of Building Engineering*, 11, 17–24. <http://dx.doi.org/10.1016/j.jobe.2017.03.008>.
- 2- Yanne, E., Oumarou, A.A., Nde, B.D. and Danwe, R. (2018) Physico-Chemical and Mineralogical Characterization of Two Clay Materials of the Far North Region of Cameroon (Makabaye, Maroua). *Advances in Materials Physics and Chemistry*, 8, 378 386. <https://doi.org/10.4236/ampc.2018.89025>.
- 3- Mache J.R., Signing P., Njoya A., Kunyukubundo F., Mbey J.A, Njopwouo D. and Fagel N. (2013). Smectite clay from Sabga deposit (Cameroon): Mineralogical and Physicochemical Properties. *Clay Minerals*, (48), 499 – 512.

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Please check the appropriate contribution: Oral or Poster

Characterization of a metakaolin-based geopolymer mortar and marble reinforced with plant fibers from Nero Peltis Accuminate Djik

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Abstract

Geopolymer mortar based on metakaolin and marble, reinforced with vegetable fibers of nero peltis accuminata djik pussa (NPADP) are evaluated. The raw materials used were Kaolinite clay, marble and NPADP fibres. The alkaline solution used was obtained by mixing sodium silicate and sodium hydroxide (NaOH) at a molarity of 10 M. The metakaolin resulting from the activation of the clay at 750°C was substituted at 45% by the marble and the formulation of the mortars was made according to an activator solution/powder mass ratio of 0.78 with the addition of 0%, 0.5%, 1%, 1.5% and 2% of the fibers of NPADP. The characterization of the raw materials was carried out and the physico-mechanical properties of the mortars were determined at 7 and 28 days. The results obtained for the characterization of the treated fibers show an average section of the fibers of 0.0937 mm², with an absolute density of 1.956 g/cm³. Their breaking stresses are 42 Mpa for a Young's modulus of 843.75 Mpa. According to chemical analysis, they contain 24% lignin and 39.60% hemicellulose and metakaolin exhibits amorphous phases. The results of the physical characterization of geopolymer mortars show that the high fiber absorption rate contributes to the increase in the porosity of the mortars, thus reducing their apparent densities with the increase in the fiber rate. The mechanical characterization reveals that the incorporation of the fibers in the geopolymer cement mortar improves its mechanical properties and the maximum resistances in bending in compression are respectively 6.188 MPa and 13.792 MPa for a percentage of incorporation of the plant fibers of NPADP of 1.5%.

Keywords: geopolymer mortar , plant fibers, activating solution, mercerization , characterization.

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Please check the appropriate contribution: Oral or Poster

Influence of different metakaolins mixture on the geopolymers properties

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Abstract

Environmental impact related to the energy consumption of materials has led to the development of more environmentally friendly materials such as geopolymers. Geopolymers are obtained by activating an aluminosilicate source with an alkali silicate solution at room temperature. These materials develop interesting properties (mechanical strength, thermal resistance, low thermal conductivity, etc.) depending on the choice of precursors. Several studies have been carried out on the synthesis of geopolymers with different aluminosilicate sources in relation with their properties. However, the control of the reactivity of metakaolin mixtures remains poorly understood. The objective of this work is to investigated the reactivity of different metakaolin mixtures on the geopolymers properties.

Formulations of geopolymers were selected within a ternary of different metakaolins. The reactivity of the different metakaolin mixtures was highlighted by physicochemical and structural characterization techniques (zeta potential, wettability, ²⁷Al NMR spectroscopy and X-ray diffraction). Afterwards, the geopolymerisation reactions of formulations was investigated from the fresh to the consolidated state with various techniques (infrared spectroscopy (FTIR), thermal analysis (DTA) and viscosity, water content, amorphous content) and the properties such as, mechanical strength and extrusion workability.

Whatever the mixture, the results show that, it's the aluminum moles number which governs the geopolymers properties. The viscosity of the mixtures shows that the setting time of the pastes is shorter for the geopolymers containing more reactive aluminum. The structural data indicates an increase of the Si/Al ratio from 1 to 1.7 in relation with heterogeneous networks displaying a lower amorphous content.

Keywords: geopolymer, properties, aluminosilicate, metakaolin, viscosity

Please check the appropriate contribution: Oral or Poster

INFLUENCE DE LA CRYSTALLINITE ET DES FRACTIONS ARGILEUSES SUR LE MECANISME DE DESHYDROXYLATION SOUS GRADIENT THERMIQUE DE DEUX KAOLINITES FAIBLEMENTS CRISTALLISEES

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Abstract

Les produits céramiques sont fabriqués en faisant des mélanges contenant des matériaux argileux qui interagissent à haute température pour donner un produit final. Leur fabrication nécessite donc la compréhension d'un des processus clés de la transformation en phase solide dans les céramiques qui est la deshydroxylation des minéraux argileux, notamment la kaolinite. Dans cette étude, la deshydroxylation de deux argiles de type kaolinitique nommées KG et MY3 a été étudiée par la méthode de Coat Redfern en utilisant l'analyse thermogravimétrique. Les diffractions des rayons X ont montré que la kaolinite KG a une cristallinité de 16 %, tandis que la cristallinité de la kaolinite MY3 est de 53 %. L'argile KG est de type argileuse (particules de tailles inférieures à 2 µm), tandis que MY3 est de type sablo-alumineux. Les structures de ces kaolinites sont désordonnées et elles présentent des lacunes atomiques faisant en sorte que les deux kaolinites subissent une deshydroxylation par des processus de diffusion. La modélisation montre que le mécanisme de deshydroxylation de la kaolinite KG est d'ordre 1, donc, sa deshydroxylation dépend de la concentration en groupe hydroxyle et des sites présents dans la structure cristalline. Alors que pour MY3, la présence de la fraction sableuse rend difficile la modélisation en une étape, la diffusion se subdivise en deux étapes de mécanisme d'ordre 1. Dans MY3, la deshydroxylation n'est alors fonction que du nombre de groupes hydroxyles présents. Les résultats montrent aussi que les processus de diffusion de ces argiles sont influencés par les fractions sableuses qui augmentent l'énergie d'activation de la deshydroxylation. Aussi, une plus grande cristallinité de la kaolinite augmente l'énergie d'activation et ralentit le processus de deshydroxylation de la kaolinite. Ces observations permettent ainsi d'adapter en conséquence le cycle de cuisson de la céramique afin de répondre aux exigences du produit recherché.

Keywords: Dehydroxylation, Coats-Redfern, Kinetics, Diffusion, clays

Please check the appropriate contribution:

Poster

Alkaline and acid activations of calcined laterites: a comparative study

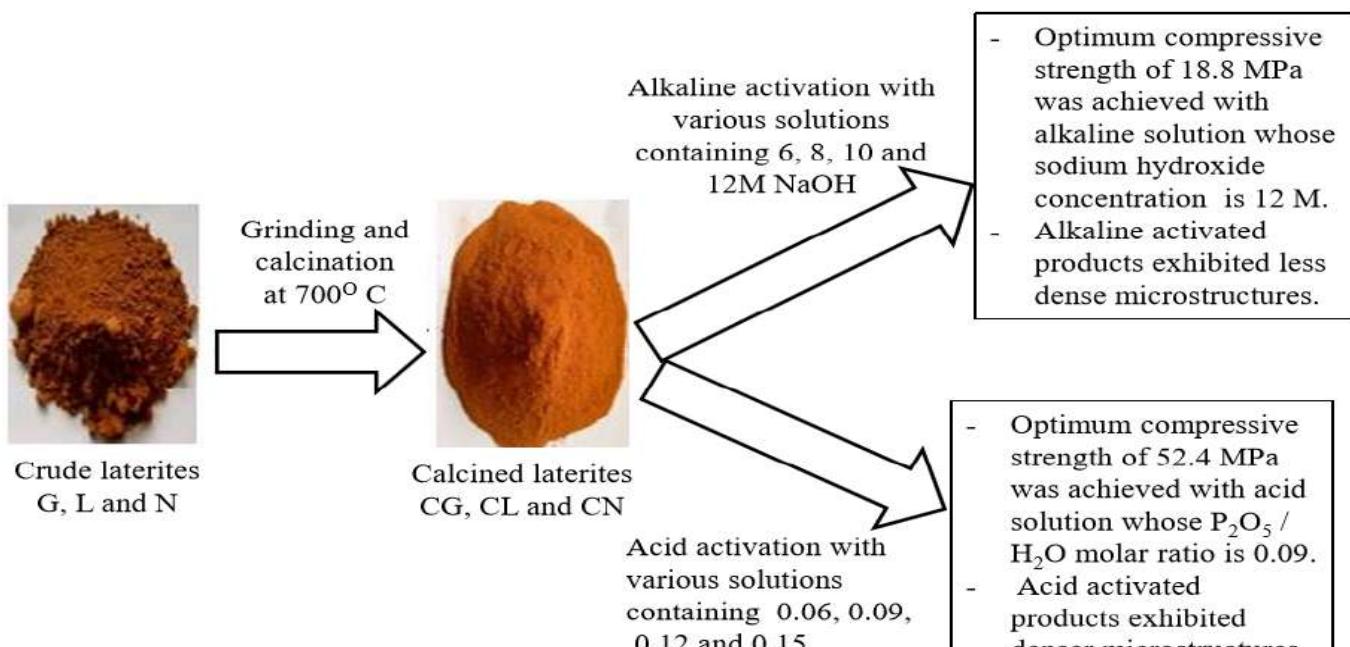
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Abstract

In order to improve the characteristics of natural laterites for earth building issues, activation of three laterite samples calcined at 700° C were carried out in both alkaline solutions of constant SiO₂ / Na₂O molar ratio of 1.4 and in phosphoric acid of various P₂O₅ / H₂O molar ratios (0.06 to 0.15 respectively). Depending on the natural or the calcined laterites along with their activated products, X-Ray Diffraction (XRD), Fourier Transform Infrared (FTIR) spectroscopy, Scanning Electron Microscopy (SEM), compressive strength, water absorption, bulk density and Strength Retention Coefficient (SRC) were performed. Optimal compressive strengths were achieved respectively in alkaline solution whose sodium hydroxide concentration was 12M and in phosphoric acid with P₂O₅ / H₂O molar ratio of 0.09. Compressive strength of the products ranged between 2.0 and 18.8 MPa (alkaline media) and between 18.9 and 52.4 MPa (phosphoric acid media). On soaking in water, they was a 31.9 % decrease in compressive strength for the alkaline activated products as compared to 20.6 % for their acidic activated counterparts. To get better earth building materials, activation of calcined laterites is more effective in phosphoric acid than in alkaline medium. In fact, contrarily to alkaline medium that is mostly concerned with metakaolin, phosphoric acid allows an additional activation with certain oxides contained in calcined laterites.



Keywords: Calcined laterite, Alkaline activation, Acid activation, Inorganic polymers, Comparative study

Please check the appropriate contribution: Oral or Poster

ETUDE DE LA STABILISATION DES SOLS A L'AIDE DE LA CHAUX ET DU CIMENT : CAS DE LA ZONE DE PK 21

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RESUME

L'objectif de cette étude est de stabiliser un sol avec la chaux et le ciment. Les essais ont été réalisés pour déterminer et identifier les caractéristiques physiques de ce sol. Les résultats obtenus de ces essais ont donné : pour la teneur en eau naturelle moyenne 14,62%, le poids spécifique 2,623T/m³, l'analyse granulométrique : 17.7% de sable, 49,6% de limon, 32,7% d'argile donc nous avons à faire à un sol sableux argileux. Les limites d'Atterberg ont données 41,5% de limite de liquidité, 25,2% de limite de plasticité, 16,3% d'indice de plasticité. L'essai Proctor normal a donné 10,70% de teneur en eau optimale 1,934g/cm³ de densité sèche maximale. Le CBR après immersion a donné 13,70%. Après immersion des éprouvettes le taux d'absorption est de 12,00% au dosage 2/10 de chaux et de ciment. Les résultats obtenus montrent que les dosages à 8% de ciment et 4% de chaux sont optimaux. Le meilleur résultat est obtenu pour l'échantillon 4/8 qui correspond à 4% de chaux et 8% de ciment. Une petite quantité de chaux (par exemple 2%) peut transformer notre sol quasi non-cohérent en un sol cohésif.

Mots clés : éprouvette de sol stabilisée, chaux, ciment,

REFERENCES BIBLIOGRAPHIQUES

- [1] M. bayat et Asgari 'Effect of cement and lime treatment on geotechnical properties of a low plasticity clay', 2013.
- [2] Salem Islam et Laoubi Oussama, " Caractérisation d'une argile expansive faiblement traitée par différents types de ciment et reconstituée à faible énergie de compactage » thème de Master soutenu à l'université Mohamed Boudiaf – M'Sila, p.89, 2004.
- [3] Khemisa and Mahamedi 'Cement and lime mixture stabilization of an expansive over consolidated clay' ACS Elsevier 2014.
- [4] J.C. Ndoumou Ndogsa, "Stabilisation au ciment et à la chaux des graveleux latéritiques sur schistes de la région d'Ayos (centre - Cameroun) : application en géotechnique routière" Mémoire de Master en Sciences de la Terre, soutenu à l'université de Yaoundé I, p.81, 2017.

Please check the appropriate contribution: Oral Poster

Mise sur pied d'un processus de stabilisation éco-responsable des chaussées du Cameroun

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Résumé

Les études menées sur les chaussées routières en Afrique Sub-Saharienne et particulièrement au Cameroun ont révélé des endommagements sévères, précoces et coûteux pour l'état et les usagers (Koubikana 2013). De plus ces observations ont mis à jour les limites des outils utilisés pour la conception structurale des routes et la calibration des matériaux utilisés. Il s'est avéré nécessaire d'apporter une contribution dans la recherche de solutions à cet échec. De ce fait, la nécessité de mettre sur pied un processus de conception et d'utilisation des matériaux disponibles localement pour la stabilisation des chaussées à travers l'application de la technologie des géopolymères est une impérative. La solution alcaline obtenue à partir des cendres de balles de riz et la soude (Venite et al. 2021) sera mélangé avec la latérite, argile, pouzzolane, cendres de déchets agricoles et alumino-silicates riches en silice, fer et aluminium pour la stabilisation des couches de chaussées. La résistance à la compression de la couche de base varie entre 2,71 et 13,57 MPa à 28 jours après stabilisation. Les propriétés mécaniques des matériaux composites (Sontia et al. 2021) obtenus seront utilisées pour le dimensionnement en utilisant la théorie des multicouches afin de déterminer les épaisseurs des différentes couches de chaussées à mettre en oeuvre.

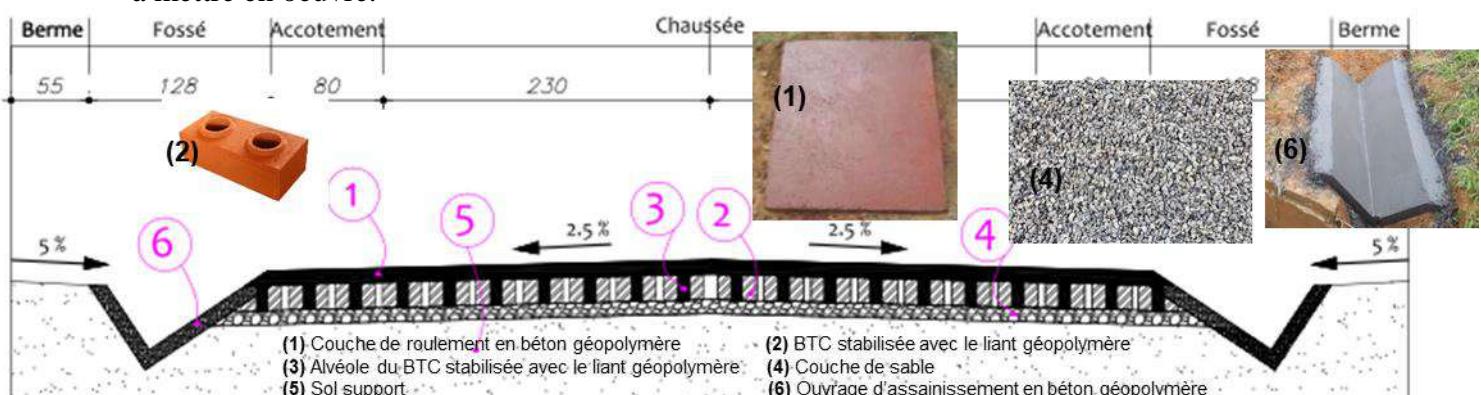


Figure 1: Modèle de disposition de couches de chaussées proposé avec ancrage sur le profil en travers de la chaussée

Keywords: Latérite, cendres de balles de riz, liant géopolymère, Chaussées, Théorie des multicouches

References:

Koubikana Pambou Claude Hugo, 2013, Développement d'un catalogue de conception des chaussées pour les pays sub-sahariens, Mémoire de Maîtrise en Génie Civil, Montréal, École de technologie supérieure, 171 p.

Venite, Paul, Eugene Charles Makone, Rodrigue Cyriaque Kaze, Achille Nana, N J G Deutou, Elie Kamseu, M U Chinje, and Cristina Leonelli. 2021. "Effect of Combined Metakaolin and Basalt Powder Additions to Laterite-Based Effect of Combined Metakaolin and Basalt Powder Additions to Laterite-Based Geopolymers Activated by Rice Husk Ash (RHA) / NaOH Solution," no. February. <https://doi.org/10.1007/s12633-021-00950-7>.

Sontia, M. J. V., R. C. Kaze, G. J. Deutou, P. Venite, A. Nana, E. Kamseu, U. Chinje, and T. T. Tamo. 2021. "Evaluation of Performances of Volcanic-Ash-Laterite Based Blended Geopolymer Concretes : Mechanical Properties and Durability." Journal of Building Engineering 34 (August 2019): 12p. <https://doi.org/10.1016/j.jobe.2020.101935>.

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November 28 – December 1, 2023, Yaoundé

Please check the appropriate contribution: Oral or Poster

TITLE: Characterization of a geopolymers based on calcined shell substituted for oyster shell powder

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Abstract

This study consisted the characterization of a geopolymers based on calcined clay substituted by oyster shell powder. The raw materials (clay; oyster shell;) were characterized by determining their chemical and mineralogical compositions; particle size distribution; specific surfaces; their thermal analyses; then used for the synthesis of geopolymers by substituting calcined clay at 5; 15; 25; 50% by oyster shell powder. Analytical techniques such as Fourier Transform Infared Spectroscopy; X-Ray Powder Diffractometry, the physicals and mechanics analyses have been used to elucidate the evolution of linear shrinkage, onset time and strength.s Compression of synthesized cement pastes. The results obtained show that the oyster shell is rich in Al₂O₃ and CaO₃ and contains crystalline phases. Geopolymers of formulations obtained from metakaolin-oyster shell mixtures, onset times setting vary between 70 and 202 min and the compressive strengths between 39 and 45 MPa. It appears from this study that the addition of 25 oyster shell powder increases the compressive strength by 39.13 MPa. At 44.60 MPa. At 28J and bending from 3.96MPa to 4.66MPq at 28d of geopolymer cements but also leads to a considerable drop in linear shrinkage. Beyond this last percentage of substitution, the compressive strength decreases drastically from 44.60 MPa to 44.64 MPa , at 28 days and to bending from 4.6 MPa to 3.34 MPa; the time of taken also, the degree of absorption including.

Keywords: Geopolymers, Calcined clay, substitute, oyster shell powder

References:

- [1] Yoon H., Park S., Lee K., Park J., « Oyster shell as substitute for aggregate in mortar », Waste Manage Research 22, (2004) p 158–170.
- [2]. Davidovits J., Geopolymer Chemistry and Applications, second edition, Institut Géopolymère, Paris, 2008.
- [3]. J. Davidovits, Synthetic mineral polymer compound of the silico-aluminates family and preparation process, 1985, molded articles containing such polymer compound and production process thereof, Patent n° EP 0 066 571 B1.

Please check the appropriate contribution: Oral or Poster

POTATO AND ORANGE PEELS POWDER TO PRODUCE GEOPOLYMERS BASED ON IRON RICH CLASS C-FLY ASH: CONTROLLED EFFLORESCENCE AND MECHANICAL- MICROSTRUCTURAL PROPERTIES

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Abstract

This work studies the potential of potato peels powder (PPP) and orange peels powder (PPO) on the physicomechanical, chemical and microstructural properties of geopolymers obtained by alkaline activation of an iron-rich class C fly ash (FA) at room temperature. The chemical composition of PPP and PPO was determined by X-ray fluorescence. The optimization was done by the substitution of 5%, 10%, 15% and 20% of the FA with PPP on the one hand and PPO on the other hand different. Properties such as density, porosity, water absorption and compressive strength were then characterised. The results indicate a better performance for a substitution of 10%. The strength is improved by 54.5% for PPP-containing geopolymers and 28.86% for PPO-containing geopolymers. There is also a very significant decrease in efflorescence which is even greater with samples containing PPO. As chemical and microstructural characterization is underway, we hope to observe the formation of new ferrosialate bonds caused by the presence in volcanic slag of a significant amount of iron oxide.

Keywords: geopolymer, alkali-activated ,Orange and potato peels, efflorescence.

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Please check the appropriate contribution:

X Poster

Elaboration doped TiO₂ for water photodecontamination

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Abstract

Titanium dioxide is largely used in the field of photocatalysis for water purification under visible light irradiation. The advantages of TiO₂ as a photocatalyst are the high photocatalytic activity long-thermochemical stability, non-toxicity, low cost, inertness, etc. However, the applications of TiO₂ in the domain of photocatalysis is limited as TiO₂ is activated only under UV light (which represents about 5% of the sunlight spectrum) due to its large band gap (3.2ev). In addition, the rapid recombination of charge carriers (e-/h+) which is in competition with the photogeneration of this pair decreases the photocatalytic efficiency of TiO₂. To limit these challenges, previous studies have shown the value of TiO₂ in nanoscale form and the effect of doping on photocatalytic activity. This allows to have a large surface/volume ratio and to limit the recombination of photogenerated charges.

In our studies, we are focused on the modification of the properties of TiO₂ with additions of LiF and Mo, for the improvement of its photocatalytic applications under visible light. Two ways of powders synthesis have been used, by flash combustion method and by solid state reaction and grinding with different amounts of dopant. The structural and microstructural characterizations of powders are carried out by X-ray diffraction (DRX), thermogravimetric analysis (TGA), differential scanning calorimetry (DSC), scanning electron microscopy (SEM), elemental analysis by (EDS), measurement of the specific surface by (BET), laser granulometry and by thermodilatometry. These characterizations will allow us to compare the physicochemical properties of powders in order to evaluate their photocatalytic properties. The photocatalytic activity, on the degradation of methylene blue (MB), of our powders are good as shown in fig1.

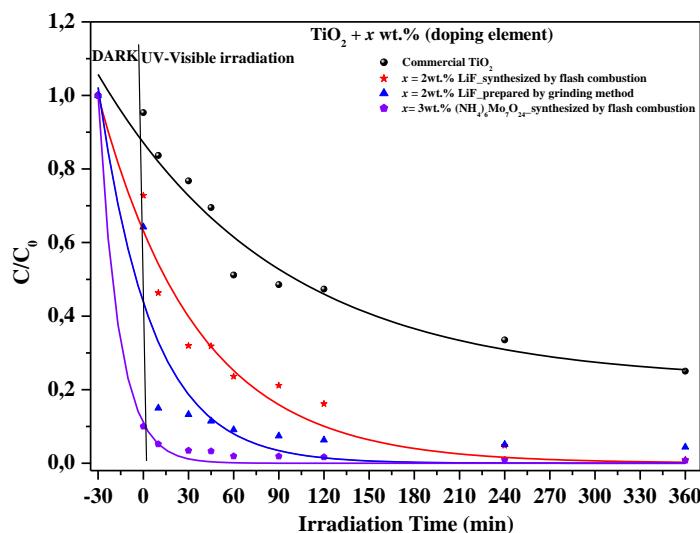
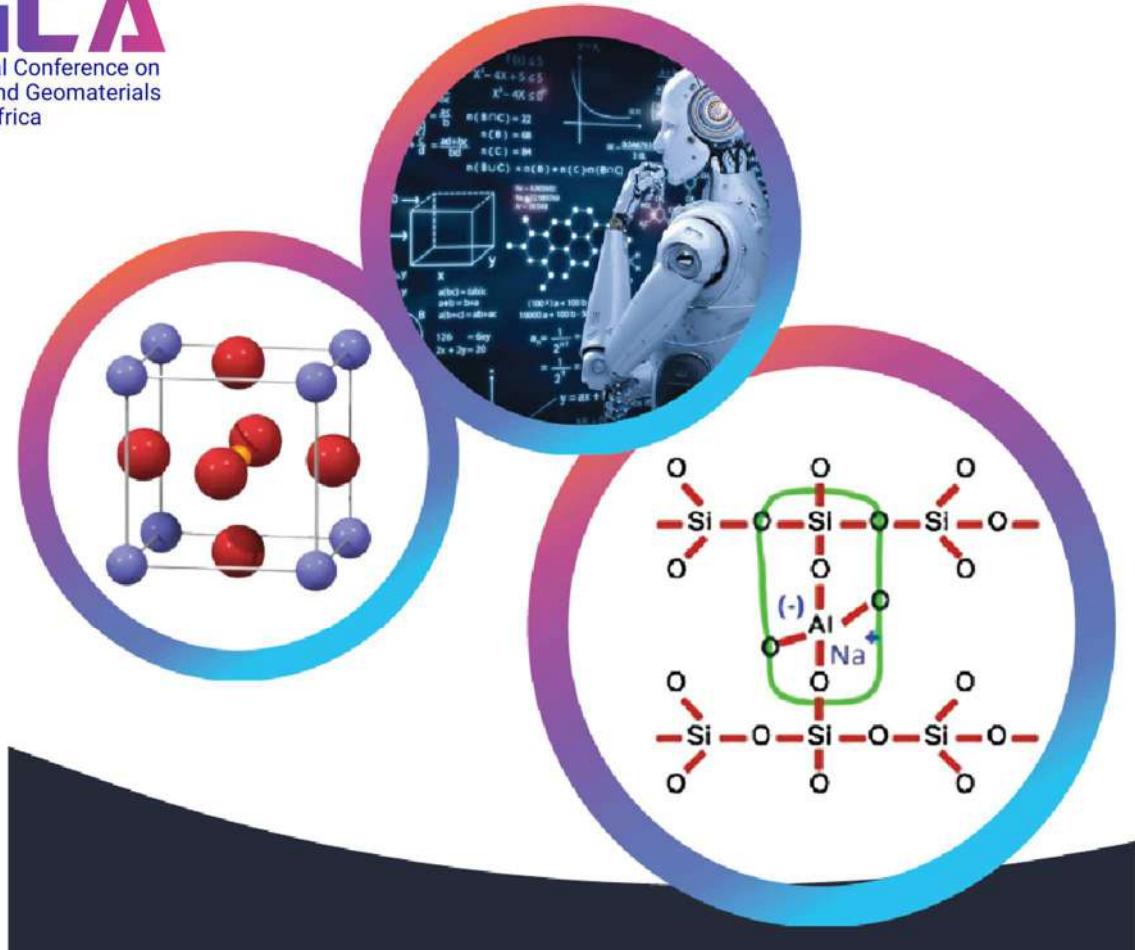


fig1 : MB conversion over time

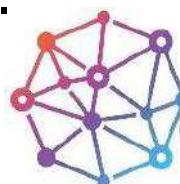
Keywords : TiO₂, Flash combustion, photocatalysis, water treatment

Corresponding author: David Houivet, david.houivet@unicaen.fr

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