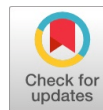


Evaluation of the Geotechnical and Mineralogical Properties of the Clay of the Locality of Leboulou

Banzouzi Samba Vivien Igor, Dimouangana Zita Flora, Vezolo Stanislas Prudence, Mbendi Mpingui, Maniongui Kris Berjovie, Moutou Joseph-Marie



Abstract: This work aims to valorise clay sourced from Leboulou, Kimbangou District, Niari Department, southeastern Congo. With this in mind, we determined the mineralogical, physicochemical, thermal, and geotechnical properties of this clay. To achieve the expected results, several techniques were employed, including X-ray diffraction, Fourier transform infrared spectroscopy, gravimetric and differential thermal analyses, scanning electron microscopy, ICP-AES chemical analysis, Atterberg limits, particle size analysis, and cation exchange capacity. Mineralogy reveals that Kaolinite is the only clay species present in this clay, associated with quartz, with a kaolinite-to-quartz ratio of 88.37% to 11.63%, respectively. The geotechnical properties indicate that LEB can be compared to a very plastic clay and loamy soil, with a plasticity index of 26.6 and 58% fine particles (less than 2 microns). Given these properties, LEB cannot be used for the applications proposed by WINKLER; it would be necessary to add a material with fewer fine particles, such as sand. Chemical analysis reveals that the dominant minerals in this clay are aluminium and silicon oxides. A ratio of $Al_2O_3/SiO_2 = 0.6$ will limit the use of LEB in pottery and earthenware. It could also be used in the manufacture of geopolymers and as an ingredient in paint production.

Keywords: Clay, Valorization, Mineralogy, Geotechnical, Physico-Chemical, Thermal.

Nomenclature:

DRX: X-ray Diffraction

FTIR: Fourier Transform Infrared Spectroscopy

ICP-AES: Inductively Coupled Plasma Atomic Emission Spectroscopy

LEB: Clay from the Locality of Leboulou

ATR: Attenuated Total Reflectance

CEC: Cation Exchange Capacity

IRSEN: National Institute for Research in Exact and Natural Sciences

LOUK: Loukolela

MO: Organic Matter

TGA: Thermogravimetric Analysis

DTA: Differential Thermal Analysis

UQTR: University of Quebec in Trois-Rivières

I. INTRODUCTION

Clays are rocks mainly composed of more or less hydrated aluminosilicates (aluminosilicates), also called phyllosilicates [1]. Pure clays do not exist [2], mineralogically they exist in the form of rocks formed from mixtures of clay minerals, to which minerals are associated allogenic (quartz, feldspars, micas, heavy minerals) or authigenic (anatase, sulfates, etc.) [3]. They constitute the most abundant class of sedimentary rocks and are the main constituents of soils. They are also formed of particles of the size of a micron. Knowledge of clay minerals began to be known thanks to particular techniques: differential thermal analysis, especially X-rays, allowing the determination of the structure of minerals and electron microscopy [3]. In this context, a characterization program of the different clay soils present in the Republic of Congo was initiated by the Ministry of Plans for the five-year plan of 1980 [1]. Several soils, such as the soil of Loutété [1], Mouyondzi [4], londéla-kaye [3], and Dolisie [5], found their interests in this plan of the Ministry of Plans.

In the locality of Leboulou, on the banks of the Jordan River, there is a deposit of white clay used by the natives as paint. The use of this soil in painting is done in an artisanal and precarious way; no other use of this clay has been observed. The observation of buildings painted with this clay reveals uncontrolled variations in quality due to the lack of appropriate means and techniques. All this is favoured by the lack of geotechnical, physicochemical, and mineralogical information on this clay.

This study was conducted to determine the potential of clay collected in the locality of Leboulou, in the district of Kimbangou, in the department of Niari, in the south-east of Congo, which has not yet been identified. This work aims to determine the physicochemical, geotechnical, and mineralogical characteristics of this clay to optimise its various uses.

II. MATERIALS AND EXPERIMENTAL METHODS

A. Sampling

The sample tested in this work is a soil sample taken in the locality of Leboulou, district of Kibangou,



Manuscript received on 23 September 2025 | Revised Manuscript received on 05 October 2025 | Manuscript Accepted on 15 October 2025 | Manuscript published on 30 October 2025.

*Correspondence Author(s)

Banzouzi Samba Vivien Igor, Department of Chemistry, Faculty of Applied Sciences, Denis Sassou N'guesso University, Brazzaville, Congo, Republic, Email ID: vinzsamba@gmail.com, ORCID ID: [0009-0003-3959-9583](https://orcid.org/0009-0003-3959-9583)

Dimouangana Zita Flora, Department of Chemistry, Higher Normal School, Marien Mouabi University, Brazzaville, Congo, Republic, Email ID: florajullic@gmail.com

Vezolo Stanislas Prudence*, Department of Chemistry, Laboratory of Mineral and Applied Chemistry, Marien Mouabi University, Brazzaville, Congo, Republic, Email ID: stan01vezolo@gmail.com, ORCID ID: [0009-0008-6870-5716](https://orcid.org/0009-0008-6870-5716)

Mbendi Mpingui, Department of Chemistry, Laboratory of Mineral and Applied Chemistry, Marien Mouabi University, Brazzaville, Congo, Republic, Email ID: mbedismill@gmail.com

Maniongui Kris Berjovie, Department of Chemistry, Laboratory of Mineral and Applied Chemistry, Marien Mouabi University, Brazzaville, Congo, Republic, Email ID: stanconception@gmail.com

Moutou Joseph-Marie, Department of Chemistry, Laboratory of Mineral and Applied Chemistry, Marien Mouabi University, Brazzaville, Congo, Republic, Email ID: moujomasba@gmail.com

© The Authors. Published by Lattice Science Publication (LSP). This is an open-access article under the CC-BY-NC-ND license <http://creativecommons.org/licenses/by-nc-nd/4.0/>

Evaluation of the Geotechnical and Mineralogical Properties of the Clay of the Locality of Leboulou

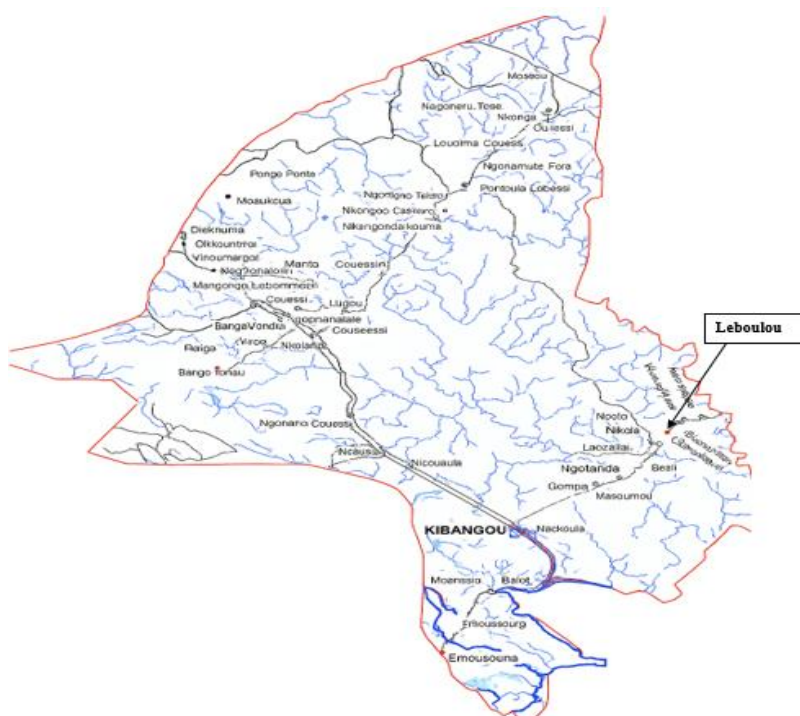
department of Niari, Congo Brazzaville, 4 kilometres north of the right bank of the Niari River and about 80 kilometres north of Dolisie, on the national road N°3 leading to the

border with Gabon. The sampling was conducted at a depth of about 1 meter along the banks of the Jordan River.

The following figures show the location of the study area.



[Fig.1: Location of LEBOULOU on the Map of CONGO]



[Fig.2: Map of the KIBANGOU District]

The following table gives the geographic coordinates of the study area

Table I: Geographic Coordinates of the KIBANGOU District

Longitude	X = 12°27'41,22"
Latitude	Y = -3°28'27,084"

B. Geotechnical Properties

The geotechnical properties of the material were determined by granulometric analysis and by Atterberg limits. The granulometric analysis was carried out by

humic sieving and gravity sedimentation using Stokes' law. The manipulation was carried out at the Analytical Chemistry laboratory at IRSEN (Pointe-Noire Science City). The Atterberg limits were determined at the Soil Analysis Laboratory of the Building and Public Works Control Office (BCBTP) in accordance with standard NF P 94-051[4].

C. Mineralogical Studies

XRD, FTIR, and SEM were used for mineralogical analysis. The XRD and FTIR are performed at the DuongLab Laboratory, Department of Chemistry, Biochemistry and Physics, at UQTR in Canada, and the SEM at the laboratory AARON KLUG CENTRE FOR IMAGING AND ANALYSIS ELECTRON MICROSCOPE UNIT at the University of CAPE TOWN in SOUTH AFRICA. The instrument used is a FEI Nova NanoSEM 230. XRD measurements were performed on a Bruker D8 diffractometer in Bragg-Brentano geometry using CuK α radiation. Data were recorded over a range of 10° to 70° with a step size of 0.006° and a fixed divergence slit of 0.3°. IRFT was performed on a Thermo Scientific Nicolet iS10 FTIR spectrometer. LEB (solid and sol-gel state) was ATR by mounting an ATR unit in the sample compartment of the spectrometer. The spectrum was recorded over 500-4500 cm⁻¹ with a spectral resolution of 0.5 cm⁻¹.

D. Chemical Composition

Chemical properties were determined by chemical analysis, organic matter quantification, and CEC. ICP/AES was performed at the Demo-Centre laboratory at the University of Modena (Italy). The CEC test and the determination of organic matter quantity were carried out at the Analytical Chemistry laboratory (Pointe-Noire Science City), at IRSEN. For the amount of organic matter, we used the method DUMAS. The device used is the brand NA 1500 series 2 CARLO-ERBA, Thermo Electron. Data processing was performed using BORWIN software (1994), version 1.22, VARIAN-JMBS, under Windows 95.

III. RESULTS

A. Granulometric Analysis

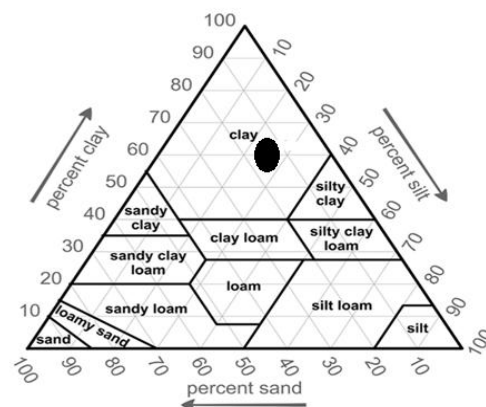
The results of the particle size distribution of Le Boulou clay are reported in Table II.

Table II : Granulometric Analysis of LEB

MATERIALS	Clay < 2 μ m	Fine silts (2-20 μ m)	Coarse silts (20-50 μ m)	Fine sands (50-200 μ m)	Coarse sands (200 - 2000 μ m)
LEB	58.00%	20.50%	3.90%	10.05%	5.44%

LEB consists of 15.19% sand, 24.4% silt, and 58% clay. The presence of characteristic quartz peaks in the DRX diffractogram confirms the relatively high sand content.

The results of the granulometric analysis allowed us to place LEB in the Soil Survey Manual diagram (Figure 3). This diagram classifies soils by texture. LEB is found in clayey soils. Compared with the results of the Dolisie clay studied by OBA and all in 2022 [5], the granulometry of LEB does not allow it to be used in the manufacture of refractory materials.

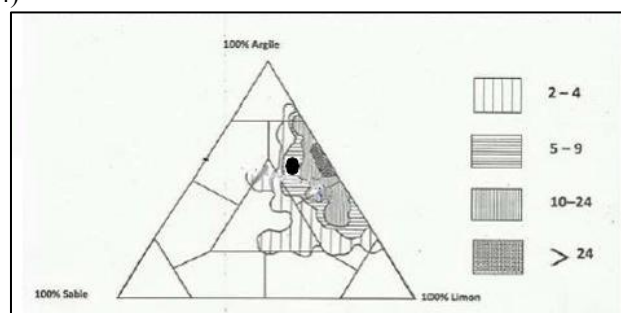


[Fig.3: Soil Survey Manual Diagram [1]]

Dondi et al. define four zones based on the frequency of use of Italian clays in the manufacture of ceramics.

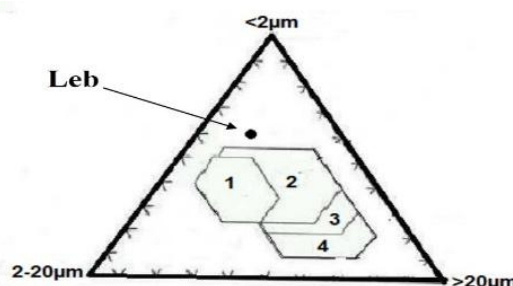
- Area of very high frequency of use (>24);
- High frequency of use area (10-24);
- Average frequency of use zone (5-9);
- Low frequency of use area (2-4)

LEB, according to its granulometry, is in the zone of average frequencies of use in the ceramic industries (Figure 4)



[Fig.4: Shepard diagram [1]]

The WINKLER diagram (figure 5) indicates the nature of the terracotta product depending on the granulometric composition of a soil.



[Fig.5: Winkler Diagram [1]]

From this diagram, we can conclude that our clay cannot be used in the proposed applications by WINKLER; it would be necessary to add a material less rich in fine particles, such as sand with well-defined granulometry.

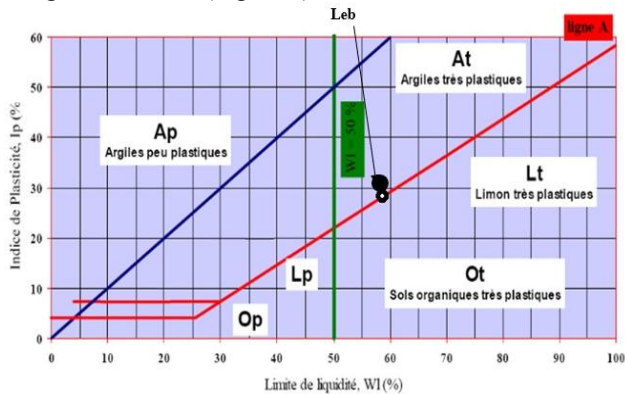
B. Atterberg Limits

The following table presents the results of the Atterberg Limits

Table III : Atterberg Limit Contents

Liquidity limit (%)	Plastic limit (%)	Plasticity index (%)
56	29.40	26.6

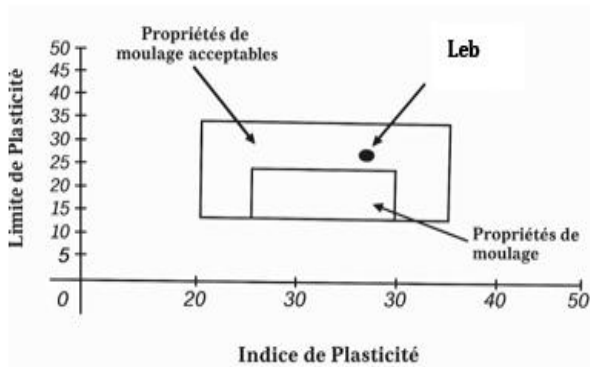
These results made it possible to position LEB in the Casagrande abacus (Figure 6)



[Fig. 6: Casagrande Abacus [5]]

The results of the Atterberg limits (liquid limit and plasticity index) for the LEB soil, plotted on the CASAGRANDE diagram, indicate that LEB can be classified as a very plastic clayey-silty soil, with a plasticity index of 26.6. This plasticity of the LEB sample could be explained by its appreciable clay content, as observed in the granulometric analysis (58%). This high plasticity would make parts made from this soil more difficult to dry and, on the other hand, would reduce wear on the grinding and shaping equipment. It is also associated with bodies presenting a greater resistance to compression [6]

The moulding properties of our clay can be estimated using the moldability map (Figure 7)



[Fig.7: Formability Map [5]]

The studied material exhibits acceptable moulding properties.

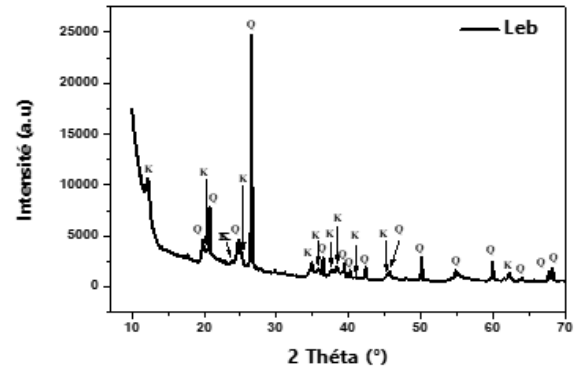
The nature of LEB prevented the use of the Proctor test for optimal density measurements. LEB, rich in the clay fraction, proved unsuitable for conducting the test [5].

C. Residual Humidity

The non-hygroscopic character of this clay explains the low value of residual humidity [6]. This indicates that the LEB is made up of non-swelling clay minerals of class 1:1, represented by kaolinite

D. DRX

The following figure shows LEB's DRX diffractogram



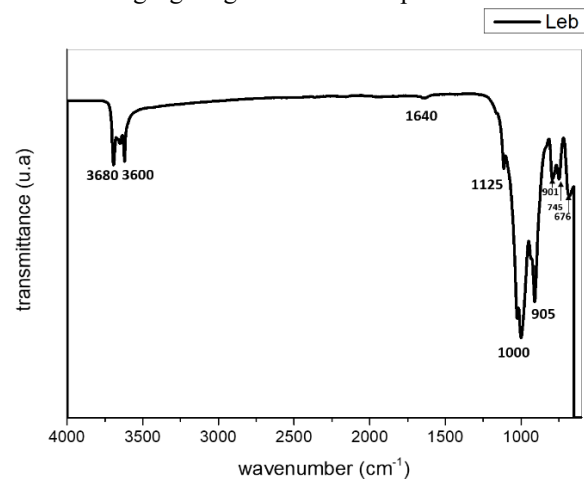
[Fig.8: DRX Spectrum of LEB]

It is clear from this diagram that the clay species in our sample is kaolinite. Its presence is reflected by the observation of peaks at $2\theta = 13^\circ$; 20.131° ; 23.07° ; 24.6° ; 25.08° ; 35.66° ; 37.558° ; 38.169° ; 45.289° ; 62.106° , with the peak at 13° as a harmonic. This clay species is not pure; it is associated with quartz. This quartz is identified by peaks at $2\theta = 19.656^\circ$; 20.72° ; 24.69° ; 26.51° ; 36.39° ; 39.36° ; 40.10° ; 42.26° ; 45.79° ; 50.06° ; 54.85° ; 60.00° ; 62.28° ; 63.91° ; 67.09° . The angular value of the first harmonic is. The high intensity of the peaks characteristic of quartz compared to the peaks of kaolinite; this is explained by the fact that quartz appears better crystallized than kaolinite.

The Republic of Congo, with its humid tropical climate, favours very advanced alteration, leading to the production of 1:1 clay species, and most clay deposits are predominantly kaolinitic. This is the case of the clay soil from the locality of Loutété [4], which revealed the presence of kaolinite, as did the soil from Mouyondzi [1]. The presence of kaolinite is supported by the clay's white colour and the results of granulometric analysis of the Atterberg limits and residual humidity.

E. IRFT

The following figure gives the IRFT spectrum of LEB.



[Fig.9: IR Spectrum of LEB]

On the DRX spectrum, the presence of kaolinite and quartz in the LEB sample was revealed. Thus, the infrared spectrum of our sample shows the vibrations

characteristic of kaolinite. This spectrum, shown in Figure 9, can be subdivided into three domains:

- The range from 3680 to 3600 cm^{-1} ,
- The range from 3600 to 1125 cm^{-1} ,
- The range is from 1125 to 600 cm^{-1} .

The bands at 3680 cm^{-1} and 3600 cm^{-1} correspond to the elongation modes of the OH groups [2]. Previous work by Ray and collaborators shows that these bands are attributed to the elongation or valence modes of Al-O-H in kaolinite [7], in agreement with the DRX results, which revealed the presence of kaolinite in the clayey soil of LEBOULOU.

In the range from 1125 to 600 cm^{-1} , we encounter frequencies relating to the deformation of OH groups [8]

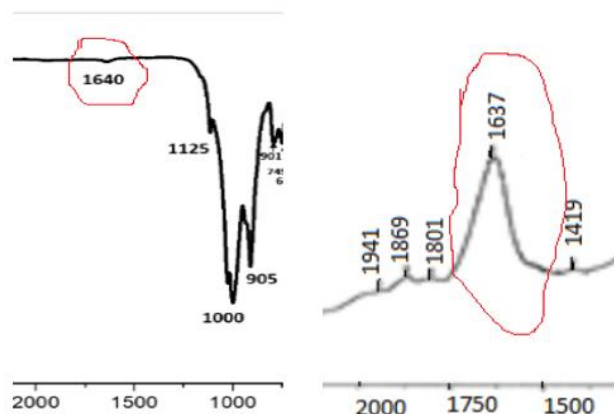
The bands at 905 cm^{-1} and at 1000 cm^{-1} , with a shoulder at 1110 cm^{-1} , are attributed to Al-OH-Al and AlO-H deformation vibrations in a 1:1 clay.

The symmetric and asymmetric Si-O modes are located at 1110-1125 cm^{-1} . The elongation of the Si-O bond of kaolinite is around 1125 cm^{-1} [9].

Quartz identified by XRD is manifested here by the bands at 750 cm^{-1} (in Si-O stretching mode) and 678 cm^{-1} (in Si-O deformation mode) [10].

The low-intensity band observed at 1640 cm^{-1} is due to hygroscopic water. Hygroscopic water is water from atmospheric humidity that forms a thin layer around soil clay particles.

Comparing the IR spectra of LEB (Figure 10a) and that of LOUK (Figure 10b)

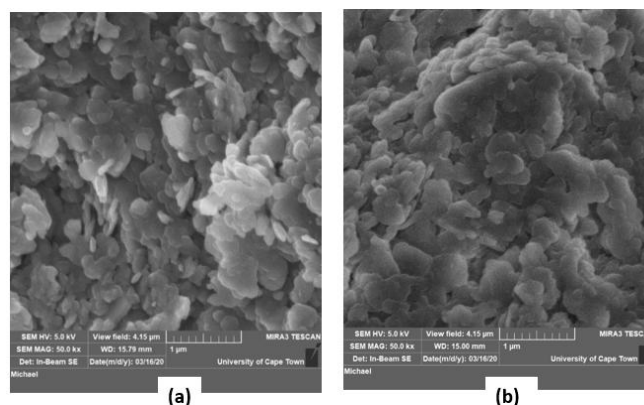


[Fig.10: IFRT Spectrum a (LEB), b (LOUK)]

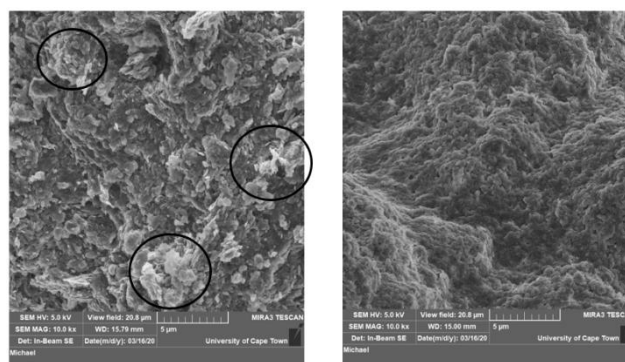
The IFRT of the Loukoléla clay at 1640 cm^{-1} shows a very intense band, suggesting that Loukoléla is predominantly montmorillonite, a swelling species that would therefore contain a lot of water. This results in a high intensity of this band [8]. The low intensity of this same band in LEB can be explained by the presence of kaolinite, which is a non-swelling clay species.

Organic matter and carbonates are almost non-existent in LEB. Indeed, organic matter is identified by bands at 2920 and 2850 cm^{-1} , and a band identifies carbonates at 1415 cm^{-1} [8]. These latter are absent on the IFRT spectrum of LEB.

F. MEB



[Fig.11: Micrograph of LEB on Solid (a) and on Powder (b) at 1 μm]



[Fig 12: Micrograph of LEB on Solid (a) and on Powder (b) at 5 μm]

The SEM images show the shape and size of the basal faces of LEB. It also provides the texture of the clay sample and characterises the mineralogical assemblage. The clay particles are uniform and appear as platelet clusters in the form of a tiny sheet, continuous and with a regular outline. We distinguish the classic flattened accordion shape of kaolinite as observed by Kanon for a poorly crystallized kaolinite [6]. The observation of white aggregate confirms the presence of quartz, as identified in the IR spectrum and the X-ray diffractogram of LEB.

G. Chemical Property

Table IV : Quantity of Organic Matter, Cation Exchange Capacity and Carbon Content of the Clayey Soil of LEBOULOU

Sample	C (%)	MO (%)	CEC (meq/100)
LEB	0.28	0.48	19.00

Table V: Chemical Analysis of Leboulou Clay

SiO ₂	Al ₂ O ₃	Fe ₂ O ₃	MgO	Na ₂ O	P ₂ O ₅	K ₂ O	CaO	TiO ₂
58,2	34,9	1,55	0,67	0,73	0,11	1,48	0,09	1,58
8482	3971	7481	1841	4992	2907	8762	4126	974

i. Quantity Of Organic Matter, Cation Exchange Capacity and Carbon Content

The presence of organic matter in a clay sample provides information on the soil's origin or on environmental activity. It can be of animal or plant origin. In the case of LEB, the OM is 0.48%, which remains very low in the soil of LEBOULOU, and the

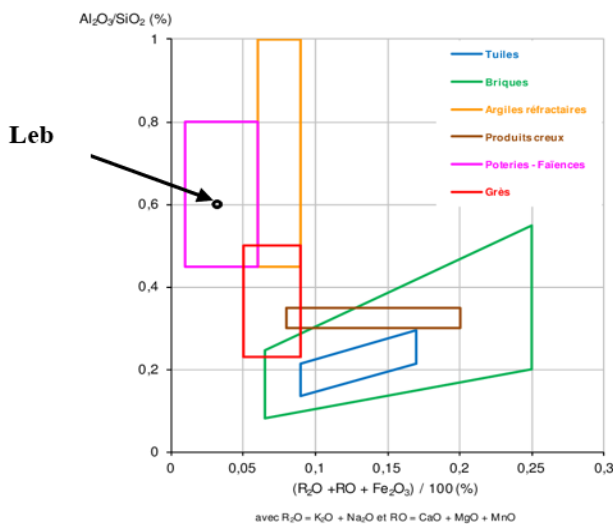
infrared did not show bands characteristic of organic molecules. The carbon rate is 0.28% which is almost half that of the OM. The carbon would come from the decomposition of plants or from exogenous organic matter (e.g., livestock effluents), as we observed in our sample (Figure 24). This quantity is higher than that of the clay from Lout  t   (0.367%) and that of Mouyondzi (0.839%). This percentage is less than 2%, the threshold percentage of the quantity of organic matter in a clayey soil. LEB is therefore a soil very poor in organic matter and is called an inorganic soil. This low organic matter content will have a negligible role in the manufacturing processes (stabilization or firing) of certain terracotta products from LEB [2]. The cation exchange capacity is 19MEQ/100), characteristic of 1:1 clay.

ii. Chemical Analysis

Table IV shows the results of the chemical analysis of LEB. This analysis indicates that the principal oxides in this sample are Al₂O₃ and SiO₂. The SiO₂/Al₂O₃ ratio is an indicator of a sample's clay mineral content; it ranges from 2 to 4. Here, its value is 1.668 [2]. It is close to that of pure kaolinite, which is 1.177. This ratio shows that LEB does not contain enough quartz. The Fe₂O₃ content is low. The presence of colouring oxides (Fe and Ti) at a rate of 3.146 suggests a colored product after firing. The low alkaline earth content (0.769) indicates the absence of carbonate in LEB. This result confirms the IRFT by the absence of vibrations attributed to the characteristic bonds of carbonate (C = O; CO)

The high value of Al₂O₃ associated with low values of alkali oxides (CaO and Na₂O) gives LEB a possible use in refractory products [2].

The following figure shows the Augustinik diagram, obtained from the chemical analysis of LEB.



[Fig. 13: Augustinik Diagram of LEB]

This diagram shows that the possible uses of LEB are limited to pottery and earthenware.

iii. Mineralogical assessment

The quantitative mineralogical balance is determined from the results of the chemical analysis and by DRX using the following empirical formula [5]:

$$T(a) = \sum M_i P_a$$

With:

T (a) content (in % of oxide) of the chemical element "a";
M_i content (%) of mineral "i" in the studied material and containing element "a";

P_a proportion of element "a" in mineral "i" (this proportion is deduced from the ideal formula (simplified formula) attributed to mineral "i").

DRX allows the identification of mineral species present in clay.

Calculations are performed using simplified chemical formulas expressed as oxides.

For Kaolinite, we have: 2 SiO₂, Al₂O₃, 2H₂O

For Quartz: SiO₂.

Based on the XRD results, LEB is composed of kaolinite and quartz. The quantitative approach was carried out based on the following assumptions:

- Alumina comes only from kaolinite;
- Silica comes from both quartz and kaolinite.

Table VI : Molar Mass of Minerals

Mineral Species	Molar Mass in g.mol ⁻¹
Kaolinite (2 SiO ₂ , Al ₂ O ₃ , 2H ₂ O)	258
Quartz (SiO ₂)	60
Alumina (Al ₂ O ₃)	102
Hematite (Fe ₂ O ₃)	160

So therefore:

$$\% \text{ Kaolinite} = \frac{\% \text{ Al}_2\text{O}_3}{102} * 258$$

$$\% \text{ Quartz} = \% \text{ SiO}_2 - \% \text{ Kaolinite} \frac{60 * 2}{258}$$

Based on the hypotheses mentioned above, the percentages of the different mineral phases were calculated and presented in the following table.

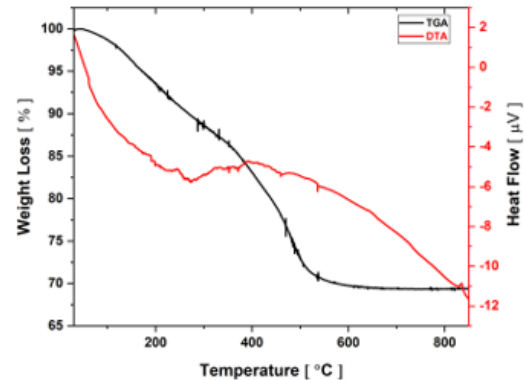
Table VII : Mineralogical balance of LEB

Mineral	Kaolinite	Quartz
% Mineral	88.37	17.18

As confirmed by the granulometric analysis and the Atherberg limits, LEB is 88.37% kaolinitic clay.

H. Thermal Analyses

The results of the thermal analyses are shown in the following figure



[Fig.14: Leb's ATG and ATD Thermogram]

The interpretation of these thermograms gives three critical areas:

An endothermic peak between 100 and 250  C corresponding to a mass loss

of 18%. This peak is associated with the release of hygroscopic water weakly bound to clay particles [2].

An observed inclination between 250 and 550°C is associated with the release of organic oxides (carbon dioxide, nitrogen oxides) following the destruction of the organic matter in our sample [10]. This significant slope is justified by the quantity of organic matter of 0.48% present in LEB (Table VII).

An endothermic peak around 550°C, with a mass loss of approximately 28%. This phenomenon corresponds to the dehydroxylation of kaolinite [1]. We note the departure of water of constitution due to thermal diffusion mechanisms, which transform the crystalline aluminosilicate material (kaolinite) into an amorphous material (metakaolin). This amorphous phase is critical in geopolymerization because of its very high reactivity in contact with the alkaline solution. The mass loss exceeding 20% associated with this phenomenon reflects the abundance of kaolinite in the clayey soil of Le Boulou [1].

Quartz is observed during cooling of the material on the ATD curve at 550°C. It corresponds to the reversible transformation of beta quartz into alpha quartz [5]. It is not very visible during heating due to the strong kaolinite content, which masks this phenomenon [1].

IV. CONCLUSION

This study was based on the geotechnical, mineralogical, chemical, and physical characterisation of clay collected in the locality of Le Boulou, to valorise it. The geotechnical research was carried out using granulometric analysis and Atterberg Limits. The chemical analysis was carried out by ICP-AES, by CEC, and by determining the quantity of organic matter. DRX, IRFT, and SEM were used to determine the mineralogy. Gravimetric and differential thermal analyses were used to study the physical properties.

The results of the granulometric analysis and the Atterberg Limits allowed LEB to be placed in the texture and WINKLER triangle, in the CASGRANDE chart, and in the workability map. These results showed that LEB is a clayey-textured soil located in the zone of average use frequency in the ceramic industries. It cannot be used in the applications proposed by DONDI; this soil is considered a very plastic clayey soil and has acceptable moulding properties.

The DRX identified two mineral species: kaolinite and quartz. The IRFT confirmed its results by the vibrations at 3600 cm⁻¹, attributed to the Al-OH bond of Kaolinite, and at 1000 cm⁻¹, attributed to the Si-O bond of quartz. These mineralogical results also show that kaolinite is poorly crystallised. The mineralogical assessment confirms kaolinite content exceeding 80% and indicates the kaolinitic clayey soil status. With a low organic matter content (0.48%), LEB is classified as an inorganic soil.

Thermal analysis shows three critical areas.

An endothermic peak between 100 and 250°C reflects the elimination of hygroscopic water, resulting in an 18% mass loss.

An exothermic peak between 250 and 550°C is attributed to the destruction of organic matter.

An endothermic peak around 550°C with a loss of approximately 28% in mass associated with the transformation of kaolinite into metakaolinite.

The properties thus evaluated would guide the use of LEB in the field of geopolymer and in pottery-earthenware.

DECLARATION STATEMENT

After aggregating input from all authors, I must verify the accuracy of the following information as the article's author.

- **Conflicts of Interest/ Competing Interests:** Based on my understanding, this article has no conflicts of interest.
- **Funding Support:** This article has not been funded by any organizations or agencies. This independence ensures that the research is conducted with objectivity and without any external influence.
- **Ethical Approval and Consent to Participate:** The content of this article does not necessitate ethical approval or consent to participate with supporting documentation.
- **Data Access Statement and Material Availability:** The adequate resources of this article are publicly accessible.
- **Author's Contributions:** The authorship of this article is contributed equally to all participating individuals.

REFERENCES

1. Moutou, J.M., Foutou, P.M., Matini, L., Samba, V.B., Mpissi, Z.F.D. and Loubaki, R. (2018) Characterization and Evaluation of the Potential Uses of Mouyondzi Claymu. *Journal of Minerals and Materials Characterization and Engineering*, 6, 119-138. DOI: <https://doi.org/10.4236/jmmce.2018.61010>
2. He, I.L., Atheba, G.P., Allou, N.B., Drogui, P., El Khakani, M.A. and Gbassi, G.K. (2023) Physic, Chemical and Mineralogical Characterizations of Clays Used in the Making of Traditional Ceramics in the City of Katiola, Cote d'Ivoire. *Journal of Minerals and Materials Characterization and Engineering*, 11, 81-91. DOI: <https://doi.org/10.4236/jmmce.2023.114008>
3. Voula Mackosso R., Diamouangana M.Z.F., Moutou J.M., Samba Vivien, Foutou P.M., Ngoma J., Characterization and Valuation of a Clay Soil Sampled in Londéla-Kayes in the Republic of Congo., *Journal of Minerals and Materials Characterization and Engineering*, January 2021., 09(02):117-133., DOI: <https://doi.org/10.4236/jmmce2021.92009>
4. Moutou, J.M., Bibila Mafoumba, C., Matini, L., Ngoro-Elenga, F. and Kouhounina, L. (2018) Characterization and Evaluation of the Adsorption Capacity of Dichromate Ions by a Clay Soil of Impfondo. *Research Journal of Chemical Sciences*, 8, 1-14. DOI: <https://doi.org/10.4236/msa.2023.142005>
5. R N Mboho Oba, G M Ifo, E E Nzaba Madila, F Z Mpissi Diamouangana, T Vila, M P Foutou, J-M Moutou. Characterization of the Clay Collected in the Locality of Dolisie in Congo-Brazzaville. *Journal of Minerals and Materials Characterization and Engineering*, 2022, 10, 93-105. DOI: <https://doi.org/10.4236/jmmce.2022.102007>
6. A. Qlihaa, S. Dhimni, F. Melrhaka, N. Hajjaji, A. Shhiri. Physico-chemical characterization of a Moroccan clay., *J. Mater. Environ. Sci.* 7 (5) (2016) 1741-1750. https://www.jmaterenvironsci.com/Document/vol7/vol7_N5/192-JMES-2132-Qlihaa.pdf
7. Dah-Traoré, Y., Zerbo, L., Seynou, M. and Ouedraogo, R. (2018). Mechanical, Microstructural and Mineralogical Analyses of Porous Clay Pots Elaborated with Rice Husks. *Journal of Minerals and Materials Characterization and Engineering*, 6, 257-270. DOI: <https://doi.org/10.4236/jmmce.2018.63019>
8. J.M. Moutou, Z.F. Diamouangana Mpissi, J.G. Ossebi, P.M. Foutou and J.C. Bibila. Mineralogical and Physicochemical Characterisation of the Clay Soil in the Locality of Loukolela (Congo). *Journal of*

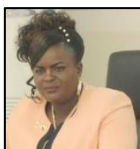
Environmental and Earth Sciences 9(2): 14-23, 2017., DOI: <https://doi.org/10.4236/jmmce.2022.102007>

9. H. Elenga, F. Ngoro-Elenga, J. N. Ngakosso Ngolo, T. Nsongo (2021). Determining the Effect of Wood Sawdust and Sand on the Compressive Strength and Water Absorption of Clay Pavers. *Novel Perspectives of Engineering Research Vol. 4* (pp.130-141). DOI: <https://doi.org/10.9734/bpi/nper/v4/11932D>
10. F. Ngoro-Elenga, A.I. Ngopoh, H. Elenga, J-R. Mambou, J.N. Ngakosso Ngolo, T. Nsongo. Characterisation and Application of the Makoua Clay in the Chemical and Bacteriological Depollution of Gutter and Well Waters of Brazzaville. *Materials Sciences and Applications*, (2021), 12, 263-275. DOI: <https://doi.org/10.4236/msa.2021.126018>

AUTHOR'S PROFILE



Banzouzi Samba Vivien Igor, born on December 30, 1983, is a lecturer and researcher in chemistry at the University Denis Sassou N'Guesso and an associate lecturer at the University Marien Ngouabi, Republic of Congo. He holds a PhD in Inorganic Materials Chemistry (2022), focusing on the thermo-mechanical study and valorization of local clays for ceramic and geopolymer cement production. An expert in mineral chemistry, electrochemistry, and analytical techniques, he actively participates in international conferences and is a member of several scientific societies, including the American Ceramics Society. His research aims to innovate and optimise the use of local materials for sustainable development.



Dimouangana Zita Flora, born on March 9, 1985, is a CAMES Assistant Professor of Chemistry at the École Normale Supérieure, University Marien Ngouabi, and Deputy Coordinator of the Laboratory of Inorganic and Applied Chemistry (LACMA). She specialises in inorganic, crystallographic, and environmental chemistry. She holds a PhD in Inorganic Materials Chemistry (2018), with a focus on clay soil characterisation and its application to adsorption and the development of modified electrodes. An active educator and researcher, she regularly publishes in international journals and participates in scientific conferences. Her research focuses on mineral synthesis, clay studies, and the environmental valorisation of these materials.



Vezolo Stanislas Prudence is a researcher in inorganic materials chemistry, affiliated with the Laboratory of Applied Inorganic Chemistry (LACMA) at Marien Ngouabi University in Brazzaville. A PhD candidate awaiting defence, his research focuses on the development and characterisation of geopolymer cements derived from local clays and volcanic slags, thereby contributing to the sustainable valorisation of natural resources. He holds a Master's degree in Inorganic Materials Chemistry, with expertise in the physicochemical characterisation of materials. He is also involved in supervising students in experimental research. His scientific commitment aims to foster innovation and the development of alternative construction materials suited to Central Africa's needs.



Mbendi Mpingui is a Principal Engineer in Industrial Techniques and a PhD candidate in Chemistry at Marien Ngouabi University. With extensive experience in the hydrocarbons sector, he currently serves as Head of the Drilling Office at the Directorate of Exploration and Production. His background reflects deep expertise in drilling engineering, HSE management, and technical supervision. He has participated in numerous specialized training programs both in Congo and abroad, strengthening his skills in petroleum exploration. Passionate about scientific innovation and capacity building, he is committed to contributing to the sustainable development of Congo's energy sector.



Maniongui Kris Berjovie, born on June 2, 1993, in Mouindi, is an engineer specialized in industrial process engineering. After earning a Bachelor's degree in Physics and Chemistry at the École Normale Supérieure, University Marien Ngouabi, he completed a Master's and is pursuing a PhD at the École Nationale Supérieure Polytechnique, at the Laboratory of Mechanical Energy and Engineering. Passionate about teaching, he has worked in several secondary and private schools, guiding students from middle to high school. Dedicated and creative, he combines scientific expertise, teamwork, and open-mindedness, with skills in office software and interests in reading, sports, and meditation.



Moutou Joseph-Marie, born on September 7, 1956, in Brazzaville, is a CAMES Senior Lecturer in Chemistry at the École Normale Supérieure and Coordinator of the Laboratory of Inorganic and Applied Chemistry. He holds a Doctorate of State in Chemistry from the University of Bordeaux I and specializes in mineral chemistry, crystallography, and materials chemistry. As an educator and researcher, he supervises numerous doctoral theses and participates in international conferences. His research focuses on ceramic development, the characterisation of local clays, and the addressing of environmental challenges. He is actively involved in several scientific associations in Central Africa.

Disclaimer/Publisher's Note: The statements, opinions and data contained in all publications are solely those of the individual author(s) and contributor(s) and not of the Lattice Science Publication (LSP)/ journal and/ or the editor(s). The Lattice Science Publication (LSP)/ journal and/ or the editor(s) disclaim responsibility for any injury to people or property resulting from any ideas, methods, instructions or products referred to in the content.