Available online at www.jlls.org

JOURNAL OF LANGUAGE AND LINGUISTIC STUDIES

ISSN: 1305-578X

Journal of Language and Linguistic Studies, *18*(4), 180-193; 2022

Approval Controls Applied To Raw Materials In The Brick Industry

Caicedo-Rolon, Alvaro Junior[a] [1] , Palacios-Alvarado Wlamyr[b], Luna-Pereira, Henry Orlando[c]

[a] *Doctor in Engineering, emphasis in Industrial Engineering, Director of productivity and competitiveness research group, Orcid: https://orcid.org/0000-0002-3651-3364, E-mail: alvarojuniorcr@ufps.edu.co, Universidad Francisco de Paula Santander, Cúcuta, Colombia.*

[b] *PhD in Business Administration, productivity and competitiveness research group, Orcid: https://orcid.org/0000-0002-0953-7598, E-mail: wlamyrpalacios@ufps.edu.co, Universidad Francisco de Paula Santander, Cúcuta – Colombia*

[c] *PhD in Business Administration, Director Director of investigación & Desarrollo Regional IDR Group, Orcid: https://orcid.org/0000-0003-2741-9170, Email: henryorlandolp@ufps.edu.co, Universidad Francisco de Paula Santander.*

APA Citation:

Junior, C.R.A., Wlamyr, P.A., Orlando, H., (2022). Approval Controls Applied To Raw Materials In The Brick Industry , *Journal of Language and Linguistic Studies, 16(4), 180-193. 2022*

Submission Date: 19/08/2022

Acceptance Date: 17/10/2022

Abstract

Taking a tour of all of Norte de Santander and its Metropolitan area (Cúcuta, El Zulia, Villa del Rosario, Los Patios) it is announced that this city is one of the richest in clay material occupied by ceramic industries that make or develop different types of products that are derived from clay, that is why we objectively focus on this research carried out, revealing the importance of handling raw material very well since it can determine its composition, structure and quality of the material , in order to better observe the behavior that it is going to present throughout its process. With these controls that can be carried out in Nortesantandereanas companies, we determine in the geological formations of some municipalities of Cúcuta, therefore using some technological analyzes such as X-ray fluorescence, diffraction analysis, infrared analysis, thermal characteristics, soil analysis , physical-ceramic characteristics, which are of great help in the final results of these sample tests carried out previously, with which we can determine which clay or which mixture is the ideal for the manufacture of the products to be carried out in the companies that require it, since these analyzes are techniques applied to clay samples to be able to easily detect the usefulness of said material and save control time in the quality of the product and facilitate the management of the processes, the importance of apply these tools and methods in companies of ceramic industries since in it s Material costs could be saved and continuous improvement of the product to be sold could be obtained, in order to achieve a better level of competitiveness in innovative sectors..

Keywords: Competitiveness, Commerce, Private Label Retail, Discount stores

1. Introduction

[1] Corresponding author.
E-mail address: *alvarojuniorcr@ufps.edu.co*

Historically, ceramics has been involved since the earliest times in the human species, if we talk about man and his creations making known his mastery over the elements that nature possesses (earth, water, fire and air) in order to achieve new products, Dr. Ing. L. TCHEICHVIL, in his article mentions (TCHEICHVILI, n.d.) "that one crucial day a man "X" decided to take in his hand part of this material (mud, clay), perhaps to spend time" referring to the use of clay which is a component of the soil and the clay is a component of the soil.) "that one crucial day a man "X" decided to take in his hand part of this material (mud, clay), perhaps to pass the time" referring to the use of clay which is a component of the soil and by adding water would create a moldable paste and easy to handle with the hands creating pots (vessels, Among their ideas and occurrences they placed their products already created under the fire to be able to see which was its maximum point of heat and to provide the product with the hardness of the ceramic, thanks to these small inventions the creation of the pottery was born.

With the passage of time, the industrialization of ceramics began, Dr. Ing. L. TCHEICHVIL, in his article, states that (TCHEICHVILI, n.d.) It is demonstrated that in the history of ceramics man's technology dominated this art of making and masonry of vessels, plates, figures and statuettes with good finishes perfectly since 7000 years B.C." Brick was one of the first materials created in which the clay with its skillful molding and patient drying was made into stone giving it the necessary heat point. C." Brick was one of the first materials created in which the clay with its skillful molding and patient drying became stone giving it the necessary point of heat, thus differentiating it from natural stones.

There are different ceramic materials and applications for them, Juan Morales Gueto in his book wrote that (Güeto, 2010) "Ceramics is a type of technology which studies the processes and characteristics of elaboration of different ceramic products." Ceramics, which come from clays, are essential constituent powders of soils and most of them have physical resistance to high temperatures thanks to a compound called silica, currently ceramic materials are very useful products in different fields, especially in industry.

"Ceramics is a type of technology which studies the processes and characteristics of elaboration of different ceramic products." Ceramics, which come from clays, are essential constituent powders of soils and most of them have physical resistance to high temperatures thanks to a compound called silica, currently ceramic materials are very useful products in different fields, especially in industry.
(Sánchez-Molina et al., 2016a) "Norte de Santander is known for being one of the Departments with greater abundance and characterization that form the deposits of clay, which is used as raw material in the manufacturing process of derivatives whose products are ceramic products such as brick, block, tile, among others" which are the main products of the process that leads to the manufacture of themselves, Therefore, the Leon geological formation and the Guayabo group are the main geological references where the exploitation deposits are located. Within the ceramic industry there are an infinite number of products dedicated to the process, control and manufacture of clay.

Getting to the basic topic of clay, (Besoain, 1985) in his book Mineralogía de arcillas de suelos talks about how "clay is not the only element there is, it is a heterogeneous portion which is constituted by crystalline or amorphous aluminosilicates and are defined as clay minerals" thus we understand that clays are essential constituents for a large part of the deposits, soils and their sediments are due to the fact that in most of the final products are based on the meteorization of silicates which are formed at higher pressures and temperatures, in the exogenous medium are hydrolyzed, this formative process occurs thanks to flocculation, which is a process by which solid particles on the soil portion are joined together, obeying different physical-chemical mechanisms.

(García García, 1997) tells us "that the beginning of the knowledge of ceramic materials begins with the study of their raw materials. In traditional ceramics, the main clay is the one whose characterization is difficult because of the complexities that have structural characteristics, since its grain size is very fine and has great similarity in terms of the chemical composition of the clay" given to understand the above, it is important to be clear and recognize the characteristics and properties of the clay to have a clear concept of manufacturing the product improving the quality that it can offer, in order to mitigate future negative effects that may affect the economy of the industrial sector, taking into account this it is important that physical characterizations of the clay can be made to offer a guarantee of a good final product and not have setbacks in the process stages.

The present research has been carried out as a main objective to make known some of the necessary controls that clay may need to facilitate the handling of the processes and its future products more thoroughly, supplying with more clarity the capacity and usefulness that the raw material can offer in ceramics and the industry.

2. Materials and Methods

In this review article we propose to take samples of clays at the municipal level from all the companies that manufacture clay products. Previous studies were carried out in the Metropolitan Area (Cúcuta, El Zulia, Villa del Rosario, Los Patios), the place where the studies were made was in relation to the clay components belonging to the geological formations Leon and Guayabo that appear in this district, currently in Norte de Santander there is a great variety of natural deposits that can be used for the manufacture of confectionery and masonry products for the decoration and construction of homes such as blocks, bricks, tiles, floors, among others; but most of the companies that are manufacturers, which develop in their companies many wastes because of the lack of knowledge about the technological analysis that has the research of the raw material to predict the behavior that has the clay and thus obtain a continuous improvement in the quality of the final product.

2.1. Soil Preparation for Sample Formation in Analysis

The sustainable management of soils has in its process a pertinent and effective requirement for its own research, since these have their own geological, mineralogical, chemical, physical and ceramic aptitude characterization that the materials naturally possess from the geological formations that occur in the deposits.

(Julián et al., 2018) "Natural materials such as rocks, reservoirs, soils, sediments, waters, etc.) which can present a great intrinsic variability in their chemical composition that could depend on the source area and the sedimentary or pedogenetic environment in which it is manifested or in which it was formed" implying that it can be understood in two phases, the sedimentary environments that are the type of material found and can identify whether the clayey material is the product of the weathering of igneous or metamorphic rocks and on the other hand is the exploration that can establish the selection criteria of the geological formation of a clayey material.

2.2. Sampling and Sample Selection Criteria

(Julián et al., 2018) "Soil sampling is an activity for the collection of soil sediment samples which are representative, since they allow characterizing the soil with a study. The sample is representative and indicates the same characteristics as a part that presents the properties of the material being studied" Sampling is a type of activity in which a variety of samples must be taken, so every company must take

into account the abundant characteristics of clay and take priorities in some of them, in particular where it is more sensitive physicochemical changes of the material and that influence the behavior and quality of the finished product.

2.3. Clay Treatments for Sampling in Analysis

2.3.1. Extraction

Different types of clayey material must be extracted, where each of these is used according to its properties and characteristics, therefore, working slopes must be developed that are temporary and may have a greater slope than the definitive ones. (Morales, 2015) "The clay must go through a selection and extraction process, which are necessary procedures for artisans or potters, since the creation of the product or piece depends on this. A clay can hinder a piece, if it is not well handled, offering impurities to the product and generating bad quality to it" and going to the concept of ceramic industry, the exploitation is a geotechnical management in which it must be done in the open, in most cases it must be done by means of slopes (slopes or slopes of a land that remains when excavating) in mines suitable for the excavation and extraction of clay.

2.3.2. Formulation and Mixing

After proceeding to the extraction of the clay, the raw material chosen for the samples must be taken into account, and the type of grinding to be used must also be defined. The first basic operation in the manufacturing process of ceramic products is the size reduction or grinding (dry or wet way).

2.3.3. Dry Milling

This process includes grinding at humidities lower than 2%, in which the bodies are free to move inside the mill, after which the pulp is humidified to the working humidity in the workpiece forming stage.

2.3.4. Wet Milling

Wet milling can be carried out in batch or continuous, the required quality is not directed to any particular type, the composition is ground and by means of ball mills is dried by filter presses.

2.3.5. Homogenization

Ceramic manufacturing companies need raw materials with highly homogeneous properties that are maintained over time, as these must be homogenized with the clay, both in terms of appearance and physical and chemical characteristics. The extraction and preparation procedures do not guarantee homogeneity and stability in the properties, so it is essential to carry out homogenization procedures prior to putting the clays into production..

Therefore, it would be very interesting to carry out a technical investigation of these materials recommending the following aspects; X-ray fluorescence, diffraction analysis, infrared analysis, thermal characteristics, soil analysis, physical-ceramic characteristics, fulfilling certain expectations of the companies under these analyses and with some parameters we could project ourselves in the production process.

Next, some concepts of some technological analysis researches that can be applied to clays to obtain more specific data about their components and alterations will be presented.

2.4. X-Ray Fluorescence

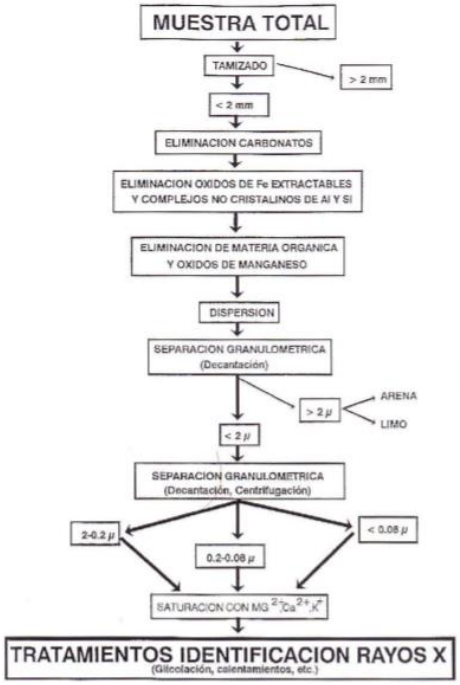
(Zavala Gómez, 2015) "X-ray fluorescence (XRF) has the characteristics of simple sample preparation (it can be analyzed in solid state), multi-elemental capability, wide linear working range, high throughput and low cost per analysis. Wide application in the analysis and characterization of samples related to earth sciences" referring to the above, X-Ray Fluorescence is a method used by spectroscopy, which as its name says uses fluorescent emissions of radiation that are used to cause or generate stimulation to the sample. XRF has as its main function the elemental chemical analysis, the elements included in the samples can be solids or liquids.

2.5. Análisis De Difracción De Rayos X

(Justo & Morillo González, 1999) "The technique of X-ray diffraction by the powder method, via photographic (DebyeScherrer camera) or diffractometric, can be applied to different phases of soil granulometry (sand, silt and clay). Although all minerals possessing components can be studied by this diffraction method, especially clay minerals will be treated. Due to the abundance of factors that can intervene in the identification of clay minerals, the pretreatments that must control a soil sample or clay deposit are essential to the success of a diffractometric analysis. Sample preparation for analysis must include treatments to remove cementitious entities and amorphous components. This includes the removal of carbonates, organic matter, free iron oxides, manganese oxides, silica and alumina" X-ray diffraction analysis is a method widely used in high technologies which is non-destructive to obtain analysis of materials such as metals, minerals, polymers, ceramics, among others, polymers, ceramics, among others, its main function is to obtain a qualitative identification of the mineralogical composition of a crystalline sample, one of the requirements for the samples is that it must be largely representative and homogeneous of the total set to be analyzed to obtain an optimal result.

Figure 1 shows a schematic representation of the pretreatment that must be followed with a sample to proceed to obtain the analysis by X-ray diffraction (and in general it can also be used for any other method of mineralogical analysis of clays).

Figure 1. "Sample preparation scheme for the identification of clay minerals by x-ray diffraction".



(Justo & Morillo González, 1999)

2.6. Infrared Analysis

(Bravo et al., 1980) "The use of this technique in the study of minerals and the inorganic fraction of soils only began in about 1950. IR spectroscopy is very useful in mineralogical studies when used in association with X-ray diffraction and other similar techniques. The method can be used in the identification of inorganic compounds and minerals that have well-defined absorption bands, to determine whether a phyllosilicate is dioctahedral or trioctahedral in composition, in the study of isomorphic substitutions, in investigations on the hydration of minerals and on the interaction of clays with organic and inorganic compounds, and finally in quantitative analysis. The study of IR spectra of mineral mixtures becomes more complex as the number of components increases. In the case of clay minerals, the unit crystallographic cell may contain several dashes or polyatomic molecules" infrared analysis is a type of method which has been used for some years where this analytical technique is used to control the state of such matter, this analysis has an absorption that is characteristic of the nature of the chemical bonds present in the sample.

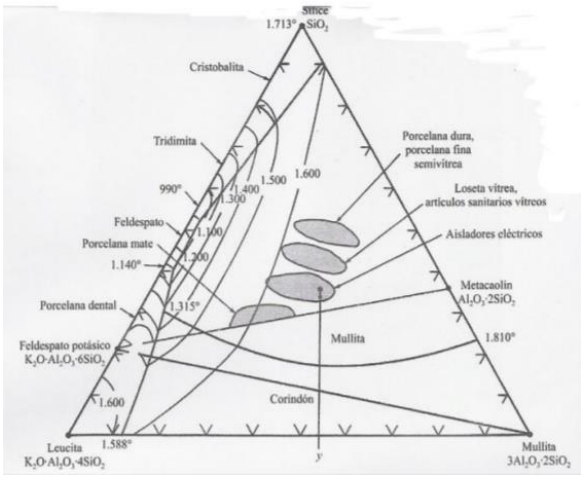
2.7. Thermal Characteristics

(León et al., 2018) “Thermal characterization is carried out to determine the possible variations in dimensions and morphological characteristics of the optimum samples obtained experimentally in other phases of the research, by means of differential thermal analysis (DTA) and thermogravimetric analysis (TGA), Thermal characterization has some phases where thermogravimetric analysis can be performed, which are widely used where the sample is measured (in product mass) to observe whether it is heated or cooled in a defined atmosphere. This type of technique consists of examining the weight loss of a substance as it is subjected to an increase in temperature (heat). This type of analysis is used to qualify the chemical and physical properties of materials, this method provides such information to obtain better quality processes.

2.8. Physical-Ceramic Characteristics

(Maldonado & Molina, 2018) “This research is developed from the superficial and physical ceramic analysis in a properly characterized ceramic paste; whose paste is atomized and by means of the extrusion process the samples are extracted from the clay deposits that are going to be subjected under a CNC mechanized modeling by subtraction before the firing process, which are analyzed by means of Optical Microscopy to observe the changes that are generated at surface level. The study of the changes or alterations in the physical ceramic properties that are produced in this material by the machining process, is relevant to accurately determine the alterations that occur in the material and the development of the same parts manufactured by this process or method" the ceramic has a great combination of links and the strongest it has is called ionic bond and the greater the number of shared electrons the greater the force of attraction, since this type of links has a high level of elasticity and hardness, also has a very high thermal expansion and corrosion resistance.

Figure 2. Three-phase diagram of the clays.

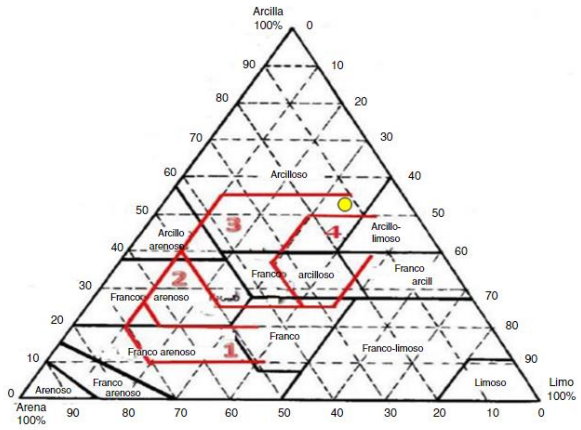


(Mamani Ruiz, 2015)

2.9. Soil Analysis

(García, 2003) "Soil analysis is used as a tool for the diagnosis of soil fertilization and the recommendation of fertilizers for crops is an excellent option, especially if it is properly combined with tissue and water analysis for homogenization. To obtain success with this type of analysis, it is necessary to start from an adequate sampling conceived according to the type of material to be used and considerations tending to give a rational use to the soil and to the inputs that may be required. The maintenance of the soil productivity capacity is for long periods of time which should be the primary objective of the activity of the soil scientist in charge of the soil analysis" soil analysis is a method or a tool of great benefit which is used to diagnose nutritional problems and to implement the technical characteristics of the soil, Among the benefits and advantages, it stands out for offering low costs and being fast, this analysis allows to determine the degree of soil fertility and its basic functions are to indicate the nutritional levels in the soil and to monitor on a regular basis the changes that are caused by farms.

Figure 3. Ceramic suitability triangle



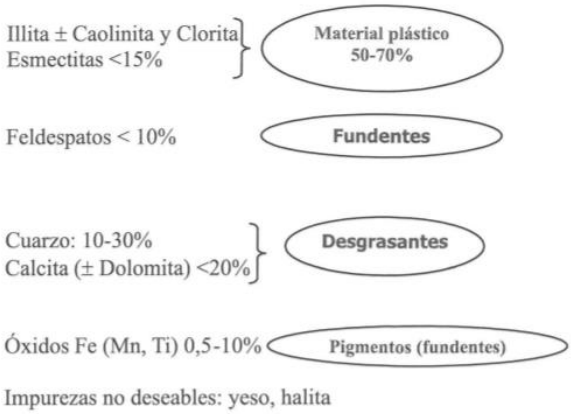
(Quintero et al., 2019)

3. Results

(Diaz et al., 2009) "The specialists in the subject related to ceramics affirm that in order to have a good result in the extrusion stage, two factors must be considered, the first refers to the machinery or equipment used for molding and the second refers to the raw material" it is necessary to take into account the good maintenance of the machines in order to establish a good molding, therefore the raw material must have a ceramic paste with the required characteristics in order to avoid future problems in the manufacturing process of the final product.

(Galán & Aparicio, 2006) talks about "the compositional range allowed for the manufacture of structural ceramics".

Figure 4. Compositional range allowed for the manufacture of structural ceramics



Analyzing the investigated information, we present the results obtained, which have been previously carried out in the metropolitan area.

Opting for a sampling to explain the use of these technological analysis and its function in real samples of clays found throughout Cúcuta and its Metropolitan area, we find a certain variety of studies already conducted previously with many of these resources or techniques, which reiterate the importance of its use in all companies of ceramic management or clay derivatives to obtain a better recognition of

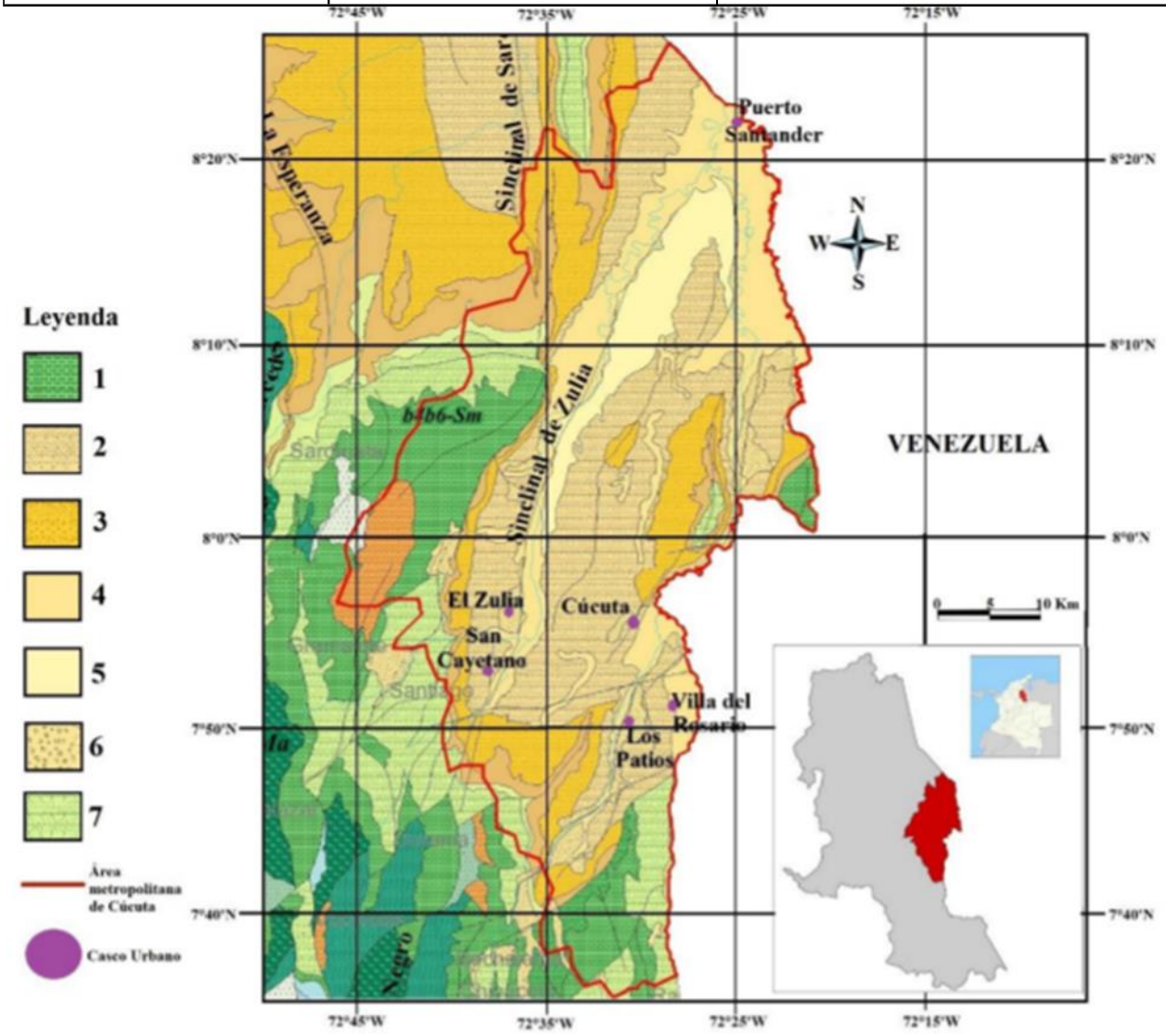
application in their raw material, likewise generating a lower economic interest in the future for poorly manufactured products.

These tools will generate a better efficiency in the quality of the product since depending on the option of use of the correct application would lead them to coincide with better results for the production and manufacture of ceramic derivatives (tablet, block, tile, among others).

An image showing the location of the most important points of geological formations, which have been previously studied, is shown in Figure 5, which is a geological map of the metropolitan area of Cúcuta.

Figura 5. Muestra del mapa geológico del área estudiada

1. Rocas calizas intercaladas con margas, lodolitas calcáreas y arenosas.	2. Intercalaciones de arenitas localmente conglomeriticas, lodolitas y arcillolitas. Ocasionalmente delgadas capas de carbón.	3. Arenitas de grano fino a conglomeriticas, interestratificadas con arcillolitas y limolitas, ocasionalmente algunos lentes de hierre y carbón.
4. Depósitos aluviales y llanuras aluviales.	5. Terrazas aluviales. 6. Abanicos aluviales y depósitos coluviales.	7. Shales, calizas, arenitas, cherts y fosforitas



(Flórez-Vargas et al., 2018)

3.1. Next, we will show some examples of samples already made in the metropolitan area in order to better understand and appreciate the quality of these applications and the parameters that govern their functions and results.

3.2. Drx Mineralogical Characterization

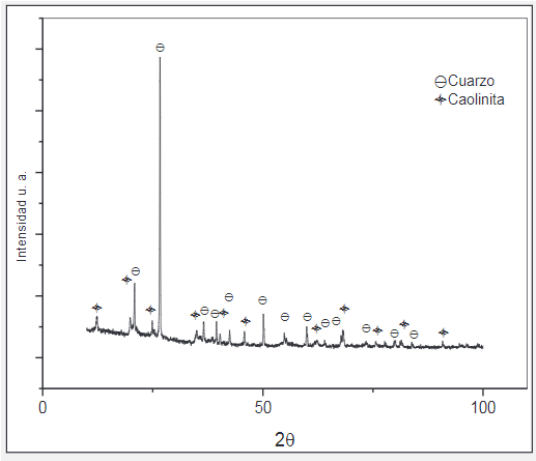
In this method, which is X-ray diffraction, it is known that its clay sampling was performed in a mine called "La Alejandra" which indicates that its sample has a 33.6% content of quartz, which is a non-clay mineral and naturally is found in most of the other minerals in the clay.

(Sánchez-Molina et al., 2016b) "Figure 1 shows the presence of kaolinite (19.3% by weight) in a more representative way in the 001 plane, which coincides with what is stated by SACMI who report that peaks of this mineral are formed in the following angular positions: 12.5° (001); 24.9° (002); 37.7° (003); 51.1° (004)."

The main mineral used for the manufacture of clay materials or ceramics is kaolinite, since this is a very influential material in the process which favors the homogenization of moisture in the raw material, low moldability, low water absorption, easy drying and firing at high temperatures.

Figure 6 shows the influence generated by the quartz and kaolinite phases.

Figure 6. Mineralogical analysis of La Alejandra clay.



3.3. X-Ray Fluorescence

On this occasion, this chemical analysis carried out in Villa del Rosario and El Zulia, made by means of X-Ray Fluorescence, shows the chemical composition of the sample taken in Table 1.

Table 1. XRF results obtained for the samples of interest.

Element	Villa del rosario (%)	Zulia (%)
Si	28,03	28,96
Al	11,86	10,62

Fe	3,46	4,73
K	1,30	1,29
Ti	0,53	0,53
Mg	0,44	0,47
Na	0,27	0,13
Ca	0,21	0,09
P	0,07	0,06
Ba	0,04	0,04
V	0,02	0,03
Zr	0,02	0,02

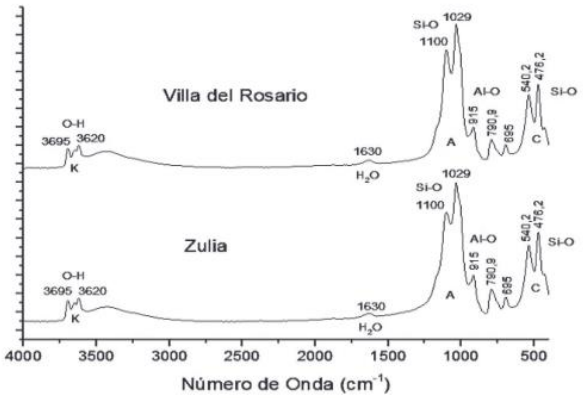
(Cáceres et al., 2017) "From Table 1, the high contents of silicon and aluminum stand out, as well as the high percentage of iron, which justifies the characteristic red color of the clays of the Metropolitan Area of Cúcuta."

When observing the table and reading in depth about this method, the stoichiometric analysis that is shown in the crystalline phases of these is revealed, therefore, it is deduced that in the Villa del Rosario sample 27.29% of the silicon is crystalline and 0.75% is amorphous, and for the Zulia sample 25.60% is crystalline and 3.36% is amorphous.

3.4. Fourier Transform Infrared Analysis

Figure 7 shows the FTIR spectra corresponding to the Villa del Rosario and El Zulia samples without heat treatment.

Figure 7. IR spectra of the clay samples studied.



Nota: Caolinita (K); Aluminosilicatos (A); Cuarzo (C); Agua (H2O)

(Cáceres et al., 2017) "En el estudio realizado de IR de las arcillas analizadas, las vibraciones de estiramiento del enlace Si-O fueron analizadas a 790,8cm-1, 692,1cm-1, 538,1cm-1 y 468,7cm-1 mostrando la presencia de cuarzo (León et al., 2018). Las bandas tales como 1031,9cm-1, 914,2cm-1, 790,8cm-1, 692,1cm-1, 538,1cm-1, 468,7cm-1 muestran la presencia de caolinita (Maldonado & Molina, 2018); las vibraciones analizadas a 914,2cm-1 indican la presencia de hematita. Las bandas a 1031,9cm-1, 914,2cm-1 (vibraciones de flexión del enlace Al-Al-OH), 790,8cm-1 y 468,7cm-1 (vibración de flexión del enlace O-Si-O) indican la presencia de illita" en este estudio de análisis IR para la muestra han sido identificados una variedad de formas en los minerales anteriormente dichos los cuales estuvieron presentes en la arcilla, los cuales también fueron tenidos en cuenta por unas bandas que

fueron observadas por un rango de 400 a 1400cm-1.

3.5. Caracterización Fisico – Ceramica

Tabla 2. Resultados obtenidos de la caracterización físico-cerámica.

Property	Villa del rosario (%)	Zulia (%)
Retention on ASTM 230 sieve	13,88	13,52
% of sand	29,11	29,55
% of silt	32,24	32,71
% of clay	38,65	37,74
Plasticity index	24,5	24,5
Water absorption 1150 °C	7,51	7,94
Contracting in firing at 1150 °C	2,88	2,71
Contracting in firing at 1150 °C	10,39	11,38
Calcination losses at 1100 °C	5,94	5,42

(Cáceres et al., 2017) The retained on sieve - passing sieve 230 mesh, allows the determination of the percentage of sand in the clayey material, which is essential for the correct drying of the products. This test is very useful because knowing the amount of sand present in the sample, you can quickly infer the behavior in the different stages of the production process" observing the table we can see that there is a similar percentage of sand, taking the 3 percentages found in Table 2, (%sand, %silt and %clay) a suitable percentage is deduced which to achieve the manufacture of products derived from clay or ceramic materials which if they are extruded should range between a minimum of 16% and a maximum of 35%.

Highlighting all the above it is known that there is a great possibility in which many companies could join (thinking about the great costs involved in performing these methods of sampling analysis) to obtain a better quality in their products leading to innovation and creation of new materials being competent in the ceramic industry, opting as a necessity these advances in technological analysis, how good it would be that in the industrial ceramic sector companies take the initiative of growth in their products opting for a quality improvement endlessly applied in their manufactured products, thus being a good investment and not an expense.

4. Conclusions

The raw material should be the fundamental factor to which all the observation and analysis should be focused, because if it is not analyzed correctly, its function could have variability in the processing of the product to be manufactured.

The reliability, importance and necessity of applying these tools and methods to improve the quality of the raw material and therefore the products manufactured in the industrial ceramic sectors can be demonstrated in the current research.

It is important that both large companies or those that are just starting at this stage of ceramic industrialization can know and implement these methods which were mentioned in this article, which could facilitate some bottlenecks in the processing of their products using new tools thus achieving the

improvement towards the optimum quality and thus reach a level of competitiveness equal or greater than that of large innovative sectors that manufacture ceramic products.

References

Besoain, E. (1985). Mineralogía de arcillas de suelos (Issue 60)). Bib. Orton IICA/CATIE.

Bravo, Y. O., Gómez, C., & Ramírez, I. (1980). Análisis por espectroscopia infrarroja de algunas arcillas colombianas. Revista Colombiana de Química, 10(1), 45–52.

Cáceres, V. I., Chaparro-García, A. L., & Sánchez-Molina, J. (2017). Evaluación de arcillas caoliniticas-illiticas provenientes de la formación guayabo del Área Metropolitana de Cúcuta, Norte de Santander, Colombia. Revista Ion, 30(1), 117–127.

Diaz, J. F. G., Molina, J. S., & Rodríguez, G. P. (2009). Comportamiento de las arcillas del área metropolitana de Cúcuta sometidas a proceso de moldeo por extrusión. Respuestas, 14(2), 32–38.

Flórez-Vargas, A. O., Sánchez-Molina, J., & Blanco-Meneses, D. S. (2018). Las arcillas de las formaciones geológicas de un área metropolitana, su uso en la industria cerámica e impacto en la economía regional. Revista EIA, 15(30), 133–150.

Galán, E., & Aparicio, P. (2006). Materias primas para la industria cerámica. Seminarios de la sociedad española de mineralogía, 2, 31–49.

García, A. (2003). Un sistema de interpretación del análisis de suelos basado en la concepción causa y efecto. SCCS.

García García, C. P. (1997). Algunos análisis físico-químicos para la identificación de los minerales componentes de una arcilla. Escuela de Física.

Güeto, J. M. (2010). Tecnología de los materiales cerámicos. Ediciones Díaz de Santos.

Julián, P. L. L., Anchuela, Ó. P., & Portal, M. A. F. (2018). Geoquímica de elementos mayores aplicada al análisis forense en suelos arcillosos. Estudio de caso y análisis de alcance. Geogaceta, 64, 155–158.

Justo, Á., & Morillo González, E. (1999). Técnicas de difracción de rayos X para la identificación cualitativa y cuantitativa de minerales de la arcilla.

León, R. A. G., Solano, E. F., & Peñaloza, C. A. (2018). Caracterización térmica de mezclas de arcillas utilizadas en la fabricación de productos de mampostería para la construcción. Revista Colombiana de Tecnologías de Avanzada, 1(31), 22–30.

Maldonado, A. E., & Molina, J. S. (2018). Análisis de las propiedades físico cerámicas y efectos superficiales en un tipo de pasta cerámica, sometida a proceso de modelado mecanizado CNC por sustracción material, para la vinculación de un nuevo modelo de fabricación en la industria cerámica regional. BISTUA REVISTA DE LA FACULTAD DE CIENCIAS BASICAS, 16(2), 110–116.

Mamani Ruiz, R. C. (2015). Estudio y evaluación de formulación de mezclas para la obtención de ladrillos de arcilla en la Ciudad de Cusco.

Morales, C. C. (2015). Extracción y uso de la arcilla por alfareros tradicionales. Revista Herencia, 28(1).

Quintero, M. P. M., Acevedo, Y. A. P., Illera, L. C., & Niño, J. C. (2019). Influencia de la molienda húmeda en el comportamiento estructural y mecánico de productos cerámicos conformados por extrusión de una arcilla del Zulia (Norte de Santander, Colombia. Boletín de la Sociedad Española de Cerámica y Vidrio, 58(5), 190–198.

Sánchez-Molina, J., Sarabia-Guarin, A., & Alvarez-Rozo, D. C. (2016a). Evaluación de materias (Vol. 21, Issue 2, pp. 48–56). Respuestas.

Sánchez-Molina, J., Sarabia-Guarin, A., & Alvarez-Rozo, D. C. (2016b). Evaluación de materias primas utilizadas en la fabricación de baldosas de gres en el sector cerámico de Norte de Santander (Colombia). Respuestas, 21(2), 48–56.

TCHEICHVILI, L. (n.d.). Que le debe la humanidad a la arcilla.
Zavala Gómez, C. E. (2015). Desarrollo de membranas porosas a partir de arcilla para el ablandamiento de agua.

Makalenin Türkçe başlığı buraya yazılır….

Özet

Türkçe özet.

Anahtar sözcükler: anahtar sözcükler1; anahtar sözcükler2; anahtar sözcükler3

AUTHOR BIODATA

Insert here author biodata**.**