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**Determination of the structural and mechanical properties of bauxite red mud
of Ngaoundal as a precursor for ceramic production**

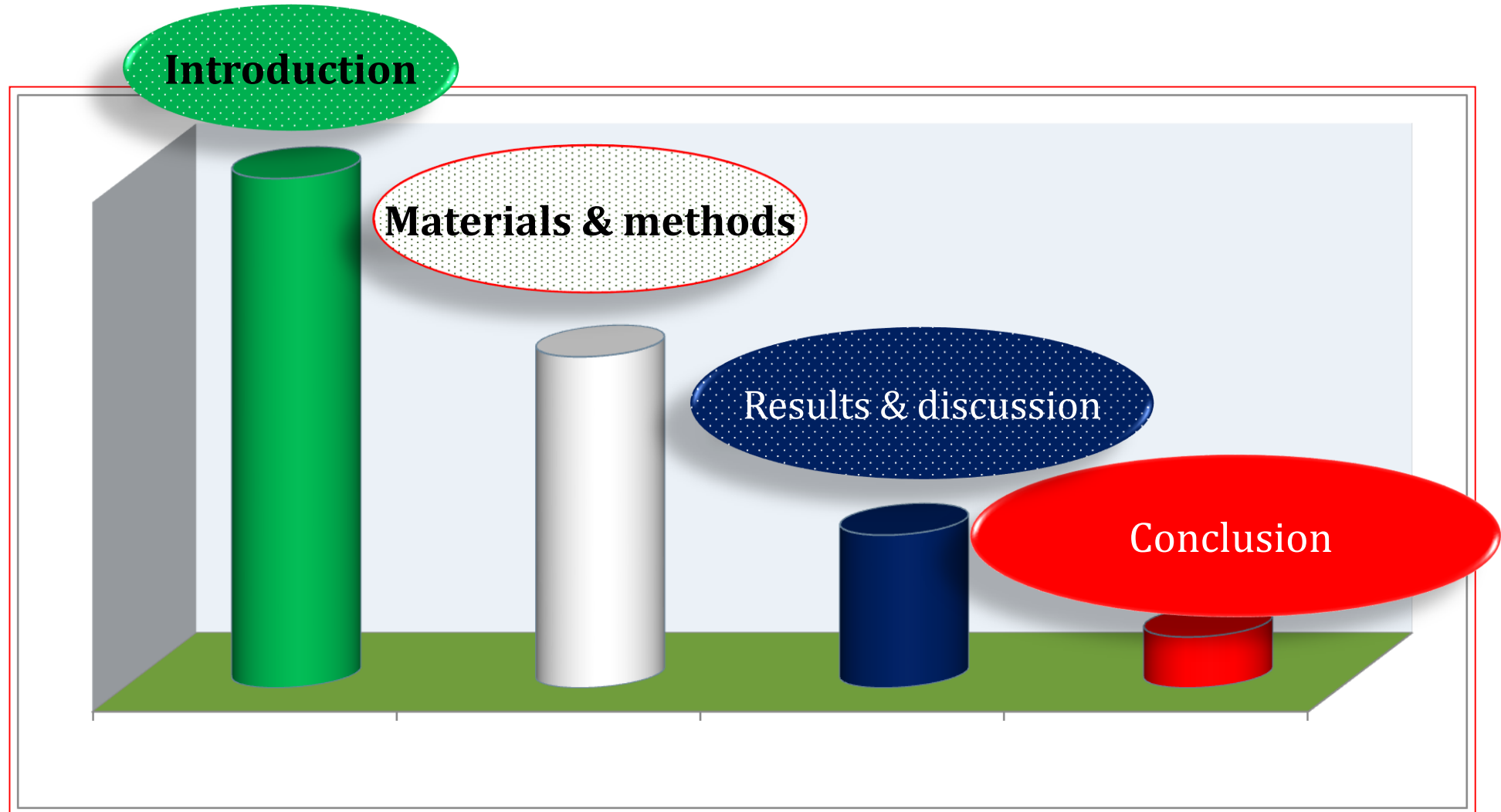
Presented by

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PLAN OF PRESENTATION



INTRODUCTION: Motivation

Recent industrial developments have drastically increased the amounts of waste materials and many concerns have been raised regarding the treatment and disposal of these wastes materials

Red mud (RM) is a waste by-product resulting from the extraction of alumina from bauxite. Approximately, 35–40% of the processed bauxite goes into waste as red mud (Yalçin, 2000).

Red mud is the biggest problem in producing alumina. This waste present serious problems of storage and environmental pollution and accounting for about 5% of the price of alumina.

Many studies conducted since 1950 to use improved processes that can reduce red mud production have mostly not been put into practice because of economic reasons (Liu et al., 2007)

INTRODUCTION: Motivation

Because of the environmental impact of red mud and its enormous volume, its treatment to change the alkalinity is an extremely urgent issue with the aim of converting the harmful red mud to useful products for different applications (Sushil et al.,2008).

There is not yet an viable economic way for scale utilization of this red mud. Much has been said about the possibility of using the red mud as a cheap source of raw material for the manufacture of low-cost ceramic products (Puskas et al., 1983).

However, there are very few studies on using the red mud for producing ceramic. From earlier researches it was seen that red mud consists of several oxides which can form a glassy phases after sintering. SiO_2 , CaO and Na_2O may be responsible for the glassy phase.

INTRODUCTION: OBJECTIVES

- This will produce significant benefits in terms of environment and economics by reducing land fill volume, contamination of soil and ground water, and release of land for alternative uses. Moreover, it can be used to produce valued materials in ceramic manufacture and for other applications and thus saving natural resources (Wang, 2008).
- The objectives of the present work were to investigate the potential of red mud as a precursor for ceramic tiles, through the preparation of test specimens from the red mud.

Properties of the red mud as raw material and apparent density, water absorption, linear shrinkage, flexural strength, and chemical resistance in acidic and basic conditions were used to access the properties of the obtained ceramic specimens.

MATERIALS AND METHODS

Preparation of sample: RM used for this study was produced in our laboratory from bauxite collected at Ngaoundal (6° 27' 55" -North, 13° 16' 16" East). Extraction method of RM from bauxite was that used by Benhamou et al.,(2008) adapted from the Bayer process.

Characterization techniques

Characterization	Analyse parameter	Technique/Equipment used
Physical	Particle size distributions	Mastersizer 2000 Malvern Instrument Ltd
Chemical	oxides	X-Ray Fluorescence
Mineralogical category	Cristalline phase	X-ray diffraction Bruker Axs D8 Advance
	Microstructures	Scanning Electron Microscopy (SEM Hitashi S-4500N)
	Infrared spectroscopy	
Thermal Analysis	Thermal behaviour	Thermogravimetric Analysis (TGA) and Differential Scanning Calorimetry (DSC)

Materials and Experimental Methods

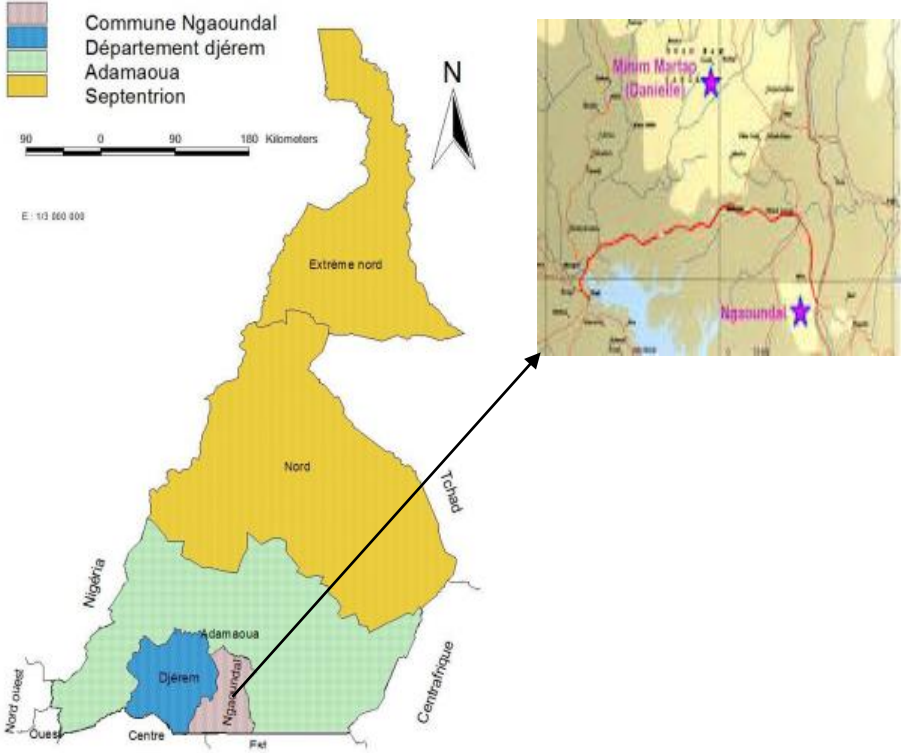


Figure 1. Ngaoundal site



Figure 2. Bauxite and sampling area.

MATERIALS AND METHODS

Formulation and shaping

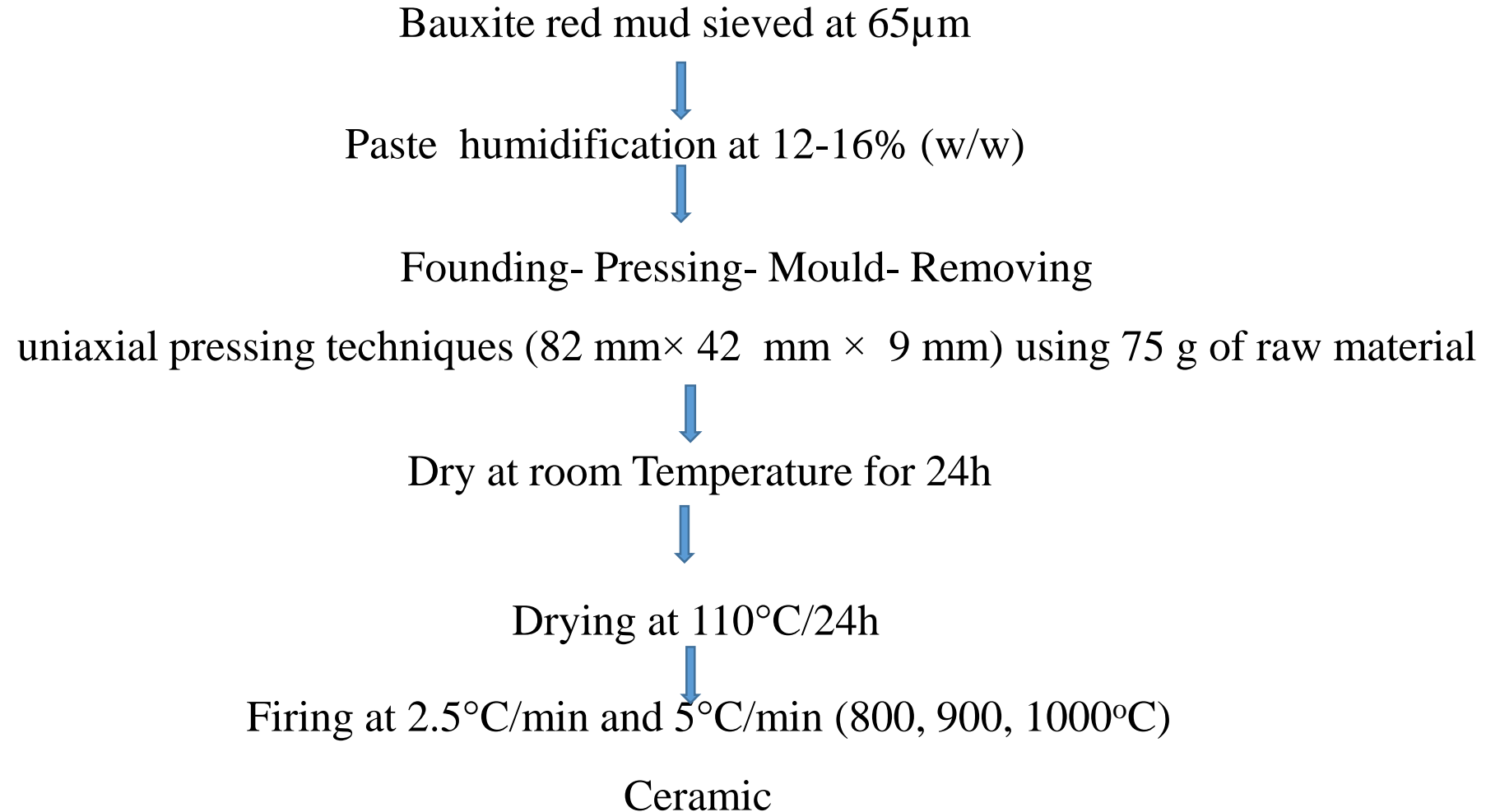


Figure1:flow chart for ceramic processing

MATERIALS AND METHODS

Table 2: Physico-Chemical Characterization of Fired Products

	Properties	Standard
Mechanical Properties	Linear shrinkage	ASTM-C326
	loss of mass	
	Water absorption	
	Bulk density	ASTM-C373
	Flexural strength	ASTM - C 674
Chemical properties	Acidic résistance test	NEN-7375

RESULTS AND DISCUSSION

Table 1: Chemical composition of the Red mud determined by XRF

Element %	LOI ^a	SiO ₂	Al ₂ O ₃	Fe ₂ O ₃	CaO	MgO	SO ₃	Na ₂ O	K ₂ O	P ₂ O ₅	TiO ₂	MnO ₃
Red mud												
%	20,26	7,68	19,6	37,21	2,75	0,08	0,08	4,71	0,06	0,12	1,07	0,09

Al₂O₃ and SiO₂ is responsible for the refractoriness, shrinkage of a sample and Fe₂O₃ in constitution determines the colour of the sample after firing

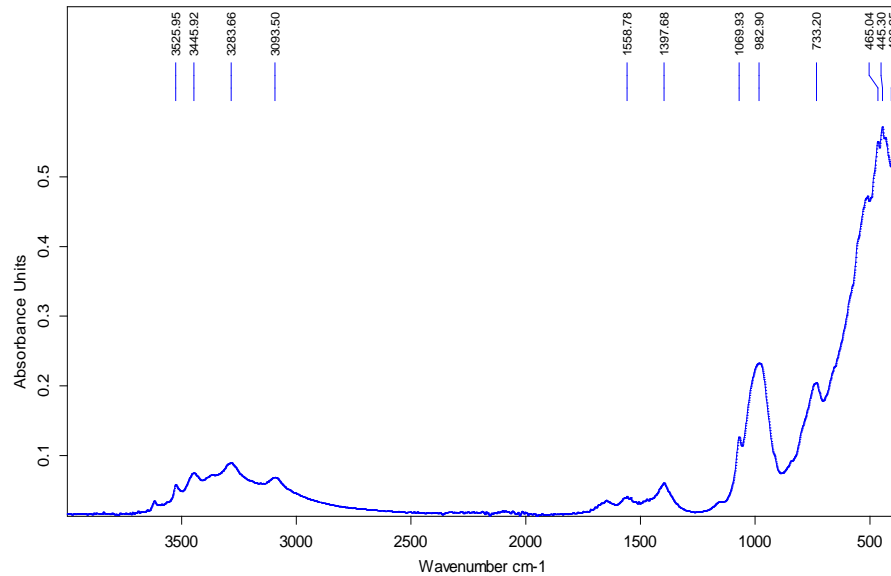


Figure 2: IR curve of red mud of Ngaoundal bauxite

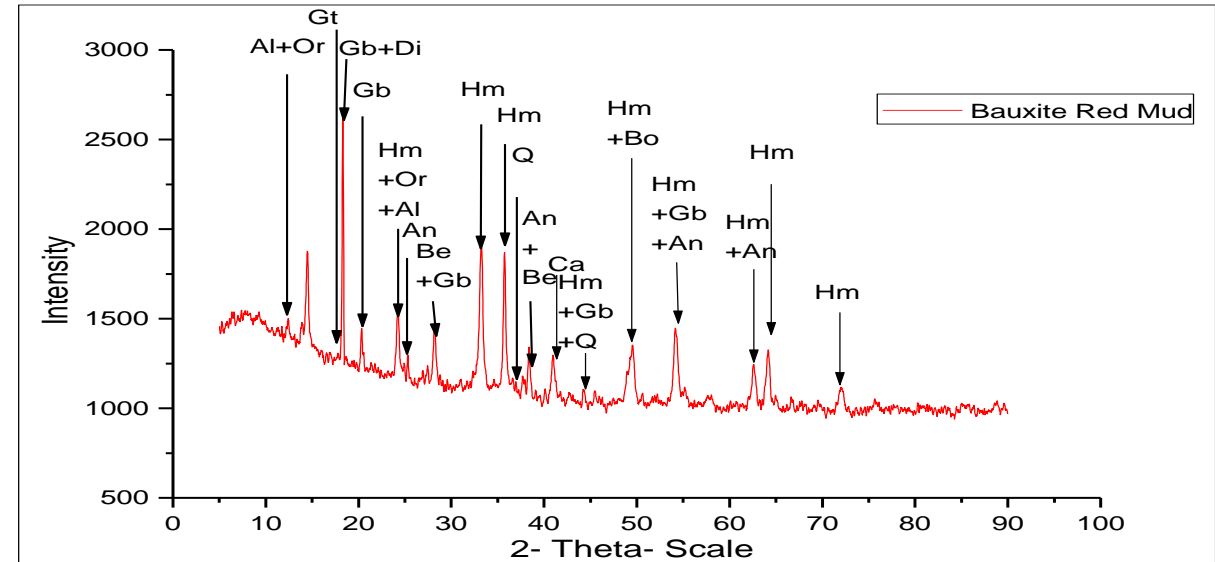


Figure 3: XRD pattern of red mud

RESULTS AND DISCUSSION

Thermal analysis

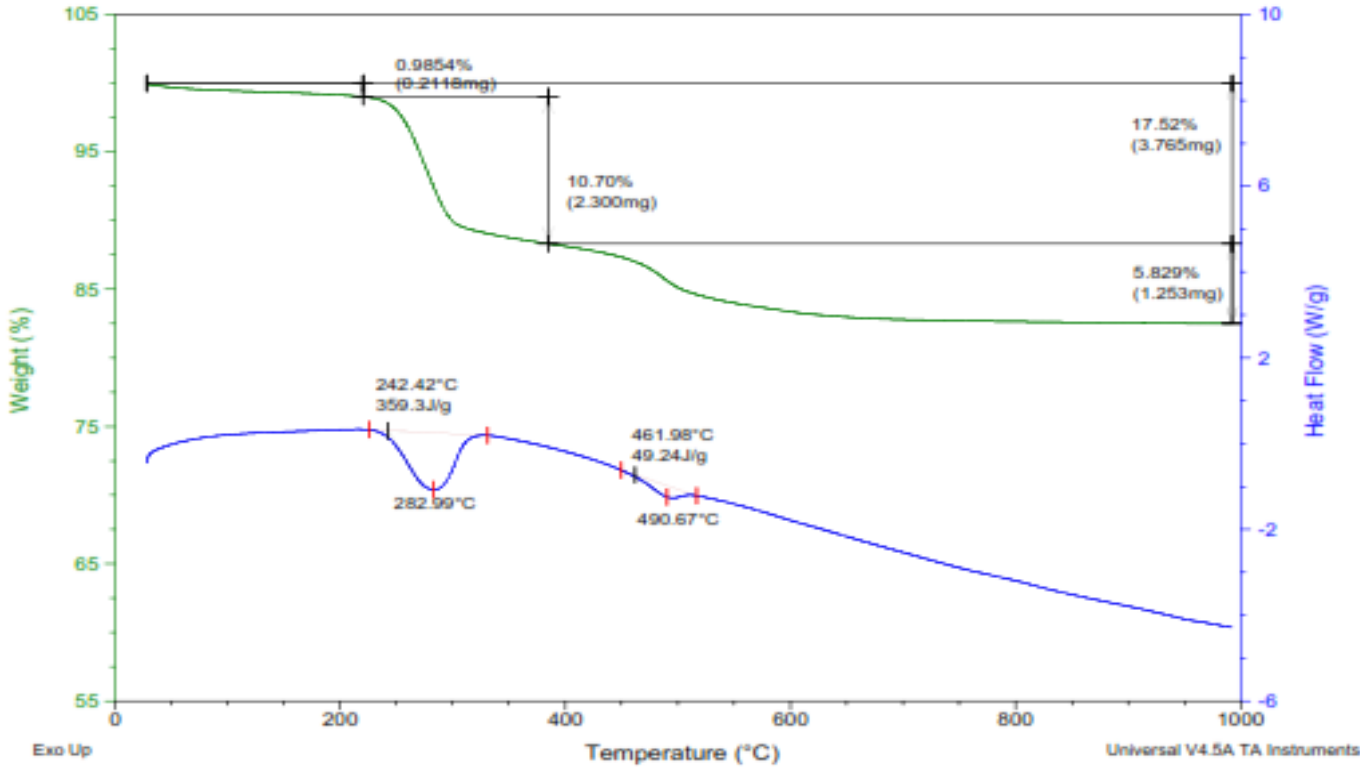


Figure 4: DSC-TGA curves of red mud (blue is DSC, green is TGA)

An important endothermic peak around 283°C, corresponds to the dehydroxylation of gibbsite (Kloprogge et al., 2002) according to equation (1)



morphological characteristics

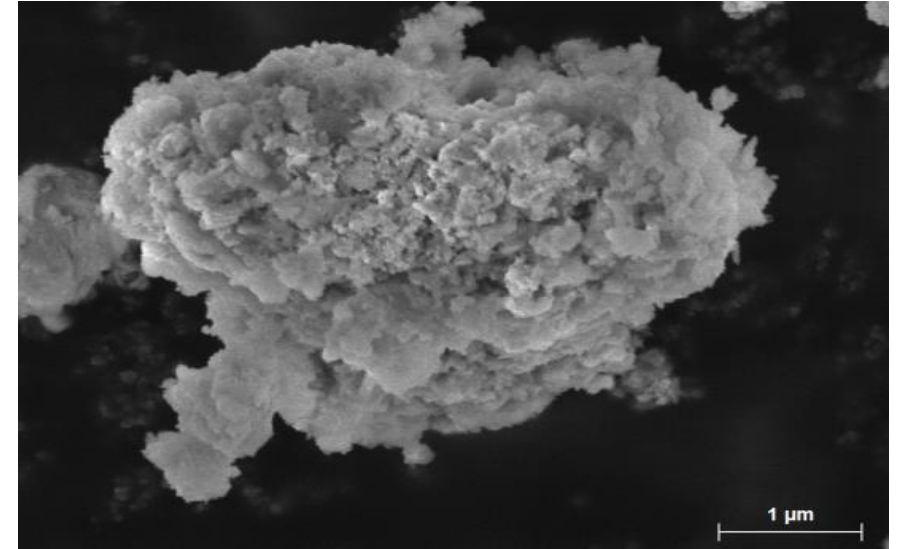


Figure 5: SEM images of red mud of Ngaoundal bauxite

An endothermic peak around 491°C that corresponds to the dehydroxylation of boehmite to Equation (2):



RESULTS AND DISCUSSION

particles size (PS) of red mud

PS has an impact on the reactivity of the material and the product obtained after the firing process, thus the finer the particles of a material, the greater the reactivity of this material (Diaz et al., 2010).

Table 2: particles size of red mud

%	d_{10}	d_{50}	d_{90}
size (μm)	1.641	14.341	62.458

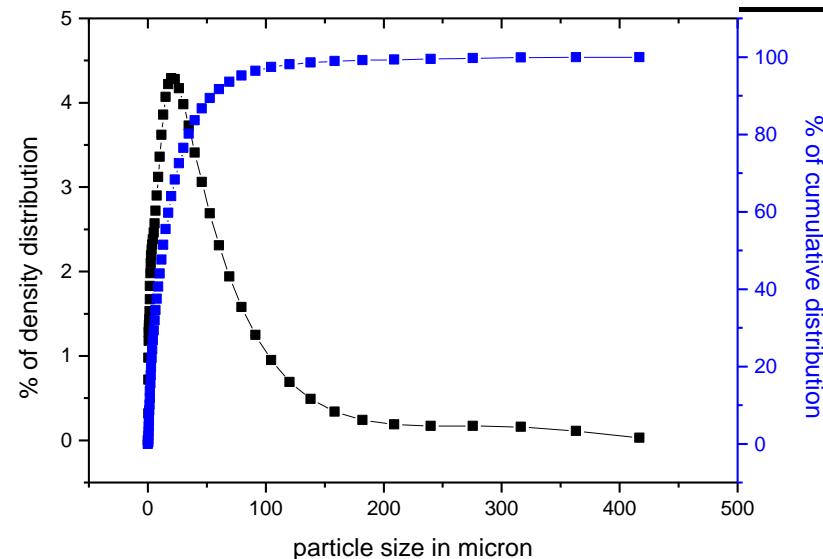


Figure 8: Particle size distribution of the red mud powder

RESULTS AND DISCUSSION

Physicochemical and technology properties

Baking temperature, linear shrinkage, fire loss, porosity and flexural strength are essential for judging ceramic product quality

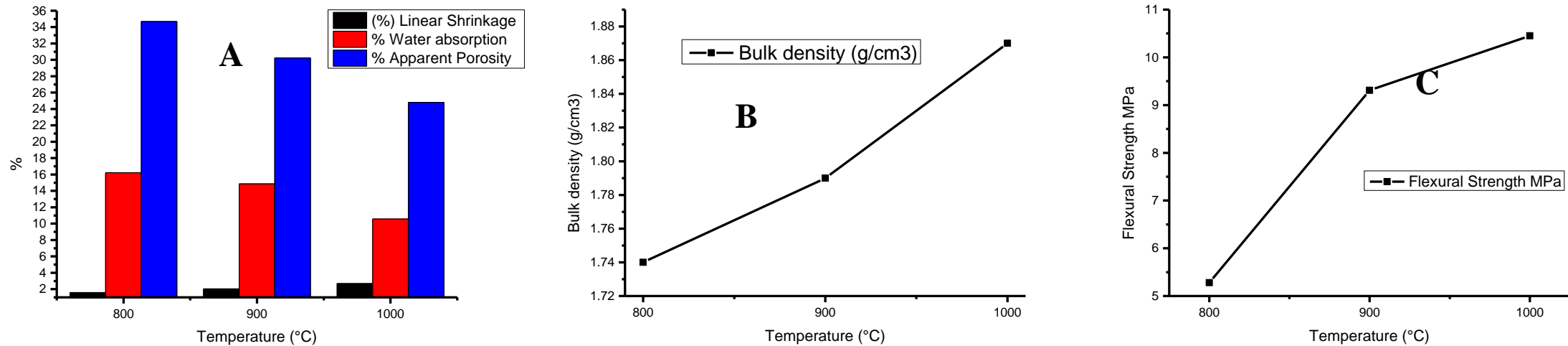


Figure 6: Influence of firing temperature. A: Linear shrinkage, Water absorption and Apparent Porosity; B: Bulk Density; C: Flexural Strength

Table 3: chemical resistance tests at 1000°C

Time	Day	2	4	6	8	10	20	30
Differential weight in %	HNO ₃ 0.1N	0	0.088	0.11	0.13	0.15	0.165	0.172
	NaOH 0.1N	0	0.021	0.07	0.11	0.123	0.127	0.127

RESULTS AND DISCUSSION



Drying at room temperature



Fired product

CONCLUSION

Results of this work confirmed the possibility of using red mud as raw material for ceramic materials

XRF, XRD and IR revealed components which give the possibility to enhance the quality of manufactured ceramic.

Linear Shrinkage (0.59 to 1.28%), Flexural strength (5.28 to 10.45MPa), Water absorption (16.23 to 12.56%), and Apparent Porosity (34.68 to 24.80%) with increasing temperature

Red mud firing at 1000°C can be used in ceramic manufacture, also the use of this waste could be beneficial for sustainable development of the environment.

THANKS FOR LISTENING