Global Journal of Pure and Applied Chemistry Research
Vol.3, No.3, pp.15-19, November 2015
Published by European Centre for Research Training and Development UK (www.eajournals.org

EVALUATION OF BAUXITE FROM ORIN-EKITI, EKITI STATE, SOUTH-WEST NIGERIA USING CHEMICAL AND SPECTROSCOPIC METHODS OF ANALYSIS.

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ABSTRACT: *Bauxite samples were collected from Orin-Ekiti and analyzed using chemical and spectroscopic methods of analysis to substantiate its quality. The results obtained revealed that both method show close values for all parameters determined in all the samples. The silicon oxide concentration of all samples was found to have the highest value ranging between 44.22% and 56.02% while aluminum oxide concentrations in all the samples have values between 27.13% and 37.20%. The Iron concentration ranged from 0.63% to 6.01% while titanium oxide concentration was between 0.36% and 2.4% these values were all found to be within the specification range. The concentration of alkaline metal oxide and alkaline earth metal oxide determined are alkali metal and alkaline earth metals are below 1%. Results obtained have been compared with International standard for bauxite ore and it was discovered that the quality of Orin-Ekiti bauxite analyzed does not meet the specification for the production of aluminum but meet the specification as chemical bauxite for the production of Aluminium sulphate (Alum) and refractory materials.*

KEYWORDS: Bauxite, X-ray fluorescence spectroscopy, chemical analysis, Orin-Ekiti.

INTRODUCTION

Development of man has been characterized by the quest to utilize the vast mineral resources available to him. All over the world, the solid mineral; has played vital role in the emerging civilization. Mineral resources is defined as a concentration of naturally occurring solid, liquid or gases mineral in or on the earth crust in such a form and amount that economic extraction of the commodity from the concentration is currently or potentially feasible[1]. To sustain the technological based society of this present age, demands for commodities obtained from these minerals are increasing and exploration for these commodities has become imperative.

Among several mineral deposits in Nigeria are bauxite deposits found in four states of the federation, and they are Plateau, Ondo, Ekiti, and Adamawa states[2.]

The word bauxite is used mainly for lithified and non lithified residual weathering product which is rich in alumina and low in alkali metals, alkali earth metals. It comprise mainly one or more of hydrated aluminum mineral; Gibbsite, Boehmite, and Diaspore with other impurities such as silica, iron oxides, titanium oxide and other elements in minor to trace amount[3].

Bauxite has found so many uses for a long time. It has been the major source of aluminum hydroxide which itself has wide application as a major raw material in the production of aluminum sulphate (alum), as well as aluminum production by the Bayer process.

ISSN 2055-0073(Print) ISSN 2055-0081(Online)

Chemical method of analysis has been employed in the analysis of several mineral resources from time past and these methods has been found to effective and reliable, if properly carried out. For a thorough and reliable bauxite analysis, a well organized laboratory is required as well as using well prepared reagents of analysis.

X-ray Spectroscopy is an analytical technique used for the elemental analysis of chemical characterization of a sample. It relies on an interaction of some source of x-ray excitation and a sample. Its characterization capabilities are due in large part to the fundamental principle that each element has a unique set of peak on its x-ray spectrum[4]. X-ray fluorescence spectroscopic method of analysis has been shown to be the most effective method for bauxite analysis which enables a short and multi-elemental analysis in a very short period of time and requires minimal preparation of sample[5].

The aim of this research work is to evaluate the bauxite deposit in Orin-Ekiti using both chemical and spectroscopic methods of analysis and to compare the result obtained from both methods. Hence, comparing these results with the standard for bauxite ore.

EXPERIMENTALS

Sample collection

Bauxite representative samples were obtained from the site in Orin-Ekiti, South west Nigeria, by grab sampling method. The samples were identified at the geological survey agency, Kaduna state. A total of fifteen samples were collected. All samples were grounded into powder using a ceramic mortal and pestle, screened until all the materials passed through the screen mesh aperture 125mm. the fine powdered samples were stored in a dry plastic bag.

All chemical analysis and reagents preparation were carried out in accordance with the Nigerian industrial standard (NIS) [6].

X-ray fluorescence spectroscopic analysis was carried out at the Nigerian geological survey agency (NGSA), Kaduna. The following conditions were maintained; Primary filter used was kapton, X-ray current was 14Kv, Air as the carrier medium, Measurement time was 100 seconds.

Results and discussion

The results of chemical and spectroscopic analysis of samples are presented in figure 1and 2. Fig 3 presents the comparism of results obtained from both methods with standard of bauxite ore.

ISSN 2055-0073(Print) ISSN 2055-0081(Online)

FIG 1: RESULT OF CHEMICAL ANALYSIS OF ORIN EKITI BAUXITE

S/N	SAMPLE	%MOISTURE CONTENT	%LOSS ON IGNITION	% SiO_2	% Al_2O_3	% Fe_2O_3	% CaO	% TiO_2
1	A1	18.469	12.331	35.122	32.235	0.453	0.31	-
2	A2	19.232	12.472	32.739	29.632	4.725	0.21	-
3	A3	18.597	13.011	29.251	31.131	7.110	0.27	-
4	A4	10.788	11.721	37.860	33.011	5.320	0.21	-
5	A5	18.912	12.113	32.639	29.523	6.013	0.23	-
6	B1	20.103	13.035	32.124	35.210	0.335	-	-
7	B2	19.557	11.577	32.045	31.730	3.971	0.19	-
8	B3	19.315	13.997	29.896	35.118	0.71	0.20	-
9	B4	18.920	14.010	35.967	29.013	1.010	0.23	-
10	B5	20.117	11.520	30.176	33.312	3.992	0.21	-
11	C1	12.553	14.535	45.461	23.175	3.159	0.22	-
12	C2	15.731	15.117	32.709	29.711	5.332	0.24	-
13	C3	15.812	14.114	41.670	22.513	4.991	-	-
14	C4	14.994	15.015	44.325	19.322	5.311	0.19	-
15	C5	15.312	11.110	45.898	22.117	4.793	0.20	-
	MIN	**10.788**	**11.11**	**29.251**	**19.322**	**0.335**	**0.19**	**-**
	MAX	**20.117**	**15.117**	**45.898**	**35.21**	**7.11**	**0.31**	**-**
	AVERAGE	**17.228**	**13.0452**	**35.8588**	**29.117**	**3.815**	**0.224**	

FIG 2: XRF ANALYSIS RESULT OF ORIN -EKITI BAUXITE.

OXIDE%	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	AVERAGE
SiO_2	56.02	52.03	53.49	52.11	52.36	53.74	48.20	44.22	49.02	47.70	50.889
TiO_2	0.74	0.54	0.87	0.36	0.77	1.04	1.92	2.15	2.41	2.05	1.2
Al_2O_3	29.10	29.07	27.13	29.24	28.52	31.00	31.66	37.20	32.47	32.10	30.749
Fe_2O_3	0.93	5.62	6.01	5.50	5.42	0.63	4.68	0.72	0.91	4.51	3.493
CaO	0.37	0.19	0.21	0.19	0.26	0.24	0.16	0.22	0.22	0.19	0.225
MgO	0.26	0.09	0.16	0.07	0.13	0.09	0.38	0.08	0.24	0.36	0.186
Na_2O	0.11	0.17	o.21	0.13	0.18	0.11	0.43	0.13	0.31	0.47	0.227
K_2O	0.43	0.16	0.13	0.41	0.14	0.18	0.50	0.16	0.37	0.80	0.328
MnO	-	0.02	-	0.02	-	-	-	-	-	-	0.02
BaO	0.41	0.36	0.36	0.29	0.21	0.21	0.11	0.27	0.15	0.12	0.249
LOSS ON IGNITION	11.63	11.72	11.43	11.68	12.01	12.76	11.96	14.85	13.90	11.69	12.363

ISSN 2055-0073(Print) ISSN 2055-0081(Online)

FIG 3: XRF AND CHEMICAL METHOD ON AVERAGE CONCENTRATION OF MAJOR OXIDES IN COMPARISM TO SPECIFICATION RANGE FOR BAUXITE ORE.

S/N	OXIDE%	XRF	CHEMICAL METHOD	RESIDUE	SPECIFICATION RANGE
1	SiO_2	50.889	35.859	15.03	<5%
2	Al_2O_3	30.749	29.117	1.632	>45%
3	Fe_2O_3	3.493	3.815	0.322	<20%
4	LOI	12.363	13.045	0.682	-
5	CaO	0.225	0.224	0.001	Trace
6	TiO	0.02	-	0.02	Trace

Chemical Analysis

The result of chemical analysis of samples is presented in figure 1. Chemical composition of bauxite is represented by the following components; Al_2O_3, SiO_2, Fe_2O_3, TiO_2, CaO, and loss on ignition[7]. Hence, parameters determined are moisture content, loss on ignition, silicon oxide, aluminum oxide, iron (111) oxide, calcium oxide and titanium oxide. The result shows a high concentration of silicon oxide in all the samples with an average of 35.86%. aluminum oxide has an average of 29.12%, iron (111) oxide has average of 3.82% , calcium oxide has average of 0.22%, titanium oxide was not detected using this method while the loss on ignition and moisture content have average concentrations of 13.05% and 17.23% respectively.

Spectroscopic Analysis

The spectroscopic analyses of samples are presented in figure 2. The result shows that the silicon oxide average concentration is 50.89%, aluminum oxide has average concentration of 30.75%, iron (111) oxide has average concentration of 3.49%. alkali metal present as potassium oxide and sodium oxide have average concentrations of 0.33% and 0.23% respectively while alkali earth metals present as calcium oxide and magnesium oxide have average concentration of 0.23% and 0.19% respectively. Other oxides detected by this method are titanium oxide 1.20%, Manganese oxide 0.02%, Barium oxide 0.25%. The average loss on ignition is 12.36%.

Information from figure 3 shows that both methods of analysis show close concentration values for both methods except silicon oxide concentration which has a higher value of 50.89% for the spectroscopic method and 35.86% for chemical method giving a residual of 15.03%.

Moreover, titanium oxide was detected by the spectroscopic method but was not detected using the chemical method of analysis.

The following are the standard for bauxite ore: $Al_2O_3 > 45\%$, $Fe_2O_3 < 20\%$, $SiO_2 < 5\%$.Other oxides should be in trace concentration[8].

From the result obtained as presented in figure 3, it is obvious that the silicon oxide concentration for both methods of analysis exceeds that of standard for bauxite ore. The aluminum oxide concentration as well is less than the standard specification for bauxite ore in

ISSN 2055-0073(Print) ISSN 2055-0081(Online)

both methods of analysis. The iron (111) oxide concentration falls within the specification limit, while the alkali metal and alkali earth metals also fall within the trace specification range.

The result indicates that the bauxite analyzed are not sufficient to be used as a raw material for aluminum production[9] due to the low aluminum oxide concentration and the high silicon oxide concentration as revealed by both methods of analysis.

CONCLUSION

This research has revealed that the bauxite samples obtained from Orin-Ekiti is not suitable as a raw material for the production of Aluminum using the Bayer process. It can however be channeled into production of refractory materials as well as chemical production (alum). However, cost analysis should be carried out to ascertain its feasibility.

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ISSN 2055-0073(Print) ISSN 2055-0081(Online)