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INDUSTRIAL APPRAISAL OF TALCOSE ROCK FROM BREWERY AREA, ILESA, SOUTHWESTERN NIGERIA

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Abstract: The talcose rock of Brewery area, Ilesa in the Ife-Ilesa Schist Belt, Southwestern Nigeria was investigated using physical properties and geochemical properties in order to evaluate its economic potentials. Five (5) samples were collected, sealed in polythene bag and labeled differently. They were taken to the laboratory for analyses where they were first air dried and grinded. X-Ray Fluorescence (XRF) analysis and determination of physical properties that included Loss on Ignition, LOI; Water Absorption Capacity, WAC; Linear Shrinkage (LS); pH and colour were carried out on each sample. From the XRF, the talc samples have average SiO_2 concentration of 55.41 wt. %, MgO (26.6 wt. %), Fe_2O_3 (6.38 wt. %), Al_2O_3 (2.42 wt. %), P_2O_5 (0.37 wt. %), MnO (0.08 wt. %), CaO (0.05 wt. %) and Na_2O (0.004 wt. %). From the physical properties carried out, this talcose rock have LOI of 4.44%, LS of 2.42, WAC of 7.75%, pH of 7.89 and on firing, colour of brown. The talcose rocks plotted in the peridotitic-komatiite field of the Al_2O_3 – (FeO + TiO_2) – MgO diagram. This study concluded that the talcose rock can be used for different industrial purposes like ceramics, roofing, plastics, cosmetics, rubber, paints, textile and refraction.
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1. Introduction

Talc is the softest mineral on the Mohr's scale of hardness since it is 1 compared to the hardest mineral, diamond which is 10. Talc is a hydrated silicate of magnesium with chemical formular $Mg_3Si_4O_{10}$ $(OH)_2$ (Luzenac, 2004) (Fig. 1). It belongs to a subclass of phyllosilicates in a larger group called clays. It can be relatively pure with white colour but can have other colours like green, dark green or brown depending on the impurities present like aluminum, iron, magnesium and titanium and the composition of the host rock (Luzenac, 2004). It is an alteration product of original or secondary magnesian minerals or rocks resulting from mild hydrothermal processes aided by simple dynamic metamorphism but not from weathering as erroneously thought. Talc is composed of microscopic platelets and the bonds holding the platelets together are very weak.

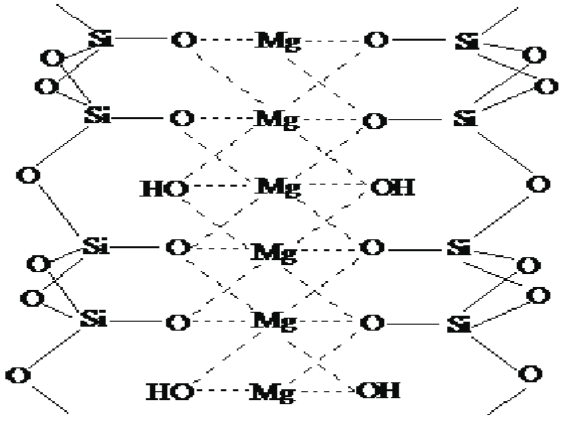

Figure 1: The chemical composition of talc (Li *et al.*, 2015).

Talc is formed by carbonation:

$2Mg_3Si_2O_5$ $(OH)_4$ + $3CO_2$ → $Mg_3Si_4O_{10}$ $(OH)_2$ + $3MgCO_3$ + $3H_2O$ …… (I)

Serpentine Carbon (iv) oxide Talc Magnesite Water

Talc is also formed via a reaction between dolomite and silica which is typical of skarnification of dolomites by silica-flooding in contact metamorphic aureoles:

$3CaMg(CO_3)_2$ + $4SiO_2$ + H_2O → $MgSi_4O_{10}$ $(OH)_2$ + $3CaCO_3$ + $3CO_2$ …… (II)

Dolomite Quartz Water Talc Calcite Carbon (iv) oxide

The study area is around the western part of the Ilesa Farm Institute and is located within the longitude 7°36'N and 7°37'N and latitude and 04°47'E and 04°48'E (Fig. 2) with an area extent of the study area is 200 m by 200 m.

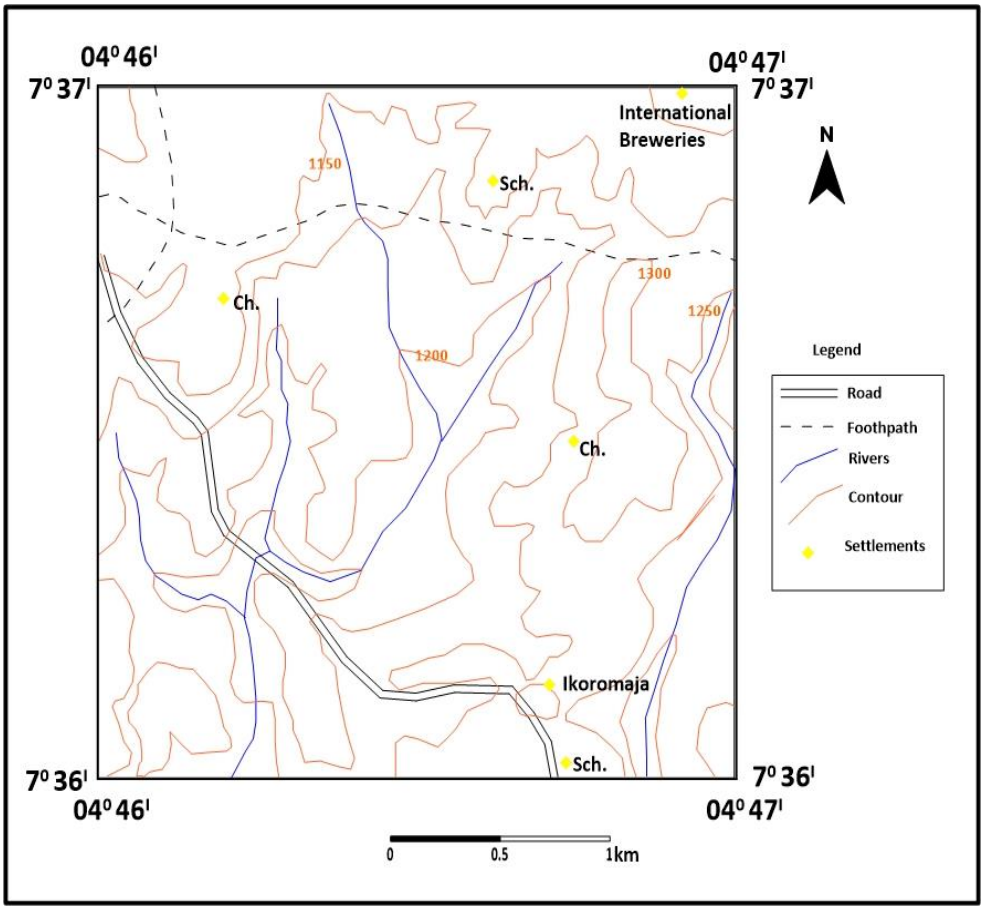

Figure 2: Topographical map of the study area (modified after Geological Survey of Nigeria, 1965, Ilesa NW Sheet 243).

The aim of this research is to investigate the geochemical composition and physical properties of Ilesa-Brewery talc deposit with the goal of assessing its industrial usage.

2. Geology of the Study Area

The study area is within the Ife-Ilesa Schist Belt of the Precambrian Basement Complex exposed in southwestern Nigeria (Fig. 3). The talc is associated with schist; it has schistose texture. The nature of exposure of the rock in the study area is slightly hilly although blast holes were seen which means it covered a large distance before it got reduced to the present size. The talc is brownish to white (Fig. 4). This could be as a result of iron staining from the thin layer of clay overlying the talc. The samples have fine-grained texture with characteristics soapy feeling. Five samples were taken from different parts of the location. The study area is dominated by two (2) main rock types which are mica schist and talcose rocks.

2.1 Mica Schist

Mica schist is widespread in the study area; it is the most abundant rock type. They are low-lying, although some of them are exposed by road-cut and stream channels. Many of the mica schists had weathered and so they are reddish due to abundance of iron (III) oxide.

2.2 Talcose Rock

The talcose rock which is off-white in colour also possesses streaks of whitish talc minerals. Along Ilesa-Akure expressway, road-cut outcrop of talcose rock about 4m high and 12m wide was mapped and the samples were taken at different parts of this location for this research.

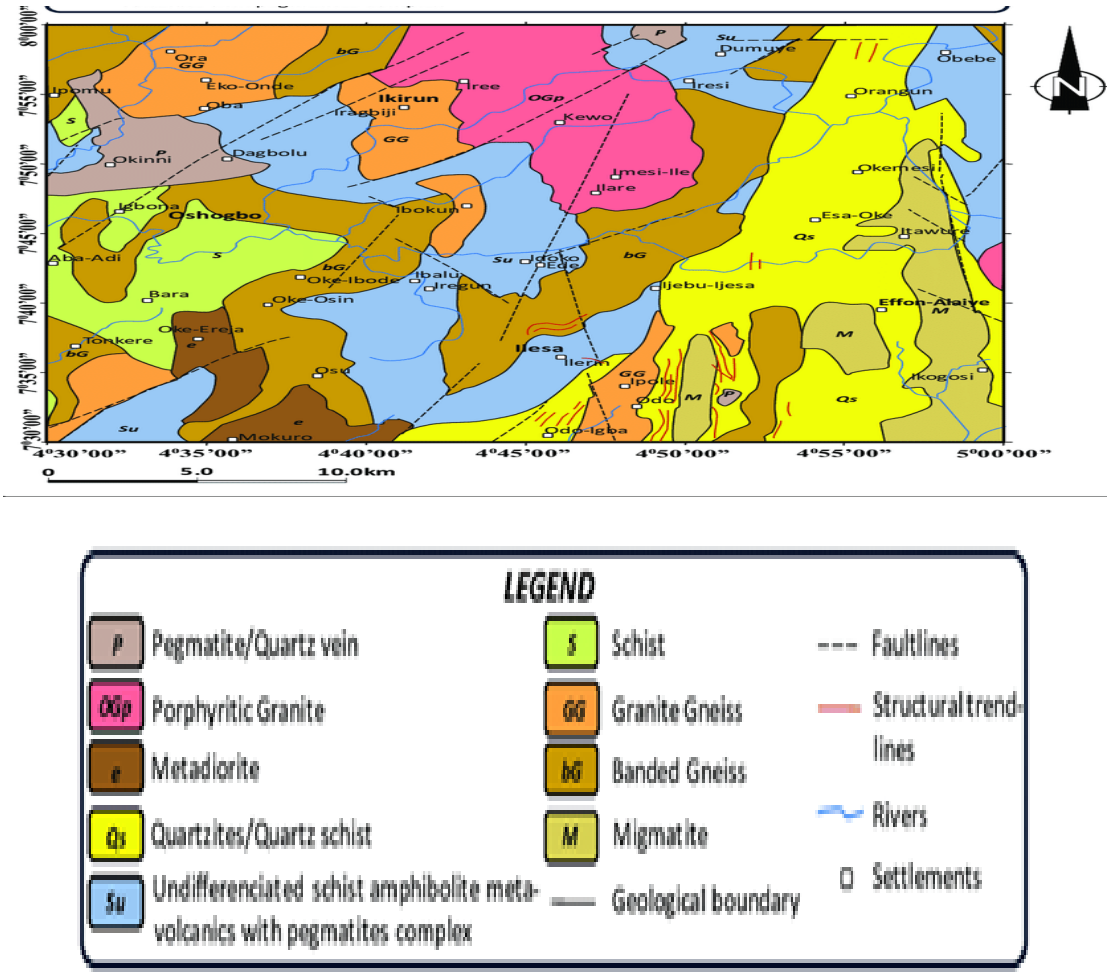

Figure 3: Geological map of Brewery area and its environs (Adapted from Olurin, 2018).

3. Methodology

3.1 Mapping and Sampling

Five (5) different samples of talcose rocks were collected from five locations within the study area. The samples were taken at a distance of 1m apart. Each sample was taken in a separate nylon bag, sealed and labeled appropriately.

3.2 Physical and Geochemical Methods

The economic potential of talc is largely dependent on its physical properties. The physical properties that were determined are: Loss on ignition (LOI), Water Absorption Capacity (WAC), Linear Shrinkage Value (LSV), pH and colour.

XRF analytical technique was used to determine the amount of major and trace elements in the samples and it was done at NASENI (National Agency for Science and Engineering Infrastructure) Complex, Akure, Ondo State, Nigeria.

LOI involved heating a sample of the material at a specified temperature and allowing volatile substances to escape until its mass ceases to change. The pellets of the talc samples were fire; the sample change in colour was noted accordingly. To determine the pH of talc, a 10 % suspension of pulverized sample was made and pH metre was used to know the pH.

4. Results and Interpretation

4.1 Geochemistry of Talc around Brewery Area, Ilesa

The range of the oxides of the major elements are SiO_2 (54.15 wt. % - 56.72 wt. %), MgO (25.6 wt. % - 27.78 wt. %), Fe_2O_3 (5.46 wt. % - 6.59 wt. %), Al_2O_3 (2.19 wt. % - 2.72 wt. %), P_2O_5 (0.09 wt. % - 0.97 wt. %), MnO (0.08 wt. % - 0.09 wt. %), CaO (0.00 wt. % - 0.09 wt. %), Na_2O (0.000 wt. % - 0.01 wt. %) and K_2O with value that is below detection limit (Table 1).

Table 1: Major element concentrations of talc around Brewery Area, Ilesa, Osun State

Oxide (wt. %)	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Mean
SiO_2	55.05	54.19	56.72	55.06	56.01	55.41
MgO	26.73	25.94	25.67	26.9	27.78	26.6
Fe_2O_3	6.6	6.59	6.68	6.59	5.46	6.38
Al_2O_3	2.19	2.57	2.23	2.72	2.38	2.42
P_2O_5	0.28	0.97	0.24	0.28	0.09	0.37
MnO	0.09	0.09	0.08	0.08	0.08	0.08
CaO	0.08	0.06	0.04	0.00	0.09	0.05
Na_2O	N.D	N.D	N.D	0.01	0.01	0.004
K_2O	N.D	N.D	N.D	N.D	N.D	N.D
LOI	4.60	4.50	4.33	4.34	4.45	4.44
Total	95.62	94.91	95.99	95.98	96.26	95.75

*N.D means Not Detected.

Each concentration value of the chemical elements in the talc samples of Brewery Area was compared to those of other similar talc bodies within the pre-Cambrian domain of Southwestern Nigeria like Iseyin talc-tremolite-chlorite schist (Elueze and Awonaiya, 1989), Oke-Ila tremolite-chlorite schist (Bolarinwa, 2001), Baba-Ode talcose rock (Okunlola *et al.,* 2002), Igbo-Agbon talcose rock (Ayemo, 2003), Erin-Omu talcose rock (Anikulapo, 2005), Esie talcose rock (Olorunfemi, 2007) and Itagunmodi-Igun talcose rock (Olajide-Kayode *et al.,* 2018) (Table 2).

The SiO_2 content ranges from 54.19 wt. % to 56.72 wt. % with mean value of 55.41 wt. %. This value is comparable to those of Esie talcose rock (Olorunfemi, 2007) and Baba-Ode talcose rock (Okunlola *et al.,* 2002). However, the average SiO_2 concentration of Itagunmodi-Igun talcose rock (Olajide-Kayode *et al.,* 2018) and Erin-Omu talc bodies (Anikulapo, 2005) is higher than the average SiO_2 concentration of Ilesa-Brewery. The average SiO_2 concentration of the study area is lower than that of Oke-Ila tremolite-chlorite Schist (Bolarinwa, 2001) and Igbo-Agbon talcose rock (Ayemo, 2003) which have 52.30 wt. % and 53.92 wt. % respectively.

The concentration of MgO for the talc from the study area ranges between 25.67 wt. % and 27.78 wt. %, with mean of 26.6 wt. %. This value is comparable to those of Erin-Omu talc bodies (Anikulapo, 2005) that has mean value of 26.87 wt. % and Oke-Ila tremolite- Chlorite Schist (Bolarinwa, 2001) that has 26.98wt. %. Fe_2O_3 concentration ranges between 5.46 wt. % and 6.59 wt. % with a mean of 6.38 wt. %. This value is comparable with that of Esie Talcose rock (Olorunfemi, 2007) that has mean value of 6.90 wt. %.

The Al_2O_3 content of the studied talc ranges from 2.19 wt. % to 2.72 wt. %, with mean value of 2.42 wt. %. This mean value is comparable to that of Baba-Ode talcose rock (Okunlola *et al.,*2002) which has mean value of 2.46 wt. % and Itagunmodi-Igun talcose rock (Olajide-Kayode *et al.,* 2018) which have mean value of 2.60 wt. %. Oke-Ila tremolite-chlorite Schist (Bolarinwa, 2001) and Igbo-Agbon talcose rock (Ayemo, 2003) have higher average Al_2O_3 concentration of 3.14 wt. % and 4.13 wt. %, respectively. Erin-Omu talc bodies (Anikulapo, 2005) and Esie talcose rock (Olorunfemi, 2007) have lower average Al_2O_3 concentration than that of Brewery Area talc.

Table 2: Comparison of Brewery Area, Ilesa talc with other talc bodies in Southwestern Nigeria

Oxide (%)	Brewery-Ilesa.		Oke-Ila (Bolarinwa, 2001).		Baba-Ode (Okunlola *et al.*, 2002).		Igbo-Agbon (Ayemo, 2003).		Erin-Omu (Anikulapo, 2005).		Esie (Olorunfemi, 2007).		Itagunmodi-Igun (Olajide-Kayode *et al.*, 2018)	
	Mean	Range	Mean	Range	Mean	Range	Mean	Range	Mean	Range	Mean	Range	Mean	Range
SiO_2	55.41	54.19 – 56.72	52.30	44.82 – 56.52	56.88	56.31 – 57.21	53.92	52.36 – 55.02	59.72	57.84 – 61.76	56.21	50.48 – 58.30	57.53	55.26 – 59.15
MgO	26.6	25.67 – 27.78	26.98	20.54 – 28.15	30.87	30.62 – 31.09	23.11	22.15 – 24.73	26.87	24.72 – 29.06	29.71	26.09 – 31.35	24.82	22.19 – 26.98
Fe_2O_3	6.38	5.46 – 6.59	5.22	5.03 – 8.84	4.64	4.41 – 4.81	5.36	4.31 – 6.29	7.34	5.65 – 8.34	6.90	5.23 – 10.63	7.73	5.78 – 11.35
Al_2O_3	2.41	2.19 – 2.72	3.14	2.66 – 5.49	2.46	2.31 – 2.65	4.93	4.10 – 5.84	1.65	0.85 – 2.91	1.66	0.50 – 5.54	2.60	1.59 – 3.30
P_2O_5	0.37	0.09 – 0.97	0.02	0.01 – 0.05	0.03	0.02 – 0.06	0	0	0	0	0.2	0.01 – 0.03	0.02	0.01 – 0.03
MnO	0.08	0.08 – 0.09	0.18	0.12 – 0.20	0.08	0.07 – 0.09	0.13	0.10 – 0.18	0	0	0.10	0.30 – 0.178	0.11	0.04 – 0.21
CaO	0.05	0.00 – 0.09	7.40	6.28 – 8.66	0.04	0.03 – 0.06	7.40	6.85 – 7.91	0.06	0.04 – 0.08	0.16	0.04 – 0.37	0.64	0.11 – 1.74
Na_2O	0.0	0.00 – 0.01	0.05	0.03 – 0.08	0.06	0.05 – 0.08	0.09	0.07 – 0.11	0.02	0.01 – 0.03	0.16	0.12 – 0.25	0.04	0.02 – 0.10
K_2O	N. D	N. D	0.02	0.01 – 0.03	0.03	0.01 – 0.05	0	0	0.02	0.01 – 0.03	0.03	0.01 – 0.12	0.03	0.01 – 0.08
LOI	4.44	4.33 – 4.60	4.45	3.75 – 5.20	4.34	4.25 – 4.41	4.06	4.63 – 5.5	3.82	2.87 – 4.11	4.63	3.90 – 6.07	5.38	4.80 – 6.13

P_2O_5 content of Brewery Area talc ranges between 0.09 wt. % and 0.97 wt. %, with mean value of 0.37 wt. %. This mean value is only comparable with that of Esie talcose rock (Olorunfemi, 2007) which has mean value of 0.2 wt. %.

MnO content of Brewery Area talc ranges between 0.08 wt. % and 0.09 wt. %, with mean value of 0.08 wt. %. This mean value is only comparable to that of Baba-Ode talcose rock (Okunlola *et al.*, 2002). Esie talcose rock (Olorunfemi, 2007) and Itagunmodi-Igun talcose rock (Olajide-Kayode *et al.*, 2018) have slightly high MnO mean value of 0.10 wt. % and 0.11 wt. %, respectively. CaO content of Brewery Area, Ilesa talc ranges between 0.00 wt. % and 0.09 wt. % with mean value of 0.05 wt. %. The value is comparable with that of Erin-Omu (Anikulapo, 2005) which has 0.06 wt. % and Baba-Ode talcose rock (Okunlola *et al.*, 2002) which has 0.04 wt. %.

Na_2O content of Brewery Area, Ilesa talc ranges between 0.00 wt. % and 0.01 wt. % with mean value of 0.004 wt. %. This value is not comparable with any talc body listed in Table 2 because the value is very low.

The trace element concentration of Brewery Area, Ilesa talc (Table 3) is compared with those of Oke-Ila talc-tremolite-chlorite schist (Bolarinwa, 2001), Erin-Omu talc body (Anikulapo, 2005) and Esie talcose body (Olorunfemi, 2007).

The talc has cobalt (Co) mean concentration of 2642 ppm and ranges between 1602 ppm and 3602 ppm (Table 3). This mean value is not comparable with other bodies mentioned above as the gap is very wide. The concentration of chromium (Cr) for Brewery Area, Ilesa ranges between 1127 ppm and 2197 ppm with a mean concentration of 1137 ppm. This Cr mean value is comparable with that of Erin-Omu talc body (Anikulapo, 2005) but slightly lower than the value of Oke-Ila talc-tremolite-chlorite schist (Bolarinwa, 2001) and Esie talc body (Olorunfemi, 2007). The mean concentration of Nickel (Ni) for the studied talc is 2950.2 ppm and ranges between 2554 ppm and 3654 ppm. This value is not comparable with those of other bodies mentioned. The Brewery talc ranges between 337 ppm and 677 ppm in zinc (Zn) content and a mean value of 477 ppm.

Table 3: Trace element data for talc around Brewery Area, Ilesa (in ppm)

Elements	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Mean
Ni	2554	3654	3114	2254	3175	2950.2
Co	1602	3602	2202	2402	3402	2642
Cr	1197	1197	1167	1127	2197	1137
Zn	577	677	417	377	337	477
Cu	275	275	245	245	185	245
Au	103	118	123	119	106	113.8
Pb	98	98	78	68	88	86
Ag	57	37	47	49	46	47.2
Mo	2210	2960	1210	2310	1810	2100
W	388	1388	278	332	378	552
Nb	46	36	36	36	36	38
Rb	9	8	7	8	12	8.8
V	16	14	11	13	17	14.2

Table 4: Trace elements of Brewery talc compared with other trace elements of other talc bodies in southwestern Nigeria

Elements (ppm)	Brewery Area, Ilesa		Erin-Omu		Oke-Ila		Esie	
	Mean	Range	Mean	Range	Mean	Range	Mean	Range
Co	2642	1602 – 2602	62.17	56 – 70	66	52– 79	70..23	42 – 81
Cr	1137	1127 – 2197	1229.41	428.5 – 1699	1629	608 – 2310	1969	1330 – 2690
Ni	2950.2	2554 – 3654	1029.89	915.8 – 1101.1	774	639– 979	1370.4	637 – 1870
Zn	477	337 – 677	58.08	49 – 69	78	81 – 96	112.04	66 – 182

4.2 Physical and Industrial Properties of Brewery Area, Ilesa Talc

The Loss on Ignition value of Brewery Area, Ilesa talc ranges from 4.33 to 4.60 % with a mean value of 4.44 (Table 5). This value is comparable with the LOI value of Oke-Ila tremolite-chlorite schist (Bolarinwa, 2001) which has mean value of 4.45, Baba-Ode talcose rock (Okunlola *et al.*, 2002) which has a mean value of 4.34 and Iseyin talc-tremolite-chlorite Schist (Elueze and Awonaiya, 1989) which has 4.0. The LOI mean value of Brewery Area, Ilesa talc is much lower than the LOI value of Itagunmodi-Igun talcose rock (Olajide-Kayode *et al.*, 2018) and much higher than the value of Erin-Omu Talc bodies (Anikulapo, 2005).

The pH value of Brewery Area, Ilesa talc ranges between 7.87 and 7.99, with mean value of 7.89 (Table 6). This means that the talc is alkaline and can be compared with those of Erin-Omu talc bodies (Anikulapo, 2005) and Baba-Ode talcose rock (Okunlola *et al.*, 2002).

Table 5: Loss on Ignition (LOI) of talc around Brewery Area, Ilesa

	Sample 1		Sample 2		Sample 3		Sample 4		Sample 5	
Crucible number	10	11	9	12	2	3	8	7	10	11
Mass of empty, clean crucible (g)	17.20	18.20	18.20	18.30	17.80	19.20	19.20	18.30	18.60	18.40
Mass of crucible and dry soil (g)	34.20	33.80	34.61	33.20	35.20	34.00	35.60	34.20	34.60	33.90
Mass of crucible and burned soil (g)	33.40	33.10	33.85	32.55	34.40	33.40	34.90	33.50	33.90	33.20
Mass of dry soil (g)	17.00	15.60	16.41	14.90	17.40	14.80	16.40	15.90	16.00	15.50
Mass of burned soil (g)	16.20	14.90	15.65	14.25	16.60	14.20	15.70	15.20	15.30	14.80
Mass loss on ignition (g)	0.80	0.70	0.76	0.65	0.80	0.60	0.70	0.70	0.70	0.70
Loss on ignition, LOI in %	4.71	4.49	4.63	4.36	4.60	4.05	4.27	4.40	4.38	4.52
Mean			4.50		4.33		4.34		4.45	

Table 6: pH Value of talc around Brewery Area, Ilesa

Sample code	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Mean
pH	7.89	7.93	7.87	7.9	7.88	7.89

The Linear Shrinkage Value (LSV) of Brewery Area, Ilesa talc has a mean value of 2.42 and it ranges between 2.1 and 2.9 (Table 7). These mean values can be compared with that of Oke-Ila talc-tremolite-chlorite schist (Bolarinwa, 2001). Water Absorption capacity (WAC) value ranges between 7.65 % and 7.92 %. It has mean value of 7.75 % (Table 8). This value is not comparable with other talc bodies listed in Table 9. This means that the porosity of Brewery Area, Ilesa Talc, compared to other talcose bodies in southwestern Nigeria, is not too high or too low. The colour of the talc samples is brown. This is due to the iron content in it. After firing, all samples are still brown.

Table 7: Linear shrinkage result of talc around Brewery area, Ilesa

	Original length L_0 (mm)	Final length L_f (mm)	Linear Shrinkage $(1-(L_f/L_0)) \times 100$
Sample 1	140	136	2.9
Sample 2	140	137	2.1
Sample 3	140	137	2.1
Sample 4	140	137	2.1
Sample 5	140	136	2.9
Mean			2.42

Table 8: Water absorption capacity value in the talc around Brewery Area, Ilesa

	Mass of sample (g)	Mass of sample after immersion (g)	Mass of water absorbed (g)	% of water absorbed
Sample 1	41.4	44.6	3.20	7.73
Sample 2	36.6	39.5	2.90	7.92
Sample 3	44.2	47.6	3.40	7.69
Sample 4	42.4	45.7	3.30	7.78
Sample 5	40.5	43.6	3.10	7.65
Mean				7.75

Table 9: Comparison table of physical properties of Brewery area Ilesa talc with other talc bodies in southwestern Nigeria

Physical Properties	Brewery Area, Ilesa		Iseyin (Elueze and Awonaiya, 1989)		Oke-Ila (Bolarinwa, 2001)		Baba-Ode (Okunlola *et al.*, 2002)		Erin-Omu (Anikulapo, 2005)		Itagunmodi-Igun (Olajide-Kayode *et al.*, 2018)	
	Mean	**Range**	**Mean**	**Range**	**Mean**	**Range**	**Mean**	**Range**	**Mean**	**Range**	**Mean**	**Range**
pH	7.89	7.87 – 7.93	–	–	8.50	7.50-9.5	8.08	8.01 – 8.21	8.07	8.01 – 8.21	–	–
LOI	4.44	4.33 – 4.60	4.0	1.45 – 6.03	4.54	3.75 – 5.28	4.34	4.25 – 4.41	3.82	2.87 – 4.11	5.34	4.8 – 6.1
WAC (%)	7.75	7.65 – 7.92	9.0	6.98 – 11.65	5.11	4.21 – 5.80	16.41	15.14 – 18.25	14.82	13.25 – 16.25	6.85	5.35 – 8.20
LSV	2.42	2.1 – 2.9	1.15	0.25 – 2.0	3.01	2.45 – 3.50	1.28	1.01 – 1.52	1.47	1.01 – 1.81	1.44	1.25 – 1.70

On the SiO_2-CaO-MgO ternary diagram, the samples fall in the talc region. This is due to high content of SiO_2 and low CaO content (Fig. 4). On the Al_2O_3 – (FeO + TiO_2) – MgO plot of the talc-chlorite schist ternary diagram, the samples fall in the peridotitic komatiite field (Fig. 5). This is due to the fact that it has low concentrations of (FeO+TiO_2) and the high concentration of MgO and Al_2O_3 in the rocks.

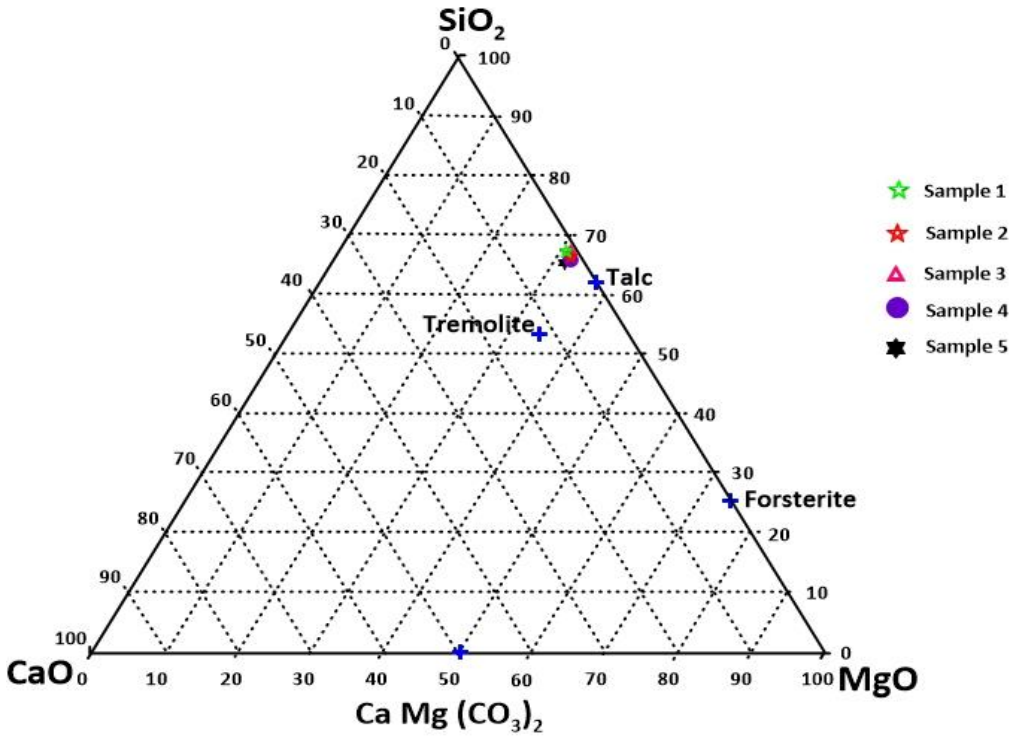

Figure 4: Ternary diagram of CaO – SiO_2 – MgO (Modified after Tahir *et al.*, 2018).

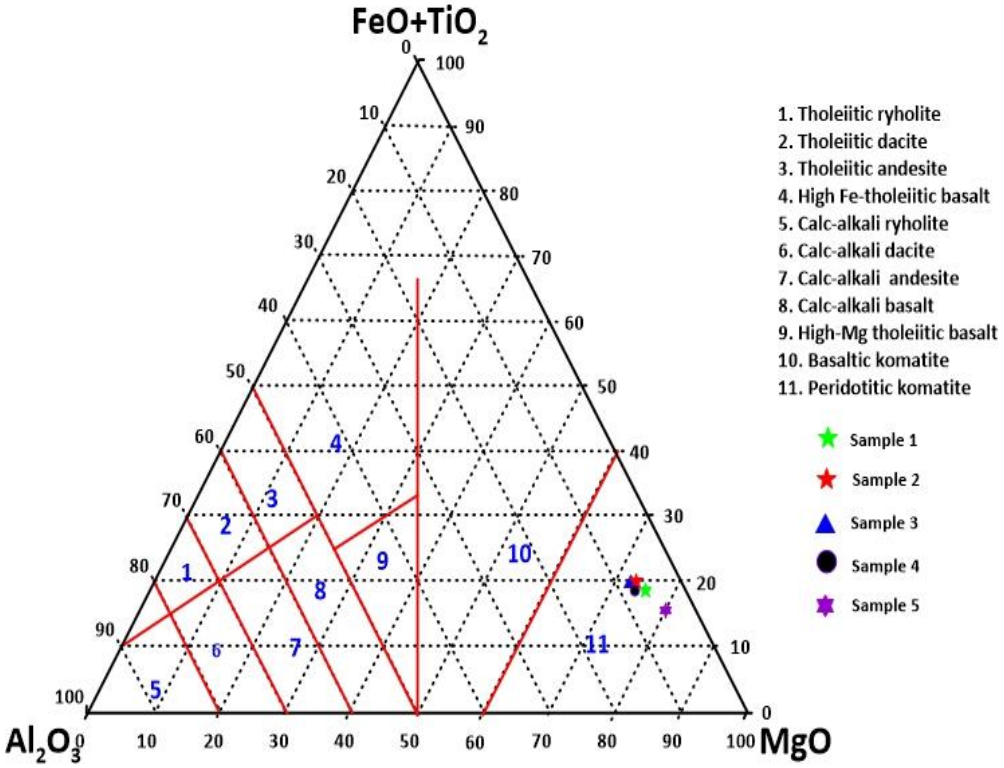

Figure 5: Ternary diagram of Al_2O_3 – (FeO + TiO_2) – MgO (Modified after Verma *et al.*, 2017).

The evaluation of the talc from Brewery for various industrial applications is as summarized in Table 10

Table 10: Evaluation of economic importance of talc from Brewery Area, Ilesa, Osun State

Industry	Requirements	Brewery-Ilesa Talc Characteristics	Suitability of Brewery-Ilesa Talc
Paint Payne (1981)	Good white colour	Off white	Fair
	Small particle size	Small particle size	Good
	Absence of hard particle	Absence of hard particle	Good
	$Al_2O_3 \leq 2$ wt. %	$Al_2O_3 = 2.42$ wt. %	Poor
	$MgO + SiO_2 > 75$ wt. %.	$MgO + SiO_2 = 82.1$ wt. %	Very Good
	LOI of 4-8	LOI 4.44	Good
	pH of 8-10	pH = 6.106	Poor
Paper Noble (1988)	White colour	Brown	Fair
	Fine grained	Fine grained	Very good
	Free from mica and Fe_2O_3.	Free from mica but not Fe_2O_3.	Fair
	CaO < 5 wt. %	CaO = 0.05 wt. %	Very good
	High reflectance.	High reflectance	Very good
	Soft	Soft	Very good
	Smooth	Smooth	Very Good
Rubber Severinghus (1975)	Low density	Low density	Very Good
	Off white	Off white	Very Good
	No gritty particle	No gritty particle	Very Good
	100% must pass through BS-mesh	100% pass through BS-mesh	Very Good
	MnO and CuO must be low	MnO and CuO is low	Very Good
Ceramics Mitchel (1975) (a) Wall and floor tiles.	Good firing colour	Brown colour	Poor
	CaO > 6 wt. %	CaO = 0.05 wt. %	Poor
(b) Low-loss electron ceramics.	Low Fe_2O_3	$Fe_2O_3 = 6.38$ wt. %	Poor
	Low Al_2O_3	$Al_2O_3 = 2.42$wt. %	Good
	CaO ≤ 1 wt. %	CaO = 0.05 wt. %	Very good
	Good firing colour.	Brown colour	Poor
(c) Electrical insulation ceramics.	$SiO_2 \geq 60$wt. %	$SiO_2 = 55.41$ wt. %	Fair
	MgO ≥ 30 wt. %	MgO = 26.6 wt. %	Fair
	$Al_2O_3 \leq 2.5$ wt. %	$Al_2O_3 = 2.42$ wt. %	Good
	CaO ≤ 1 wt. %	CaO = 0.05 wt. %	Very Good
	$Fe_2O_3 \leq 1.5$w t. %	$Fe_2O_3 = 6.38$ wt. %	Poor
	$Na_2O + K_2O \leq 0.4$ wt. %	$Na_2O + K_2O = 0.00$ wt. %	Very Good
	LOI ≤ 6%	LOI = 4.44	Good
Roofing (National Paint and Coating Association, 1975).	Relatively low grade.	Relatively low grade.	Good
	Coarse	Smooth	Poor
Textile. (American Textile Manufacturer Institute, 1978).	No gritty particle	No gritty particle	Very Good
	Good colour	Brown colour	Good
	Smooth, greasy feel	Smooth greasy feel	Very Good
Plastics Nobel (1988).	Low specific gravity	Specific gravity =2.76	Very good
	Fine particles size	Fine particle size	Very good
	Fibrous or lamella form	Lamella form	Very good
	Soft	Soft	Very good
	Good colour	Brown colour	Good
Cosmetics, Pharmaceuticals and Food processing. (American Association of Test	Odourless	Odourless	Very good
	No gritty particle	No gritty particle	Very good
	Fine grained	Fine grained	Very good

and Measurement).	Good white colour	Brown colour	Poor
	Good slip	Good slip	Good
	LOI ≤ 5wt. %	LOI = 4.44	Good
	pH 8-10	pH = 6.106	Poor
	CaO ≤ 1.5 wt. %	CaO = 0.05 wt. %	Very good
Refractory (American Association of Testing Materials, 1988).	Good firing colour	Brown colour	Poor
	CaO < 1 wt. %	CaO = 0.05 wt. %	Very good
	Fe_2O_3 < 1.5 wt. %	Fe_2O_3 = 6.38 wt. %	Poor
	SiO_2 ≥ 60 wt. %	SiO_2 = 55.41 wt. %	Poor
	MgO ≥ 30 wt. %	MgO = 26.6 wt. %	Poor
	$Na_2O + K_2O$ < 0.4 wt. %	$Na_2O + K_2O$ = 0.00 wt. %	Very good
	Al_2O_3 < 2.5 wt. %	Al_2O_3 = 2.42 wt. %	Good
	LOI < 6%.	LOI = 4.44	Very good

Conclusions

The XRF analysis showed that Brewery-Area Ilesa talc has high silica concentration which is more than half of the entire mineralogy of the rock. Physical analysis like Loss on Ignition (LOI), Water Absorption Capacity (WAC), Linear Shrinkage Value (LSV), pH and colour show that Brewery Area, Ilesa talc can be used for different purposes in the industry and it has economic viability.

Based on the result of the geochemical analysis and physical properties, talc bodies in Brewery Area, Ilesa can be used for different purposes, like painting, ceramics, roofing, paper, plastics and rubber. The high amount of trace elements like Cu, Zn, Ni and Pb disqualifies it from been used in pharmaceutical company. In cosmetics, the brownish colour disqualifies it to be used as white powder. The low amount of CaO disqualifies it form been used to make wall and floor ceramics.

The ternary diagram shows the field occurrence and relationship with other rock types in the area as a product of low-grade metamorphism of mafic and ultramafic rock with the N-S trending shear zone of the Ife-Ilesa Schist Belt.

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