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Environmental Effects of Processing Marine Clay in Olotu, Ondo State, Nigeria

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Abstract
In this work, analysis of the released gas from calcined marine clay and lime shell was investigated. Study of the emitted gas/air from the calcined clay and shell showed that average concentration of carbon dioxide (CO_2: 20.09PPM and 8.12PPM) are below the maximum standard natural concentration 600PPM of carbon dioxide in fresh air and the recommended World Health Organization Threshold Limit Value (TLV) of 500PPM. Average carbon monoxide (CO) concentration (0.004PPM, 0.010PPM) and sulfur dioxide (SO_2) concentration (0.002PPM are below the Nigeria Ambient Air Quality Standards (NAAQS) and World Health Organization (WHO) maximum limit of 10PPM-20PPM (for carbon monoxide) and 0.01PPM- 0.5PPM (for sulfur dioxide) for an 8-hourly time. It was established that the average concentration of C0, $C0_2$, and $S0_2$ is so low and so pose no threat to the environment based on the review of the existing regulation, standards and codes (WHO and NAAQSO).

Keywords: Ambient, Testo 350XL- Analyzer, PPM- Part Per Million, calcining

1. Introduction

Pollution is the introduction of contaminants into a natural environment that causes instability, disorder, harm or discomfort to the ecosystem that is physical system or living organisms. **The rate** of environmental pollution in developing nations most especially from manufacturing companies or industries is at an alarming rate. Many of the industries release solid particles, water droplets and gases in to the atmosphere, while some release their wastes on land or in to water bodies. Majority of these are not friendly with the environment. They cause harm to human and the environment directly and indirectly. Air pollution is caused by smoke, particulate dust, gaseous emissions, noise among others. Common gaseous pollutants include carbon monoxide, chlorofluorocarbons (CFCs) and nitrogen oxides produced by industries and vehicles (Buchanan and Horwitz, 2010).

The directly emitted pollutants (primary pollutants) have direct negative effects on the environment within the shortest period of time. Generated complex pollutants (secondary pollutants) as a result of reaction or interaction of primary pollutants generally have prolonged effects on the environment are responsible for greater damages (Wikipedia, 2009).

Processing of the marine clay into cement involves many processes. Calcining the clay and lime shell is one of the major processes in which mainly gases are released in to the atmosphere. Though particulate matter in form of dusts is released during grinding and mixing, this can be controlled or captured and recycled into the process.

Heating of furnace was done electrically so, there is no combustion of fuel and the level of pollutants such as SO_2 and CO_2 produced is reduced. Pollutants from calcined materials cause respiratory problems and contribute to increase morbidity and mortality, especially among susceptible individuals (Air now, 2009).

The objectives of this work is identify and determine the ambient concentration of emitted gases from calcined clay and shell and compare the concentration of the pollutants with existing regulatory standards and make recommendations.

2. Experimental Procedure

2.1 Matrials and Equipment

The marine clay and periwinkle shell samples used in this study were collected from Olotu, a town in Ilaje Local Government, South Western part of Ondo State. Fabricated laboratory size electric furnace for calcining the marine clay and periwinkle shell was used in the research. A thermocouple which automatically control the heating and cooling of the furnace, and a gas monitor or analyzer were used. Testo 350XL was also used to ascertain the composition of the gases. The limits/standards of the gases applicable to the possible air pollutants were determined from the review of existing regulations, standards and codes (World Health Organization and The Nigerian Air Ambient Quality Standards, WHO, 2005; FEPA, 1999; Katie and John, 2000).

2.2 Method

The sample of marine clay (Pozzolana) was moulded into balls of about 30mm in diameter and dried in the sum to

reduce the moisture content. At a temperature of 700^0C, the dried clay was calcined in the electrically heated fabricated furnace for about 3 hours. During this process, gas coming out from the exhaust of the furnace was introduced into the analyzer, which displayed the content of the gas and their ambient concentrations (ppm).
The periwinkle shell was heated at a temperature of 750^0C for 1.45 hours in the fabricated furnace with the temperature controlled using the thermocouple, and the gas pressure reduced or controlled by the suction fan at the exhaust. The fan sucks out the emitted gas by the shell, reducing the pressure in the furnace. The emitted gas was introduced into the analyzer for analysis.

3. Results and Discussions

3.1 Results Composition of analyzed gas/air from calcined shell and clay.

Table 1 shows the result of composition of emitted gas/air from calcined shell and Table 2 shows the result of composition of emitted gas/air from calcined clay.

3.2 Discussions

The concentrations of carbon dioxide (CO_2) contained in the emitted gas by calcined shell lies between 19.97-20.17ppm and 7.78-8.27ppm for calcined clay (Table 1 and 2). This implies that the average concentrations (8.12ppm ppm and 20.09 ppm, Table 3) falls below the maximum standard natural concentration (600ppm) of carbon dioxide in fresh air and the recommended World Health Organization Threshold Limit Value (TLV of 500ppm) (which is safe for healthy adults for an 8-hour work day). These values are presented in Figure 1.
The carbon monoxide (CO) concentrations from calcined shell and clay are between the range 0.003ppm – 0.006ppm and 0.008ppm – 0.013ppm respectively (Table 1, 2). These results imply that the average concentration of carbon monoxide (0.010 ppm and 0.004 ppm, Table 3) is below the Nigeria Ambient Air Quality Standard (NAAQS), which stipulates a range of 10 ppm – 20 ppm for an 8-hourly range time (FEPA, 1999). These concentrations are presented in Figure 2.

Figure 3 represents the concentration of sulfur diode (SO_2) in clay which ranges between 0.001ppm - 0.003ppm. The average concentration (0.002 pmm) is below the Nigeria Ambient Air Quality Standard (NAAQS) which stipulates a range of 0.01ppm for an 8- hourly average time (FEPA, 1999). The trace of SO_2 is as a result of oil contamination from sea water or rivers.
The carbon monoxide is naturally oxidized by oxygen in the atmosphere (Abdulkarim et al, 2006); so the trace concentration is possibly oxidized by oxygen to carbon dioxide which is useful by green plants during photosynthesis (which serves as natural process of air purification), releasing oxygen for man use.

4. Conclusion

Processing the clay has no negative effects on the environment since the average concentration of CO, $C0_2$ and $S0_2$ from calcined clay and shell are so low. These compared with the regulations, standards and codes of World Health Organization and the Nigerian Ambient Air Quality Standards appeared so insignificant to cause any health hazard. The land area also will not be under any treat as a result of mining the clay due to the activities of the sea which serves as a reclamation agent by bringing in clogs of clay from time to time which can be used to fill mined out space or spaces.

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Table1: Composition of Emitted Gas/Air from Calcined Shell.

Tests	Composition	
	CO	CO_2
1	0.005	20.10
2	0.003	20.08
3	0.004	19.97
4	0.004	20.17
5	0.006	20.12

Table 2: Composition of Emitted Gas/Air from Calcined Clay

Test	Composition		
	CO_2	CO	SO_2
1	8.23	0.008	0.003
2	7.78	0.013	0.002
3	8.27	0.010	0.001
4	8.19	0.009	0.002
5	8.15	0.011	0.01

Table 3: ONE WAY ANOVA Results (Mean Value) of Emitted Gases

Composition	Shell	Clay
CO	0.04	0.010
CO_2	20.09	8.124
SO_2	-	0.002

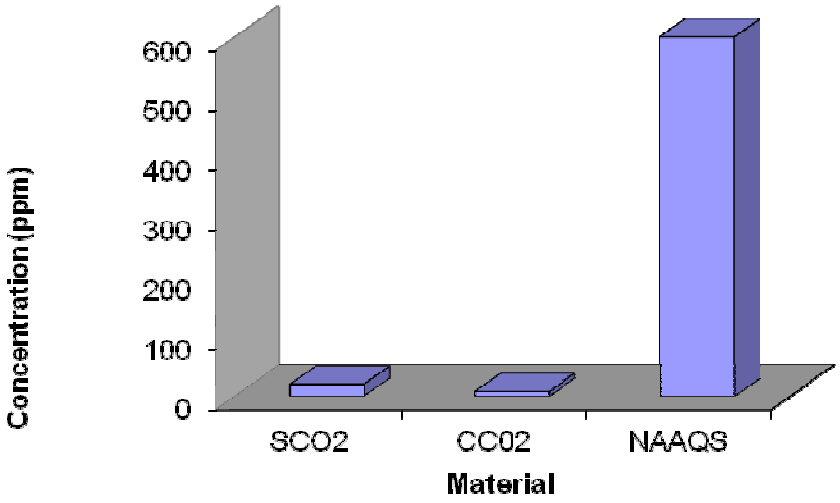

Fig.1: Concentration of Carbondioxide from Shell and Clay. Value is expressed as means of replicates (n=5). SCO2: Carbondioxide in shell; CCO22:Carbondioxide in clay; NAAQS: Nigerian Ambient Air Quality Standard.

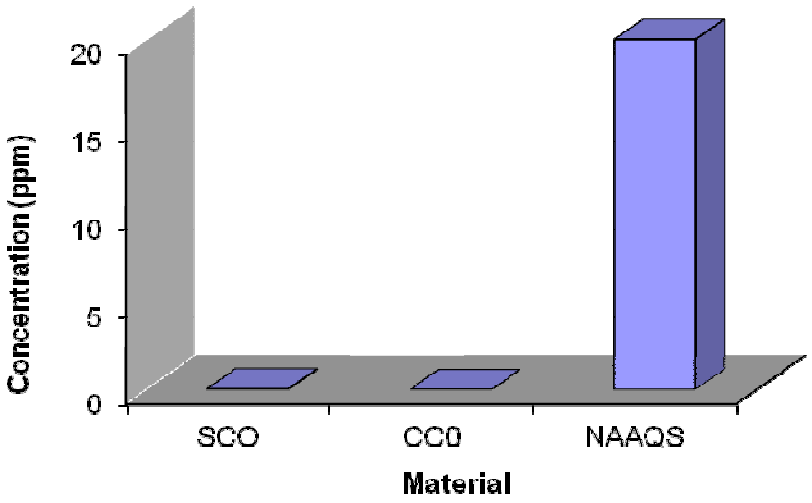

Fig.2: Carbonmonoxide concentration (ppm) in shell and clay. Value is expressed as means of replicates (n=5). SCO: Carbonmonoxide in shell; CCO:Carbonmonoxide in clay; NAAQS: Nigerian Ambient Air Quality Standard.

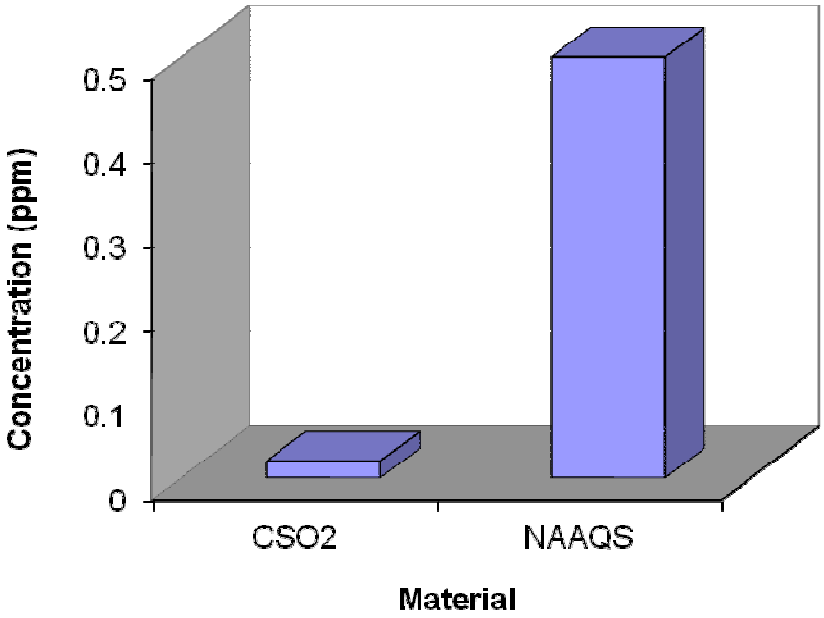

Fig.3: Sulphur dioxide concentration from clay. Each Value is expressed as means of replicates (n=5). CSO2: Sulphur dioxide in clay; NAAQS: Nigerian Ambient Air Quality Standard.

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