Manukaji John U. / International Journal of Engineering Research and Applications (IJERA) ISSN: 2248-9622 www.ijera.com
Vol. 3, Issue 2, March -April 2013, pp.006-009

The Effects Of Sawdust Addition On The Insulating Characteristics Of Clays From The Federal Capital Territory Of Abuja

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ABSTRACT

Insulating properties of clays from The Federal Capital of Abuja like linear shrinkage, solid density, apparent porosity and thermal conductivity were characterized with a view of studying the effect of sawdust on them. The results showed that the linear shrinkage improved from an average of 8.57% for the three samples for 0% sawdust to an average of 8.32% with 40% addition of saw dust, bringing them closer to the lower range of the international standard of 7-10%. Solid density averaged 3.18g/cm^3 with 0% saw dust and 2.91g/cm^3 with 40% saw dust, still bringing them closer to the international range of 2.3-3.5g/cm^3. Apparent porosity averaged 13% with 0% saw dust and 17% with 40% addition of saw dust bringing them closer to the acceptable range of 20-80%. while thermal conductivity averaged 0.493W/m^{o}k with 0% saw dust and 0.134W/m^{o}k with 40% saw dust thereby improving their insulating properties. This 40% sawdust addition was discovered to be the maximum under which mechanical strength and other refractory properties of clay will remain stable.

INTRODUCTION

Clay is a natural earthy fine grained material, which is powdery when dry, plastic when wet and stone-like when baked **Mohammed et al (2011).** Most clays are crystalline, with a definite repeating arrangement of atoms in them. The majority of them are made up of planes of oxygen atoms, with silicon and aluminum atoms holding the oxygen together by ionic bonding .**Brady et al (1999)**

Clay minerals have the ability to exchange ions. This mineral property of clays that causes ion in solution to be fixed on the clay surface or within internal sites applies to all types of ions, including organic molecules. **Hans(1994)**
Depending on the source, there are four main groups of clays namely montmorillonite-smectite, illite, and chlorite.

Montmorillonite often results from the further degradation of illite, but the weathering of plagioclase feldspar in volcanic ash deposits also forms it. Essentially, the structure consists of three layer arrangements in which the middle octahedral layer is mainly gibbsite but with some substitution of aluminum by magnesium.**Manukaji (2004)** A variety of metallic ions (other than k^+) provide weak linkage between sheets. As a result of this weak linkage water molecules are easily admitted between sheets, resulting in a high shrinkage swelling potential.**Agha (1998)**

The degradation of micas (e.g. muscovite and sericite) under marine conditions results in a group of structurally similar minerals called illites. These, feature as predominant minerals in marine clays and shells, such as London clay and Oxford clay. **Mahmoud et al (2003).** Some illites are also produced when in the weathering of orthoclase not all of the potassium ions are removed. The structures consist of three layer gibbsite sheets with k^+ ions providing a bond between adjacent silica layers. The linkage is weaker than that in kaolinite, resulting in thinner and smaller particles. **Li Zaigeng et al (2001)**

INSULATING REFRACTORIES

These are high porosity refractories having low thermal conductivity and high thermal insulation properties suitable for minimizing heat losses and maximizing heat conservation in furnaces. They derive their low thermal conductivity from their pores, while their heat capacity is determined almost entirely by the solid component. The insulating effect is principally the result of achieving a series of air spaces between an alternate series of solid boundaries. Other things being equal, the more pores present, and the less solid, the lower will be the conductivity. Such correlations between porosity and conductivity are therefore to be expected. These refractories are produced from fireclay, kieselguhr or asbestos, glass wool, slag wool. Vermiculite are also used as insulating materials at low temperatures. Ceramic fibres and wool are used for high temperature insulation. Foam ceramic fibres and wool are used for high temperature insulation. Foam ceramic is a recent addition to this class of refractories.**Olusola (1998)**

Insulation rarely adds to refractory life, and indeed may even reduce it. It does however save energy- the heat loss through many refractory structures can be halved by judicious use of external insulation. **Abifarin (1999)** Insulating refractories

owe their low conductivity to their pores, while their heat capacity depends on the weight per unit volume of solids, and of course its specific heat. **Obi (1998)**
One of the most widely used materials is diatomite, also known as kieselguhr, which is made up of a mass of skeletons of minute aquatic plants-deposited thousands of years ago on the beds of seas and lakes. Chemically this consists essentially of silica contaminated by clay and organic matter. Among the larger deposits are those of Denmark, Germany, Portugal etc. **Theraja et al (1999)**

Insulating refractories are a special class of refractories produced to have a highly porous structure with air entrapped therein. The presence of air in this pores reduces the conductive capacity of the refractories and therefore increasing their insulating characteristics. Apart from the natural occurring fire clays which has been adjudged an insulating refractories, other clays can have their insulating characteristics improved by the addition of materials like saw dust, rice husks and other farm wastes. **Akinbode (1996)**
For a refractory clay to have good insulating characteristics, it must have amongst others the following characteristics
(1) It must be highly porous
(2) It must have low thermal conductivity
(3) It must have low solid density
(4) It must have a reasonably low linear shrinkage.
In this experiment therefore, the effects of saw dust addition on the above properties of the clay specimens were studied and the results are shown in the graphs below

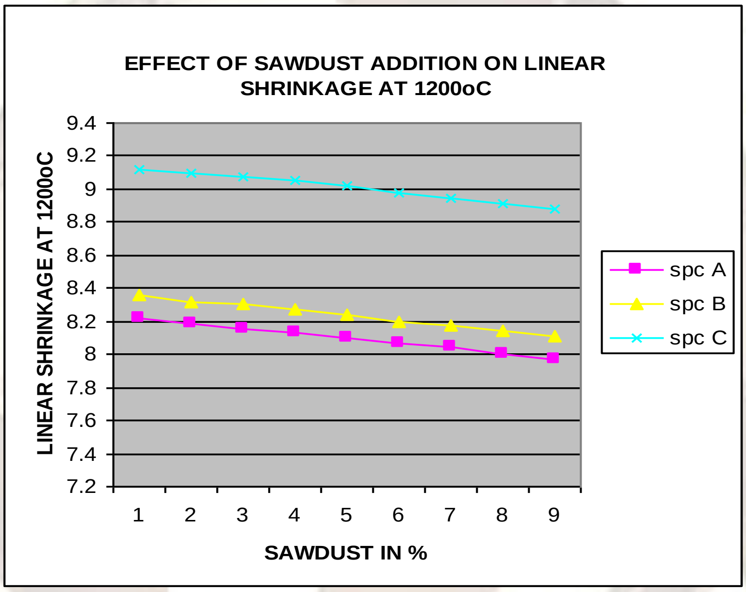

FIGURE 1

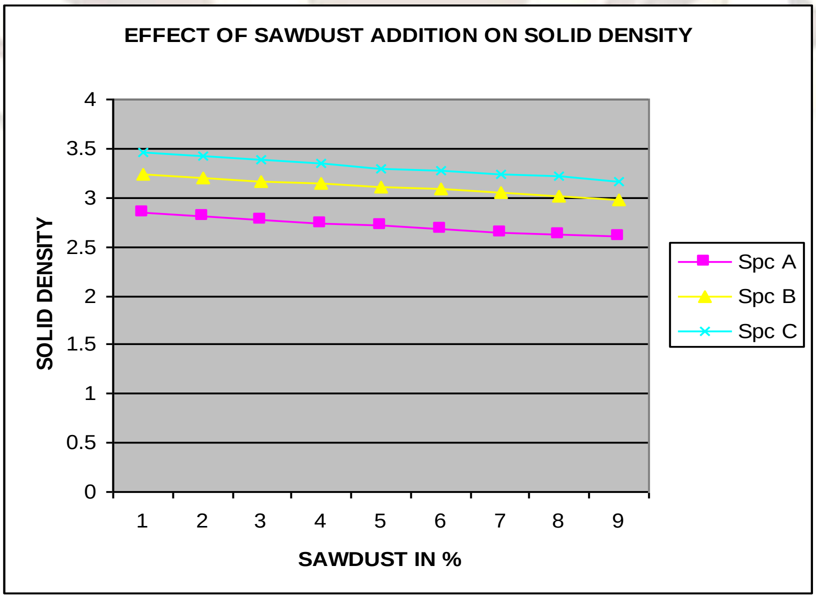

FIGURE 2

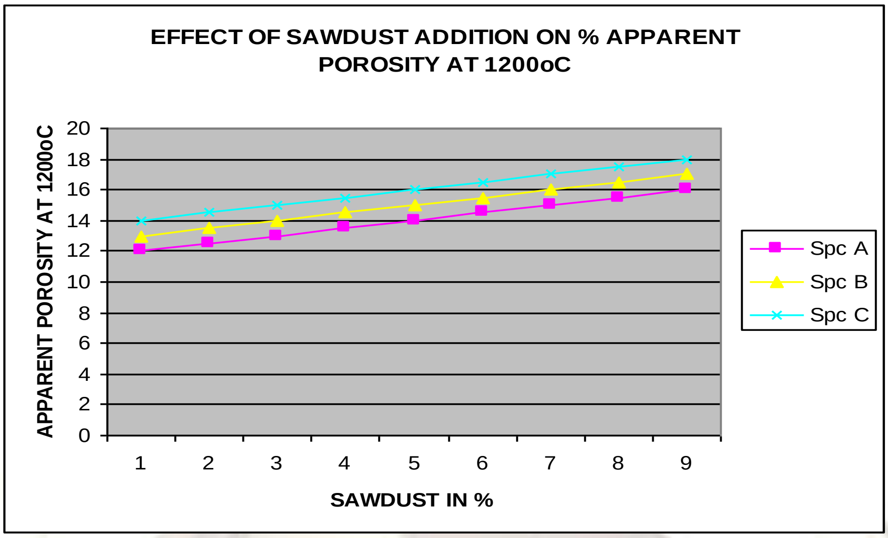

FIGURE 3

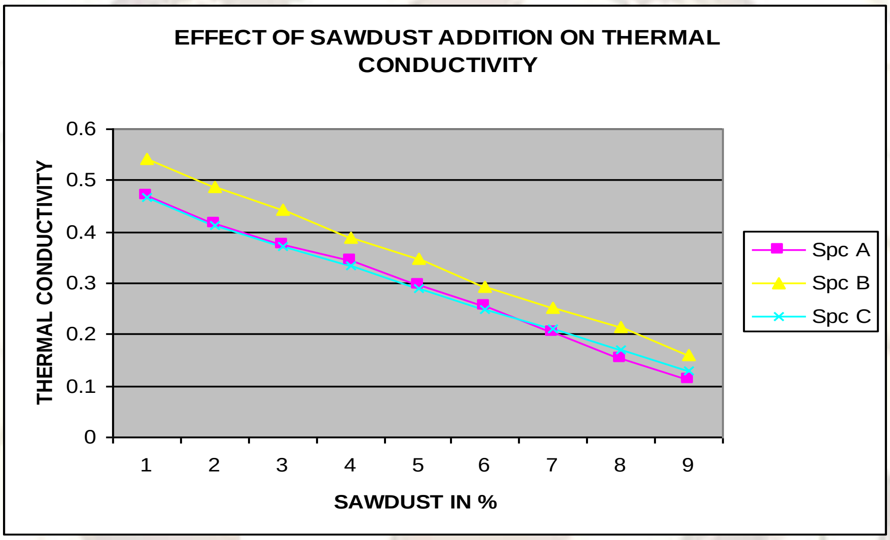

FIGURE 4

RESULTS AND DISCUSSION

The effects of saw dust addition on the above properties of the clay specimens were studied and the results are shown and discussed as follows.

1. The linear shrinkage showed a steady reduction in value from 8.57 -8.32% as the quantity of sawdust addition increased thereby bringing the values closer to the lower values of the acceptable range of 7-10% **IEE(1992)**.
2. The solid density of the samples reduced steadily from 3.18 -2.91 g/cm^3 as the sawdust addition increased moving them closer to the lower acceptable range of 2.3-3.5g/cm^3 **Ijagbemi (2002)**
3. The apparent porosity increased in value from 13- 17% in most of the samples thereby bringing them closer to the international range of 20-80% **Theraja et al(1999), Oaikhinan (1988)**.
4. The thermal conductivity of the samples decreased steadily from 0.491 – 0.134 W/m^{o}k as more sawdust was added making the samples better insulators **Manukaji(2004)**

CONCLUSION AND RECOMMENDATION

CONCLUSION

(1) From the tests carried out on the addition of saw dust to the clay samples, it could be concluded that properties like porosity, thermal conductivity, linear shrinkage and solid density of the clays from these locations improved significantly and can be varied to suit the particular insulating property desired.

RECOMMENDATIONS FOR FURTHER WORK

With the studies carried out, and the analysis done of the accruing results, the following recommendations for further studies and analysis is hereby proposed.

(1) Further studies on the insulating properties of the clay samples could be carried out by analyzing the effects of the addition of rice husks, ash and other farm wastes on the clay samples.
(2) An investigation should also be carried out on the effects of the addition of bentonite on the clay samples.
(3) A study should also be carried out on how the addition of graphite, coal and asbestors would reduce the linear shrinkage properties of the clay.
(4) Efforts should also be made to reduce the ferrous and ferric content of the samples thereby reducing their thermal conductivity.
(5) Slag from iron extraction should be added to the samples to improve their insulating properties.
(6) Investigation should be made on the effects of the addition of foam-ceramic-fibres on the insulating properties of the samples.

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