RESEARCH ON VITRIFICATION OF COW DUNG

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OCTOBER, 2014

ABSTRACT

One of the problems faced by our modern society is the increasing amount of animal waste. For these reasons, it is important to investigate possible ways of improving the environment by utilizing wastes from cattle i.e cattle dung. The research work was aimed at investigating the possibility of producing glass from cow dung, and the mixture of cow dung with clay. Different mixtures of dung and clay were prepared in the ratio 1:0, 1:1, 7:3, 2.5:7.5 and classified respectively into samples 1, 2, 3 and 4. Vitrification method which involves melting at high temperature and quick cooling was carried out on the different samples. Using the preprocessing glass production standards, each of the samples were prepared by sun drying, grinding, sieving and addition of chemicals such as Soda (Na_2CO_3), Lime ($CaCO_3$), NaS_2O_4 and cullet. The samples were subjected to high temperature at about 1100 ^{O}C for three hours. The melting temperature (T_m) of vitrified dung was observed to have begun at 1000 ^{O}C up to 1100 ^{O}C, a phase transition from the ashed vitrified dung to a glassy phase was also observed as a result of the quick cooling in which the samples were subjected to; this is referred to as glass transition temperature T_g found to have occurred between 1000 and 1100 ^{O}C. The result showed that sample 1 gave properties similar to a standard glass and appears glassy; sample 2 and 3 gave properties similar to a glass ceramics while sample 4 properties were similar to that of an advance ceramics which has many applications in engineering. In conclusion, glass can be produced from pure vitrified dung which could be used in many areas such as widow glass, glassy materials used for construction of furnitures. The mixture of vitrified dung and clay can be used to produce glass ceramics for building construction and those containing high composition of clay for advance ceramics.

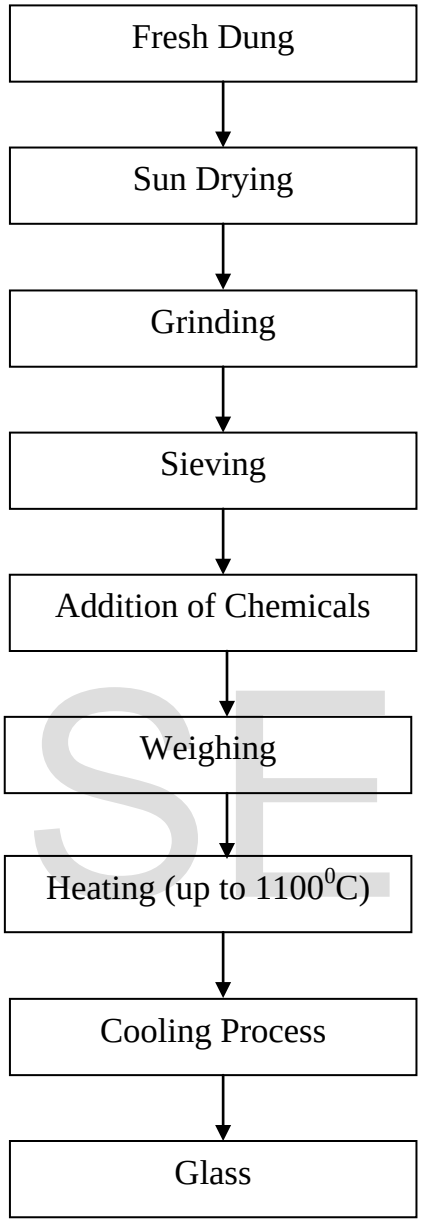

Figure 4: Stepwise details of the methodology

Fig (i) 

fig (ii) 

Fig (iii) 

fig (iv)

Fig(i) – vitrified dung in a standard working blast furnance, fig (ii) – dried cow dung ready for grinding followed by seiving, fig (iii) – samples of the glassy material, fig (iv) – A working blast furnance already at the proposed glass transition temperature (T_g) for the vitrified dung samples.

Table 1: The chemical compositions and densities of the various samples under consideration

Sample	PARAMETERS						
1	Vitrified Cow Dung	MgO (%)	CaO (%)	Fe_2O_3 (%)	Al_2O_3 (%)	SiO_2 (%)	DENSITY(g/cm^3)
		3.22	10.99	0.38	14.39	70.00	1.004
3	70% Dung and 25% Clay	1.53	3.70	0.05	14.76	67.33	1.08
2	50% Dung and 50% Clay	1.37	2.58	0.05	15.91	77.62	1.13
4	25% Dung and 75% Clay	1.28	4.37	0.10	17.54	74.21	1.15

Table 2: The chemical composition and density of Vitrified cow dung in comparison with a standard glass

	PURE VITRIFIED COW DUNG	STANDARD GLASS
% MgO	3.22	3.40 – 3.60
% CaO	10.99	8.40 – 8.60
% Fe_2O_3	0.38	0.06 – 0.15
% Al_2O_3	14.39	1.45 – 1.60
% SiO_2	70.00	70 – 72.5
% Na_2O	1.02	13. 50 – 14.50
Density (g/cm^3)	1.004	2.49 – 2.50

From the result obtained, the composition of the glass sample produced from pure vitrified cow dung falls within the range of the soda lime silicate glass standard. It appears transparent with a light green colour. The following ingredient of glass; Magnesium oxide, Aluminum oxide and Calcium oxide enhance and contribute to the mechanical properties and chemical durability of the glass, the result of the chemical analysis is similar to that obtained by Butterworth J. S (1979)

Table 3: The chemical composition and density of the 50% clay and 50% vitrified dung mixture in comparison with a standard glass.

	50%Clay + 50%Vitrified dung	**STANDARD GLASS**
% MgO	1.37	3.40 – 3.60
% CaO	2.58	8.40 – 8.60
% Fe_2O_3	0.05	0.06 – 0.15
% Al_2O_3	15.91	1.45 – 1.60
% SiO_2	77.62	70 – 72.5
% Na_2O	2.47	13.50 – 14.50
Density (g/cm^3)	1.13	2.49 – 2.50

There is presence of small crystals on the glass sample which appears greenish; the sample properties are similar to that of LAS – system of glass ceramics. The LAS – mainly refers to a mixture of lithium, silicon and aluminium oxides with additional components e.g. glass phase forming agents such as sodium, potassium and calcium oxides and refining agent. Glass–ceramics materials share many properties with both glasses and ceramics. according to M. Rezvani (2010) the author of the Iranian journal of material and engineering vol. 7 Number 4, Autumn 2010 states that “glass crystallization has led to the enhancement of mechanical properties, presence of the crystalline phase with stronger atomic bond and higher modulus increases the strength of such glass – ceramics”

Table 4: The chemical composition and density of the 30% clay and 70% vitrified dung mixture in comparison with a standard glass

	30% clay + 70% vitrified dung	**STANDARD GLASS**
% MgO	1.53	3.40 – 3.60
% CaO	3.70	8.40 – 8.60
% Fe_2O_3	0.05	0.06 – 0.15
% Al_2O_3	14.76	1.45 – 1.60
% SiO_2	67.33	70 – 72.5
% Na_2O	12.63	13.50 – 14.50
Density (g/cm^3)	1.08	2.49 – 2.50

The glass sample appears greenish with traces of small crystals. This sample is similar to that of sample 2 whose properties falls within the range of LAS system glass ceramics.

Table 5: The composition and density of the 75% clay and 25% vitrified dung mixture in comparison with a standard glass

	75% clay + 25% vitrified dung	**STANDARD GLASS**
% MgO	1.28	3.40 – 3.60
% CaO	4.37	8.40 – 8.60
% Fe_2O_3	0.10	0.06 – 0.15
% Al_2O_3	17.54	1.45 – 1.60
% SiO_2	74.21	70 – 72.50
% Na_2O	2.5	13.50 – 14.50
Density (g/cm^3)	1.15	2.49 – 2.50

The sample appears grayish with high mechanical strength such as hardness, stiffness (modulus), and has the ability to withstand high temperature strength. It is completely opaque whose properties are similar to that of an advance ceramics. Advance ceramics are different from ordinary or traditional ceramics composed of mainly clay. Advance ceramics have high compositions of silicon oxide and aluminium oxide with some other compounds depending on the application it is to be used for.

Generally from the result of all the samples obtained has a drawback of low density relative to that of the standard use as comparison, it can however be addressed by increasing the mass of the composition and by addition of the ingredients to the glass composition such feldspar ($KAlSi_3O_8$).

CONCLUSION AND RECOMMENDATION

Conclusion

Glass can be produced from vitrified dung which could be used in many areas such as widow glass, glassy materials used for construction of furniture's. The mixture of vitrified dung and clay can be use to produce glass ceramics for building construction and those containing high composition of clay for advance ceramics. Glass transition temperature T_g for vitrified cow dung was confirmed to have occurred between 1000 and 1100 ^{O}C

Recommendation

Government and investors should invest on pure vitrified dung as an alternative means of glass production

Government and investor should support researchers in further research on cow dung. From the result obtained we could see how cow dung is rich in many compositions which can be used for many other applications.

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