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PREPARATION OF GLASS FROM BIOMASS ASH AND STUDY OF ITS PROPERTIES

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ABSTRACT

Glasses were prepared by using Biomass ash (BMA). BMA contains large quantity of silica and alumina. Silica is the basic material used in the preparation of glasses. The BMA is the bye product of the thermo electric power plant making use of agro waste for combustion. This is an attempt to utilize this BMA to prepare glasses. The glass samples were prepared using BMA along with analytical reagent (AR) grade chemicals such as Boric acid, Sodium chloride, Potassium chloride. The powder was fired in a furnace at a suitable melting temperature. The duration of melting was two hours. The homogenized melt was then cast in steel discs. The DC electrical conductivity and other physical properties of the glasses were measured.

KEY WORDS: Biomass ash, glasses, DC conductivity

1. INTRODUCTION

Biomass ash (BMA) is produced after burning biomass, the combustion of biomass feedstock used to produce heat energy which is utilized for producing electricity.. Biomass ash is obtained after burning agricultural waste products of heterogeneous compositions. These include cotton stalk/chips, Paddy straw, Wheat Straw, Soya bean husk, Rice Husk and Baggase. Baggase is obtained in large quantity after crushing the sugarcane and extracting its juice for sugar production. This is an attempt to utilize this biomass ash to prepare glasses.

1.1 REVIEW OF LITERATURE

Biomass ash is the waste product. It also poses a significant environmental hazard. Currently, various researchers in India and abroad are working on utilizing these waste materials to develop some value added products.

Rowero M[1] et al has tried to crystallize SiO_2-Cao-N_2O glass from sugarcane Bagasse bottom ash while Teiveira S[2] et al studied glass ceramic material from SiO_2-Al-CaO system using sugarcane bagasse ash. Physical and mechanical properties of glass-ceramics fabricated from thermal power plant fly ash were analyzed and compared by Myungkim J[3] et al. This paper reports the formation of glasses using biomass ash and various properties of glasses.

2 MATERIAL AND METHODS

Biomass ash contains large quantity of silica and aluminum. The biomass ash used in this work is obtained from THE PURTI POWER AND SUGAR LTD™, Bela, Dist. NAGPUR. The ash was subjected to chemical analysis to confirm the presence of silicates, alumina (Table1)at ANACON LAB,Nagpur.

The glass sample is prepared from BMA by adding analytical reagent (A R) grade chemicals such as Boric acid, Sodium chloride, Potassium chloride. The appropriate amounts in mole percentage of different chemicals in a powder form and BMA are weighed on digital balance (SansuiVibra of 0.001 gm least count). Repeated grinding of the mixture is done to ensure homogenization in the aget stone mortar with the help of a pestle.

The powder is fired in a furnace at a suitable melting temperature ranging from 1000^0C to 1200^0C. The duration of melting is generally two hours. The homogenized melt is then cast in steel discs. After quenching, all samples are immediately transferred to an annealing furnace. Sample is annealed at 150^0C for two hours

Composition of received biomass ash

Table1 Chemical Analysis of BMA

Sr.No.	Component	%
1	Silica	59.19
2	Aluminium	14.32

The glasses thus prepared are named as follows

N1 – 18 BMA + 40 H_3BO_3+ 42NaCl

K1 -- 20BMA + 44 H_3BO_3 +36KCl

2.1Density measurement

The densities were determined using Archimedes' principle with distilled water as a buoyant fluid.

2.2 D C electrical conductivity

The D C conductivity measurements were carried in the temperature range 303^0 K– 373^0 K using polished samples. The glasses were coated with silver paste to serve as electrodes. The samples were placed in a suitable holder and then in a furnace. The resistance of samples was calculated by VI method by applying potential difference of 5.04 volt and measuring the current on a digital piccoammeter (DPM-111, Scientific Equipments, Roorkee) . The experimental error in determining the conductivity is expected to be ≈ ± 5% . The graphs were plotted between ($-\log\sigma_{dc}$ VS 1/T) (Fig 1) and (logJ V/S T) for all samples.(Fig 2). DC electrical conductivity (σ_{dc}), Molar volume (V), polaron hopping distance (R), polaron radius (r_p), No of ions /cm^3 (N) Activation energy (W) , were calculated using the following equations.

1) $\sigma_{dc=}$(d/AR), d- thickness of sample, A- area of electrode, R- resistance of sample

2) V= (M/dexp), M- Molar percentage, dexpt- experimental density

3) $R= M^{1/3}/(NoXdexp)^{1/3}$ No- Avagadro's number

4) $r_p= R/2(\Pi/6)^{1/3}$

5) $N = \pi/ 48\ r_p^3$

6) W= k x slope of ($-\log\sigma_{dc}$ V/S 1/T) (from Fig 1), k- Boltzmann's constant

7) J= I/A, I- DC current, A- area of electrode

3 RESULTS AND DISCUSSION

The Density, molar volume, hopping distance, number of ions per ccs and polaron radius are calculated and are presented in Table 2. Density of glass containing NaCl i. e. N1 is less as compared to glass sample containing KCl i.e. K1. The molar volume, hopping distance, polaron radius, DC electrical conductivity of the glass N1 is greater than the glass sample K1 though N, the number of ions/cm^3 in sampleN1 is less than in sample K1. Current density of sample K1 increased linearly where as current density of sample N1 did not show a linear rise with temperature (Fig 2),

Table 2

Sr. no.	Sample	Density	Molar volume	Hopping Distance	Poleron Radius	No of ions /cm^3	DC electrical conductivity	Activation energy
1	sample N_1	2.5152gm/ cm^3	24.59cm^3	4.534A^0	0.39A^0	1.058x10^{23}/cm^3	44.40x10^{-10}ohm^{-1}cm^{-1}	0.0396 eV
2	sample K_1	3.4562 cm/cm^3	19.81cm^3	3.6534A^0	0.31A^0	2.022x10^{23}/cm^3	7.92 x 10^{-10} ohm^{-1}cm^{-1}	0.174e V

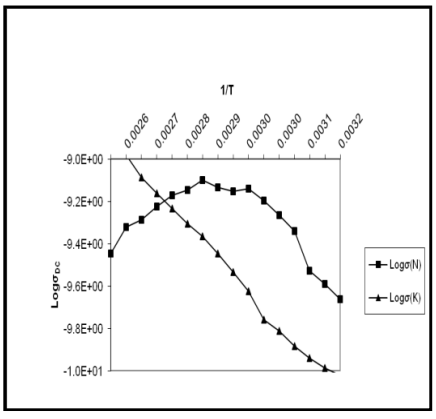

Fig 1 Logσ_{DC} V/S 1/T

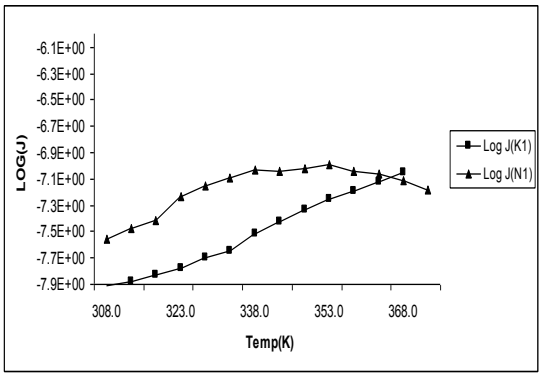

Fig2 Log(J)V/STemp

4 Conclusion:

Glasses were prepared using biomass ash by adding Boric Acid as glass former and Sodium Chloride, potassium chloride. Glasses prepared from biomass ash have conductivity of the order of $10^{-10}ohm^{-1}cm^{-1}$.The adiabatic hopping conduction is observed in glasses. The small polaron model [4] is applicable.

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