WEAR TEST ON ALUMINIUM FOAM PREPARED FROM ALUMINIUM (LM0) AS BASE METAL AND DOLOMITE (CaMg $(CO_3)_2$) AS FOAMING AGENT

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Abstract: The aim of this project is to produce aluminium foam from aluminium (LM0) for the application of light weight structural components. Melt route method is the technique adapted, in which 2kgs of aluminium (LM0) is melted to its melting temperature (750°C) and 200g of preheated dolomite CaMg $(CO_3)_2$ was mixed to the molten metal and stirred for 30 – 90 seconds at 1200 rpm approximately. Gas bubbles produced in the liquid aluminium (LM0) form cells and pores. The mixer then was solidified at room temperature, to get aluminium foam. Finally pin-on-dist test was conducted to study the wear behavior of the metal foam.

Keywords: Aluminium (LM0), dolomite, melt route method, pin-on-dist test.

1. Introduction

"*The foam is characterized as a uniform scattering of gas rises in a fluid, isolated by thin film of fluid making a pore or cell*".

In globalization there is an severe struggle between the manufacturing sectors for choosing a metal for economical production of the component [1-4]. In current scenario, the foam materials and composite materials are used in industries [5-8]. Due to their structure foams behave differently in testing when compared to conventional metal. The behavior of aluminium foams depends on several parameters such as: tensile strength, shear strength, impact strength, hardness strength and pear property [9-16]. Machinability of metals has received significant attention because of high tool wear connected with machining [17-26].

Banhart [3] reviewed about the introduction of aluminium foams, its properties, applications and its various types of its manufacturing methods. Simancik et al., [5] had done a work on preparation of Aluminium foam - a new light weight structural material by melt route method. Duarte et al., [6] had done a work on aluminium Alloy Foams: production and properties. Mukherjee [7] reviewed about the introduction of aluminium foams, its properties, applications and its various types of its manufacturing methods. Surace et al., [9] said on a work on investigation and comparison of the different manufacturing techniques of the aluminium foam. Vivekananthan and Senthamarai [10] said on a work on experimental evaluation of aluminium fly ash composite material to increase the mechanical and wear behavior by stir casting method. Hussain and Suffin [11] investigated the microstructure and mechanical behavior of the foam produced by sintering dissolution process.

Initially, 2kgs of LM0 grade aluminium was melted in the furnace. The melting temperature of aluminium was about 750°C. After attaining the melting point the preheated foaming agent was added in the ratio of 1:10 to the molten aluminum and the aluminium foam is prepared by using stir casting furnace.

2. Experimental Procedure

2.1. Melt Route Method

- Aluminium bar is melted to its melting temperature (750°C).
- The molten metal is stirred for several minutes.
- The dolomite powder was pre heated up to 200 °C and it is mixed with the molten metal.
- The foaming agent attains the decomposition temperature (660°C) the carbon dioxide (CO_2) which is present in it will be emitted as CO_2 gas.
- The uniform gas bubbles are formed by stirring. This makes the porosity inside the molten aluminium; finally the created aluminium foam is solidified into molten metal.

2.2. Reaction of dolomite:

When the dolomite attains the decomposition temperature the carbon dioxide (CO_2) which is present in it will be emitted in the form of CO_2 gas. So the uniform dispersion of gas bubbles is formed by stirring it at 1200rpm. This makes the porosity inside the molten aluminium so that the foam is created.

$$CaMg(CO_3)_2 = CaCO_3 + MgO + CO_2 \quad (1)$$
$$CaCO_3 = CaO + CO_2 \quad (2)$$

Table 1: Preheated foaming agent (Dolomite)

Sl. No.	Weight of Al (Kg)	Raise of temp (°C)	Drop of temp(°C)	Weight of foaming agent (Dolomite) (Grams)	Stirring time (Sec)	Stirring speed (rpm)	Solidification
1	2	750	680	200	70	1200	Room temperature

Figure 1: Stir Casting Set up

3. Results and Discussions

3.1. Pin on Disc Test

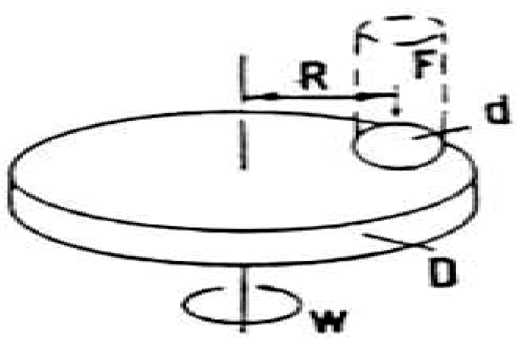


Figure 2: Schema of wear test

Where,

F: Applied normal load
R: Radius of the wear track that is produced
d: Diameter of the spherical top of the pin
D: Diameter of the disc
W: Rotational speed

3.1.1. Specifications

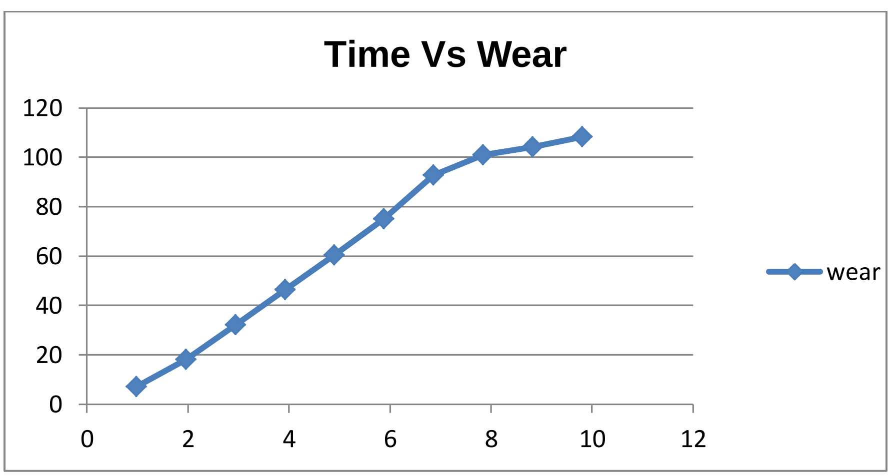
Pin diameter = 10mm
Pin length = 10mm

3.1.2. Observation

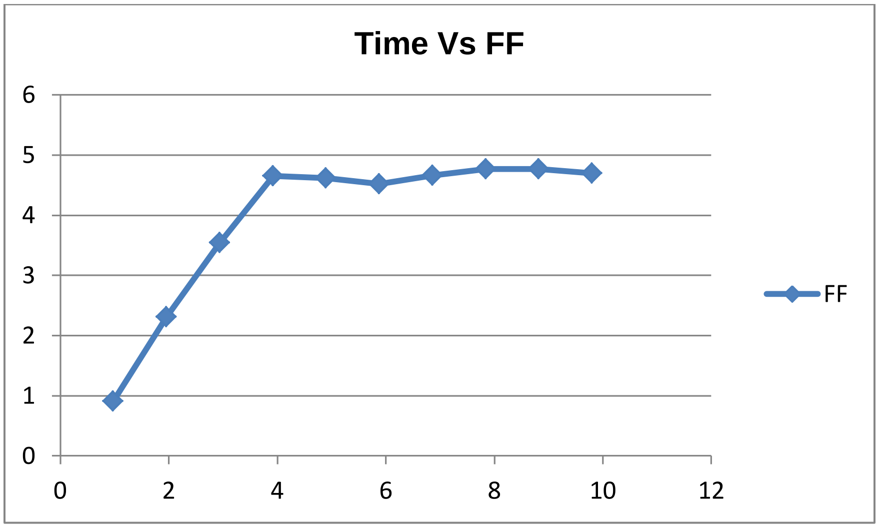
Disk rotational speed = 238 rpm
Velocity =1.5m/s
Distance = 1000 m
Load = 1.5 kg

Table 2: Wear test result

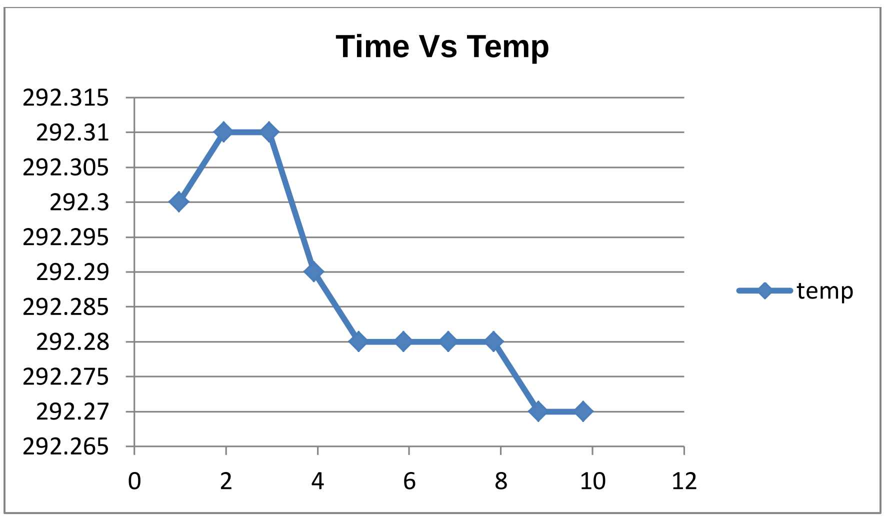
Time	Wear	Friction Force	Temperature (^0C)
0.98	7.15	0.91	292.30
1.96	18.11	2.31	292.31
2.94	32.08	3.54	292.31
3.921	46.26	4.65	292.29
4.9	60.44	4.62	292.28
5.882	75.05	4.52	292.28
6.862	92.7	4.66	292.28
7.843	100.82	4.77	292.28
8.822	104.05	4.77	292.27
9.802	108.15	4.60	292.27



As time increases, wear increases with respect to time.



As time increases the friction force (FF) increases up to certain point and it is maintained gradually for a certain period of time.



As time increases the temperature decreases with respect to time.

4. Conclusion

Aluminium foam was produced, using dolomite as foaming agent in the ratio of 10:1 by melt route method. The mechanical properties like tensile strength and hardness were tested. The preheated Dolomite-aluminum foam samples have the better porosity and good mechanical properties. In general applications like window, sliding doors, etc were pure Aluminium are used. Aluminium foam can be used as an alternative material for the above applications.

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