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Effect & Analysis of Different Silicon Content on Aluminium based Alloy

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Abstract: ***Zinc-aluminium alloys are alloys whose main ingredients stay zinc and aluminium. Other alloying elements clasp magnesium and copper .Zinc Aluminum Alloys over the past decayed are occupying attention of both researches and industries as a promising material for tribological applications. At this moment commercially available Zinc-Aluminium alloys and bearing bronzes due to good cost ability and unique combination of properties. They can also be deliberated as competing material for cast iron, plastics and even for steels. It has been shown that the addition of alloying elements including copper, silicon, magnesium, manganese and nickel can improve the mechanical and tribological properties of zinc aluminum alloys. This alloy has still found limited applications encompassing high stress conditions due to its lower creep resistance, compared to traditional aluminum alloys and other structural materials. This has resulted in major loss of market potential for those alloy otherwise it is excellent material. The aim of this paper is to measure the coefficient of friction and wear under different operating conditions for material with silicon content. Then wear equation will be found out for all the materials experimented under various conditions. In this paper there is discussion of the effect of Silicon on tribological properties of aluminium based Zinc alloy by experiment as well as Ansys software based and compares the same.***
Keywords: Pin- on -Disc machine, Wear Properties, Ansys.

I. INTRODUCTION

Wear which is one of the cause of material wastage, is an important problem associated with industrial components. Though wear resistance is not a materials property, an understanding of the dominant wear mechanism is very essential is very essential. The cost of wear to industry is high and the recognition of this fact lies behind the continuing development in the field of advanced materials, in order to provide a solution for mitigating tribological losses.

Whenever there is contact between solid bodies, surface phenomenon, designated by friction and wear, are developed. By conflict we callous the fight to the virtual motion between bodies rolling or sliding, in open or closed loop, with immorality of dynamism. Frictional force is tangential force that is common in the frontier of the bodies in contact. By wear it is understood the progressive lost material of the active surface of the body, by direct action of relative motion in that surface. These are phenomenon that in general, leads to loss of efficiency of mechanical components where they occur, with relevant monetary implications. This reason led to the development of large number of studies on these types of problems. Therefore, the precise knowledge of the influence of the mechanical parameter, the sliding velocity, load and the temperature of the contact, the wear and the coefficient of friction, is extremely important. To know the nature and magnitude of coefficient of friction and the amount of wear undertaken by direct contact of Al-Zn alloy with metal counter surface EN31 steel disc. As wear depends totally on normal load and sliding velocity. It is necessary to experimentally evaluate and measure the corresponding friction and wear. The check to be carried out on under the various operating condition and meticulous conditions. Here, Sliding Velocity, load and time, these three parameters were selected for experimentation. Experimentation is done by varying the speed from 200rpm to 600rpm, load varies from 30N to 90N and time from 30minutes to 90minutes. With view to generate new performance data we have chosen three alloy Such as Al-25Zn-2Cu-0.45Mn, Al-25Zn-2Cu-0.45Mn-3Si and Al25Zn-2Cu-0.45Mn-6Si. Experiment are to be carried out on standard pin-on-disc machine at ambient temperature and under wet operating condition.

II. PROBLEM STATEMENT

As we discern that the wear is nil but deduction of material i.e. depletion of material and we need to diminish this wear to increase the existence of machineries such as bearing and brake pad etc. Summing up the world know-how, based on laboratory research and polls in exploitation surroundings (primarily on trade machines in mining), the conclusion can be drained that the Zn-Al alloys, equaled to bronzes, have better anti frictional characteristics, better characteristics since the standpoint of running in, better ability for tenacious in the abrasive particles, lower friction coefficient, longer waged life and lower price costs.

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III. OBJECTIVE OF EXPERIMENT

A. The main objective of this project is to diminish wear of element by addition of silicon in aluminium established alloy.
B. To test out the density, hardness properties and wear resistance on the specimen.
C. To analysis the innumerable factors in wear mechanism with the help of analysis software.

IV. EXPERIMENTAL PROCEDURE

Procedure are as follows:

A. Preparation of Alloys

The alloy where arranged from commercially pure aluminium (99.7%), highly limpidness zinc (99.9%) and electrolytic copper (99.9%). Alloy where smelted in an electric furnace at a tall temperature and pure permanent mold at occasion temperature.

B. Physical and Mechanical Tests

1) Density: The density of the alloys was resolute by assessing their bulk and mass.
2) Hardness: The hardness of the models was unrushed using a Brinell hardness tester at a load of 62.5-kgf and 2.5mm diameter toughen ball as the indenter. The specimen is placed on the top of the table and raised it with the elevating screw, till the test sample just touched the ball. Load is applied on the specimen for a certain period, during which indenter presses onto the specimen. The steel ball during this period moved to the position of the sample and made indentation. The diameter of the indentation made in the specimen is recorded by the use of the micrometer microscope. The diameter of indentations is taken and the BHN is calculated

Properties of material	Material-A	Material-B	Material-C
Density, Kg/m^3	3224	3200	3221
Hardness, BHN	112	115	116

Table : Shows Density & Hardness Results

C. Friction and Wear Test

The wear test were passed out on sole pin type "pin- on- disc friction and wear observer. Test was carried out at the apartment temperature beneath dry operating conditions. To avoid rise in malaise at the interface pin and it's centre face plate material the sliding time level was set at 1/3rd time for each setting time. Then the summative wear value was summed up. The cylinder-shaped pin flat ended varieties of size a 10 mm diameter and 25mm length were tested in contradiction of steel disc material[7].

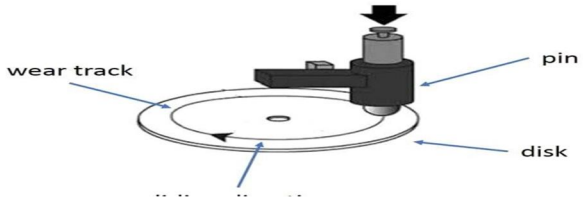

Fig. PIN ON DISC TEST

D. Design of Experiment

Material	Chemical composition in Wt. %
A	A1-25Zn-2Cu-0.45Mn-0Si
B	A1-25Zn-2Cu-0.45Mn-3Si
C	A1-25Zn-2Cu-0.45Mn-6Si

Table: Chemical composition (weight %) of material-A, material-B and material-C

Scheming to find specific pressure and sliding velocity are as:
For material A ,material B and material C
Test at differents load , changed Speed and different Time as shown in table.

Table .Comparative results of wear for all material

Sr. No.	S (RPM)	L (Kg)	T (min)	W (mg) Material-A	W (mg) Material-B	W (mg) Material-C
1	200	3	30	22	18	11
2	200	6	60	52	50	58
3	200	9	90	96	94	97
4	400	3	60	42	38	49
5	400	6	90	84	82	102
6	400	9	30	30	32	28
7	600	3	90	72	68	69
8	600	6	30	28	15	30
9	600	9	60	77	69	76

E. Analysis The Wear Mechanism In Analysis Software

Wear testing is a method for gaging erosion or sideways displacement of factual from its "derivative" and original spot on a solid surface performed by the achievement of another surface. Wear ensues to the hardest of materials, including diamond, wear studies devouring focused on surface mutilation in terms of material-removal mechanisms, plus transfer film, plastic deformation, brittle fracture and tribo-chemistry.

ANSYS, the saleable FEA software used for this research can grip several material and structural nonlinearities, i.e., plasticity, viscoelasticity, and friction. For contact problems, ANSYS can model contact circumstance with different types of contact element and present Lagrange multiplier, penalty gathering and direct constraint approaches.

The wear for a polymer-polymer slipping surface connection in dry condition can be obtained by creating simulation. There are two inputs requisite for determining the wear volume loss over its usage time. One is the nodal burden value at the contact area for small sliding steps which can be considered by subjecting the geometrical model to the finite element analysis. ANSYS was used as finite element tool. Swiveling of mirror concluded the base resulted in the wear. By the above techniques, the wear loss and reliability of the rear emulate can be predicted.

As per requirement one by one analysis the total deformation of material A, material B and material as shown below.

Which find out by kept the constant data for all three different composition

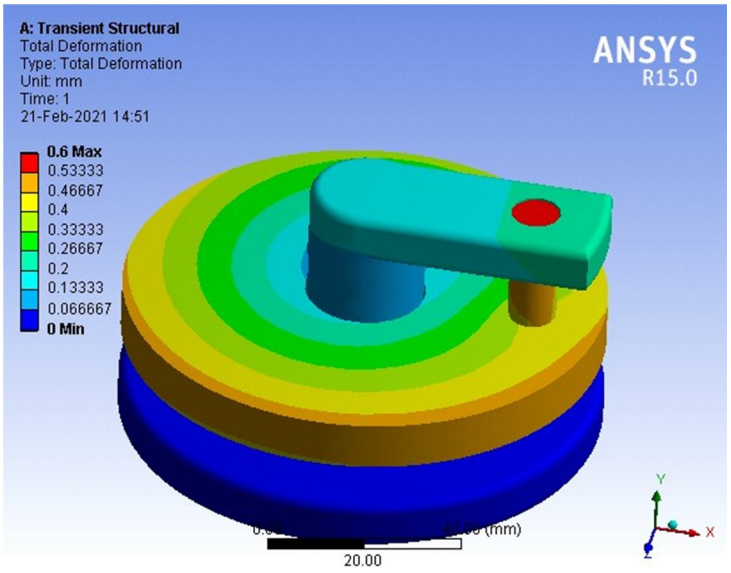

Figure A. Total deformation for material-A

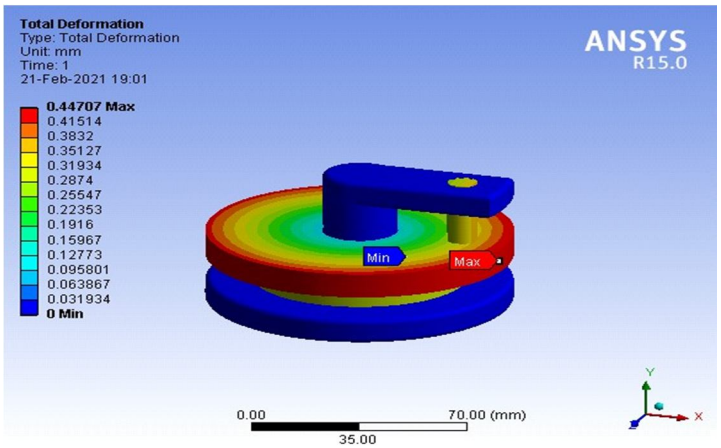

Figure B. Total deformation for material-B

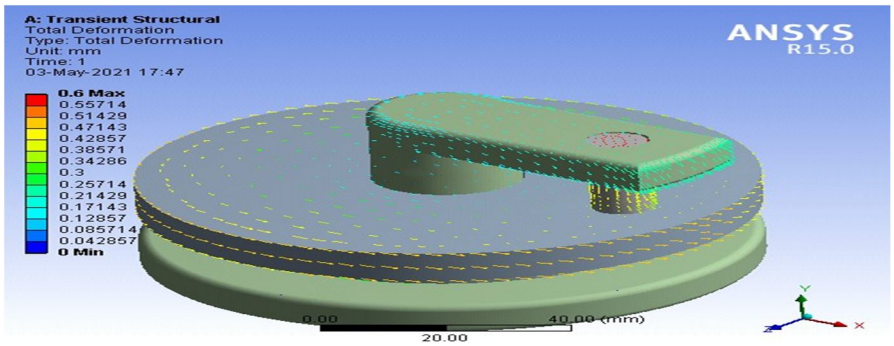

Figure C. Total deformation for material-C

V. CONCLUSION

For these three materials the generalized testing & wear equations are found. Based upon above described tribological performance testing Zn-Al alloys have been tested and applied in a variety of engineering applications. As per above results it has been seen that the hardness of the three different specimen goes on increasing because of the increase in percentage of silicon and in case of wear, material B with 3% of silicon content found high wear resistance as compared to other two materials. These alloys have been found to be most effective tribomaterials, especially as substitute of bronzes for bearing purpose

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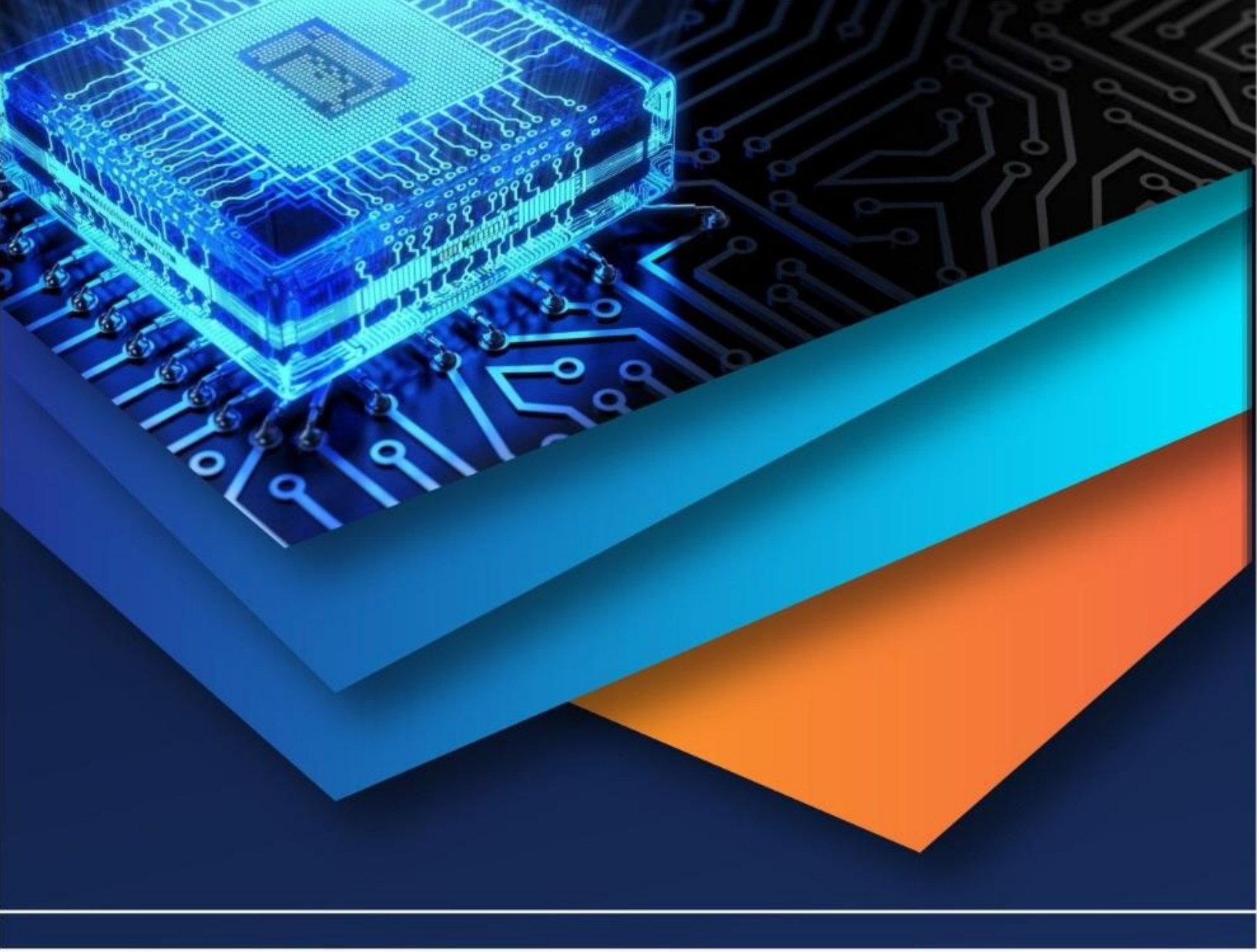

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