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Stress Analysis on Pin Disk of AA7072 Hybrid Composite

Bone Surya Teja[1], M Padmanabham[2]
[1, 2]M. Tech Student, Department of Mechanical Engineering, #VITAM, Vizag, AP

Abstract: This work investigated the influence of fly ash and sic on the wear behavior of Al 7072,5 and 10 wt. % of hybrid composites. Research reveals the effectiveness of incorporating Sic into the compound to obtain reduced wear. The Al 7072 reinforced with sic-fly ash were investigated. The composites were fabricated using the under-stir casting route. Ceramic particles along with solid lubricating materials were incorporated into an aluminum alloy matrix to accomplish a reduction in both wear resistance and enhance the coefficient of friction. The Al 7072/fly ash/sic hybrid composite was prepared with 5,and 10 wt. % of sic /fly ash particles. It was observed the stress on pin in composites was good compared to the matrix alloy. And it was evident from the SEM microstructures that no particle was cracked or pulled out from the matrix. This was due to a good interfacial bond between the alloy and the matrix. These findings suggest that a hybrid composite system gives better wear-resistant properties.

Keywords: ***Al7072, SiC, fly ash, hybrid composite, stress, ANSYS***

I. INTRODUCTION

Years of research in Tribology confirm the claim that the friction and wear properties of a given material are not intrinsic, but depend on many factors associated with specific applications. The quantitative values for friction and wear in the form of friction coefficient and wear rate, cited in many engineering textbooks, depend on the following groups of basic parameters: (1) System structure, that is, the relevant components and properties, (2) Operating variables, namely load (voltage), kinematics, temperature and time, (3) Reciprocal interactions of system components. Sumit Khute, Utal Purah [1] said that the main goal of this work is to evaluate the stress and pressure state in the context of the POD disk test. Austenitic stainless steel 316LN as a friction element in conditions of self-coupling using the finite element method (FEM) .U. S. Ramakanth; Buti Srinivasa Rao [2] shows that the investigation studied the effect of fly ash and fly ash on the corrosion behavior of aluminum 7075/5 and the weight ratio of the hybrid compound. 7075 fly ash aluminum alloys were examined This study investigates the efficacy of incorporating such in the compound to obtain corrosion reduction. Yunfeng Zhang.etal. [3-8] The analysis presents the pressure field distribution and changes the law of the friction surface to obtain the mechanism and characteristics of worn-out torque. The concept of theoretical paired stress on the disk was observed according to the semi-elastic modular model, and the finite element model was built using the ABAQUS program. C. Gonzalez, A. Martin [9] has taught that contact surface nodes are moving in the normal direction, and the geometry of the pin and mesh elements is automatically updated. This model includes many other important characteristics, such as coulomb friction, plastic pin temperature behavior, and the formation of heat on the contact surface due to the plastic deformation of the pin. The all-step thermocouple equation is combined with the Abaqus standard code. Luis Ferranti Jr., Ronald W. Armstrong presents continuous indentation tests that are generally used to measure a material's elastic modulus according to the discharge response of a plastic curve. The test results show that the ductile ductile aluminum modulus has a value and exactly matches the value in the guide.

II. METHODOLOGY

ANSYS (version 19.4.0) is a finite element program that is used to simulate real technical problems. The program solves the problem using three different phases: pre-treatment, solution, and post-processing. There are 10 specific modules in this program. In the pre-treatment stage, you create engineering and FEM prototyping, defining element types, material properties, and reactions. During the solution phase, ANSYS creates a network that describes the behavior of each node and element and computes unknown values for output field variables, such as total stress, stress fatigue, friction behavior, pressure distribution, wear rate, wear rate, wear pressure, contact pressure, etc. You are. The post-processing stage is visualization. At this point, you can analyze and plan the results. ANSYS is a software application used for modeling and analysis (pre-processing) of machine components and assemblies, as well as for displaying finite element analysis results. This is a general purpose limited element analyzer with an implicit integration scheme. This works as a background process and performs actual numerical calculations. Once the simulation is complete, the results can be monitored in post-processing. ANSYS is also used to display, draw and process data. There are 9 units of analysis in ANSYS.

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III. STRESS ANALYSIS OF AA 7072 COMPOSITE MATERIAL

To perform wear simulation in ANSYS, communication analysis is performed using five basic steps and shown below with Figure 1.2. Determine whether the contact analysis in ANSYS parameter design language (APDL) or the workbench in this thesis simulates wear in ANSYS Workbench. The model is designed with basic graphics and scaling. The diameter of the screw on the disc track is from 80 mm to 140 mm and the disc thickness is 5 mm. Pin dimensions are 40 mm in length and 10 mm in diameter. Pin material is Aluminum Alloy (AA 7072), Young Coefficient of 70 Gpa and Poison Ratio of 0.3. This material properties data was taken from reference. The material of the disc is generally of steel, i.e. the Young's modulus is 210 GPa and the toxic ratio is 0.3. The disk was rotated in the z direction at 4.71 m / s. A static structural analysis was performed. Two types of boundary conditions are used (disk rotation and external force on the pin surface in the Z direction). The strength on the pin surface varied from 30 to 90N. The following parameters are outputs for this analysis. (1) total deformation, (2) energy, energy, tension,(3) Equivalent elastic,(4) Equivalent stress.

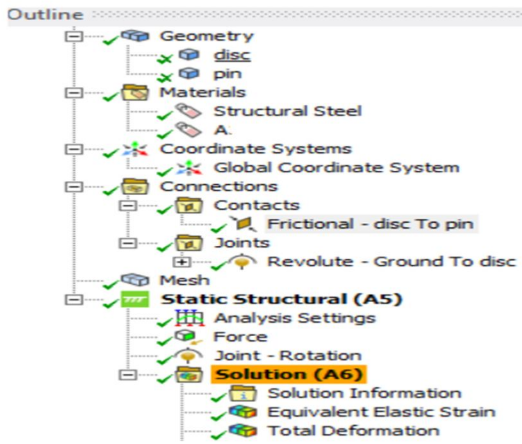

Fig1.2 The Detailed project structure of the pin on disk analysis

Table I represents the results of the analysis of the AA 7072 material identified by ANSYS WORKBENCH. Figure 1.3 Friction between contacts and the rotating union, Figure 1.4 Pin on and disk revolution, Figure 1.5 Force on pin Z in direction and Total deformation on pin - on disk (30N). For the screw in the aluminium alloy disc material (AA 7072), the load increases the overall stress, and the equivalent pressure and stress energy are shown in Figure 6.1 to Figure 6.3. At loads of 30N and 60N, the deformation was the same as for 90N, and it increased slightly.

Table I
Results of AA7072 w.r.t varying Load

Load (N)	Total Deformation (mm)	Equivalent Stress	Strain Energy
30	0.0057544	2.0869e6	1.1312e-6
60	0.0057544	4.19e6	4.53e-6
90	0.0057545	6.26e6	1.018e-5

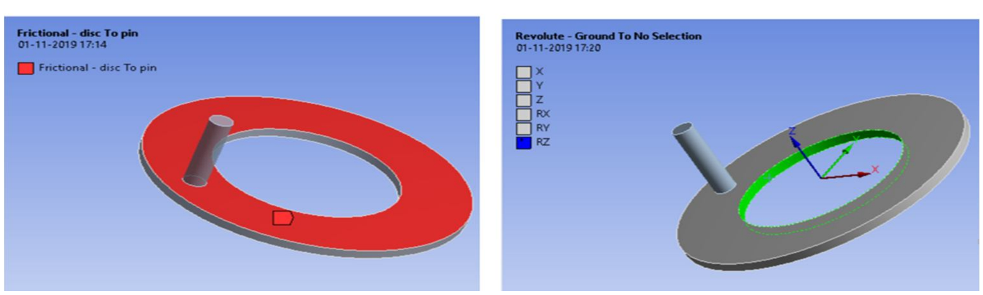

Fig 1.3 the friction between the contacts & revolute joint

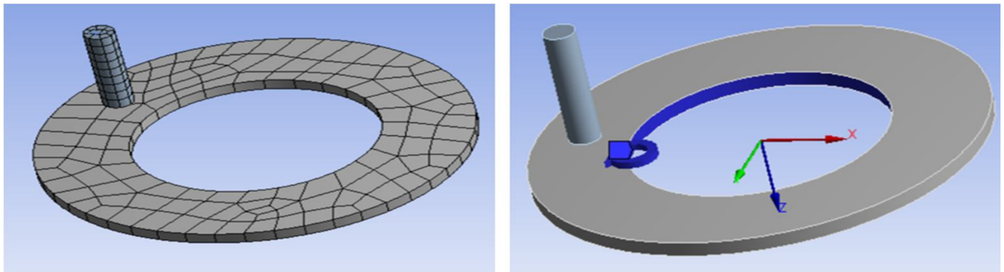

Fig 1.4 the meshing & revolution of the disc

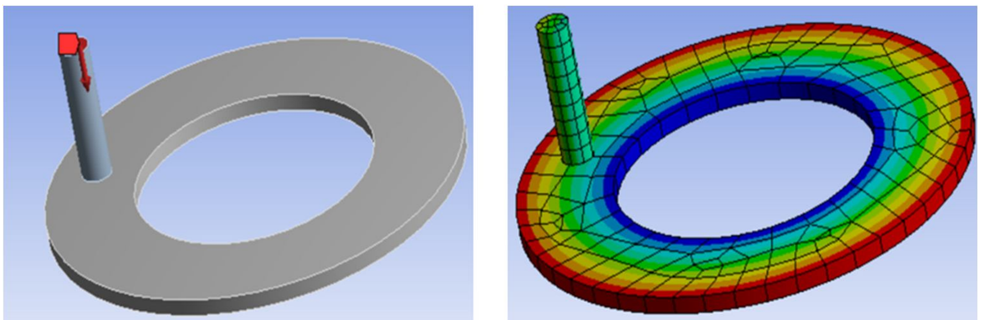

Fig 1.5 Force on pin in Z-direction & total Deformation on Pin – On- Disc (30N)

IV. ANALYSIS OF COMPOSITE- AA 7072+ 5%+ 10% REINFORECEMENTS

Pin is made of compound material (AA 7072 + 5% and AA 7072 + 10% composite). Its characteristics are youth units (E = 64.26 and 68.06Gpa) and a proportion of toxins (ϑ = 0.3). Values are taken from the literature review. Pin dimensions (10mm * 40mm). The disc speed is 4.71 m / s, and the disc material is steel (E = 210Gpa and poison's ratio = 0.3). The load was applied to the surface of the pin. They differed from 30N, 60N, and 90N (the corresponding friction coefficient is 0.519, 0.00865, and 0.45). The inner and outer diameter of the turntable is 80mm and 140mm. Stress analysis of this compound (AA 7072 + 5% Composite) was performed using ANSYS WORKBENCH finite element analysis software. Tables II and III represent the results of variable load (AA 7072 + 5% and AA 7072 + 10% composite) w.r.t. Figure 1.6 shows Von-Misses pin-on disk (AA 7072 + 5%) and load AA 7072 + 10% composite) at 90N.

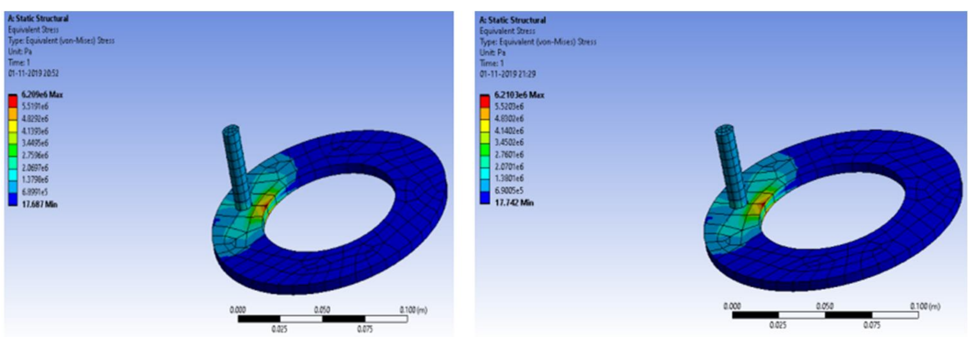

Fig 1.6 Von – Misses Stress of pin on disc (AA 7072+ 5%) & (AA 7072+ 10%) Load of 90N

Table II
Results of (AA 7072+ 5%Composite) w.r.t varying Load

Load (N)	Elastic Strain	Deformation	Equivalent Stress	Strain Energy
30	1.9115e-6	0.0057544	2.069e6	1.1245e-6
60	3.823e-6	0.0057544	4.148e6	4.5129e-6
90	5.7345e-6	0.0057545	6.209e6	1.0124e-5

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Table III
Results of (AA 7072+ 10 %Composite) w.r.t varying Load

Load (N)	Elastic Strain	Deformation	Equivalent Stress	Strain Energy
30	1.9115e-6	0.0057544	2.0692e6	1.1245e-6
60	3.823e-6	0.0057544	4.1483e6	4.5129e-6
90	5.7345e-6	0.0057545	6.2103e6	1.0128e-5

V. RESULTS AND DISCUSSIONS

Tensile analysis on a rotating pin on the disc was determined for all three compounds. For each composite material, the load tolerance varied to the surface of the pin 30N, 60N and 90N, the setback pressure, the total pressure on the disc, the total stress, and the stress energy.

Initially, mathematical and theoretical modelling developed on a pin on the disc was discussed. In general, corrosion analysis, i.e. weaning the pin on the disc, was found in the previous investigation, in this letter we tried to determine the tension on the pin on the disc when looking at three composite materials. No research was found to pin stress stress analysis using the literary finite method. The three properties of the composite material are taken from the literature (for AA 7072-E = 70 Gpa & ϑ = 0.3, for AA 7072 +5% Composite -E = 64.26Gpa & ϑ = 0.3, for AA 7072 +10% Composite -E = 68.06Gpa & ϑ = 0.3)

Total deformation is constant for AA 7072, AA 7072 +5% Composite and AA 7072 +10% Composite for compound materials. The equivalent stress values and stress intensity values are high for the A380. Compare two other items for special download conditions. Figure 1.7 Total and iPhone deformation - No stress AA 7072, AA 7072 +5% Composite and AA 7072 +10% Composite (90N) and Figure 1.8 Energy AA 7072, AA 7072 +5% Composite and AA 7072 +10% Composite (30 and 90N).

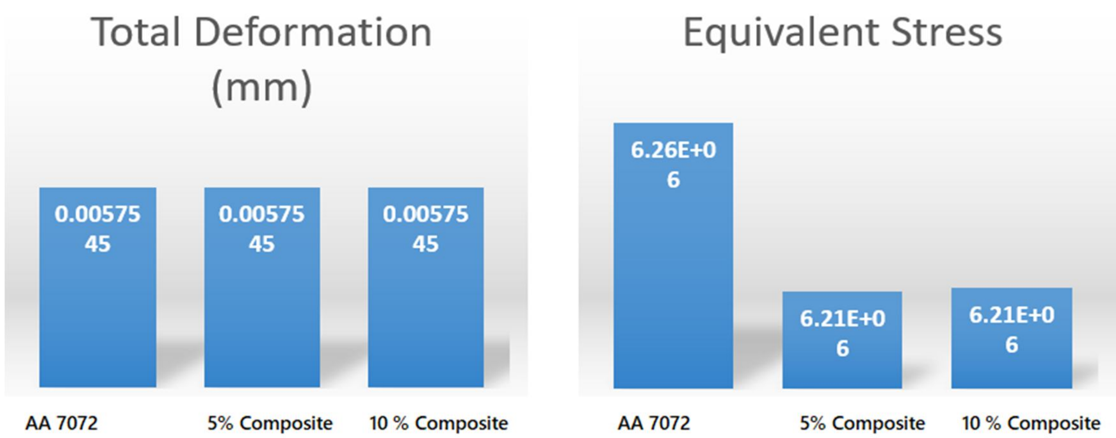

Fig 1.7 Total Deformation & Von – Misses Stress of AA 7072, AA 7072+5% & AA 7072+10 % (90N)

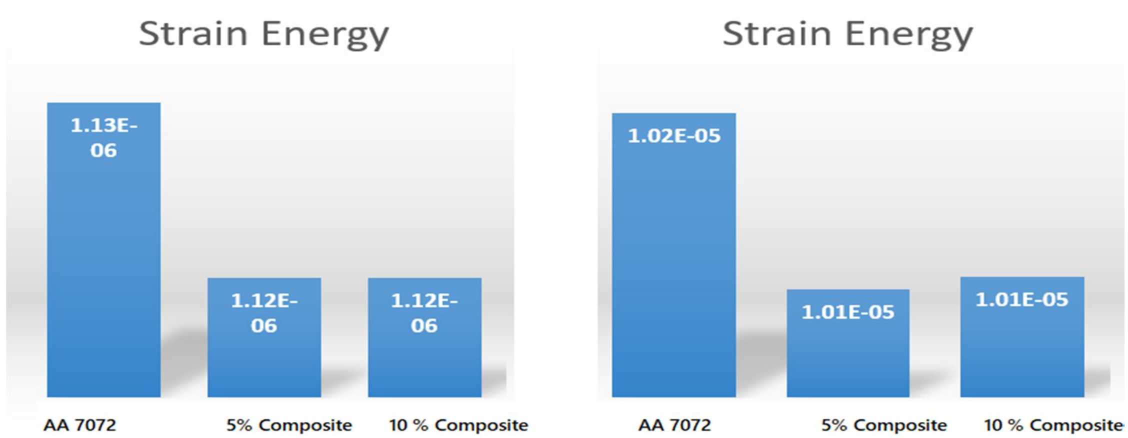

Fig 1.8 Strain Energy of AA 7072, AA 7072+5% & AA 7072+10 % (30 & 90N)

VI. CONCLUSION

Total stress and strain distortions of AA 7072, AA 7072 + 5% and AA 7072 + 10% were found using ANSYS WORK BENCH. Distortion Total deformation is constant for load conditions of 30N and 60N for all metal matrix compounds. For AA 7072 + 5% and AA 7072 + 10%, compound materials show good results compared to other AA 7072.

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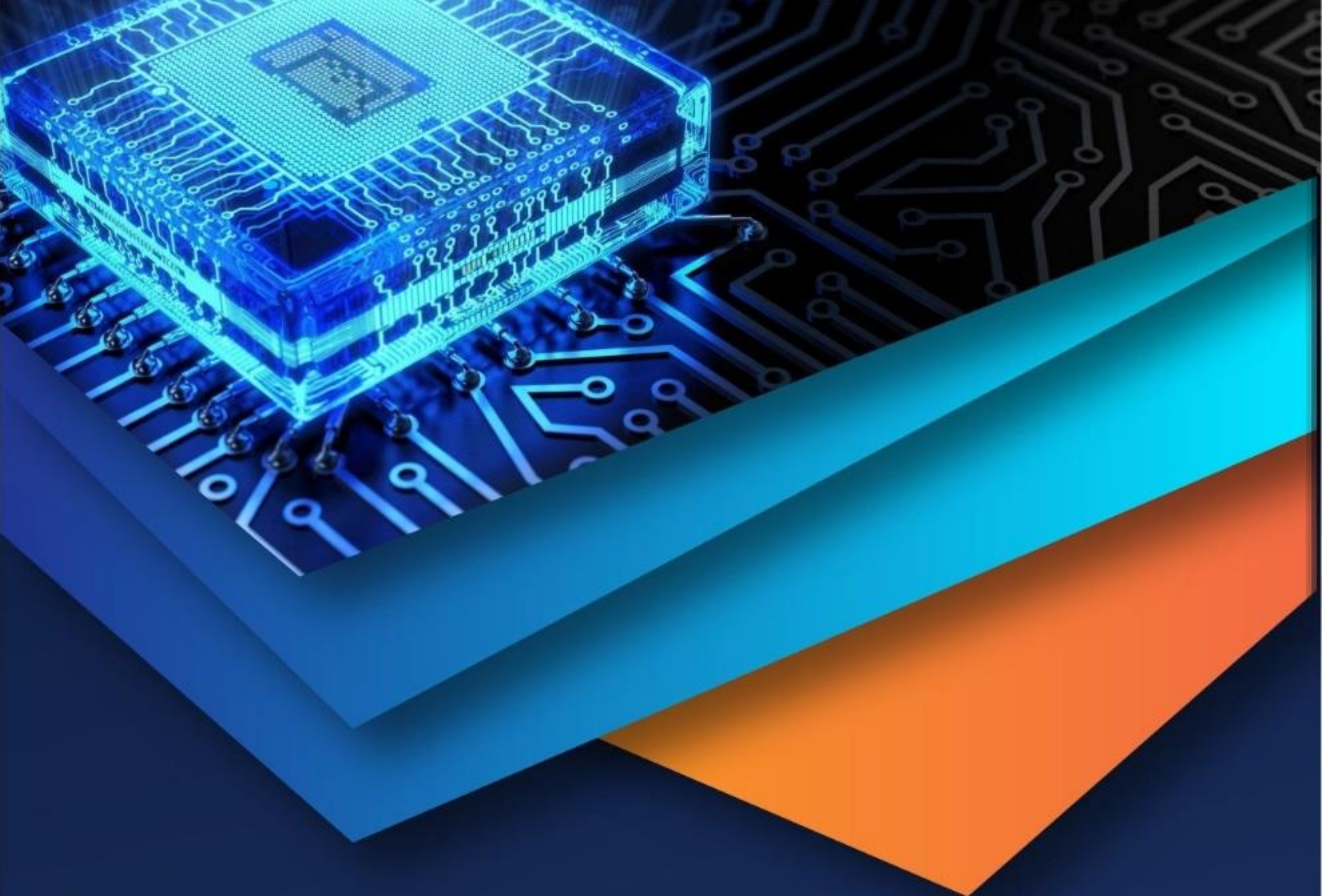

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