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CONTACT STRESS SIMULATION AND TRIBOLOGICAL BEHAVIOUR OF STAINLESS STEEL, GREY CAST IRON AND AL2014 UNDER LABROTARY SIMULATED CONDITIONS FOR CAM FOLLOWER MECHANISM

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Abstract:

A cam is a mechanical device used to transmit movement to a follower through direct communication. The driver is called the cam and the moving component is called the follower. In a pair of cam followers, the camera rotates naturally while the follower can move or swing. The cam is a rotating part that provides reciprocating or oscillating movement of the follower through direct contact. The jump occurs when the camera rotates at a critical speed above a certain value. When jumping, the speed is so high that the follower doesn't follow the camera and we get a different kind of sound. You must enjoy Cam-Follower material with good thermal conductivity, good thermal resistance and high contact pressures. Friction compounds mainly consist of about ten classes of components such as adhesives, fibres, friction modifiers and fillers. The correct choice of cam coil is the most important aspect of a diesel engine, as it determines how much valve lift. Therefore, in this case study, the gray cast iron cam follower material is tested using stainless steel and Al2014. The main objective of the research is to find an alternative material to gray cast iron to reduce weight and maintain strength. Therefore, wear analysis is performed on the wear scale to analyze the wear rate and the magnitude of the wear. Similarly, contact stress analysis is performed using FEA software.

Keywords*: *Contact stress, Tribological Behaviour, Wear analysis.

I. Introduction :

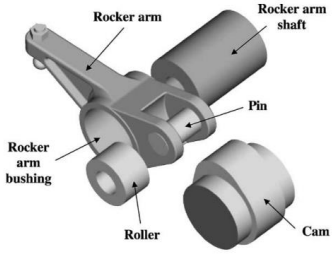

Fig 1. Cam follower mechanism [2]

A cam is a mechanical device used to transmit movement to followers through direct communication. The driver is called the cam and the moving element is called the follower. Cam in pairs of followers, cam when

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the follower can move or swing. [1] The crankshaft of a car engine is a familiar example, where the cam drives push rods as they follow the push rod to open and close the valve with the movement of the piston.. [1] Cam design is hard work and dedication for the design engineer as every competitor in the industry market is always looking for the best performance from the mechanical system. So the designer should research the purpose of the system, where it can be used, the right materials, the right dimensions and their calculations and most importantly how to implement the follower human system. [1].

II. Wear in the Material of Cam :

Fig 2.Worn out Cam

Cam-Follower material should have good thermal conductivity, good thermal resistance and withstand high contact stresses. Friction compounds mainly consist of about ten classes of components such as adhesives, fibres, friction modifiers and fillers. A bond called resin or matrix provides mechanical integrity to the compound in addition to contributing to friction and wear. Multifunctional fibers play a vital role in absorbing stresses generated at the mating interfaces, while at the same time maintaining the integrity of the compound at temperatures.

Friction modifiers are added to smooth it out and reduce its volatility. The fillers category is again divided into functional fillers (to improve the specific function, such as resistance to discoloration, porosity, thermal conductivity, etc.) and spatial inert fillers (mainly to reduce cost). Among the various shims, mineral shims are important in friction materials (FM) because they control the conductivity of composite materials as well as additional functions, such as: abrasion resistance; strength, etc.

Fig 3.Pitting of Surface under Wear

When surface erosion occurs, the particles are removed and the resulting pitting is relatively large, as shown in Fig. 3. [8]. It is surface failure that manifests itself in the shattering of small rough parts of the surface of the material. This failure is primarily due to the high pressures causing fatigue failure at a subsurface point where the highest combined stresses occur. A heavily loaded surface will continue to etch with increasing intensity under misuse [8].

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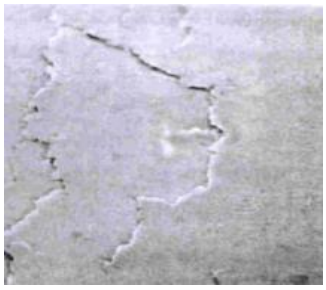

Fig 4. Surface Flaking under Cyclic Loading [8]

The destructive nature of surface stress cracks is increased due to high contact stresses and sliding action, and is a source of stress and accelerates subsequent surface fatigue failure. Surface scales leave the mother surfaces and damage the soft follower surfaces. Abrasion or scratching, as shown in Fig. 4, is the general wear of the mating surface. Visually, the surfaces have a mirror side and the dimensional control measures wear. It is the spot welding of two heavily bearing surfaces, especially when a high degree of relative slip occurs under poor lubrication conditions, followed by rupture of the welded material. It starts especially at the level of highly stressed areas due to poor surface condition, and generally during the period of operation of new parts [8].

III. Objectives of Study:

The Present Work is undertaken to accomplish the following Objectives:

- To study different loading constraint subjecting to wear for Cam Mechanism.
- To study the failure of cam material under Wear rate Investigation.
- To understand Tribological Properties of cam-follower Material using laboratory scale experiment.
- To fabricate a perfect composite material having low wear rate at different temperature, load and velocity conditions.
- Wear Analysis is to be carried out.

IV. Experimental Investigation for Wear :

Fig 5. Sample Specimen of Grey Cast Iron, Stainless Steel

The follower cam is made of cast iron which is used specifically for casting purposes. For the casting process, many factors must be considered to get a better result, such as material properties, mechanical properties, chemical composition, fluidity, boundary clearance, thermal properties, etc. Current cam seal in gray cast iron. The auto bearing is used for stainless steel. Stainless steel is distinguished by its corrosion resistance, which increases with increasing chromium content. Molybdenum additives increase the corrosion resistance in acid reduction and against pitting attack in chloride solutions. Thus, there are many grades of stainless steel with varying chromium and molybdenum contents to suit the environment the alloy must withstand. Al alloy 2014 which t is an aluminum-based alloy often used in the aerospace industry. It is the second most common aluminum alloy of the 2000 series, after aluminum alloy 2024. It is usually machined by extrusion and forging. The wear resistance of this alloy is generally not very appreciating.

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Fig 6. Experimental Setup for Wear

V. FEA for Contact Stress Analysis :

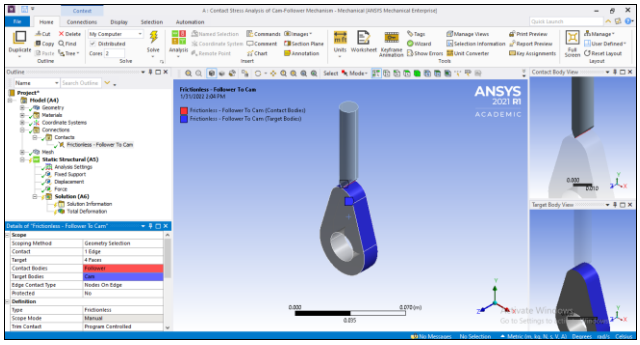


Fig 7. Contact Settings

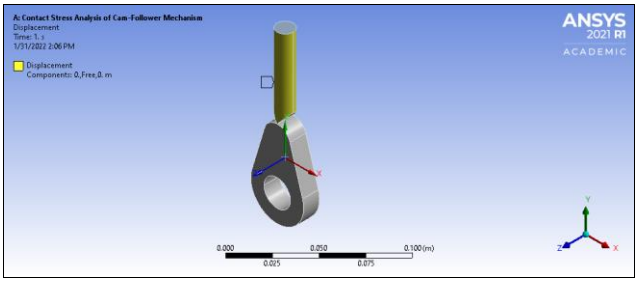


Fig 8. Displacement Setting

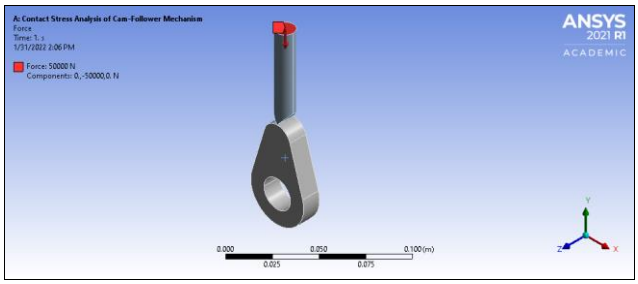


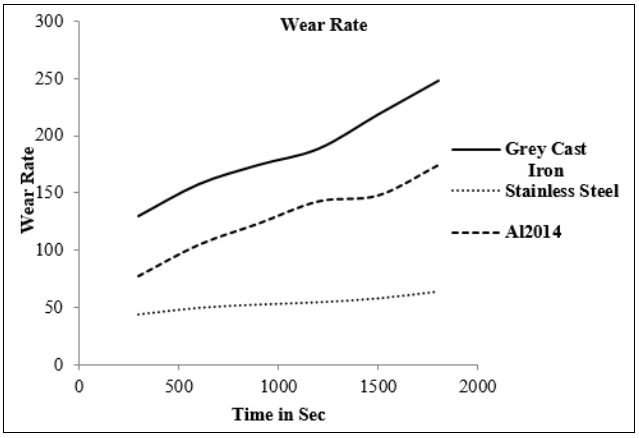
Fig 9. Application of Force

In the current analysis, the different parts which are mating with other are the Cam which are in contact with the Surface of follower. The description of contact setting is described in the figure 7. All the contacts (intimated by red color) are considered as contact bodies and the cam (intimated by blue color) is considered as target bodies for performance of FEA

Bearing pressure is a special case of contact mechanics that often occurs in cases where a convex surface (male cylinder or ball) comes into contact with a concave surface (female cylinder or ball: cavity or hemispherical cup). In the contact area between the outside of the cam and the underside of the follower, determine the maximum shear stress, the maximum contact pressure in hertz

VI. Result and Discussions :

6.1 Wear Rate



Graph 1. Experimental response for Wear Rate Analysis

The wear rate of all materials is described with respect to time. It was found that stainless steel has the lowest corrosion rate over time. The gray cast iron specimen

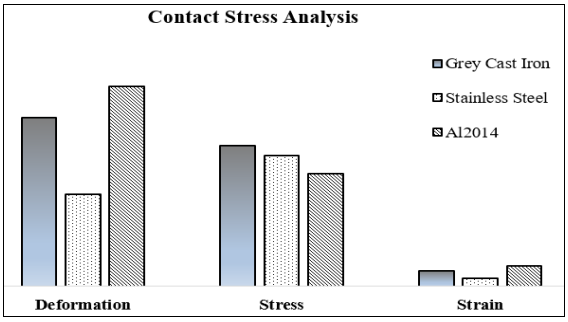
began to corrode at a higher rate during and continued to progress over time. Al2014 corrosion rate is also lower than that of gray cast iron.

6.2 Wear Volume

Graph 2. Response analyses for Experimental Wear Volume

The magnitude of abrasion is actually the amount of physical loss in a tribological test after a specified period or period of time. The corrosion magnitude of stainless steel is the lowest among all samples. Due to its low density and good wear resistance property, Al2014 also wears less during pilot testing than gray cast iron. The volume of weight loss for gray cast iron is comparatively greater due to the nature and composition of the bottom.

6.3 Contact Stress Simulation



Graph 3. Contact Stress Simulation

Chart 3 shows a comparison of the results identified for the contact stress analysis. As we can see from the above graph, for all static loading conditions, the resulting stress for all materials is the same. However, with careful and careful comparison, the stress obtained for Al2014 and Al6082 is the lowest according to stainless steel and cast iron. In terms of stress for all static load conditions, the produced strain of stainless steel is the lowest. In all the contact stress, strain, stress and strain results for Al2014 were lower or moderate compared to the other materials.

VII. Conclusions :

- The tribological investigation of all materials shows the result and the calculations are related to the size of the wear, the coefficient of friction and the force of friction.
- Regarding the wear rate, the alternatives to Al2014 compounds showed better results than those of gray cast iron. But still among all types of stainless steel it proved to be the least.
- The simulation method was performed to calculate the results in more than one way. Simulations are performed for all subjects to validate the results through experimentation. Deformation is measured by simulation and the size of the wear is determined using mathematical equations. As for the deformation due to contact stress and abrasion,
- It was found that the results of Al2014 and Al6082 were as moderate as those of gray cast iron
- A successful approach has been identified to determine the abrasion resistance of aluminum composite materials. The attempt can be successfully carried out if there is a camera and a follower in order to increase the service life and weight. Reducing the weight of components can be a vital factor in reducing costs

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