Influence of Heat Treatment on Tribological, Young's Modulus and Shear Stress Properties of Spheroidal Graphite Iron

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ABSTRACT

Since last three decades, the demand for Spheroidal Graphite iron is increased Due to its superior mechanical and Tribological properties, this nature leads to the usage of Spheroidal Graphite Iron in Automotive Industry. Heat-treatment of alloys is one of the valuable methods to achieve the better properties. In the present Study Tribological , young's modulus and shear stress Properties of Spheroidal Graphite Iron was studied after various heat treatments beyond the limits, and tests are done for the measurement of Frictional force, co-efficient of friction , Wear ,young's modulus and Shear Stress for before and after the heat treatment. Results indicated that, great change in Tribological, young's modulus and shear stress properties after the Heat-treatment. From the results it can be concluded that the heat treatment of Spheroidal Graphite Iron which results in decrement of alloys composition, which alsoleads to Economical growth of Spheroidal Graphite Iron.

Keywords:-Heat Treatment, Tribological , young's modulus ,shear stress.

1. INTRODUCTION:

Spheroidal Graphite iron is a cast iron in which the graphite is present as tiny balls in metallic matrix. Spheroidal graphite iron is also known as nodular iron, Ductile iron, and spherulitic iron[1].Spheroidal graphite cast iron have versatile characteristics like castability, wear resistance, high damping, good machinability and relatively low cost compared with alloy steels with similar mechanical properties. SG irons are used as engineering materials in high temperature applications that require high-temperature corrosion resistance and mechanical strength [2]. The achievement of good mechanical properties by nodular cast iron is depends on many factors such as chemical composition, charge composition, method of inoculation, size of graphite nodules, proportion of ferrite in the matrix[3]. Due to the presence of nodular graphite in the matrix, nodular cast iron is more flexible and elastic in nature. The formation of these nodules is achieved due to the addition of magnesium and cerium. Some of the charge components added in nodular cast iron are manganese and chromium [4]. When we go for higher heat treating temperatures it results in high ductility, high fatigue, high tensile strength, and high wear resistance due to this the ductility and impact strength may Reduced [5-7].SG irons are having high strength and excellent wear resistance hence there are widely used in automotive industries[8]. The study of friction, wear and lubrication of interacting surfaces in relative motion is known as tribology. The importance of tribology at present time is crucial since most design applications involve 'wear and tear' process when subjected to relative motion [9]. Friction is a very common phenomenon in daily life and industry, which is governed by the processes occurring in the thin surfaces layers of bodies in moving contact. The simple and fruitful idea used in studies of friction is that there are two main non-interacting components of friction, namely, adhesion and deformation[10].The objective of this work was to determine the influence onTribological properties, young's modulus and shear stress on Spheroidal graphite iron carried out by before and after heat treatment.

2.EXPERIMENTATION PROCEDURE:

Experimental procedure starts from preparation of test specimens initially specimens undergone for wear test. Wear test done on Computerized Ducom friction and wear monitor pin on disc wear test machine. The rotating disc was made of carbon steel of diameter 50 mm and hardness of 64 HRC. The Spheroidal graphite iron before and after heat treatment samples were held stationary and a required normal load was applied through a lever mechanism. Table 1 shows fixed parameters used for conducting tests.

Test Parameters	**Units**	**Test values**
Speed	rpm	191
Velocity	m/s	3
Track radius	m	0.045
Time	S	700
Sliding distance	m	1800
Load applied	Newton	40

Table 1.Friction and Wear Testing Parameters

No lubricant is used as test is carried out in dry conditions. Care has been taken that the specimens under test are continuously cleaned with woolen cloth to avoid the entrapment of wear debris and to achieve uniformly in experiential procedure. During the Tribological test the continuous measurements of the coefficient of friction were carried out and the friction products were being removed from the counter sample surface. The Tribological tests were performed at a room temperature. After the completion of wear test, young's modulus and shear stress tests were done in a sequential order. In order to measure the Shear Stress, Hydraulic press is used. The temperature maintained for all the tests is above austenite formation temperature (critical temperature). Each and every test was conducted before as well as after Heat-treatment and percentage change in the results were noted and reported in the results and discussions.

3. RESULTS & DISCUSSION:

Figures 3.1(a) &3.1(b) Showthe variation of Wear Vs Time, there is a drastic change in wear rate after the heat treatment process. This change results in diminishing order while comparing to the before heat treatment process this is due to formation of new grains after the completion of heat treatment. wear rate decreases about 40%.

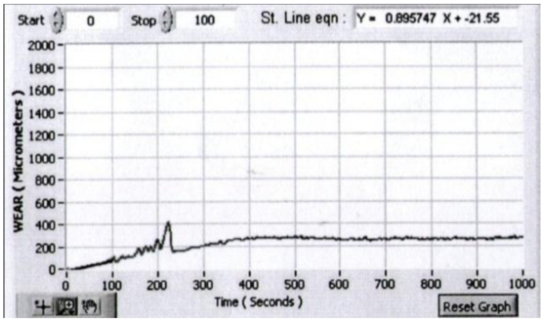


Fig 3.1(a)

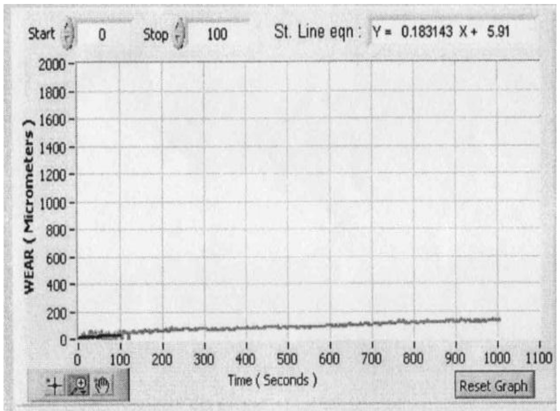
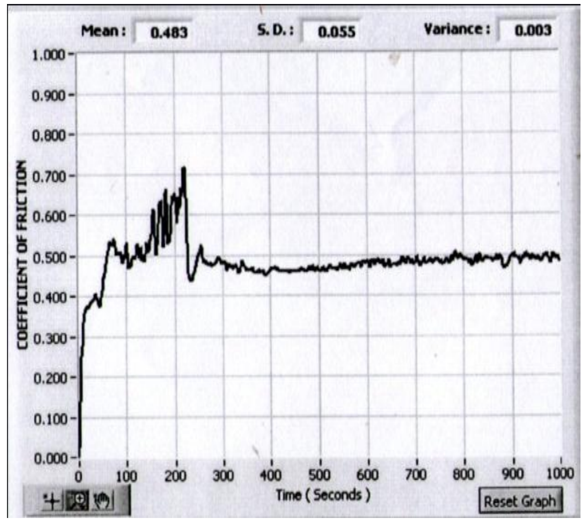


Fig 3.1(b)

Figures 3.2(a)&3.2(b)Represent the coefficient of friction Vs time, increasing tendency has been observed in the coefficient of friction in the case of before Heat treatment and after short span of time the value of coefficient of friction remains constant at 0.483 as seen in the plot. The effect of annealing and accumulation of tiny particles may be the reasons for the transient behavior more over coefficient of friction remains constant and is equal to around 0.52 after the completion of Heat treatment process.



3.2Fig.(a)

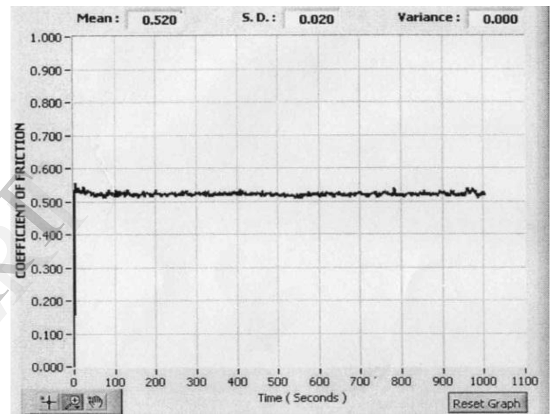


Fig 3.2.(b)

Figures 3.3(a) & (b) Represent the Frictional force versus time. It was cleanly observed that the frictional force was initially increases in the case of before heat treatment this is due to uneven contact between specimen and counterpart mating surface. Once perfect contact is achieved, frictional forceremains constant.

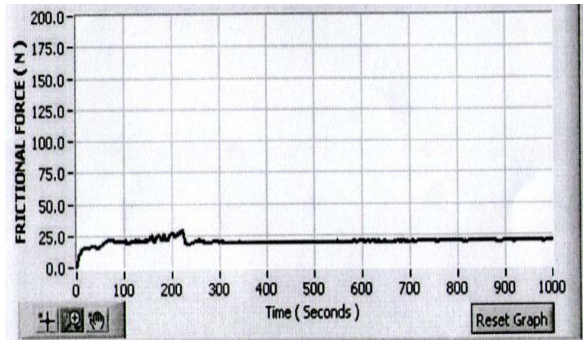


Fig3.3(a)

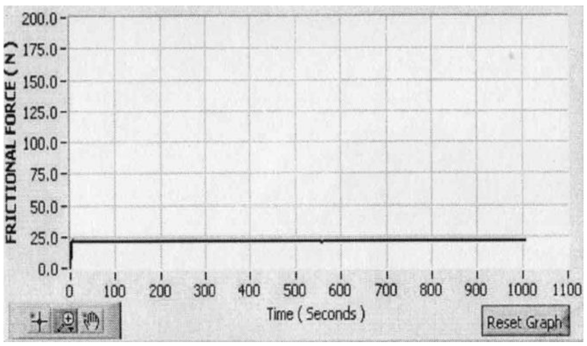


Fig 3.3(b)

Figure 3.4. Represents the variation of Shear stress compared to before and after Heat-treatment process. In order to measure the Shear Stress Hydraulic Press is used. From the figure it is observed that there is 29.3% of decrease in Shear stress after the Heat-treatment process. This decrement is due to diminishing of wear rate.

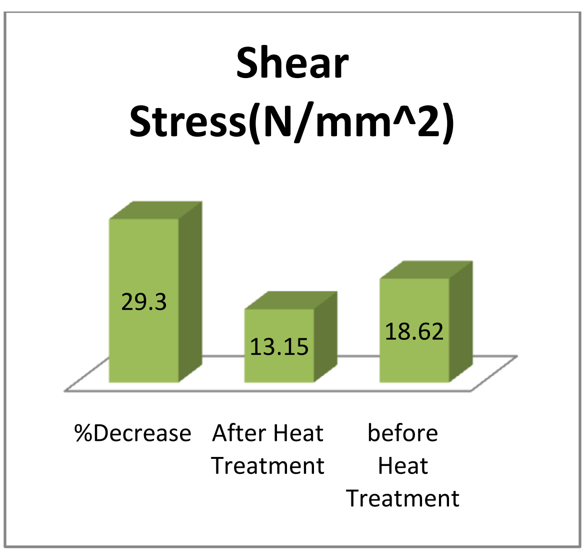


Fig 3.4.Variation of Shear Stress

Figure 3.5.Represents the variation of Young's modulus compared to before and after Heat treatment process. The measurement of Young's modulus is done by applying cantilever beam test. From the plot it is observed that there is 5.61% of Increase in Young's modulus after the Heat-treatment process this increment is due to formation of new phases and inters metallics.

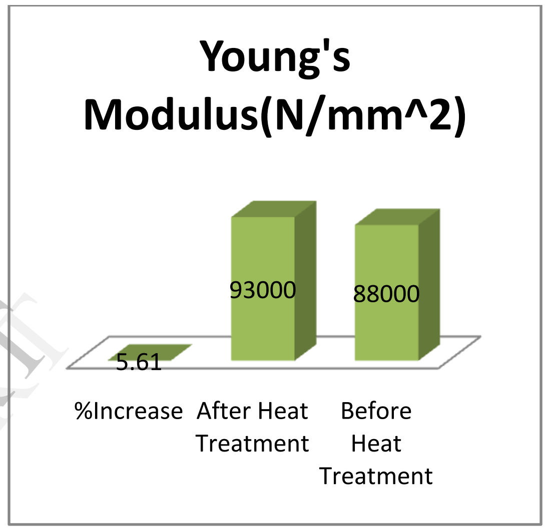


Fig 3.5.Variation of Young's modulus.

4. CONCLUSION:

This investigation gives the overall performance of spheroidal graphite iron on subjected to mechanical properties. The behaviour of nodular cast iron changes drastically after the completion of heat treatment and there is a great change observed in the properties of spheroidal graphite iron.entire results were disscussed in the results and discussions chapter . Following Conclusions were made based on the results of this study.

- Shear stress decreases 29.3% after heat treatment.

- Young's modulus Increases 5.61% after heat treatment.
- Wear rate decreases up to 40% after the completion of the test.
- Increment of co-efficient of friction is observed in the plot.

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