Introduction

Composites are combinations of materials differing in composition, where the individual constituents retain their separate identities. These separate constituents act together to give the necessary mechanical strength or stiffness to the composite part. Composite material is a material composed of two or more distinct phases (matrix phase and dispersed phase) and having bulk properties significantly different from those of any of the constituents.

Most commercially produced composites use a polymer matrix material often called a resin solution. There are many different polymers available depending upon the starting raw ingredients. There are several broad categories, each with numerous variations. The most common are known as polyester, vinyl ester, epoxy, phenolic, polyimide, polyamid, polypropylene, polyether ether ketone (PEEK), and others.

In this present work, the producing of Al₂O₃ phenolic resin red code 04-1030 composite with different additions (wt. %) was done using powder metallurgy method. A wear test used to study the behavior of wear of the investigated materials with different conditions ex: speed. A microstructure examination was carried out an optical microscope for both base material and composite materials reinforced with Al₂O₃. Microstructure of composite has shown that a good distribution of Al₂O₃. Hardness measurement was done for the investigated materials. Study has shown that the increasing of Al₂O₃ additions the increasing of the hardness more than the matrix. The wear test carried out for the investigated materials and the results have shown that the increasing of Al₂O₃ additions the decreasing the wear rate of the composite materials than the matrix. The increasing of time wear the increasing the wear rate.

Methods

1. Material of investigations

In the present work the investigated materials were Al₂O₃ phenolic resin red code 04-1030 composite with additions 10%, 20% and 30% of Alumina

2. Preparation of material of investigations

The investigated materials produced by powder metallurgy method. When phenolic resin red code 04-1030 was mixed with different percentage of Al₂O₃ as mentioned before, then compact at 45 bar with temperature 180°C in shape of cylinder with heating time 10 min and curing time 10 min.

3. Wear test

Wear test was carried out using fixed load 800gm and track diameter 20cm. The type of wear test was pin on disc as dry state, where the disc was made from steel. The test carried out at different rotating speed. The samples was weighted using a digital balance with 4 digits before and after carrying out wear test.

4. Hardness test

Hardness measurement for the alloy of investigation was carried out for the materials of investigations samples before and after additions of Al₂O₃ process using micro-hardness (Vickers test load 100gm and Dwell time 10 sec, instrument Zwick-roll hardness tester), minimum five reading was taken then average determined.

5. Microstructure preparation

The sample of investigation was prepared as ASTM standard for different additions grinding using emery paper grad no. 180, 320, 400, 600, 800, and 1200. After grinding a polishing carried out using a cloth with a suspension diamond solution. Optical microscope connected with a digital camera was used.

Results

1. Microstructure examination for investigated alloy

Investigation of microstructure for the investigated materials for both reinforced materials (phenolic resin red code 04-1030 , Al₂O₃ composite) and unreinforced materials show that the composite materials Sic have a good distribution in the matrix. The microstructure also can show that there are a cluster of Al₂O₃ particulate in the matrix of phenolic resin of course the increasing of additions percentage the of Al₂O₃ contain in the composite materials which also shows more hardness than before. Figure 1- 4 shows the microstructure of matrix and composite materials.

2. Hardness results of the investigated materials

The result of hardness for the material of investigated show that the hardness of composite materials increases more than matrix. As the reinforcement additions are increased, the hardness of the investigated material will be increased. For the material has 30 wt.% the hardness increases maybe double hardness of matrix, while for 10 and 20wt.% of Al₂O₃ the hardness increases maybe 1.5 the hardness of the matrix. Figure 5 shows the results of hardness for matrix and composite materials.

3. Wear results of the investigated materials

Wear test results show that the wear rate (as weight loss) of the matrix is higher than the composite materials, when the increasing of Al₂O₃ addition the decreasing of wear rate for time of wear 5 min. Figure 3.4 shows a comparison between the matrix and 10 wt. % Al₂O₃ composite materials, figure 6 shows the also a comparison of matrix and 20 wt. % Al₂O₃ and the same for matrix and 30wt. % Al₂O₃ composite materials in figure 7 while figure 8 shows the comparison of composite materials with each other.

Conclusions

- Al₂O₃ composite polymer was produced by powder metallurgy methods with different additions 10, 20 and 30wt.%
- Hardness increases with the increase of addition percentages
- Wear decreases as the increases of addition percentages
- No need for increasing addition to 30wt %.

Bibliography


Presented at the 12th Scientific Research Day
Organized by: Deanship of Scientific Research