Tribological Study Of Particulated Filled Epoxy Composite

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Abstract- The objective of this study is to find tribological properties of polymer composite. The composite is prepared by using Epoxy resin as base material and graphite and bronze powder as filler materials by varying the compositions of filler materials. The specimens are tested on pin on disc test and hardness machine, to study Coefficient of friction, wear rate and hardness.

Keyword : Epoxy resin, Graphite powder, Bronze powder, pin on disc test, hardness test.

Introduction
A polymer composite is prepared by mixing the proportion of Epoxy resin and hardner, Graphite, Bronze Powder. From various composite, the composite having optimum tribological properties (minimum COF, wear rate and maximum hardness) are best suited for coating purpose.

Tribology is the science and engineering of interacting surfaces in relative motion. It includes the study and application of the principles of friction, lubrication and wear.

Epoxy resins are thermosetting resins, they find wide range of applications in preparation of polymer composite, coatings, automobile sector etc. Epoxy resin provides good adhesion to metal surface, chemical as well as corrosion resistance.

B. Suresha, G. Chandramohan, prepared graphite filled glass-epoxy composite and they found reduced coefficient of friction.

School of material science and engineering shanghai university of china studied tribological behavior of graphite-epoxy composite. They found that by increasing amount of graphite up to 50% an optimal solid lubricant film was obtained which led to lowest coefficient of friction and wear rate.

Institute of metal research of china studied the tribological behavior of polyether ether ketone(PEEK) composite reinforced by carbon fibre (CF) and potassium titanate whisker(PTW) have been investigated using pin on disc configuration at different applied loads under water lubricated condition.

Materials and Methodology

Material
We selected materials for preparation of composite. Epoxy resin (CY230) as base material, Hardner (HY 951), Graphite powder (20 micron) and Bronze powder (47 micron) as filler materials.

Methodology
For the preparation composite, the graphite and bronze powder are sonicated for 15 minute. By keeping fixed proportion of epoxy resin and hardner, we varied the proportion of graphite and bronze for composite

The proportion is based on percentage mass basis. The various combinations are listed below.

<table>
<thead>
<tr>
<th>composite</th>
<th>Proportion of epoxy &amp; hardner</th>
<th>Proportion of bronze</th>
<th>Proportion of graphite</th>
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<tbody>
<tr>
<td>A</td>
<td>70</td>
<td>5</td>
<td>25</td>
</tr>
<tr>
<td>B</td>
<td>70</td>
<td>10</td>
<td>20</td>
</tr>
<tr>
<td>C</td>
<td>70</td>
<td>15</td>
<td>15</td>
</tr>
<tr>
<td>D</td>
<td>70</td>
<td>20</td>
<td>10</td>
</tr>
<tr>
<td>E</td>
<td>70</td>
<td>25</td>
<td>5</td>
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</tbody>
</table>

In the mass of composition the proportion of epoxy and hardner is fixed for A & C viz. 80% of epoxy and 20% hardner. For composite B,D &E 90% of epoxy and 10% hardner in 70% of total composition of epoxy and hardener.

Epoxy and Hardner (80/20)

Density of Epoxy resin and Hardener mixture (80/20) = 1.1383 gm/cc
Density of Graphite powder = 2.1500 gm/cc
Density of Bronze powder = 5.3000 gm/cc

Preparation of composite for testing
Pin on disc- The composite poured in test tube of diameter 15 mm and again cured for 48 hr. The specimen is removed and machined to a diameter of 10 mm and length 25 mm.

Hardness test -The prepared composite poured in mould of size 60x30x10 mm and it was cured for 48 hr and machined to size 50x25x6.7 mm Epoxy and Hardner (90/10)

Density of Epoxy resin and Hardener mixture (90/10) = 0.9933 gm/cc
Density of Graphite powder = 2.1500 gm/cc
Density of Bronze powder = 5.3000 gm/cc

Result of pin on disc
Parameters for Pin-on disc
Speed of disc = 200 rpm
Track diameter of disc = 80 mm
Load applied on disc = 40 N
Duration of test = 15 min

Calculations
Wear rate =
Where
M = mass in gm
R =radius in m
N=speed in rpm
T= time in min
Coefficient of friction
μ =

Result of Hardness test

<table>
<thead>
<tr>
<th>composite</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
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<td>71</td>
<td>48.5</td>
<td>74</td>
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Conclusion
After the results of Pin on disc test and Hardness test we found that “composite D” is having minimum coefficient of friction and optimum surface hardness so, it is suitable coating applications.

Acknowledgement
This study is supported by 5 students under the reference of guide in NKOCET Solapur. The tables of pin on disc and hardness tests are performed in Baswashewar college of engineering Bagalkot and NKOCET Solapur.

References
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<table>
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<tr>
<th>Composite</th>
<th>Mass (E+H) Gm</th>
<th>M(G) Gm</th>
<th>M(B) Gm</th>
<th>V(E+H) cc</th>
<th>V(G) cc</th>
<th>V(B) cc</th>
<th>Total M (gm)</th>
<th>Total (v) cc</th>
<th>Density gm/cc</th>
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