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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 leaded 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 compositions are listed below.

composite	Proportion of epoxy & hardener	Proportion of bronze	Proportion of graphite
A	70	5	25
B	70	10	20
C	70	15	15
D	70	20	10
E	70	25	5

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

composite	A	B	C	D	E
HRM	43	71	48.5	74	92

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.

Acknowledgment

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.

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Compo-site	Mass (E+H) Gm	M(G) Gm	M(B) Gm	V(E+H) cc	V(G) cc	V(B) cc	Total M (gm)	Total (v) cc	Den-sity gm/ cc
A	700	50	250	614.952	23.25	47.16	1000	685.37	1.459
B	700	100	200	614.952	46.51	37.73	1000	699.39	1.429
C	700	150	150	614.952	69.76	28.30	1000	713.02	1.402
D	700	200	100	614.952	93.02	18.86	1000	726.84	1.375
E	700	250	50	614.952	116.2	9.433	1000	740.66	1.350

Compo-site	Mass (E+H) Gm	M(G) gm	M(B) Gm	V(E+H) cc	V(G) cc	V(B) cc	Total M (gm)	Total (v) cc	Density gm/ cc
A	700	50	250	704.669	23.25	47.16	1000	775.09	1.290
B	700	100	200	704.669	46.51	37.73	1000	788.91	1.267
C	700	150	150	704.669	69.76	28.30	1000	802.73	1.245
D	700	200	100	704.669	93.02	18.86	1000	816.56	1.224
E	700	250	50	704.669	116.2	9.433	1000	830.38	1.204

Composite	Wt. Before test (gm)	Wt. after test (gm)	Wear rate (cc/m)	Fr. force after 5 min (N)	Fr. Force after 10 min (N)	Fr. Force after 15 min (N)	Avg. Fr. Force (N)	Coefficient. Of friction μ
	3.1095	3.1043	7.88 × 10^-6	28.3	25.4	22.2	25.3	0.6325
	2.70	2.69	15.157×10^-6	21	21.1	19.5	20.5	0.5133
	2.826	2.82	9.0945×10^-6	19.4	19.8	20.0	19.73	0.4933
	2.943	2.94	4.5472×10^-6	17.5	17.2	17.6	17.43	0.4358
	2.9078	2.90	11.822×10^-6	19.1	19.7	19.0	19.267	0.4816