International Journal of Engineering Research and Development
e-ISSN: 2278-067X, p-ISSN: 2278-800X, www.ijerd.com
Volume 10, Issue 11 (November 2014), PP.46-50

Dry Sliding Wear Behavior of Glass and Jute Fiber Hybrid Reinforced Epoxy Composites

M. Arsath rahuman[1], S.Suresh kumar[2], R.Prithivirajan[3], S.GowriShankar[4]
[1]*Assistant Professor, Department of Mechanical Engineering, Sri Muthukumaran Institute of Technology, Chennai, India.*
[2]*Assistant Professor, Department of Mechanical Engineering, Panimalar Polytechnic College, Chennai, India.*
[3]*Research Assistant, Department of Mechanical Engineering, A.C.College of Engineering and Technology, Karaikudi, India.*
[4]*Assistant Professor, Department of Mechanical Engineering, Panimalar Polytechnic College, Chennai, India*

Abstract:- Glass Fiber reinforced composites are emerging as a potential material for a wide variety of industrial applications owing to their good combination of physical and mechanical properties. In recent decades, glass fiber composites parts are widely used as sliding components in different engineering applications. Due to the legitimate theoretical and practical importance, the study of tribological performance of these emerging materials becomes highly decisive. In the present research initiative, two type of reinforcements are selected there are Glass and jute fibers with matrix of epoxy 551 was used for composite specimen preparation. The frictional and wear characteristics of the developed composites have been studied under different sliding conditions. From the results it is conclude that jute is more efficient in improving the tribological Performance of glass-epoxy composites than the raw glass fiber reinforced epoxy composites.

Keywords:- Glass fiber, Jute fiber, Epoxy, Sliding Wear

I. INTRODUCTION

Environmental issues and sustainability concept attracts the researchers towards to utilize the natural fibers as reinforcement in polymer-based composites. Fiber reinforced composites are attracting the industrial researchers due to their lower cost, light weight to high strength, renewability, lower density and lower energy requirements for manufacturing. Natural fibers in the composite industry usually refers to wood fiber and agro based, leaf, seed and stem fibers. These fibers often contribute greatly to the structural performance of plant and when used in plastic composites can provide significant reinforcement. The toughness and strength inadequacies of bio composites can be overwhelmed by structural configurations and better arrangement in a sagacity of placing the fibers in exact locations for highest strength performance. Synthetic and natural fiber composites can also be very cost effective material for application in building and construction areas like walls, celing, window[1-5].Moreover in an effort to develop a superior and cost-effective composite, a natural fiber can be joint with a synthetic fiber in the same matrix material so as to take the best advantage of the properties of both the fibers resulting in hybrid composite. Arkles et al. [6] studied the wear behavior of fluoropolymers reinforced with randomly dispersed glass and carbon fibers. They found that the wear rate decreased as the fiber content increased up to a limiting value. Jute and glass also have the greater strength. It is also established that erosive wear resistance of armored polymer composite is usually higher than unreinforced polymer matrix [7].

Deo et al. [8] 2010 analyzed the wear behavior of lantana camara fiber reinforced polyester composite. The result confirmed that the incorporation of this natural fiber improved the wear behavior considerably. The proportional wear loss was correlated to the increase in normal load. The wear mechanisms like crack, adherence and plastic deformation were described from Scanning Electron Micrographs. The present study aims to develop a glass and jute fiber reinforced epoxy hybrid composites by simple hand layup technique by varying reinforcement content and finding the wear rate and coefficient of friction for prepared composites.

II. EXPERIMENTAL PROCEDURE

2.1 Materials

The jute and E-glass where procured from Vasavibala Resins Ltd., Chennai, fiber were cut into size of 50 mm for different proportions of fiber content are shown in Figure 1. E-glass fibers were reinforced with Epoxy LY 556 resin, chemically belonging to the 'epoxide' family was used as the material for making the matrix. Its common name was Biphenyl a Diglycidyl Ether. The High temperature curing epoxy resin [LY

556] and corresponding hardener [HY951] were varied in a proportion of 10:1 by weight as suggested. The epoxy and the hardener were supplied by Ciba Geigy India Ltd.

Figure: 1 Photographic Image of Prepared Glass and Jute fiber for Hybrid Composites

2.2 PREPARATION OF COMPOSITES SHEETS

The epoxy resin LY 556 and hardener HY951 was mixed in the ratio of 10:1by weight. Different volume fraction of chopped glass fibers 50mm and jute fibers 50mm were added separately in the glass bowl and stirred well for 10 minutes by a glass rod to getting uniform dispersion. The final resultant mixture of chopped glass and jute fiber and resin was poured into cylindrical mold. There are 3 set of compositions are Glass 70%wt+ jute30%wt(GJ-1), Glass80%wt+ jute 20 %wt.(GJ-2), Glass90%wt+ jute 10 %wt.(GJ-3).Care was being taken in the experiment to make composite specimen size of 55mm diameter and 10mm thickness was shown in Figure 2. The moldings were put under load for about 1 day for appropriate curing at room temperature. Specimens of appropriate dimensions were cut using a cutter for performing wear test.

2.3 WEAR TEST

To evaluate the performance of prepared composites under dry sliding condition, wear tests were carried out in a pin-on-disc wear monitoring test rig [supplied by DUCOM] as per ASTM G 99. The experimental set up for wear test was shown in Figure 2.The counter disc material was of EN31 steel. Prior to testing, the pins and disc surface were cleaned with acetone. All of the tests were performed on hybrid composite of various compositions with applied loads of 10 and 20 N.

Figure: 2 Photographic Image of Composite Specimen and Pin-On-Disc Tribo Test Machine

The physical loss from the composite during wear test was measured by using a precision electronic balance with exactness + 0.1 mg. The coefficient of friction was determined from the applied normal load and the obtained tangential load from the strain gauges. Each test was repeated five times, and the average results were obtained.

III. EXPERIMENTAL RESULTS

TABLE 1: VARIOUS INPUT CONDITIONS WITH WEAR RATE FOR 1 Kg LOAD

DESIGNATION	FIBER PROPORTIONS (WT %)	SPEED (M/S)	TIME (S)	LOAD (N)	WEAR RATE (KG/MM^3)
GJ-1	Glass70% jute 30%	550	300	10	4.229
GJ-2	Glass80% jute 20%	550	300	10	3.719
GJ-3	Glass90% jute 10%	550	300	10	2.625

TABLE 2: VARIOUS INPUT CONDITIONS WITH WEAR RATE FOR 2 Kg LOAD					
DESIGNATION	**FIBER PROPORTIONS (WT %)**	**SPEED (M/S)**	**TIME (S)**	**LOAD (N)**	**WEAR RATE (KG/MM^3) X10-8**
GJ-1	Glass70% jute 30%	550	300	20	8.157
GJ-2	Glass80% jute 20%	550	300	20	7.753
GJ-3	Glass90% jute 10%	550	300	20	4.532

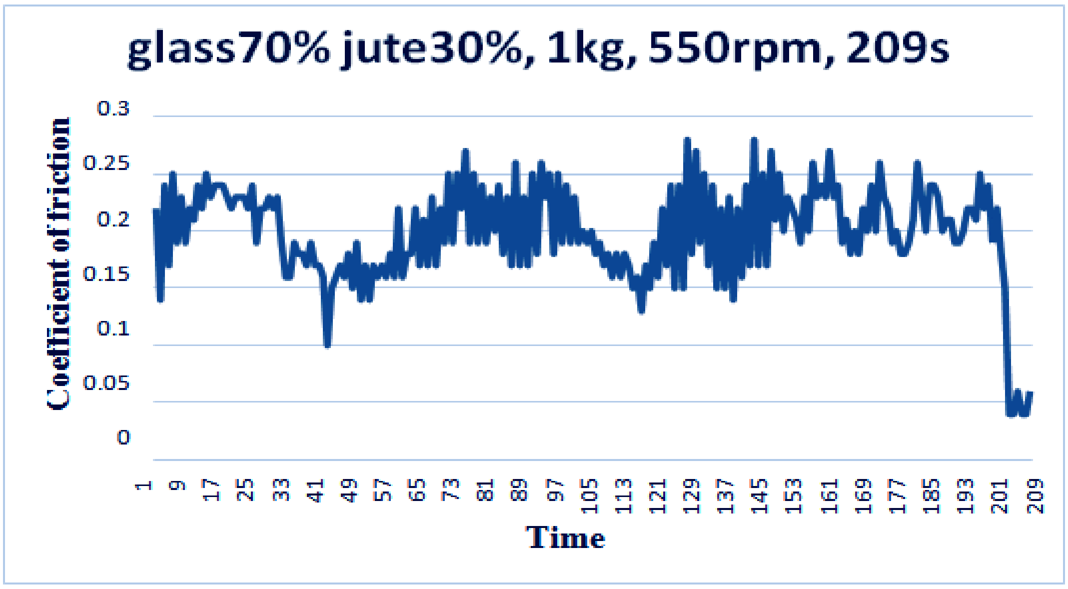

Figure: 3 Variations of Coefficient of Friction for Glass70%/Jute30% at 550 Rpm and 1kg for 209s

Table 1 & 2 shows the various input conditions at which the dry sliding wear behavior was carried out and the corresponding wear loss were also determined by using a precision weight measurer with an higher accuracy. Figure3, 4 & 5shows the friction coefficient of the material at a corresponding load and varying velocity of the materials for 300 s sliding time respectively. Since the weight loss for the loading range from 10 and 20N was predicted, the weight loss can be measured [Mylsamy and Rajendran, 2011].

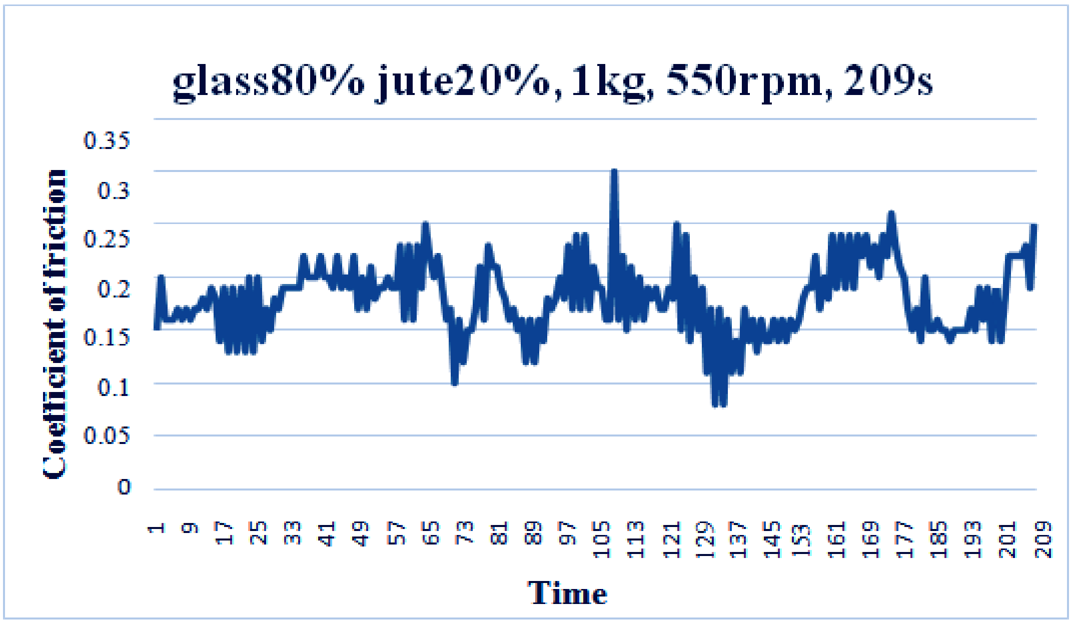

Figure: 4 Variations of Coefficient of Friction for Glass80%/Jute20% at 550 Rpm and 1kg for 209s

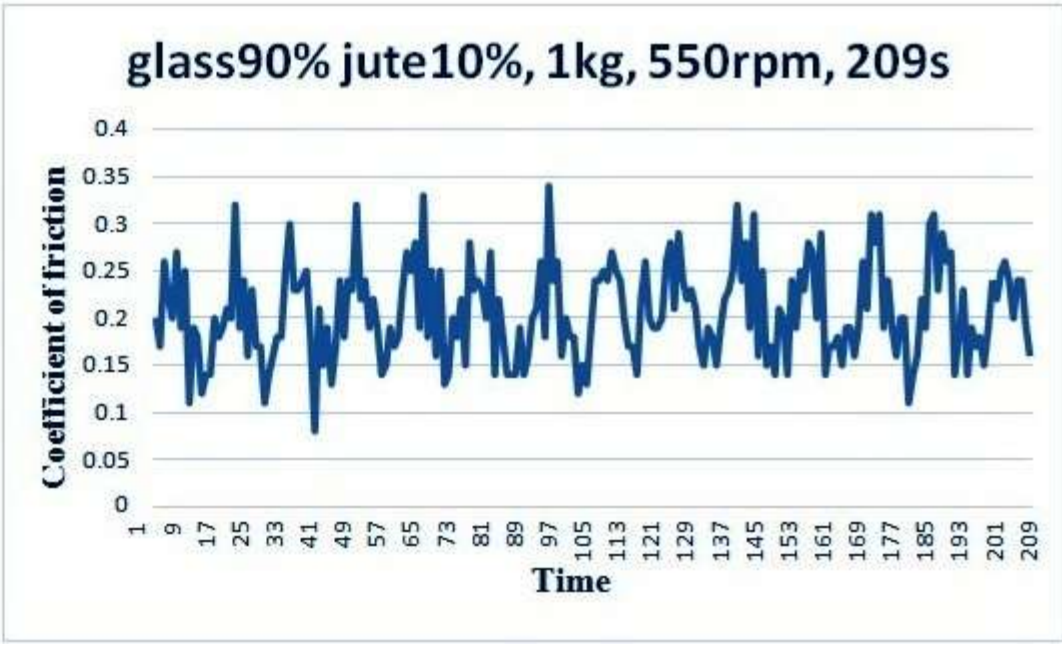

Figure: 5 Variation of Coefficient Of Friction for Glass90%/Jute10% at 550 Rpm and 1kg for 209s

Even at this load of 10N the penetration was less and hence this leads to lesser weight loss during rubbing action. It was interesting to notice that the applied load and hence the weight loss were increased proportionally, due to increase in sliding distance as well as speeds. It was observed that the weight loss for the corresponding loads and time for the hybrid fiber reinforced polymers were lesser for the lower load applied conditions. The strong fiber matrix adhesion of fibers with the matrix prevents the delamination and surface roughness during the wear process. The frictional heat generated at higher loads leads to the formation of back uneven transfer patches of polymer surface. These back transfer patches reduces the weight loss of polymeric composites. Out of the two set of the input conditions chosen lesser weight loss was observed for the 70 wt. % of glass fiber and 30 wt. % jute reinforced polymers for the applied load. Figure 3, 4& 5 shows the coefficient of friction for 3 set of composites. From the results it was observed that the friction coefficient increased proportionately to the applied load. The coefficient of friction for the hybrid fibers were found less than the other fiber reinforced composites. The 90 wt. % glass fiber reinforced polymer yielded lesser friction coefficient than that of others and hence corresponds to the lesser wear. This is due to the better bonding between the hybrid fibers and the matrix. Due to the increase in friction coefficient the interface temperature also gets increased. The increase of frictional temperature causes plastic deformation and more wear.

V. CONCLUSION

The friction and wear behavior of glass and jute hybrid composites were analyzed and interpreted in the present experimental study. The wear and friction behavior of hybrid composites were affected by varying applied load, sliding velocity and corresponding to sliding time. At varying speeds, the wear behavior and coefficient of friction of the material changed consecutively. Notably, a gradual increase in the weight loss and wear rate were observed as the sliding time and load increased. Thus the glass and jute hybrid composites produce better wear performance and suitable for light weight applications. The addition of jute and glass fiber in epoxy matrix significantly reduced the friction coefficient and wear mass loss of neat epoxy. Also the incorporation of jute and glass fiber improved the wear resistance of hybrid composites.

REFERENCES

[1]. G Hinrichsen, M.A Khan, A.K.Mohant, "Composites: Part A", Elsevier Science Ltd, 31,143–150, 2000.
[2]. P.VJoseph, J. Kuruvilla, S.Thomas, "Composites Science and Technology", 59(11), 1625-1640, 1999.
[3]. P.S Mukherjee, K.G.Satyanarayana, "Structure and properties of some vegetable fibers II. Pineapple leaf fiber," Journal of Material Science, Vol 2, 51–56, 1986.
[4]. S.Jain, R.Kumar, U.C.Jindal, "Mechanical Behavior of Bamboo and Bamboo Composites,"J. Mater. Sci., Vol 27, 4598-4604, 1992.

[5]. K.Hirao, H.Inagaki, K.Nakamae, M.Kotera, T.K.Nishino, "Kenaf Reinforced Biodegradable Composite," Composites Science and Technology", Vol 63, 1281-1286, 2003.
[6]. B. Arkles, S.Gerakaris, R. Goodhue, "Wear characteristics of fluoro polymer composites, in L.H. Lee (ed.), "Advances in Polymer Friction and Wear", Vol. 5B, Plenum, New York, 663-688, 1974.
[7]. M.M.Sain, B.V.Kokta, "Polyolefin wood filler composite.I.Performance of mphenylene bismaleimide-modified wood fiber in polypropylene composites", J. Appl. Polym. Sci, Vol 54, 1545-1559, 1994.
[8]. Chittaranjan Deo and S.K. Acharya, "Effects of fiber content on wear of Lantana camara fiber reinforced polymer matrix composite", Indian Journal of Engineering and Material Sciences, Vol 17, 219-223, 2010.
[9]. K. Mylsamy, I. Rajendran, "Influence of Fibre Length on the Wear Behavior of Chopped Agave Americana Fibre Reinforced Epoxy Composites", Tribol Lett (2011) 44:75–80.