GLOBAL JOURNAL OF ENGINEERING SCIENCE AND RESEARCHES

# WEAR BEHAVIOR OF JUTE-POLYESTER COMPOSITE FOR DIFFERENT FIBER ORIENTATIONS

**Raghu.K[*1], Harish Kumar K. C[2], Sandeep.B[3] & Dr. Keerthiprasad K. S[4]**
[*1&2]UG Students, Department of Mechanical Engineering, VVIET, Mysuru, Karnataka, India
[3]Faculty, Department of Mechanical Engineering, VVIET, Mysuru, Karnataka, India
[4]Prof, Department of Mechanical Engineering, VVIET, Mysuru, Karnataka, India

## ABSTRACT

The study of wear property was carried out on jute reinforced polyester composite by carrying out the experiment of three-body abrasive wear test. The composites has been tested and analyzed by one of the Taguchi approach for three different orientations - 0°, 30°and 45°. The test was carried out at 11, 23 and 33N loads by varying the abrading distance from 300 to 900 m in increments of 300 m and also varying the grain size of the silica sand - 106,212 & 425 microns. The wear test was carried out at 200rpm, a standard speed. The worn-out samples were measured for their weight losses by using precise digital weighing balance. The studies indicated that the wear resistance improved at 30° orientation and is at optimal rate in composite.

***Key words:*** *Abrasive, Polyester, Jute, orientation*

## I. INTRODUCTION

Polymers composites form a very imperative class of tribo-engineering materials and are customarily used in mechanical workings, where wear performance in no lubricated condition is a key parameter for the material selection [1]. Polymer composites are exposed to abrasive wear in many applications [2]. Abrasive wear is one type of wear where hard asperities on one surface move across a softer surface under load, penetrate and remove material from the softer surface, leaving grooves [3]. Most of the abrasive wear problems arise in chute liners in power plants, mining and earth moving equipments. Three-body abrasive wear is often of considerable practical importance, for example in coal handling equipments in power plants, gear pumps handling industrial fluids and agri- cultural machine components, but appears to have received much less attention than a two-body abrasion.

Very little has-been reported on the effect of fiber/filler reinforcement on three-body abrasive wear behavior of polymer composites [4]. To know the how composites perform in abrasive wear situations needs a proper understanding. In recent years, much research has been devoted to exploring the potential advantage of thermoset matrix for composite applications [5]. One such matrix is polyester, which has found a place in the family comprising the thermoset engineering polymers due to its nature of inexpensive, easy processing, long lasting and durability. Polyester resin is a synthetic resin, in its viscous form, they are highly flammable and skin irritant – something we expect from a styrene based fluid. Manufactures mix their own blend of cobalt and other conditioner addivities to help the curing process; they are compatible with any type of fiber glass. Notable advance in the polymer industry has been the use of fiber and particulate fillers as reinforcements in polymer matrix [5, 6].

Natural composites have the ability to reinstate regular materials in order to overcome some environmental problems. As more of green materials due to environmental issues, many efforts are carried out to change the common materials with biodegradable aspects where friction and wear as important factors [7]. Natural fiber reinforcement has little effect on the friction coefficient of PP polymer. Unmoving, there was a drop in the value of the friction coefficient of the prepared composites compared with that of the neat PP. A considerable upgrading in the wear rate of PP was noted, particularly at higher loads [8]. Wear performance of the jute fiber reinforced polyester composite is studied. The objective is a better appreciative of the role of jute fiber reinforced polyester matrix composites under various abrading distances/loads/Grain size for tribological applications.

## II. EXPERIMENTAL DETAILS

**Experimental materials and manufacturing method**

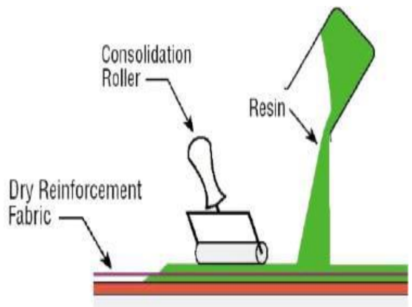


*Fig 1. Schematic diagram of Hand Lay-up process.*

The prepared composite consists of jute fiber woven mat, which was used as a reinforcing material in general purpose polyester resin. Accelerator and catalyst is added along with polyester resin to form a desired matrix composition. Hand lay-up practice was followed to produce these composites. The release film was placed on the mould. Jute fiber woven mat is placed on it first, on which a mixture of matrix system is coated with help of a brush.

The stacking procedure was followed: placing of the jute fiber woven mat at different fiber orientations, thus forming a composite stack. To ensure approximate thickness of the sample, spacers were used. At the last again release film was kept to cover layup and dead weight was placed over it to apply uniform distribution of load on the same and then it was allowed to cure for a day at room temperature. Test samples according to ASTM D-G65 were prepared from the cured sheet using cut-off machine.

**Abrasive wear test**

The picture of dry sand abrasion test set up is shown in Fig 2. In the present study, silica sand is used as the abrasive. The abrasive particles of 106,212 & 425 microns were angular in shape with sharp edges. The abrasive was fed at the contacting face between the rotating rubber wheel and the test sample. The tests were conducted at a rotational speed of 200 rpm.

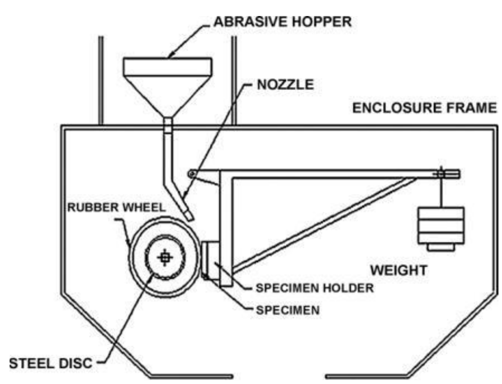


*Fig 2. Dry sand abrasion Testing rig.*

The sample was cleaned with acetone Its initial weight was determined in a high precision digital balance (0.1mg accuracy, Mettler, TOLEDO) before it was mounted in the sample holder. The abrasives were introduced between the test specimen and rotating abrasive wheel composed of chlorobutyl rubber tyre. The diameter of the rubber wheel used is 250mm. The test specimen was pressed against the rotating wheel at a specified force by means of lever arm while a controlled flow of abrasives abrades the test surface. The rotation of the abrasive wheel was such that its contacting face moves in the direction of sand flow. The pivot axis of the lever arm lies within a plane, which is approximately tangent to the rubber wheel surface and normal to the horizontal diameter along which the load is applied. At the end of set test, the specimen was removed, thoroughly cleaned and again weighed. The difference in weight before and after abrasion was determined. At least three tests were performed at specific orientations of natural polymer hybrid composite and the average values so obtained were used in this study.

The experiments were carried out for loads of 11N, 23N and 33N. Further by varying the abrading distance from 300 to 900 m in increments of 300 m and also varying the grain size of the silica sand -106,212 & 425 microns.

## III. RESULTS AND DISCUSSION

**Abrasive Wear Loss**

The graphs generated by ANOVA by the mini tab software on main effects of plot for SN ratios for wear loss show the wear loss in volume of the samples at 11N, 23N and 33N loads and varying the abrading distance from 300 to 900 m in increments of 300 m and also varying the grain size of the silica sand -106,212 & 425 microns, respectively. It is clear from these graphs that for the entire composites used in this study there is a near linear wear loss with abrading distance and different grain size sand.

It indicates a steady-state wear with a constant wear rate. The highest wear is for 0°and 45° orientation and the lowest is for 30°orientation of jute fiber reinforced polyester composite. Graph generated for different fiber orientations of jute fiber reinforced polyester composite. There is an increase in good abrasion resistance for 30°orientation. However, under mild abrasion conditions the shape and size of the reinforcement especially the carbon have major influence on the wear performance.

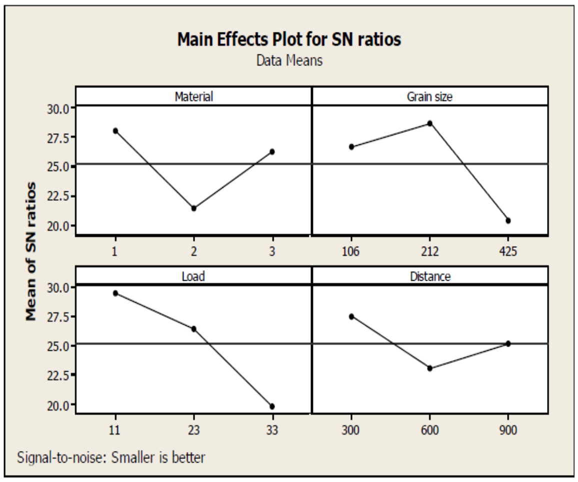


*Fig 3: Result Analysis using Main effects plot for SN ratios from ANOVA with respect to material orientation (M), Silica sand grain size (G), Load applied (L) and Abrading distance (D).*

## IV. CONCLUSION

From abrasive wear study of varying orientation of jute fiber – polyester composite, the following conclusions are drawn:

- Abrasive wear increases with varying in abrading distance/loads/Grain size for all the samples. However, the 30°orientation of jute fiber – polyester composite showed better abrasive wear resistance.
- Abrasive wear rate is higher in 0°and 45° orientation of jute fiber – polyester composite.

- The Taguchi approach which is been adopted, from the fig. 3. for Main effect plot for Signal to Noise ratio for three-body abrasion test; it is found that, The optimal condition can be reached, were in which, the wear will be at low level, if the test is carried out for 0° orientation of composite for abrading distance of 300 m at the load of 11 N using silica sand grain size of 212 microns at the constant speed of 200 rpm.

## V. ACKNOWLEDGEMENT

We are very grateful to our teachers for providing guidance and support to publish this paper in the journal.

## REFERENCES

1) *Hutchings, I.M., 1992. Tribology; Friction and Wear of Engineering Materials. CRC Press, London.*
2) *Harsha, A.P., Tewari, U.S., 2002. Tribo performance of polyaryletherketone composites. Polymer Test. 21, 697–709.*
3) *Gates, J.D., 1998. Two-body and three-body abrasion: a critical discussion. Wear 214, 139–146.*
4) *Tripaty B.S, Furey M.J, Tribological behavior of unidirectional graphite epoxy and carbon-PEEK composites. Wear, 162, 1993, 343-359.*
5) *Budunski K.G, Resistance of particle abrasion to selected plastics, Wear 302, 1997, 203-204.*
6) *Subbaya .K.M, Suresha, Rajendra, Varadarajan, (2012) Multiple response optimization of three-body abrasive wear behaviour of graphite filled carbon-epoxy composites using grey-based Taguchi Approach, Journal of Minerals, Materials Characterization and Engineering, Vol. 11, 876-884.*
7) *Emad Omrani, Pradeep L, Menezes, Pradeep K. Rohatgi, Review - State of the art on tribological behavior of polymer matrix composites reinforced with natural fibers in the green materials world, Engineering Science and Technology, an International Journal 19 (2016) 717–736.*
8) *Temesgen Berhanu Yallewa, Pradeep Kumara, Inderdeep Singha, Sliding Wear Properties of Jute Fabric Reinforced Polypropylene Composites, Procedia Engineering 97 (2014) 402 – 411.*