ANALYSIS OF ENVIRONMENTAL RISK BY USING CORN HUSK FIBER REINFORCED POLYMERIC COMPOSITE MATERIAL

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Abstract: - With growing concern about environmental issues, scientists are investigating different alternatives to replace synthetic and non-degradable fiber composites with environmentally friendly biocomposites with comparable properties and performance. This experiment illustrates the importance of polymeric composites and, for ecological reasons, is an attempt to further explore the possibility of biocomposites (especially cornhusk) as an alternative to available synthetic polymeric composites. Taking a leap forward, the experiment also addresses the properties of individual parameters on erosion using the Taguchi technique. The experimental system was developed and designed to study the erosion rate of corn husk fiber-reinforced polymeric composites at different angles of incidence with deep variables such as particle velocity, fiber content, and particle size (particles). . '' Erosion) and the corresponding hardener HY 551 was used. The extent of the erosion was of the order of its irregular shape. The tribological yield of leaves has been studied in terms of sets of several variable parameters as suggested by the L16 series of Tanguchi techniques. Morphological features before and after the experiments came from studies using SEM.

Keywords: - Biocomposites, erosive wear index, Taguchi brittle fracture, impact angle, erosive dimension.

1. INTRODUCTION

Polymers and their composites constitute a very important class of tribotechnical materials and are used without exception in mechanical components where wear behavior in the unlubricated state is a key parameter for material selection. Today, much attention is devoted to the study of the erosion behavior of polymeric compounds with solid particles due to the high potential of these materials in many mechanical and structural applications. Therefore, the resistance to erosion of polymeric compounds has become an important property of the material, especially in the selection of alternative materials, so the study of the erosion properties of solid particles of polymeric compounds is has become very relevant.

Corn husk (MH) is one of the most important agricultural residues that is a by-product of corn processing. In general, this has been a problem for corn growers due to its resistance to degradation in the soil, difficult digestion and low nutritional value for animals. Research has shown that the lignin and hemicellulose content of corn husks is lower than that of wood, while the cellulose content is similar. For this reason, MHF can be treated at higher temperatures than wood. Therefore, the use of corn husks in the productio n of polymeric compounds is attracting a lot of attention.

In this context, the present research works are carried out in order to study the treatment, characterization, various physical-mechanical properties and the behavior to erosion wear of epoxy composites reinforced with corn husk. The specific objectives of this work are clearly defined in the next chapter.

2. LITERATURE REVIEW

The purpose of this literature review is to provide background information on the issues to be considered in this thesis and to emphasize the relevance of the present study. This treatise embraces various aspects of polymer composites with a special reference to their erosion wear characteristics. This chapter includes reviews of available research reports:

- On particulate filled polymer composites
- On natural fibers and their composites
- On mechanical properties of natural fiber composites
- On erosion of polymer composites
- On polymer composites filled with Corn husk

At the end of the chapter a summary of the literature survey are presented. On that basis the objectives of the present research work are also outlined.

On particulate filled polymer composites

Particle-filled polymeric composites have been widely used in various fields due to their low manufacturing cost and ease of manufacture. Furthermore, they behave isotropically and are not as sensitive as long fiber composites to thermal expansion mismatch between matrix and reinforcement [6]. Hard particle fillers consisting of ceramic or metallic particles and fiberglass fillers are used today to significantly improve the performance of polymeric composites [7]. Different types of polymers and polymer matrix composites reinforced with metal particles have a wide range of industrial applications, such as heating and electrodes [8]. Likewise, ceramic-filled polymer composites have been the subject of extensive research over the past two decades. When silica particles are added to a polymer matrix, they play an important role in improving the electrical, mechanical, and thermal properties of composite materials [9].

On natural fiber and their composites

In polymeric compounds, the reinforcing phase can be fibrous or non-fibrous. If the fibers come from natural resources such as plants or other living species, Numerous research articles have been published to corroborate the usefulness and beneficial properties of these natural fibers [17]. The natural fibers examined include flax, hemp, jute, sisal, kenaf, coconut, kapok, banana, henequen, and many others [18]. The different advantages of natural fibers over synthetic glass and carbon fibers are reported to be: low cost, low density, comparable specific tensile properties, non-abrasive nature, not allergic to skin, low consumption, reduced energy, lower health risk. and renewable, recyclability and biodegradability [19]. These advantageous properties have created opportunities for natural fiber reinforced polymeric composites in the aerospace, construction, sports and recreational, packaging, and automotive industries [20].

3. PROBLEM IDENTIFICATION

The knowledge gap in earlier investigations

The literature review presented above shows the following knowledge gaps in the research reported so far:

- Although much work has been done on a wide variety of natural fibers for polymeric composites, very little has been reported on the strengthening potential of corn husks, despite their many advantages over others.
- Corn husk is rarely mentioned as filler for possible use in

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tribological situations where synthetic fibers are widely used. Furthermore, there is no report in the literature on the erosion properties of polymeric compounds based on corn husks.

- Understanding the relationship between the physical and mechanical properties of a polymeric compound and its microstructural properties is far from satisfactory.
- Studies on the wear behavior of composite materials have been largely experimental and statistical techniques have not been used to analyze wear characteristics..

Objectives of the present work

The lack of knowledge in the existing literature summarized above helped define the objectives of this research, which are described below.

1. Production of a new class of epoxy-based compounds reinforced with corn husk powder in various proportions by weight.
2. Evaluation of various physical, mechanical, microstructural and erosion characterizations of these epoxy compounds filled with corn husk.
3. Statistical analysis based on the Taguchi experimental design for the parametric evaluation of the erosion wear process of the studied composite materials..

4. METHODOLOGY

In the present investigation, corn husk (collected from Rajaram Corn Product, Rajnandgaon, C.G., India) is used as a polymeric matrix compound for fillers. Corn husk is an agricultural residue that comes largely from the flour milling industry. Due to the large corn production of around 200 million tons / year, there is a large amount of corn husk waste of around 8% by weight of the total production. Corn husk is one of the most important agricultural residues containing 40% by weight of cellulose, 45% by weight of hemicellulose, 7% by weight of origin, 2% by weight of proteins and 3% by weight of mineral ash. Studies are currently underway to find ways to use the jargon of cellulosic materials, including making films by pretreatment. The beneficial effects of cellulosic material pretreatment in jargon have long been known. Corn, which has become a problematic waste for the environment, is now turned into useful industrial materials.

Fig. Corn and Corn husk

Table - List of particulate filled composites fabricated by hand-lay-up technique

Sample	Composition (Corn husk as filler material)
1	Epoxy + Corn husk filler (0 wt%)
2	Epoxy + Corn husk filler (5 wt%)
3	Epoxy + Corn husk filler (10 wt%)
4	Epoxy + Corn husk filler (15 wt%)
5	Epoxy + Corn husk filler (20 wt%)
6	Epoxy + Corn husk filler (25 wt%)
7	Epoxy + Corn husk filler (30 wt%)

Care was taken to avoid the formation of air bubbles. Then pressure was applied from above and the mold was allowed to cure for 24 hours at room temperature. During pressurization, some epoxy and hardener will be released. Care has been taken to account for this loss during production in order to maintain a constant sample thickness. This process has been used to produce 5, 10, 15, 20, 25 and 30% fiber reinforced epoxy composite panels by weight. After 24 hours, the samples were removed from the mold and then cut to the required size in accordance with ASTM standards for mechanical testing.

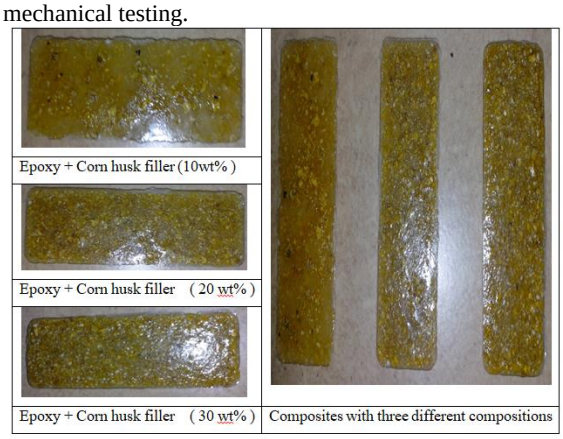

Fig.- Fabricated Composite for three different compositions

5. RESULTS AND DISCUSSION

Density and Void Fraction

Density is a critical material property in various weight sensitive applications. Polymers are known for their low density. Low densities of polymeric compounds have been shown to replace traditional metals and materials in many technical applications. The density of a composite material depends on the relative weight percent of the matrix and the reinforcing components. The theoretical and experimentally measured densities of the corn husk reinforced epoxy compounds and the corresponding void volume fraction are listed in Table 5.1.

Table 5.1: Density values along with the void fractions of the Corn husk filled epoxy composites

S.No.	Filler Content (wt %)	Measured density (gm/cm^3)	Theoretical density (gm/cm^3)	Voids contents (%)
1	0	1.1	1.1	-----
2	5	0.885	0.916	3.38
3	10	0.736	0.785	6.24
4	15	0.622	0.687	9.46
5	20	0.532	0.611	12.92
6	25	0.459	0.551	16.69
7	30	0.394	0.498	20.88

5.2 Mechanical characterization

5.3.1 Tensile properties

The change in tensile strength of the natural filler polymer composite is shown in Figure 4.1. In the present work, the epoxy resin as a polymeric matrix has a tensile strength of 34 MPa [1], while the final tensile stress of the epoxy resin is 1.24%.

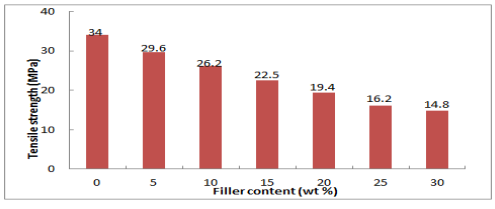

Fig. 5.1 Effect of Corn husk content on tensile strength of epoxy composites

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5.3.2 Flexural strength

Composite materials bend and cut in many technical applications. Therefore, it is important to study the flexural properties of new compounds under development. The variation in flexural strength of epoxy compounds filled with corn husks with different corn husk content is shown in Figure 5.3. There is a gradual decrease in flexural strength from a maximum of 48 MPa in pure epoxy resin to a minimum of 21.82 MPa in epoxy compounds with 30% by weight of corn husk.

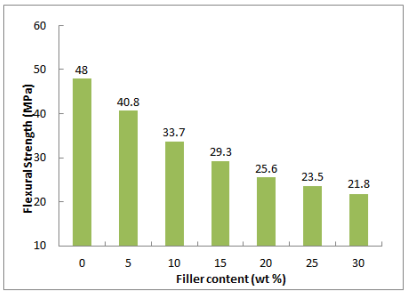

Fig. 5.3 Effect of Corn husk content on flexural strength of epoxy composites

6. CONCLUSIONS

This current study on corn husks filled with particles / epoxy compounds led to the following conclusions:

1) Corn husk has reinforcing potential for use as a filler material in polymer matrix composites.
2) Successful production of corn husk particle reinforced epoxy matrix composites is possible using a simple manual lamination technique.
3) The density of the produced composite materials decreases with increasing weight fraction and also has a low void content; Even if it is applied by hand.
4) The tensile and flexural strength of these compounds decreases with the filler content due to the poor mechanical properties of the corn husk.
5) The morphology of the surface shows that there is a good adhesion between the matrix phase and the filling phase and a very small space is seen between them which leads to low porosity.
6) The microhardness of this natural filler compound inevitably increases with the filler load and provides better impact resistance.
7) This study shows that corn husks have good filling properties as they improve the erosion resistance of the epoxy.
8) The erosion properties of these compounds can also be successfully analyzed using the Taguchi experimental design. The Taguchi method offers a simple, systematic and efficient method to optimize control factors.
9) The main factors influencing the erosion rate of composites are identified. Factors such as corn husk content, impact velocity, and impact angle are identified as the main factors affecting the erosion rate.

REFERENCES

[1] Stolarski T.A., “Tribology in machine design”, Heiman Newnes, UK. (1990).
[2] Paivi Kivikyto-Reponen, “Correlation of material characteristics and wear of powder metallurgical metal matrix composites, doctoral theses in materials and earth sciences”, Helsinki University of Technology, Laboratory of Materials Science, Espoo, (2006).
[3] Budinski K.G., “Surface engineering for wear resistance”, Prentice Hall, New Jersey, (1998).
[4] Robinowicz E., “Friction and wear of materials”, John Willey, New York, USA (1965).
[5] Suchtelen Van J., "Product properties: a new application of composite materials", Philips Res. Reports, Vol. 27, pp. 28, (1972).
[6] Ranganath S., “A Review on Particulate-reinforced titanium matrix composites”, Journal of Materials Science, Vol. 32(1), pp. 1-16, (1997).
[7] Sawyer W. G., Freudenberg K. D., Praveen B. and Schadler L. S., “A study on the friction and wear behavior of PTFE filled with alumina nanoparticles”, Wear, Vol. 254(5-6), pp. 573-580, (2003).
[8] Kim J., Kang P. H. and Nho Y.C., “Positive temperature coefficient behavior of polymer composites having a high melting temperature”, Journal of Applied Polymer Science, Vol. 92(1), pp. 394-401, (2004).
[9] Nielsen L. E. and Landel R. F., “Mechanical properties of polymers and composites”, 2nd ed. New York: Marcel Dekker, pp. 557, (1994).
[10] Bartczak Z., Argon A. S., Cohen R. E. and Weinberg M., “Toughness mechanism in semi-crystalline polymer blends: II. High-density polyethylene toughened with calcium carbonate filler particles”, Polymer, Vol. 40(9), pp. 2347-2365, (1999).

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