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Morphological Analysis of Glass/Jute/Epoxy Composite Fractured Surfaces

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ABSTRACT

Now a days, natural fiber reinforced polymer composites found applications in engineering, medical, defence and industrial fields. The application of material depends on its failure behavior under the various loading conditions. Thedecision of suitability of the composite depends on the behavior of the constituents of the composite under the application. In the present study, the morphological analysis of fractured surface of glass/jute reinforced epoxy composites were investigated using scanning electron microscopy (SEM). The failure behavior of glass/jute fiber reinforced epoxy composites under tensile, flexural and impact loading were analyzed. Scanning electronmicroscopy(SEM) images showed how glass/jute fiber breaking and debonding of fibers from epoxy is taking place. The images of glass/jute reinforced epoxy composites surface were used to analyze the suitability of fabrication process for the glass/jute fibers.

Keywords*: *Morphological Analysis, Scanning Electron Microscopy (SEM), Tensile loading, Jute fiber.

I INTRODUCTION

At present, the use of natural fiber reinforced polymer composite has widely increased for structural and non-structural purpose due to their ease of processing, comparable physical and mechanical properties to conventional materials, biodegradability and low cost. The failure behavior under tensile, flexural and impact loading affects the application area of natural fiber reinforced polymer composites. Booplan et al. [1] investigated the fractured surface of jute/banana fiber reinforced epoxy hybrid composites. The authors concluded little increase in tensile, flexural and impact properties of composite was because of poor interfacial bonding between jute/banana fiber and epoxy matrix. Chaudhary et al. [2] studied the fractured surface of jute/flax/hemp fiber reinforced epoxy composite using scanning electron microscope. The authors concluded that the failure of composite material took place due to poor adhesion between fibers and matrix, fibers debonding and due to cracking of epoxy. Braga andMsgalhes [3] analyzed the jute/glass fiber reinforced epoxy composites fractured surface. The authors showed the voids due to fiber pull out and the breaking region of jute and glass fibers. Ram and Bajpai [4] investigated the tensile fractured surface of glass/jute/epoxy composite. The authors showed the fiber breakage, voids, fiber debonding and matrix surface of developed composites. In the present work, the analysis of fractured surface of glass/epoxy and jute/epoxywas carried out using scanning electron microscope.

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II EXPERIMENTAL

Materials

Glass fibers were procured from Hindustan Tech pvt. Ltd., New Delhi, India and Jute fibers were procured from Jute N fabrics, New Delhi, India. Epoxy and hardener were procured from Shankar Dyes and Chemicals, New Delhi, India.

Composite Fabrication

Hand lay-up process was used to fabricate the glass/epoxy and jute/epoxy composites.

III MORPHOLOGICAL STUDY

The fiber-matrix interfacial properties, fracture behavior of fibers, the voids and debonding of fibers from matrix of the developed composites after tensile, flexural and impact loading were studied using JeolJsm 6610 scanning electron microscope. The fractured surfaces were cut from the composite and gold coating was done to make composite conducting.

IV RESULT AND DISCUSSION

4.1Tensile test

Figure1 shows the fractured surfaces of Jute/Glass/Epoxy composite surfaces after tensile test. The fiber pull-out, breaking of fibers and voids are shown in the images. Ramnath et al. [5] investigated morphological characteristics of abaca/jute/epoxy composite. The authors showed that the jute had better adhesion with epoxy matrix which decreased the chances of fiber breaking and pull-out of fibers. The tensile properties of the developed composites are affected by the presence of any impurity in fibers which results in poor adhesion between fiber and matrix surfaces.

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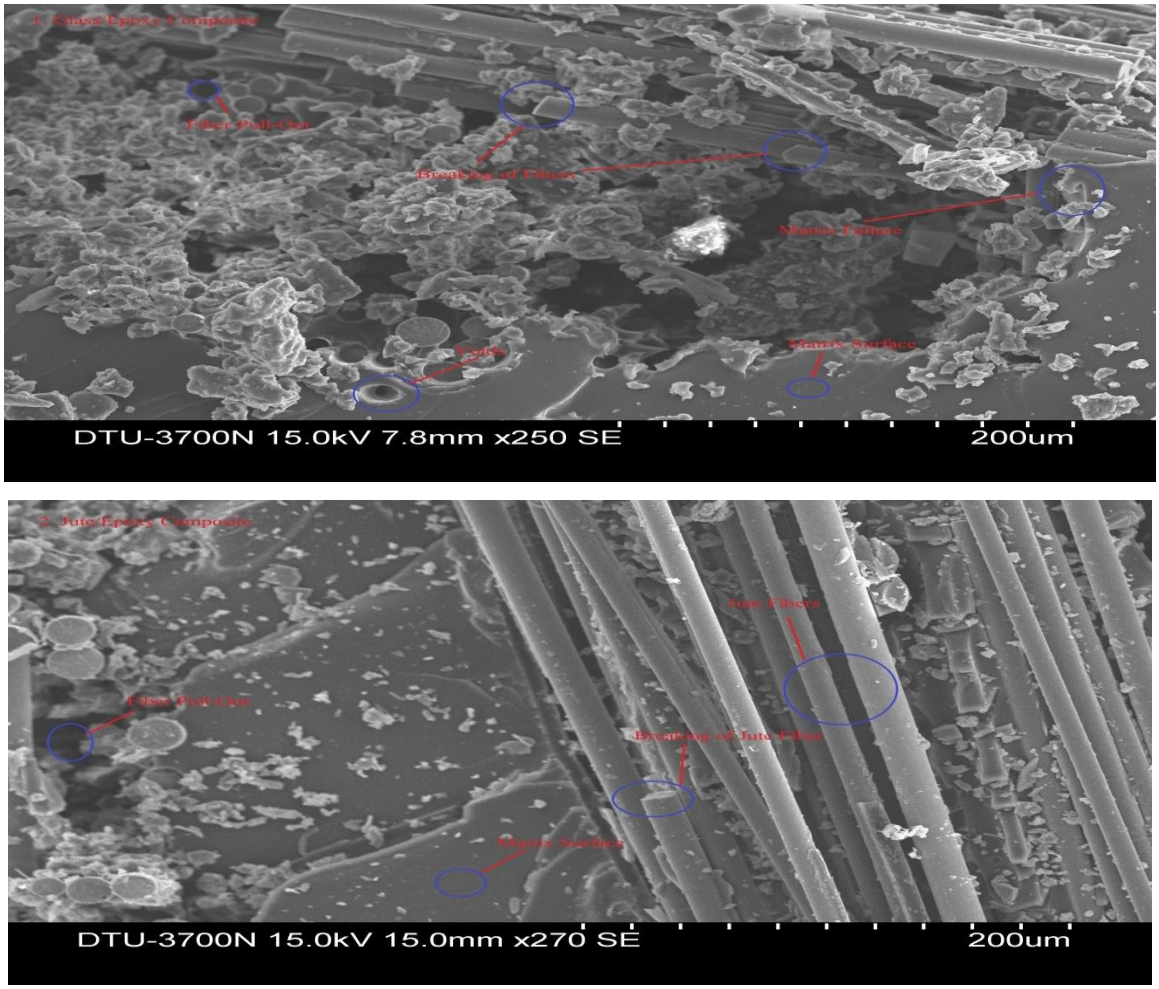

Figure1. SEM images of tensile fractured surface of Glass/Jute/Epoxy Surfaces

4.2Flexural Test

The SEM micrographs of flexural fractured composite specimen and composite surface are shown in figure 2. The composite surface shows that there is less voids on composite surface and no other impurities are present. The flexural fractured surface shows fiber breaking and pull out of fiber during three point flexural tests. Fiber provides the flexural strength to the composite and matrix holds the fibers together. If the fiber and matrix surface are not properly in contact with each other, it will result in decrease of flexural strength.

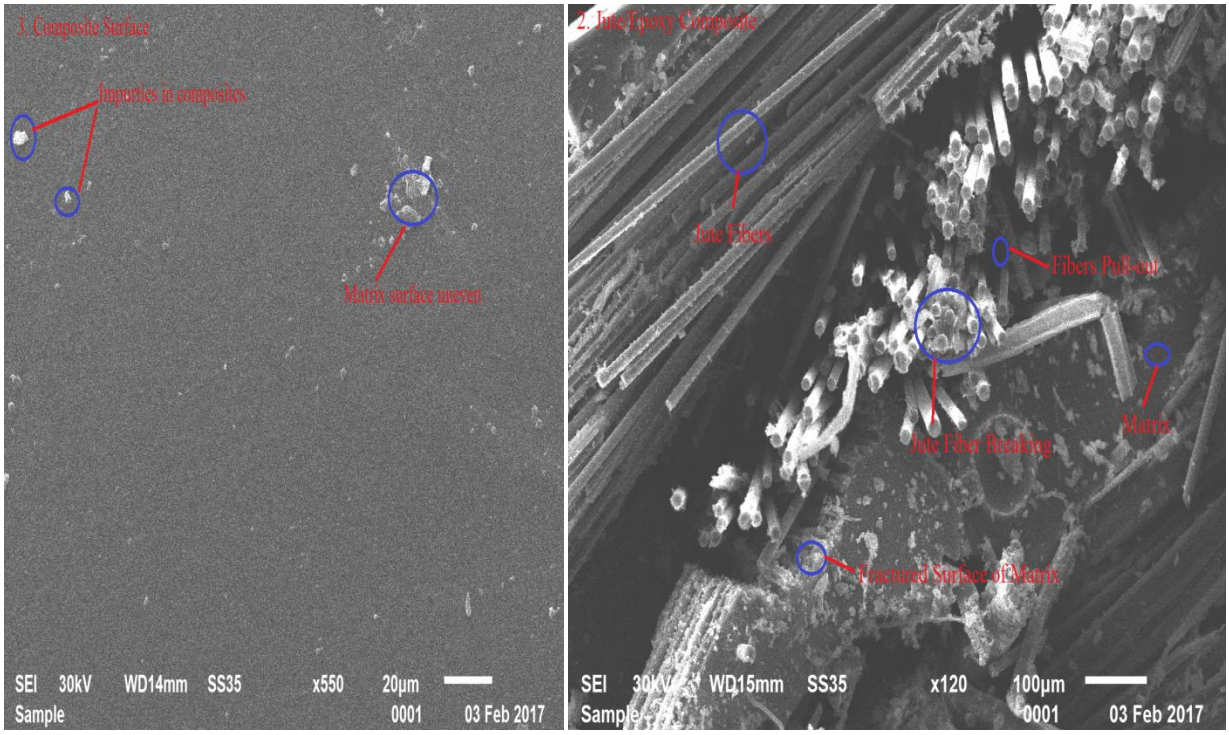

Figure2. SEM images of composite surface and flexural fractured Jute/Epoxy composite.

4.3 Impact Test

The micrographs of impact fractured surfaces of glass/jute/epoxy composites are shown in figure 3. The micrographs show the fiber breaking, fiber pull-out, fiber/matrix interface. Chaudhary et al. [6] studied the micrographs of impact fractured surfaces of jute/hemp/flax reinforced epoxy composites. The authors analyzed that fiber pull due to weaker interfacial shear strength decreased the impact strength of the developed composites.

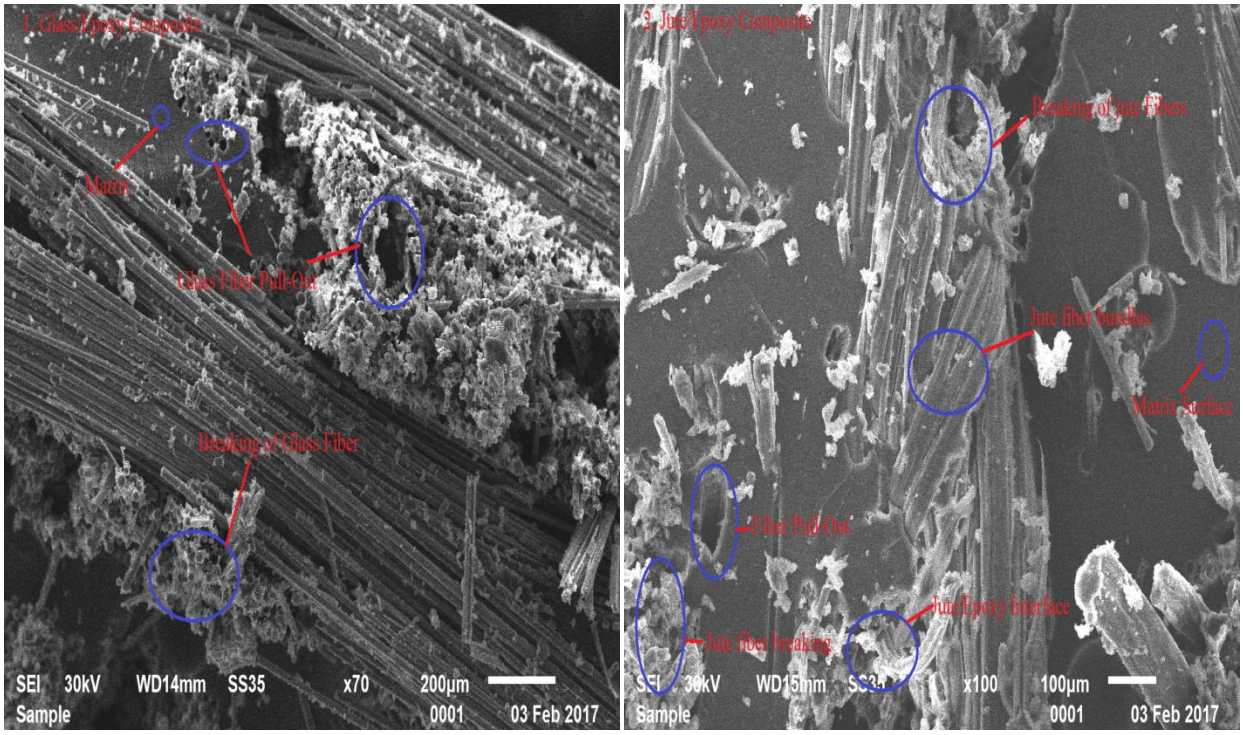

Figure3. SEM images of impact fractured glass/jute/epoxy composite.

V CONCLUSION

In this study the analysis of SEM micrographs of tensile, flexural and impact fractured composite surfaces has been carried out. The images showed the fiber breaking, fiber pull-out, matrix surface and voids present in the composites. The failure analysis plays a vital role in deciding the area of application of the developed composite. The poor fiber matrix surface adhesion and poor wet ability of fibers with matrix affects the mechanical properties of the fabricated composites.

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