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A.K. M.SRIVATAVA
Sherwood College of Engineering Research & Technology (SCERT) Barabanki U.P. India, A.K.SRIVATAVA@gmail.com

RAVI SHUKLA
Sherwood College of Engineering Research & Technology (SCERT) Barabanki U.P. India, RAVISHUKLA@gmail.com

TOOFAN SINGH
Sherwood College of Engineering Research & Technology (SCERT) Barabanki U.P. India, TOOFANSINGH@gmail.com

SANDEEP MISHRA
Sherwood College of Engineering Research & Technology (SCERT) Barabanki U.P. India, SANDEEPMISHRA@GMAIL.COM

ROHIT KANAUJIYA
Sherwood College of Engineering Research & Technology (SCERT) Barabanki U.P. India, ROHITKANAUJIYA@GMAIL.COM

TO DEVELOP AND EVALUATE IMPACT BEHAVIOR OF JUTE FIBRE REINFORCED COMPOSITE

A.K. SRIVATAVA[1], RAVI SHUKLA[2], TOOFAN SINGH[3], SANDEEP MISHRA[4], ROHIT KANAUJIYA[5]

[2,3]Graduate Student, Department of Mechanical Engineering, Sherwood College of Engineering Research & Technology (SCERT) Barabanki U.P. India
[1,4,5]Asst. Prof. Department of Mechanical Engineering, Sherwood College of Engineering Research & Technology (SCERT) Barabanki U.P. India

Abstract- The objective of this study is to investigate the impact behaviors of composites, metals and water absorption of composite. The Water absorption test is used to determine the amount of water absorbed under specified conditions .These composites (JRFC) are made of natural fibre (Jute) by volume 10% reinforcing in Epoxy (Matrix) Material. The Izod impact conditions have been considered .The result shows the specific impact energy of fibre composite is higher than the other materials.

Keywords- *Specific impact strength; Water Absorption Test; Jute Reinforced Fibre Composite (JRFC)*

I. INTRODUCTION

Composites made of conventional fibres (glass, carbon, graphite, boron, kevlar etc.) have a high cost. If made of inexpensive fibres, they will cut-down the cost of components for which they are used. Natural fibres are such materials, they are not only inexpensive, but are available in abundance also. They are light weight and they possess high specific strength and low specific weight, and are eco-friendly too. Their strength is not as high as those of synthetic fibres. Hence, natural fibre composites are likely to be a blend of lightweight and strong material [1].

The development of tough, high-strength, high-modulus fibers has led to the use of composite laminates for a number of impact-related applications, such as turbine blade containment, fuselage protection and body armor [2]. A major concern that limits the usage of composites is their susceptibility to damage due to impact loading. There are practical situations like tool drops, runway debris, bird strikes, hailstorms and ballistic loading, which induce considerable damage to the composite structures [3].

There are enormous mechanical advantages for using composite materials. Natural Fibre Composite (JFRC) illustrate the specific properties benefits of the composites structural use over traditional industrial materials. Fiber reinforced organic matrix composite materials specific-properties can double or triple the load carrying capacity over the traditional metals. This material's benefit enables structural designs that out-perform the conventional application limitations commensurately improving system performance such as reducing weight, increasing fuel efficiency or increasing speed [4]. Composite materials have been increasingly introduced in airframe and spatial applications in the last decade because of their interesting characteristics, like their low specific weight, enhanced mechanical strength, high stiffness,etc. Nevertheless, during the structure's life,damage induced in these materials by impacts ofminor and major objects like hail stones, runway debris or dropping toolscan drastically decrease the structure's life [5]. In recent years, natural fibre composites have received an increasing attention from the scientificcommunity in the light of the growing environmental awareness. Natural fibres are renewable, biodegradable and low cost resources. Natural fibres based on cellulose, because of their relative low density, can compete with glass fibres with respect to specific strength and stiffness.

Table 1.Specific tensile properties of different natural fibers and of glass fiber for comparision.

Properties	Hemp	Jute	Sisal	Flax	E-glass
Density (g/cm^3)	1.48	1.46	1.33	1.4	2.55
Specific Stiffiness (GPa. cm^3/g)	47	7-21	29	43-57	29
Specific tensile strength (MPa. cm^3/g)	370-610	275-550	450-525	570-1070	941

Depending on their origin, natural plant fibres can be grouped into bast, leaf and seed fibres. Bast- (hemp, jute, flax) and leaf- (sisal) quality fibres are the most commonly used in composite applications. The mechanical properties of plant fibres depend on different factors: the cellulose content, the degree of crystallization, the porosity, themicro-fibril angle, the conditions of growth (weather, geographical region) and finally the processing method. Table 1 presents the specific tensile properties of different natural fibres and of glass fibres for comparison [6].

Composites are materials of choice for light-weight structures due to their excellent weight/ strength and weight/stiffness properties. Composite structures may be subjected to low-velocity impacts. Under the dynamicloading of the material, these unseen damages can become larger and even cause the loss of the material.Because of this, on a layered composite build, foreseeing the damage caused by the impact is very important on design and usage [7].

Engineering structural components made up of composites materials are increasing in use in the sporting goods industry, aerospace, automobile, offshore structures and in marine and civil engineering applications. Low velocity impact is one of the most subtle threats to composite materials in aeronautics: owing to the weak bonds between the plies, even small energies imparted by out-of plane loads can result in hardly detectable damages, causing considerable strength losses in tension and especially in compression. Therefore the problem of low velocity impact of laminated composite materials has received much attention in recent years [8].

Materials and Experiments

Natural fibre-reinforced epoxy resin composites were moulded by the hand lay-up technique using naturally available Jute fibre and a matrix comprising AY-105 epoxy resin and HY-951 hardener.The Ratio of epoxy and hardener is100:80 as per manufactures. Volume fraction of fibre in laminates was about 10%.

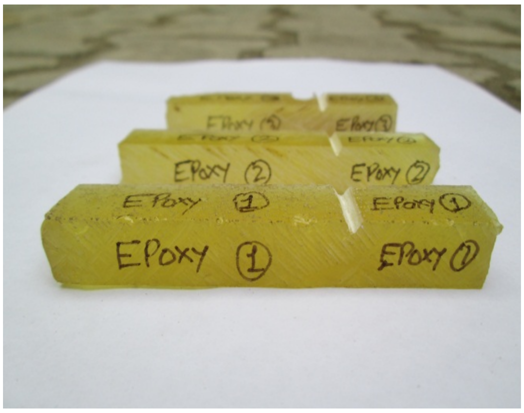
Figure 1. Composite Material Sheet.

"Fig.1", shows the composite sheet used for this study. Notched Izod impact specimens were cut from the composite sheet. The dimensions of Izod impact test specimen are 75mm×10mm×10mm as per ASTM standards D 256.

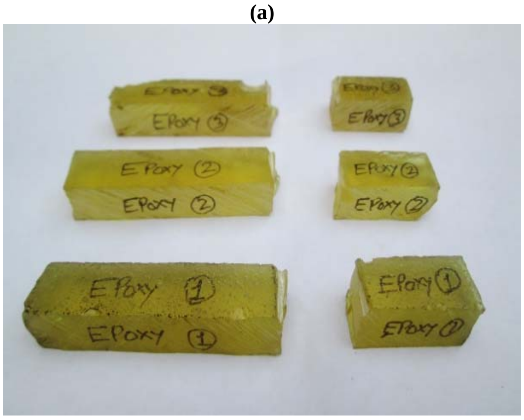
(a)

(b)

Figure 2 (a) JRFC Notched Specimen before impact, (b) Specimen after impact



(a)



(b)

Figure 3 (a) Epoxy Notched Specimen before impact, (b) Specimen after impact

The depth of V-notch is introduced 2 mm in Izod impact test specimens, as shown in Fig.2(a),Fig.3(a),Fig.4(a). The impact test was performed with instrumented Izod equipment .The impact hammer and vice lever with specimen adapter were used in Izod impact tests.

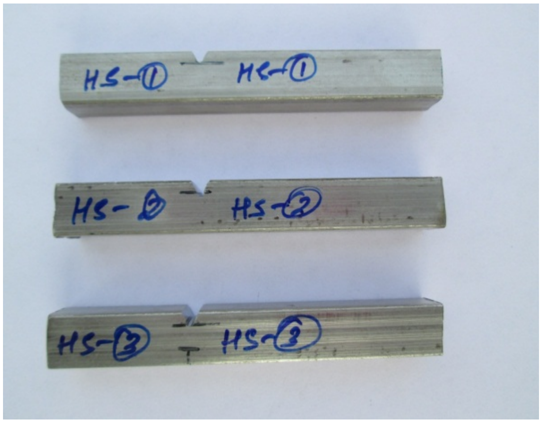
Water Absorption Test.

Water absorption is used to determine the amount of water absorbed under specified conditions. Factors affecting water absorption include: type of plastic, additives used, temperature and length of exposure. Water absorption tests were conducted by immersing specimens in a distilled water bath at 25 °C for different time durations.

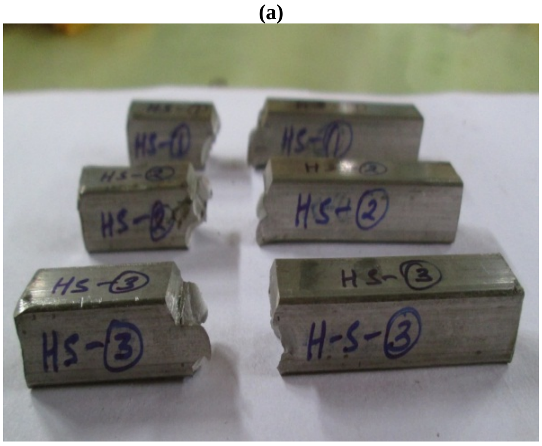
Testing Procedure

A square test piece of dimension (40mm×40mm×10mm) was dipped in a glass beaker(500ml) containing water 250ml for 48 hrs. Initial weight of the specimen was 20 g measured by the weighing balance (manufactured by Ohaus) whose least count is 0.01g.

The weight of the specimen was measured at a time interval of 4 hrs till 48 hrs. the specimen absorbed water only upto 24 hrs. The specimen weight increased upto 0.70g in 24 hrs only and after that the specimen weight shows that there is no increase in weight that is specimen weight is constant.



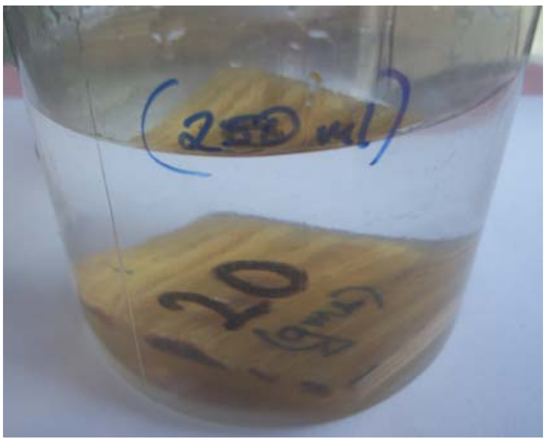
(a)



(b)

Figure 4 (a) Steel Notched Specimen before impact, (b) Specimen after impact

(a)



(b)

(c)

Figure 5 (a) Specimen for water absorption test before being dipped in water (b) Specimen dipped in water. c) Specimen after being taken out from water.

RESULTS AND DISCUSSION

Low energy impact tests were conducted to investigate the impact behaviours of composite structures. Izod impact tests were used and impact energies were considered. Three specimens were tested in each category. The average values of impact test results of composite , epoxy and steel specimen are presented for comparison. The energy absorption behavior under low velocity impact testing is shown in Fig.6.The water absorption graph as shown in figure 7 shows that the specimen absorbed water only upto 24 hours and after that the specimen weight is constant.

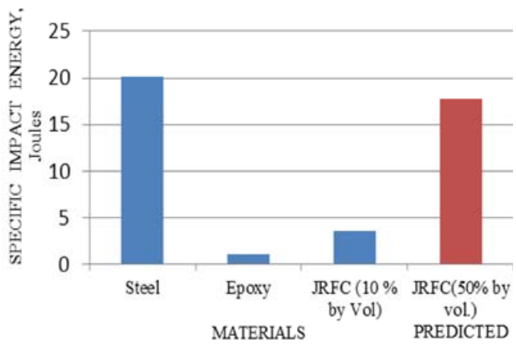


Figure 6 .Impact behavior of composite structure.

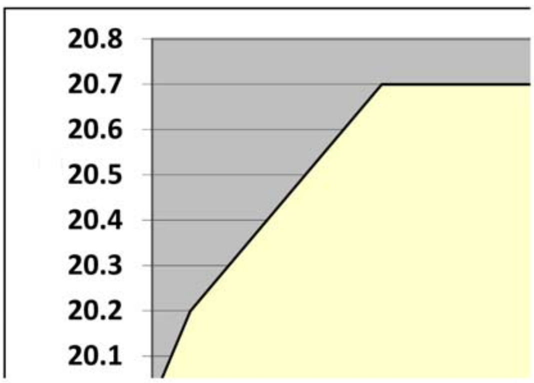


Figure 7. Water Absorption Test

CONCLUSION

An investigation has been conducted to study the effect of impact test on Composite , Epoxy and Steel specimen .Significant variation in energy absorption was found under Izod Impact conditions and the water absorption test shows that the percentage of moisture uptake increased as the fibre volume fraction increased due to the high cellulose content.

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