ISSN : 0974 - 7486 Volume 7 Issue 6

Trade Science Inc.

Materials Science

An Indian Journal

Full Paper

MSAIJ, 7(6), 2011 [391-394]

Heat capacity of sisal / glass fibre reinforced hybrid composites

V.Naga Prasad Naidu[1], G.Ramachandra Reddy[2], M.Ashok Kumar[*3], G.Harinatha Reddy[2]

[1]Department of Mechanical Engineering, Moula Ali College of Engineering & Technology, Gotkur, Kuderu-Mdl, Anantapur 515711, (INDIA)

[2]Dept of Polymer Science & Technology, Sri Krishnadevaraya University, Anantapur (INDIA)

[3]Department of Mechanical Engineering, Sri Krishnadevaraya University College of Engineering & Technology, Anantapur 515055, Andhra Pradesh, (INDIA)

E-mail : ashokkumarmala7@hotmail.com

Received: 10th May, 2011 ; Accepted: 10th June, 2011

ABSTRACT

Recently attempts have been made by several researchers in order to develop biodegradable composites. In the present work hybrid composites of unsaturated polyester based sisal/glass fibre hybrid composites were prepared. The sisal is a natural fibre which is also biodegradable and glass fibre is a synthetic fibre. These two natural and synthetic fibres are combined in the same matrix (unsaturated polyester) to make sisal/glass fibre hybrid composites and the heat capacity of these hybrid composites was studied. A significant improvement in heat capacity of sisal/glass fibre hybrid composites has been found. The chalk powder (additive) is also added to the resin (unsaturated polyester) in proportions of 1%,2%,3% by weight of resin respectively and sisal/glass fibre hybrid composites were prepared by using this resin to study the effect of chalk powder on heat capacity of these hybrid composites. It is also observed that as the chalk powder quantity increases the heat capacity also increases.

KEYWORDS

Hybrid composite;
Unsaturated polyester;
Sisal fibre;
Glass fibre;
Heat capacity.

INTRODUCTION

The polymers such as plastics, polyester and epoxy resins are widely used for making coatings and structures in the civil, chemical and consumer industries. This is because of their corrosion resistance, light weight, good mouldability, and transparent, excellent surface finish and economical, which make them suitable for the manufacture of tanks, pipe lines, bottles, bags etc…. However they are not suitable for reactors and structural parts as their mechanical and thermal properties are low. The mechanical and thermal properties of polymers can be improved by modifying and producing polymer composites. Many polymer composites are composed of just two phases one is termed as matrix phase, which is continuous and surrounds the other phase often called the dispersed phase[1-4]. The matrix phase binds the fibres together and acts as medium by which an externally applied stress is transmitted and distributed to the fibres. Only a very small portion of an applied load is sustained by the matrix phase and major portion is sustained by the fibers. The fibres

are basically two types viz., natural and synthetic fibres. cotton, jute and sisal are some examples for natural fibres and glass, nylon and carbon are some examples for synthetic fibres. The natural fibres are renewable[5] and cheaper but their mechanical properties are much lower than the synthetic fibres. The synthetic fibres exhibit good mechanical properties but they are costlier and non renewable[6]. Many researchers developed natural fibre reinforced composites and studied their mechanical properties[7-10]. In present work to take advantage of both natural and synthetic fibres, they can be combined in the same matrix to produce hybrid composite and their heat capacity is studied[11].

In the present work authors were focused on the same composite with different filler called chalk powder (additive) was an added to the resin (unsaturated polyester) in proportions of 1%, 2%, 3% by weight of resin respectively and sisal/glass fibre hybrid composites were prepared by using this resin[12], The effect of chalk powder, which is added to the matrix is also studied.

MATERIALS USED FOR MAKING HYBRID COMPOSITES

Sisal (Agaves Veracruz) short fibre (2cm long) obtained from local sources and the chopped strand mat of short glass fibre (2cm long)[13] were used for present work. The unsaturated polyester resin obtained from Allied Marketing co, Secunderabad, A.P, India, Methyl Ethyl Ketone Peroxide as accelerator and Cobalt Naphthenate as catalyst, which are obtained from M/S Bakelite Hylam Hyderabad, A.P, India, were used. The chalk powder is used as additive for present work.

PREPARATION OF COMPOSITES

In present work the composites were prepared by hand lay-up technique. The matrix of unsaturated polyester and monomer of styrene are mixed in the ratio of 100:25 parts by weight respectively. Later the additive chalk power is mixed thoroughly and then the accelerator of methyl ethyl ketene peroxide 1% by weight and catalyst of cobalt naphthenate of 1% by weight were added to the mixture and mixed thoroughly. The releasing agent of silicon is sprayed to glass mould and the matrix mixture is poured in to the mould. The fibre is added to matrix mixture, which was poured in the glass mould. The excess resign was removed from the mould and glass plate was placed on the top the casting were allowed to cure for 24hrs at room temperature and then casting is placed at a temperature of 80°C for 4 hrs. The composite were released from mould and are cut to prepare test specimens.

EXPERIMENTAL PROCEDURE

The heat capacity apparatus is designed to determine the heat capacity of the solids like metals, alloys and polymeric materials. The materials of which the heat capacity to be determined should be cut into test specimen. The specimen is a cylindrical shape of 6mm diameter and 30mm long with 1mm diameter and 3mm depth hole at one end along axis. The specimen is kept inside the silver calorimeter and its temperature is detected by using an Iron – consant Uni-junction thermo couple which is inserted into specimen hole.

The heater leads of silver calorimeter are connected to the terminals and as current of 300 MA are supplied. Suppose the heat capacity of material to be determined at a temperature of T^0C (say 40^0C),the time required to heat the specimen from $T-2.5^0C$ to $T+2.5^0C$ is measured by using stop watch and heat capacity is determined by using following relation.

$$I^2R\,t = (w+m.S)\,(T_2-T_1)$$

Where I=current flowing through calorimeter heater in mA

R=Resistance of hater in ohms

t=time required to heat the specimen form T_1 to T_2 in seconds.

T_1 and $T_{2=}$ initial and final temperatures in ^0C

m=mass of sample in Kg

w=water equivalent of calorimeter (Determined using standard specimen)

S=Specific heat of the sample at temperature T^0C J/Kg ^ok.

RESULTS & DISCUSSIONS

Heat capacity of sisal / glass fibre hybrid composites

The heat capacity of sisal / glass fibre hybrid com-

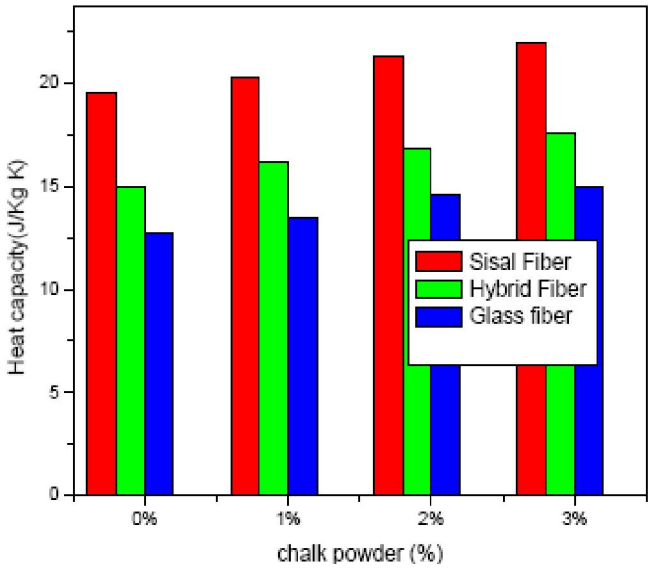

Figure 1 : Effects of Fiber Contents on Sisal/Glass Fiber Hybrid Composites.

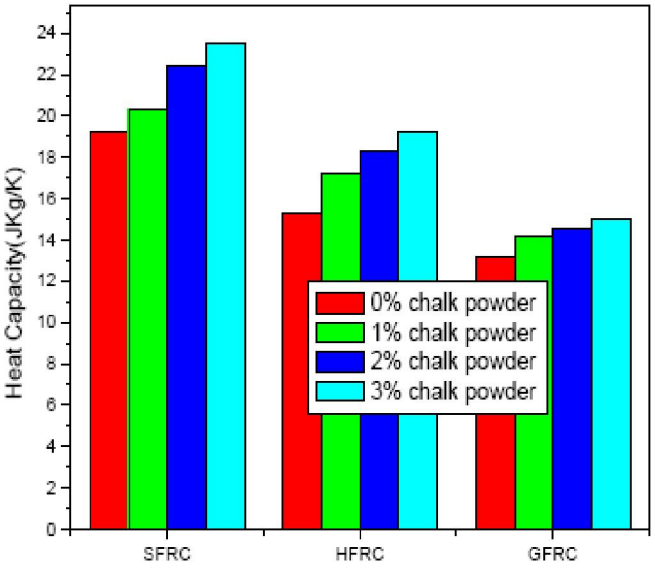

Figure 2 : Effect of Chalk Powder on Sisal/Glass Fiber Hybrid Composites.

TABLE 1 : Heat capacity test results as a function of chalk powder for three differently reinforced composites.

Chalk powder	Heat Capacity J/Kg°K		
	Sisal fiber	Hybrid fiber	Glass fiber
0%	19.5	14.95	12.7
1%	20.2	16.2	13.5
2%	21.3	16.8	14.6
3%	21.9	17.6	15.0

posites is presented in TABLE-1. It is observed that the sisal fibre composite is exhibiting higher heat capacity than the glass fibre reinforced composite. The sisal / glass fibre hybrid composite heat capacity is higher

TABLE 2 : Heat capacity test results for with four differently reinforced chalk powder composites.

Fibre	Heat Capacity J/Kg°K Chalk Powder % By Weight of Resin			
	0%	1%	2%	3%
Sisal Fibre	19.5	20.2	21.3	21.9
Hybrid	14.95	16.2	16.8	17.6
Glass Fibre	12.7	13.5	14.2	15.0

than glass fibre reinforced composite but lower than sisal fibre reinforced composite. The increase in heat capacity of hybrid composite is because of sisal fibre content. The effect of fibre content on sisal / glass fibre reinforced hybrid composites is shown in Figure 1 and the effect of chalk powder on heat capacity of sisal / glass fibre hybrid composite is shown Figure 2. It is observed that the composite without addition of chalk powder is exhibiting low heat capacity. It is also observed that as the quantity of chalk powder in the composite increases, the heat capacity also increases.

CONCLUSIONS

The heat capacity of unsaturated polyester based sisal/ glass hybrid composite has been studied as a function of fibre content. It is observed that the heat capacity of sisal/glass fibre hybrid component is higher than glass fibre reinforced composite, but lower than the sisal reinforced composite. The effect of chalk powder on heat capacity of sisal/glass fibre hybrid composite has also been studied and it is observed that as the chalk powder quantity by weight of resin increases, then the heat capacity also increases. The heat capacity of a material depends on the mass of material, its chemical composition, thermodynamic state and type of process employed to transfer of heat.

ACCKNOWLEDGEMENTS

Author would like to thank for Department of Polymer Sci and Technology, S.K. University, Anantapur, for laboratory and equipments.

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