Preparation of Eco-Friendly Natural Hair Fiber Reinforced Polymeric Composite (FRPC) Material by Using Of Polypropylene and Fly Ash: A Review

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Abstract:

The strict environmental regulations and economical purpose recycling of saloon waste hair the use of alternative Eco-friendly Natural reinforcements to produce advanced composite materials. To perform studies of natural hair fiber reinforcement polymeric Composite (FRP) with using of polypropylene and thermal wastes that is fly ash which is generated in huge quantities from various industries.

The large quantities of human & animals hair fiber are not always well managed or utilized. Three to four ton of human hair fiber wasted in India annually. These fibers pose an environmental challenge In order to find commercial application the wasted human hair fiber mixed with fly ash and polypropylene in resulting form of reinforced polymeric composite material.

 Human hair fibers are mixed into Polypropylene (PP) at 3,5,10 and 15 % by wt. using two roll mills or mixer grinder. The composite are compression molded at specific time and temperature. Polypropylene, fly ash and hair fiber polymer reinforced composite have better flexural and impact strength than PP (Polypropylene) and lower the tensile strength of polypropylene and hair fiber polymer reinforced composite than PP (Polypropylene), these saloon hair waste can be recycled in the form of hair fiber reinforced polymeric composite. This way the hair fiber reinforced polymeric composite are made a 'greener' material they are renewable, cheap, completely or partially recyclable and biodegradable.

These composites are having low density and cost as well as satisfactory mechanical properties make them an attractive due to easy availability and renewability of raw materials. Natural fibers have been proven alternative to synthetic fiber in transportation such as automobiles, railway coaches and aerospace. Other applications include military, building, packaging, consumer products and construction industries for ceiling paneling, partition boardsailing.

There is the saloon wastes of hair can be re-utilized, avoiding otherwise wasteful landfill & harmful open incineration. The aim of present study is to investigate the strength & water absorption of hair fiber polymeric composite made of fly ash. The hair fibers were replaced within the range of 0.2-0.8% by weight of fly ash.

Key Words- Compounding, Compression moulding, Flexural modulus, Fly Ash, Hair Fiber, Polypropylene, Reinforced Polymeric Composite, Tensile Strength.

1 INTRODUCTION

Composite are combination of two or more than two materials in which one of the material, is matrix phase (polymer, metal or ceramic) that is continuous phase and other is reinforcement phase (hair fiber, glass, graphite, and alumina etc.) that may be continuous or discontinuous phase. Composite materials are formed at interface phase zone where matrix phase and reinforcing phase combined to each other.

A natural hair fiber reinforced polymeric composite (FRP) is prepare & design for a specific life span, depending on its Physical and mechanical properties, its purpose for a public building construction and for defense application, making floor carpets, etc.

Deterioration in concrete structure is a major challenge faced by the infrastructure and bridge industries Worldwide. The deterioration can be mainly due to environmental effects, which include corrosion of steel, gradual loss of strength with aging, repeated high intensity loading, variation in temperature, freeze-thaw cycles, contact with chemicals and saline water and exposure to ultraviolet radiations, and also deterioration due to exposure to an aggressive environment and accident events such as earthquakes.

 Why Hair as a Fiber?
It has a high tensile strength which is equal to that of a copper wire with similar diameter.
Hair, a non-degradable matter is creating an environmental problem so its use as a fiber reinforcing material can minimize the problem and It is available in abundance and also at a very low cost.

The hair fiber which is made of mainly keratin protein with primarily alpha-helix structure. Approximately 91%of the hair is protein made up of long chain of amino acid .the long chain linked by peptide bond .The average composition of normal hair is composed of 45.68% carbon ,27.9% oxygen, 6.6% hydrogen ,15.72% nitrogen and 5.03% sulphur .Amino acid present in hair contain cytosine , serine, glutamine, threonine , glycine ,leucine, valine ,arginine. Natural fibers, as actual and potential reinforcement composites, offer many advantages: good strength properties, low cost, high toughness, biodegradability, however, in the case of cellulose fiber some disadvantages due to their intrinsic characteristic, incompatibility with hydrophobic polymer matrix, tendency to form aggregates during processing and poor resistance to moisture, finite length and large diameter, pose an important challenge of their use in advanced composite.

In this paper, human hair fibers are incorporated in to polypropylene at content of 0.5%, 1.0%, 1.5%, 2.0% and 2.5% by weight of fly ash. The composite are mixed in a two roll mill. Following mixing tensile bars are prepared by compression molding at temperature 180 C-190 C over time period 0-10 min in each case virgin Polypropylene is prepared in the same manner.

2 EXPERIMENTAL WORK

2.1 Materials: - polypropylene homopolymer (PP) (Density 0.903 g/cc), human hair (Density 1.32 g/cc, and varying length (4–40 mm) and diameter (40–111µm)), and fly ash (particles of size less than 45 microns).

The main constituents of fly ash is - Silicon dioxide (SiO2), Magnesium oxide (MgO), Sulphur trioxide (SO3), Calcium Oxide (Cao), Aluminum Oxide (Al2O3), Ferric Oxide (Fe2O3).and the main constituents of hair fiber is-45.68% carbon ,27.9% oxygen, 6.6% hydrogen ,15.72% nitrogen and 5.03% sulphur, so these both types of constituents are responsible for flexural strength of composite material.

2.2 Compounding: The polypropylene are mixed into Human hair fiber at content of 0.5%, 1.0%, 1.5%, 2.0% and 2.5% by weight of fly ash using two roll mill and the compounding temperature is 190 C.

2.3 Specimen preparation: The mould samples for testing were compression moulded using compression moulding at 190 C and 60mpa for 10 min. After pressing the sheet are removed from the press and cooled by water.

2.4 Compression Moulding-:

Compression moulding describes the process whereby a stack of pre-impregnated layers are compressed between a set matched dies using a powerful press, and then cured while under compression. This method is often used to manufacture small quantities of high-quality components such as crash helmets and bicycle frames.

Due to the use of matched dies, the dimensional tolerances and mechanical properties of the finished component are extremely consistent. However, the requirement to trim the component after curing and the need for a large press means that this method is extremely expensive. Also, it is very difficult to make components where the plies drop off consistently within the component.

Scanning Electron Microscope analysis was conducted to obtain the average diameter of human fiber. The parameter of concern in fiber selection was fiber content by weight of Fly ash Samples were prepared by adding fiber.

"Fig."1: Human hair fibres.
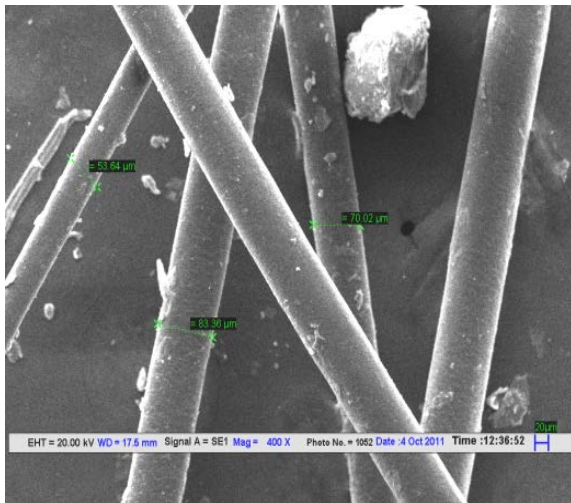
" Fig." 2: SEM Image of Human hair fibres

3 CHARACTERIZATION TECHNIQUES

3.1 Mechanical properties: The test specimen analyzing the Mechanical properties was initially conditioned at 23+20 C and 50+ 5%RH (relative humidity) for 24 hr for testing.

3.2 Tensile strength: Tensile properties were evaluated to ASTM D638 using dumbbell shaped samples and an INSTRON Universal testing machine model 3342 tensile tester with a cross head speed 5mm/min.

3.3 Flexural modulus: flexural properties are evaluated according to ASTM D790 using an INSTRON universal testing machine model 3342 with a cross head speed of 1.3 mm/min .the dimension of the specimen were 127mm in length,12.7mm in width and 3mm thickness.

4 RESULT AND DISCUSSION

The mechanical properties such as impact strength flexural strength and flexural modulus and tensile strength and elongation at break, mm of the human hair fiber fly ash and PP composite increase with the increase in fiber loading from 3 to 5wt% and then the value are decrease at 10 to 15wt%. The increase was more in composite because of improved interfacial adhesion between the matrix and the

fiber. The overall performance of any fiber – reinforced polymer composite depend to a large extent upon the fiber – matrix interface which in turn is governed by the surface topography of the fiber and by the chemical compatibility of fiber surface and resin properties.

Poly(propylene) with human hair fiber and fly ash resulting in an improved interfacial adhesion between the matrix and the fiber. This improved interfacial adhesion allows a more efficient transfer of stress along the fiber matrix interface .the liner increase with increase in fiber volume is due to availability of more fiber for increased stress transfer. The decrease in mechanical properties at higher volume fraction of fiber loading is due to the increase in fiber- fiber interaction, the fiber not being perfectly aligned with matrix and poor dispersion of fiber in the matrix more over higher void content (which might be due to the presence of moisture in trace amount) and low interfacial strength resulted in a lower efficiency of load transfer with increase fiber loading.

5 CONCLUSION

In this paper, it is shown that human hair fiber act to reinforce the polypropylene (PP) polymer matrix. Composite with 3 to 5wt% of bio fiber shows higher flexural strength, flexural modulus and than non-reinforced polymer but at 10 to 15 wt% lower the flexural strength, flexural modulus than the non-reinforced polymer. The tensile strength of the reinforced composites lower than non- reinforced composite.

The tensile and flexural properties decrease when the fiber loading percentage increases. Utilizing whole fiber not only provided good properties but will also eliminate the need for processing the fiber leading to lower costs and superior characteristics. The tensile properties can be enhanced with the increasing percentage of the human hair fiber and also with different resin. Another way to enhance the composite properties is to determine an effective treatment to eliminate lack of adhesion between matrix and fiber.

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