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NON-UNIFORM PILED UP HUMAN HAIR AND SISAL FIBERS EPOXY COMPOSITES: DISTILLED AND SEA WATER ABSORPTION TEST

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Abstract: The research work deals with the effect of moisture absorption and thickness swelling on single and double layer human hair and sisal fiber. The specimens were prepared by untreated and treated fibers. The human hair and sisal fiber epoxy composite were produced by hand-lay-up method. The specimens were immersed in the distilled water for various time intervals at room temperature to study the moisture absorption effect and thickness swelling. At different interval the absorption of water showed gradual increment. In this experiment it is concluded that the effect of moisture absorption and thickness swelling is higher in single layer (untreated) and double layer (untreated) composites.

Keywords: Human hair, Sisal fiber, Epoxy, Hand-lay-up method, Moisture absorption, Thickness swelling.

1. Introduction.

Hemp fiber fortified unsaturated polyester composites (HFRUPE) were exposed to water drenching tests so as to consider the impacts of water ingestion on the mechanical properties. HFRUPE composites examples containing 0, 0.10, 0.15, 0.21 and 0.26 fiber volume portion were readied. Water ingestion tests were led by inundating examples in a de-ionized water shower at 25 °C and 100 °C for various time terms. The ductile and flexural properties of water drenched examples exposed to both maturing conditions were assessed and looked at close by dry composite examples. The level of dampness take-up expanded as the fiber volume division expanded because of the high cellulose content. The pliable and flexural properties of HFRUPE examples were found to diminish with increment in rate dampness take-up. Dampness actuated corruption of composite examples was huge at raisedtemperature.[1].

The rising worry towards ecological issues other than the requirement for more adaptable polymer-based materials has prompted expanding of enthusiasm for learning about the polymer composites loaded up with characteristic natural fillers, which are originating from inexhaustible sources. Be that as it may, the connections between polymeric materials and the natural fillers are not sufficient, by alluding to mechanical properties. The composite's water ingestion was additionally tried. As the outcome, the silane treatment helps expanding the mechanical properties and diminishing the level of water ingestion of the composites[2]. Reused cellulose fiber (RCF) strengthened epoxy composites were created with fiber loadings of 19, 28, 40 and 46 wt%. Results demonstrated that flexural quality, flexural modulus, break sturdiness and effect quality expanded as the fiber content expanded. A definitive mechanical properties were accomplished with a fiber substance of 46 wt%. The impact of water assimilation on mechanical and physical properties of RCF/epoxy composites was explored. The estimations of most extreme water take-up and dispersion coefficient were found to increment with an expansion in fiber content. Flexural quality, modulus and break strength diminished because of dampness ingestion. Notwithstanding, the effect quality was found to increment somewhat after water assimilation. XRD, FTIR and SEM examines were done to assess the organization and microstructure of RCF and RCF/epoxy composites[3]. Glass fiber strengthened unsaturated polyester overlays were created by utilizing the VARI (vacuum helped sap implantation) strategy. The tractable and bowing quality of the seawater treated examples demonstrated a diminished pattern with delayed treating time suggesting the debasement of the composites. The SEM photo of the wrecked area after the treatment represented genuine consumption of the interface[4]. This article presents the surface adjustment of sisal (Agave sisalana) filaments by alkalization to adjust mechanical restrictions of regular strands fortified polymer composites related with helpless fiber-polymer grid similarity. Upon surface treatment, the filaments were surface covered with polyaniline through in situ oxidative polymerization to additional improve protection from water ingestion by presenting hydrophobic polymer spine. In light of the outcomes from spectroscopic and minuscule investigations, surface adjustment through alkalization is a powerful way to deal with eliminate lignin and hemicellulose from the outside of sisal strands. It likewise upgraded fiber-polymer lattice similarity guaranteed by a huge expansion in rigidity. Polyaniline affidavit on the outside of sisal strands was effective to acquaint hydrophobic polymer spine with the framework to improve protection from water assimilation, subsequently expanding elasticity altogether[5]. Water retention limits the mechanical exhibition of common fiber strengthened framework polymer. This paper plans to investigate the impact of water retention on the various kinds of regular woven fiber fortified with polyester tar. The water absorption and thickness growing investigation were performed by a drenched composite example in the refined water for 30 days. The aftereffect of the malleable properties uncovers that the layering size has more impact than the layering arrangements. The flexural properties are probably going to be influenced by the kind of texture manufactured on the top. The aftereffects of the Charpy sway test show that there is perhaps less variety for the worth paying little mind to the layering sequence and the layering size. The water retention drops the rigidity around 12–27% and elastic modulus for 15–35% on the 30th day. The outcome shows that the opposition toward water ingestion improved altogether toward hybridization[6]. Ecological discernment today empowers experimentation worldwide on the learning of plant or regular fiber strengthened polymer composite and cost productive option in contrast to manufactured fiber fortified composites. The availability to normal filaments and straightforwardness in assembling have convinced scientists to focus on locally existing ease strands and to explore their chance of fortification intensions and up how much they can fulfill the basic enumerating of prevalent strengthened polymer composite expected for various application program. Composite materials have gotten one of the quickest developing innovative work regions of Material Science in view of their high potential. In current years there is quick development in the field of strands, lattice, materials, preparing, limit structure, holding and their qualities on the last properties of composites. The mechanical advancements in composite materials help in fulfilling the worldwide modern need for materials with improved execution capacities. Keeping this in see the current work has been under taken to build up a polymer lattice composite (epoxy sap) utilizing Luffa Cylindrica fiber and to examine its dampness ingestion conduct and mechanical properties. The composite are set up with various volume portion (number of layers) of Luffa Cylindrica fiber[7]. The water sorption attributes of banana fiber–strengthened polyester composites were concentrated by inundation in refined water at 28, 50, 70, and 90°C. The impact of hybridization with glass fiber and the synthetic alteration of the fiber on the water retention properties of the readied composites were additionally assessed. On account of cross breed composites, water take-up diminished with increment of glass fiber content At long last, boundaries like dissemination, sorption, and porousness coefficients were resolved. It was seen that harmony water take-up is reliant on the idea of the composite and temperature[8]. This paper manages the impact of dampness assimilation on single coconut sheath fiber and single glass fiber. Furthermore, the dampness impact in fiber strengthened unsaturated polyester composites like coconut sheath (CS) and Glass tangle (GM) composite. At various time spans, the assimilation of water demonstrated steady augmentation. The impact of water gain in rate for CS and GM was watched. From this trial, it is reasoned that the impact of water gain in CS/UPR composite is higher than GM/UPR composite [9]. Characteristic filaments (Sisal and Coconut coir) strengthened Epoxy composites were exposed to water inundation tests so as to consider the impacts of water retention on the mechanical properties. Normal filaments like coconut coir (short strands) and sisal strands (long strands) were utilized in half and half mix and the fiber weight division of 20%, 30% and 40% were utilized for the manufacture of the composite. The pliable and flexural properties of Natural fiber fortified Epoxy composite examples were found to diminish with increment in rate dampness take-up. Dampness incited corruption of composite examples was seen at raised temperature. The water retention example of these composites at room temperature was found to follow Fickian conduct, while the water ingestion properties at higher temperature didn't observe Fick's law[10]. Long coir strands will in general have higher quality than short coir filaments. Thinking about this non uniform long coir filaments strengthened epoxy composites impregnated with sawdust filler was manufactured utilizing hand-layup procedure because of polymer decrease. Dampness assimilation test was led according to ASTM D 570 norm. Accumulated coir filaments offer shifting opposition against entrance of epoxy polymer framework through the strands bringing about Nonuniform holding all through the composite cover. Water retention example of composites showed Fickian conduct at room temperature (27ºC). Dampness retention test in ocean water and refined water at room temperature indicated higher estimation of dampness ingestion rate and dissemination coefficient because of feeble holding among fiber and network making fiber assimilate more measure of water. Composite examples were shot to dissect the perceptible deformities during creation, machining and water inundation[11].

2. Materials and Methods.

2.1 Matrix

Epoxy is a thermosetting polymer that fixes (polymerizes and cross connections) when blended in with a hardener. Epoxy resin with a density of 1.1–1.5 g/cm3 was utilized. The matix material was set up with a combination of epoxy and hardener at a proportion of 2:1.

2.2 Fibers

The fibers used for fabrication of the composites are Human hair(short fibers) and Sisal fibers(long fibers).

2.3 Human-Hair

Keratin is a protein which is the principle substance to frame hair and it is having more substance of sulfur. The actual properties of human hair are versatility, perfection and delicateness. Hair is more grounded and the primary liable for this is Cortex keratin and to shape a customary structure its long chains are compacted, and it is additionally is flexible. Human hair has been utilized for fortifying earth based developments due to its high elasticity and erosion coefficient. Quality of hair-fortified concrete and fly debris concrete is exceptionally helpful in high weight bearing structures, for example, oil wells and scaffolds.

2.4 Sisal Fibers

Sisal is a characteristic fiber (Scientific name is Agave sisalana) of Agavaceae (Agave) family yields a solid fiber customarily utilized in making twine and rope. Sisal is completely biodegradable and profoundly inexhaustible asset of energy. Sisal fiber is incredibly solid and a low upkeep with insignificant mileage. Sisal fiber is extricated by a cycle known as decortication, where leaves are squashed and beaten by a pivoting wheel set with obtuse blades, so just strands will remain.

2.5 Fiber Surface Treatment

1. The human hair and sisal fiber is washed in a NaOH solution to remove the dirt particles.

2. In 1 litre of water 10 gms of NaOH powder is mixed and sisal fiber is placed in the mixture for 1 hour.

3. Again in 1 litre of water 10 grams of NaOH powder is mixed and human is placed in the mixture for 2 hours.

4. The soaked human hair and sisal fiber is now again washed in distilled water and dried in room temperature.

5. After completion of this process now sisal fiber and human hair is weight for the preparation of hybrid composite material.

2.6 Sample Preparation.

1. There were four different types of specimens prepared.

2. In that four types of specimens, two specimens prepared specimens fibers were chemically treated and the remaining two prepared specimens fibers were not chemically treated.

3. The specimens were prepared by hand-lay-up method.

4. The hand-lay-up method consists of four steps that is mould preparation, gel coating, lay-up and finishing.

5. The mould preparation is the basic step of hand-lay-up method, in our research work glass sheet with glass frame is taken as mould. To separate the laminate easily from the mould gel coating was used.

6. The epoxy was poured in the mould and the fibers reinforcement is done with help of brush.

7. The specimens are cured at room temperature with an external load of minimum 25 kg for 24 hours.

3. Water Absorption Test

Water absorption test and thickness swelling test were conducted in accordance with ASTM D570-398. Four specimens (Single and Double layers) cut with dimensions of 140 x 15mm (length x width) and the experiment was performed using test samples. The weight of the sample was taken before subjected to the distilled water. After expose for 12 hr, the specimens were taken out from the moist environment and all surface moisture was removed with a clean dry cloth or tissue paper. The specimens were reweighed to the nearest 0.001 mg within 1 min. of removing them from the environment chamber. The specimens were weighed regularly from 12-156 hrs with a gap of 12hrs of exposure. The moisture absorption was calculated by the weight difference. The percentage weight gain of the samples was measured at different time intervals by using the following equation:

$$\%M_t = \frac{(Wt - Wo)}{Wo} \text{ X } 100$$

Where '*W0*' and '*Wt*' denote the oven-dry weight and weight after time '*t*', respectively. Equilibrium Moisture Content (EMC) of the sample is the moisture content when the periodic weight change of the sample was less than 0.1% and thus the equilibrium state was assumed to be reached.

The thickness swelling (TS) was determined by using the following equation:

$$TS(t) = \frac{Ht - Ho}{Ho} \text{ X } 100$$

Where, '*Ht*' and '*H0*' are the composite thickness after and before the water immersion respectively.

4. Result and Discussion.

Effect of Moisture Absorption and Thickness Swelling of the fibers.

Table no-01: The table shows the moisture absorption and thickness swelling of single layer (Untreated) specimen.

No. of layers	Immersion time(t) hrs	Weight of the sample(gms)	Percentage of weight gain(%)	Thickness at time H(t)	Thickness Swelling (TS)
Single Layer (Untreated)	0	12.521.	0	0.490	0
	12	12.732	1.685168916	0.491	0.2040816327
	24	12.988	2.01496134	0.492	0.4081632654
	36	13.278	2.234816925	0.493	0.6122448981
	48	13.664	2.841689421	0.494	0.8163265308
	60	14.123	3.364174324	0.495	1.020
	72	14.617	3.498269413	0.496	1.224
	84	15.155	3.681643298	0.497	1.428
	96	15.745	3.894786243	0.498	1.632
	108	16.499	4.789463428	0.499	1.836
	120	17.417	5.568432176	0.500	2.040
	132	17.417	5.568432176	0.500	2.040
	144	17.417	5.568432176	0.500	2.040
	156	18.387	5.574543287	0.500	2.040

Table no- 02: The table shows the moisture absorption and thickness swelling of single layer (treated) specimen.

No. of layers	Immersion time(t) hrs	Weight of the sample(gms)	Percentage of weight gain(%)	Thickness at time H(t)	Thickness Swelling (TS)
Single layer (treated)	0	13.027	0	0.506	0
	12	13.124	0.744607354	0.507	0.1976284585
	24	13.247	1.688800184	0.508	0.395256917
	36	13.376	2.679051201	0.509	0.5928853755
	48	13.430	3.093574883	0.510	0.790513834
	60	13.524	3.815153143	0.511	0.9881422925
	72	13.630	4.628847778	0.512	1.185770751
	84	13.741	5.480924234	0.513	1.383399209
	96	13.846	6.286942504	0.514	1.581027668
	108	13.861	6.402087971	0.515	1.778656126
	120	13.861	6.402087971	0.515	1.778656126
	132	13.861	6.402087971	0.515	1.778656126
	144	13.861	6.402087971	0.515	1.778656126
	156	13.861	6.402087971	0.515	1.778656126

Table no-03: The table shows the moisture absorption and thickness swelling of double layer (Untreated) specimen.

No. of layers	Immersion time(t) hrs	Weight of the sample(gms)	Percentage of weight gain(%)	Thickness at time H(t)	Thickness Swelling (TS)
Double layer (Untreated)	0	11.257	0	0.388	0
	12	11.412	1.376921027	0.390	0.5154639175
	24	11.634	3.349027272	0.392	1.030927835
	36	11.830	4.674879661	0.394	1.546391753
	48	11.991	6.520387315	0.396	2.06185567
	60	12.193	8.31482633	0.398	2.577319588
	72	12.405	10.19809896	0.400	3.092783505

	84	12.601	11.93923781	0.402	3.608247423
	96	12.812	13.81362708	0.404	4.12371134
	108	12.890	14.50652927	0.406	4.639175258
	120	12.890	14.50652927	0.406	4.639175258
	132	12.890	14.50652927	0.406	4.639175258
	144	12.890	14.50652927	0.406	4.639175258
	156	12.890	14.50652927	0.406	4.639175258

Table no-04: The table shows the moisture absorption and thickness swelling of double layer (treated) specimen.

No. of layers	Immersion time(t) hrs	Weight of the sample(gms)	Percentage of weight gain(%)	Thickness at time H(t)	Thickness Swelling (TS)
Double layer (Treated)	0	14.493	0	0.696	0
	12	14.943	3.104947216	0.698	0.2873563218
	24	15.112	4.271027393	0.700	0.5747126437
	36	15.410	6.327192438	0.702	0.8620689655
	48	15.541	7.231077072	0.704	1.149425287
	60	15.558	7.34837507	0.706	1.436781609
	72	15.590	7.569171324	0.708	1.724137931
	84	15.710	8.397157248	0.710	2.011494253
	96	15.904	9.735734493	0.712	2.298850575
	108	16.014	10.49472159	0.714	2.586206897
	120	16.020	10.53612089	0.715	2.729885057
	132	16.020	10.53612089	0.715	2.729885057
	144	16.021	10.54302077	0.715	2.729885057
	156	16.021	10.54302077	0.715	2.729885057

V. Conclusion

1. The human hair and sisal fiber can successfully be used as a reinforcing agent to fabricate the composite by suitably bonding with epoxy resins.

2. The moisture absorption and the thickness swelling of single layer (untreated) specimen is more than single layer (treated) specimen.

3. The moisture absorption and the thickness swelling of double layer (untreated) specimen is more than double layer (treated) specimen.

4. The double layer specimen is considerable the best.

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