A PROJECT REPORT

ON

"WATER ABSORPTION CHARACTERISTICS OF NATURAL FIBRE REINFORCED POLYMER COMPOSITE FOR VARIOUS PRETREATMENTS OF NATURAL FIBRE"

Submitted to

UNIVERSITY OF MUMBAI

In Partial Fulfilment of the Requirement for the Award of

BACHELOR'S DEGREE IN MECHANICAL ENGINEERING

BY

MOMIN OSAMA MOIZ ZAMIR	15ME31
SAKARKAR MANSOOR IMTIYAZ	15ME27
SHAIKH SIRAJ ALI JAFAR ALI	15ME51
TUNGEKAR MOHD. YOOSHA NUMAN	14ME58

UNDER THE GUIDANCE OF
PROF. ZAKIR ANSARI

DEPARTMENT OF MECHANICAL ENGINEERING
Anjuman-I-Islam's Kalsekar Technical Campus
School Of Engineering & Technology
Plot No. 2 & 3, Sector - 16, Near Thana Naka,
Khandagaon, New Panvel - 410206

2018-2019

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Department of Mechanical Engineering

SCHOOL OF ENGINEERING & TECHNOLOGY

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CERTIFICATE

This is certify that the project entitled

"Water Absorption Characteristics Of Natural Fibre Reinforced Polymer Composite For Various Pretreatments Of Natural Fibre"

submitted by

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is a record of bonafide work carried out by them, in the partial fulfilment of the requirement for the award of Degree of Bachelor of Engineering (Mechanical Engineering) at ***Anjuman-I-Islam's Kalsekar Technical Campus, Navi Mumbai*** under the University of MUMBAI. This work is done during year 2018-2019, under our guidance.

Date:30 /04 /2019

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Project Approval for Bachelor of Engineering

This project entitled ***Ẅater Absorption Characteristics Of Natural Fibre Reinforced Polymer Composite For Various Pretreatments Of Natural Fibre̎*** by ***Momin Osama Moiz, Sakarkar Mansoor, Shaikh Siraj Ali & Tungekar Yoosha*** is approved for the degree of ***Bachelor of Engineering in Department of Mechanical Engineering.***

Examiners

1. ....
2. ....

Supervisors

1. ....
2. ....

Chairman

....

Declaration

I declare that this written submission represents my ideas in my own words and where others ideas or words have been included, I have adequately cited and referenced the original sources. I also declare that I have adhered to all principles of academic honesty and integrity and have not misrepresented or fabricated or falsified any idea/data/fact/source in my submission. I understand that any violation of the above will be cause for disciplinary action by the Institute and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been taken when needed.

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ABSTRACT

It was observed through research that Natural Fibre Reinforced Polymer Composite have high water absorption capacity. In order to make the commercial use of natural fibres, which are abundantly available at a very less cost, their water absorption is to be reduced. It was found that the chemical and physical treatment of natural fibre improves their water resistant ability. The current project explores the different methods and treatments of natural fibre from the perspective of improving its water absorption properties.

The aim of current project work is to prepare and test samples for their water absorption capability. Four different samples were required to be prepared in the ratio of 50:50 for fibres to matrix respectively. The samples have the natural fibres treated under different situations such as untreated, chicken fat under cold treatment,chicken fat under hot condition and NaOH treated. The experiment were conducted as per ASTM D570-98. The prepared samples were kept in the water and were taken out after an interval of 12 hours to check the water absorbed. This was continued till the saturation level. It has to be estimated if the samples follows Fick's law.

Keywords: Eco-sustainability, Epoxy Resin, Chicken fat, Fick's Law

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Chapter 1

Introduction

Natural fibers are not new to the world. They gained popularity because of them being light weight , readily available , abundant in quantity, nonabrasive, combustible, nontoxic, low cost and biodegradable properties.But because of their lower strength and mechanical properties and also being moisture absorbent in nature [1] , they could not stand a chance against glass fibers which possess high strength and mechanical properties and also being moisture resistant in nature.But at the end of the day , glass fiber being a plastic origin is not environment friendly and after witnessing the exploitation of plastic and its adverse effect on the environment , it is something of serious concern and cannot be neglected.but the use of glass fibres cannot be completely eradicated because of it positive properties and also complete use of only natural fibers cannot be implemented because of its drawbacks..Therefore hybridization seems the only possible way.Even if replacing a small percentage of glass fibers with natural fibers in a material production on large scale can cause tremendous positive effect on the environment and also contribute to higher eco-sustainability. The use of gelatin as a binder for natural fibres in polymer matrix has been tried with in a few works [2].

Figure 1.1: Natural Fibre

In this work, coir being used as the natural fiber, because it is easily available in the local areas and one of the most widely used in natural fibre reinforced polymer composite industry. The glass fiber of 350 GSM is to be used. According to the plan of experiments, 12 samples are to be produced using hand-layup process. In every case the natural fibres are untreated, treated with chicken fat under hot treatment, treated with chicken fat under cold condition and treated with NaOH. Three samples under each case are prepared to avoid errors. The fibre to matrix ratio would be 30:70 respectively.

Chapter 2

Problem Definition

Fiberglass has been the common material for recreational boats and yachts for many years. These are not traditional laminated composites, rather the glass fibers are oriented randomly giving the structure more uniform material properties. Being fairly cheap, glass fiber can be used in large structures; whereas carbon fiber would be too expensive. glass production and glass fiber production are both energy intensive processes depending mainly on fossil fuels. Glass fiber production requires 5-10 times more non-renewable energy than natural fiber production; as a result, the pollutant emissions from glass fiber production are significantly higher than from natural fiber production. Natural fiber composites offer realistic opportunities for recovery and reuse of the trim. The rapid consumption of petroleum-based products and its negative impact on the environment has led to an increase in environmental consciousness when it comes to sustainable materials and products.

Also a recent observed problem is the burning of crops in certain parts of the world which is resulting into the release of hot gases and hence increasing global warming. If these crops are used in composites rather than burning then it may solve this issue to a certain extent. In the present scenario, there has been a rapid attention in research and development in the natural fiber composite field due to its better formability, abundant, renewable, cost- effective and eco-friendly features. This paper exhibits an outline on natural fibers and its composites utilized as a part of different commercial and engineering applications. In this review, many articles were related to applications of natural fiber reinforced polymer composites.

Figure 2.1: Farmer Burning Crop

It helps to provide details about the potential use of natural fibers and its composite materials, mechanical and physical properties and some of their applications in engineering sectors. The renewed interest in natural fiber composites are emerging as a viable alternative to glass-fiber reinforced polymer (GFRP) composites for many reasons. Natural fiber composites can be 25%-30% stronger than glass fiber for the same weight and can deliver the same performance for lower weight. In automotive parts, bio composites made from natural fibers reduce the mass of the component and can lower the total energy consumed in producing this material by 80 %. Unlike man-made glass fiber, eco-friendly natural fiber composites are seen as a solution to growing environmental threats but also as an answer to the uncertainty of the petroleum supply.

Chapter 3

Literature Review

For a research project, the material selection is one of the most important steps, as the results and the final sample products are completely dependent on it. Many materials were studied, few of them are listed below.

3.1 Sisal

Sisal with the botanical name Agave sisalana, is a species of Agave native to southern Mexico but widely cultivated and naturalized in many other countries. It yields a stiff fibre used in making various products. The sisal fibre is traditionally used for rope and twine, and has many other uses,including paper, cloth, footwear, hats,bags, carpets, and dartboards.

Mechanical Properties

TENSILE STRENGTH (MPA)	YOUNGS MODULUS (GPA)	MOISTURE REGAIN %
100-800	9-22	11

Figure 3.1: Sisal Fibre

3.2 Coir

Coir or coconut fiber, is a natural fibre extracted from the husk of coconut[1] and used in products such as floor mats, doormats, brushes and mattresses. Coir is the fibrous material found between the hard, internal shell and the outer coat of a coconut. Other uses of brown coir (made from ripe coconut) are in upholstery padding, sacking and horticulture. White coir, harvested from unripe coconuts, is used for making finer brushes, string, rope and fishing

Mechanical Properties

TENSILE STRENGTH (MPA)	YOUNGS MODULUS (GPA)	MOISTURE REGAIN %
100-200	6	13

Figure 3.2: Coir Fibre

3.3 Jute

Jute is a vegetable fibre. It is very cheap to produce, and its production levels are similar to that of cotton. It is a bast fibre, like hemp, and flax. li Jute is used to make various products: packaging materials, jute bags, sacks, expensive carpets, espadrille s, sweaters etc. it is obtained from the bark of the jute plant. Jute plants are easy to grow, have a high yield per acre and, unlike cotton, have little need for pesticides and fertilizers

Mechanical Properties

TENSILE STRENGTH (MPA)	YOUNGS MODULUS (GPA)	MOISTURE REGAIN %
100-200	6	13

Figure 3.3: Jute Fibre

3.4 Kenaf

The fibers in kenaf are found in the bast (bark) and core (wood). Uses of kenaf fibre include engineered wood; insulation; clothing-grade cloth; soil-less potting mixes; animal bedding; packing material; and material that absorbs oil and liquids. It is also useful as cut bast fibre for blending with resins in the making of plastic composites, as a drilling fluid loss-preventive for oil drilling muds, and for a seeded hydromulch for erosion control.

Mechanical Properties

TENSILE STRENGTH (MPA)	YOUNGS MODULUS (GPA)	MOISTURE REGAIN %
300-1200	22-60	17

Figure 3.4: Kenaf Fibre

3.5 Banana Fibre

Banana fiber is a natural fiber with high strength, which can be blended easily with cotton fiber or other synthetic fibers to produce blended fabric textiles. Banana Fiber also finds use in high- quality security/ currency paper, packing cloth for agriculture produce, ships towing ropes, wet drilling cables etc. Banana fiber, a lignocellulosic fiber, obtained from the pseudo-stem of banana plant (Musa sepientum), is a bast fiber with relatively good mechanical properties.

Mechanical Properties

TENSILE STRENGTH (MPA)	YOUNGS MODULUS (GPA)	MOISTURE REGAIN %
530	27-32	11

Figure 3.5: Banana Fibre

3.6 Napier Grass

Napier grass, elephant grass or Uganda grass, is a species of perennial tropical grass native to the African grasslands.[1] It has low water and nutrient requirements, and therefore can make use of otherwise uncultivated lands.[2] Historically, this wild species has been used primarily for grazing

Mechanical Properties

TENSILE STRENGTH (MPA)	YOUNGS MODULUS (GPA)	MOISTURE REGAIN %
40-90	2-4.5	0.1-0.3

Figure 3.6: Napier Grass

3.7 Hemp

Hemp is a source of raw, organic protein. Hemp fibers can be woven into any type of clothing that cotton fibers can be, without using the massive natural resources cotton production does. Hemp fiber is longer, stronger, more absorbent and more insulative than cotton fiber.

Mechanical Properties

TENSILE STRENGTH (MPA)	YOUNGS MODULUS (GPA)	MOISTURE REGAIN %
300-760	30-60	12

Figure 3.7: Hemp Fibre

3.8 Alfa(Stipa tenacissima)

Stipa tenacissima is an endemic species of the Western Mediterranean countries. It grows in Spain, Portugal, Morocco, Algeria, Tunisia and Libya. It grows in poor soils and in dry conditions, forming a steppe-like grassland. It has been managed by people for centuries. Stipa tenacissima produces a fiber product called esparto which is used for crafts, such as cords, basketry, and espadrilles as well as for making paper.

Mechanical Properties

TENSILE STRENGTH (MPA)	YOUNGS MODULUS (GPA)	MOISTURE REGAIN %
30-40	15-20	13

Figure 3.8: Alfa(Stipa tenacissima)

3.9 Flax

Flax products have been used as sail and tent canvas, fishing lines, fishing nets, book binder's thread, and leather working threads, sewing thread, suture thread, carpet warp and union cloth cotton flax blended at weaving stag. Flax are also used to produce clothing, household, industrial and furnishing fabric only the best portion of seed flax can be used for wool-pile rugs backing, twine and rope. The properties of flax/epoxy composites are strongly influenced by the processing methods and fiber configurations. Resin transfer moulding and compression moulding are preferred for high performance flax/epoxy composites. The bio-epoxy investigated in flax composites is mainly from soybean oil and the final composites have similar independent factors to flax/epoxy composites. Mechanical performance under similar conditions could follow the fiber form trend: plain weave type ¡ twill type ¡ dobb type. Flax/tannin composites have been studied only in the recent 2–3 years, mostly for automotive applications. The ease of processing, good mechanical properties and low overall cost have spurred on further development of flax/tannin composites. Also, the use of nanotechnology (flax nanofibers and the addition of Nano clays in flax composites) highly improves the mechanical performances.

Different treatments of flax-reinforced composites.

Fibre/matrix	Chemical treatment	Conditions	Effect on properties
flax/PP	esterification	10 wt % MA, 25h, 50 °C	highest flexural and tensile strength
flax/phenolic	esterification	25 wt % MMA, 30min, 210 W	more moisture retardant
flax/epoxy	alkali treatment	5 wt % NaOH, 30 min	tensile strength 21.9%; flexural strength 16.1%
flax/epoxy	alkali treatment	4 wt % NaOH, 45 s	transvers strength, 30% increment
flax/polyester	silane treatment	0.05 wt %, 24 h	hydric fibre/matrix interface
flax/pp	esterification	MA-PP coupling agent	interphase compatibility

Figure 3.9: Flax Fibre

3.10 Palm

The fibre treatment by KMnO4 soaking improved the mechanical properties like tensile strength, flexural strength, impact strength and hardness value. The various mechanical tests revel that mechanical properties of alkali treated fibres are superior to those of other compared natural fibres. Alkali soaking significantly removed surface impurities from fibres so a better fibre matrix adhesion was created. The result reveals that, the trend in all the properties increased for alkali treated and coconut shell Nano powder added palm/glass fibres sandwich composites.

Figure 3.10: Palm Fibre

3.11 Pretreatment Of Natural Fibres

Pre-treatments of the natural fiber can clean the fiber surface, chemically modify the surface, stop the moisture absorption process, and increase the surface roughness. Shortcomings associated with natural fibers have to overcome before using them in polymer composites. The most serious concerned problem with natural fibers is its hydrophilic nature, which causes the fiber to swell and ultimately rotting takes place through attack by fungi. Natural fibers are hydrophilic as they are derived from lignocellulose, which contain strongly polarized hydroxyl groups. With NaOH chemical treatment, considerable decrease in percentage moisture gain is observed. This gives another way to reduce moisture absorption for natural fibre composite.

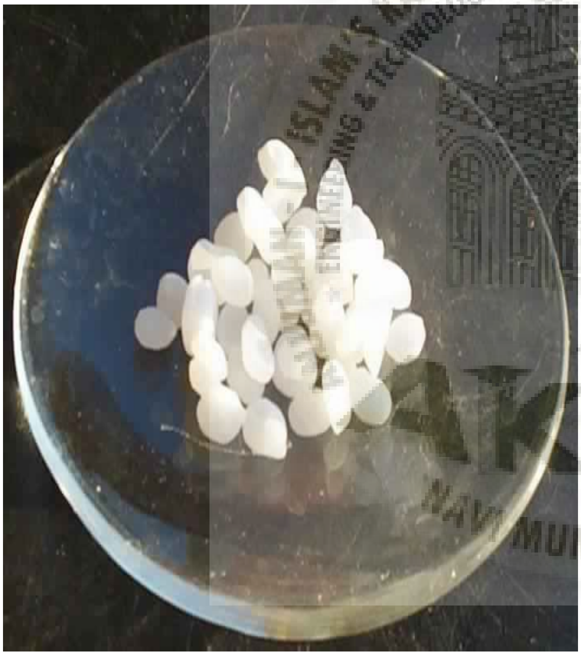

Figure 3.11: NaOH

Figure 3.12: Concentrated NaOH

3.12 Chicken Fat

Waste chicken fat is harmful for human health due to fat contain in the chicken. So, there is large amount of chicken fat is waste. On the other hand, it is noticeable from a general observation that the fats usually resist water absorption. So, to utilize this waste for the treatment of the natural fibres became the base of our experiment which intended to make natural fibres as water resistant.

Characteristic	Description
General	Oil obtained after fusion and filtration of high-quality chicken fat
Physical	Color: Creamy white particle free Odor: typical for chicken oils State: Solid at 4°C or emulsion at ambient temperature
Physicochemical	Fusion point: 30 ± 1°C Moisture: 1.5% max Peroxide value: 0.5 meq O_2/kg max Acidity: 1.5% oleic acid max
Microbiological	Mesophilic aerobics: 1*10 UFC/g max Total coliforms: 10 NMP/g max Fecal coliforms: <3 NMP/g
Package	15 kg Corrugated cardboard case with internal bag
Storage	Store at temperature lower or same as the ambient temperature. The product can resist up to six months if stored under refrigeration

Figure 3.13: Properties Of Chicken Fat

3.13 Finalized Materials

1)From one research(2) we found out that chicken fat can act as a binder between the fibre and the matrix.
2)Coir fibre with a tensile strength of 21.5 MPa is the toughest among all natural fibres (8). They are capable of taking strains4–6 times higher than other fibres (8).Although it is a cheap and efficient a major hindrance towards its wide scale use is the high rate of water absorption, which can be reduced by coating it with oil. The advantages of coir fibre are :low cost, reasonable specific strength, low density, ease of availability, enhanced energy recovery, biodegradability, ability to be recycled in nature in a carbon neutral manner, resistance to fungi moth and rot, excellent insulation to sound, flame, moisture and dampness, toughness, durability, resilience.

Chapter 4

Methodology

4.1 Resources

The glass fibre (GSM 350), epoxy resin (LY556), hardner (HY951) and chicken fat was purchase from local Store. The coin fibre was extracted from coconut. The 8 percent NaOH, weighing machine upto four digit of accuracy, burner was taken from chemistry lab of college. Handglovees and wax were purchased from a local Merchant. the handsaw and the compression machine were used and were available in the workshop of the college. the epoxy resin of the specification (LY556) and hardener of (HY951) was used after referring to a similar experiment on composites [1].

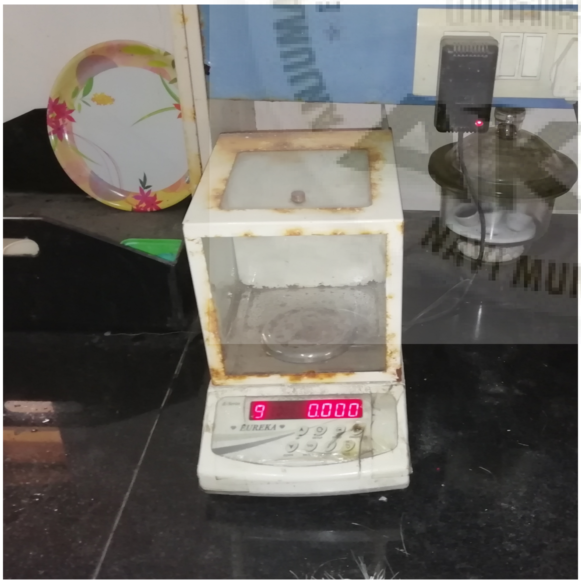

Figure 4.1: Weight Machine

Figure 4.2: Applying Wax

Figure 4.3: Epoxy Resin

Figure 4.4: Mould

The dimensions of specimen was needed to be 25.476.23 mm as per the standard used in ASTM D570. Show a mould which was bigger than the above specified dimensions was fabricated by using galvanised steel in the workshop of the college. This difference between the dimensions of the mould and the samples to be prepared were taken considering the the side waste of the composites which was rough and undesirable for testing. This guaranteed accuracy in sample preparations and the aforementioned required dimensions.

4.2 Epoxy Hardner Preparation

Epoxy LY556 of density 1.15-1.20g/cm 3 mixed with hardener HY951 of density 0.97- 0.99g/cm 3 is used to prepare the composite. The epoxy and hardener is mixed to a ratio of 10:1. Resin and hardener is purchased from Herenba Instruments and Engineers, Chennai, India.

4.3 Pre Treatment Of Natural Fibre

As it's a fact that the natural fibres inhabit water absorption properties, it is not possible to use them in applications without pre treating them. Treatment of natural fibres by certain chemicals like 8% NaOH have proved to be an agent in reducing their water absorbing properties to a great extent. The idea behind this experiment is to make a comparative study based on hypothesis so as to know which element used in pretreatment is able to reduce the water absorption properties and to what extent. Also to study the difference between the untreated fibre and the treated ones. The different elements used for pretreatment in the experiments were NaOH, hot treated chicken fat and cold chicken fat.

Figure 4.5: Cold Treated

Figure 4.6: Hot Treated

Figure 4.7: NaOH Treated

4.4 Hand Lay Up Method

Hand lay-up technique is the simplest method of composite processing. The infrastructural requirement for this method is also minimal. The processing steps are quite simple. First of all, a release gel is sprayed on the mold surface to avoid the sticking of polymer to the surface. Thin plastic sheets are used at the top and bottom of the mold plate to get good surface finish of the product. Reinforcement in the form of woven mats or chopped strand mats are cut as per the mold size and placed at the surface of mold after perspex sheet. Then thermosetting polymer in liquid form is mixed thoroughly in suitable proportion with a prescribed hardner (curing agent) and poured onto the surface of mat already placed in the mold. The polymer is uniformly spread with the help of brush. Second layer of mat is then placed on the polymer surface and a roller is moved with a mild pressure on the mat-polymer layer to remove any air trapped as well as the excess polymer present. The process is repeated for each layer of polymer and mat, till the required layers are stacked. After placing the plastic sheet, release gel is sprayed on the inner surface of the top mold plate which is then kept on the stacked layers and the pressure is applied. After curing either at room temperature or at some specific temperature, mold is opened and the developed composite part is taken out and further processed. The schematic of hand lay-up is shown in figure 1. The time of curing depends on type of polymer used for composite processing. For example, for epoxy based system, normal curing time at room temperatur is 24-48 hours. This method is mainly suitable for thermosetting polymer based composites. Capital and infrastructural reuirement is less as compared to other methods. Production rate is less and high volume fraction of reinforcement is difficult to achieve in the processed composites. Hand lay-up method finds application in many areas like aircraft components, automotive parts, boat hulls, diase board, deck etc.

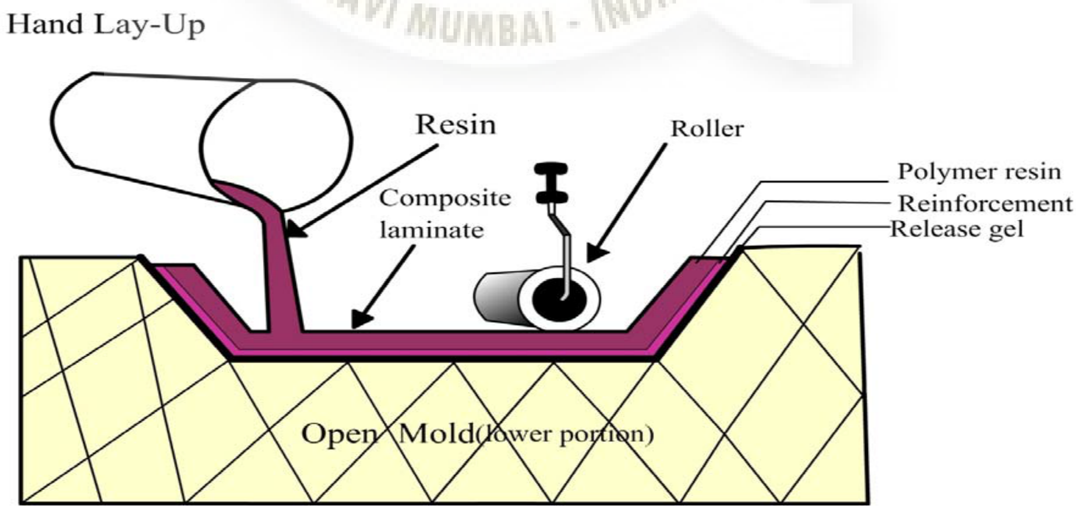

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Figure 4.8: Hand LayUp

4.5 Sample Preparation

4.5.1 Untreated Sample

The mould is cleaned and dried before using it. The coir fiber of weight (13 gram) and glass fiber of weight (18 gram) is laid into the mould uniformly. The composite is made up of two layers of glass fiber and one layer of coir fiber. The upper and lower surface of the composites is glass fiber. The fiber are mixed with epoxy. The weight of the epoxy resin is (60 gram) and hardener weight is (6 gram). The composite is removed from the mould and is kept for compression. The composite is compressed for 24 hours. Test Samples were cut to the required sizes given in the ASTM standards. The size of the samples were (25.4*76.2*3).

4.5.2 NaOH Treated

The coir fiber was first pretreated with 8%NaOH.The fiber was kept for 2 hours in NaOH solution. This treatment reduces the hydrophilic nature of coir fiber and the further procedure is same as mentioned above.

4.5.3 Cold Treated

The general observation is that the chicken fats are non-hydrophilic in nature. So the coir fibers are pretreated with cold chicken fat. The fibers are kept for for two hours and the remaining procedure of making the sample is same as above.

4.5.4 Hot Treated

The chicken fat is melted to the liquid form and then it was treated to the coir fibers and kept for 2 hours before making the composite.

4.6 Testing Standards

After fabrication, Water absorption test was carried out in accordance with ASTM D570 procedure to predict the diffusion and permeability coefficient of the hybrid composite.(1)

4.7 Water absorption behaviour

4.7.1 Moisture absorption mechanism

Moisture diffusion in polymer composites follows Fickian as well as non-Fickian character. The percentage of water absorption is given by:

% of absorption = (m2-m1)/m1
where m1 and m2 are the weight of the dry and wet samples.

The kinetic parameter, diffusion coefficient D(mm2 /s), is calculated as

$$D = \pi(h\theta/4Q)$$

where θ is the slope of the linear portion of the absorption curve and h is the initial sample thickness in mm. The diffusion coefficient characterises the ability of solvent molecules to move among the polymer segments. The permeability of water molecules through the composite sample depends on the absorption of water by the fiber. Therefore, the absorption coefficients that are related to the equilibrium absorption of the principal penetrated, is calculated by the equation

$$S=Q/Q_t$$

where Q and Q_t are molar percentages of water uptake at infinite time and at time t .The permeability coefficient P, (mm^2/s),

$$P=D*S$$

Water absorption behaviour of banana/sisal hybrid composites in water at room temperature was studied as per ASTM570 (1).

In order to study the kinetics of water absorption, specimens were submerged in water at room temperature. The samples were taken out periodically and weighed immediately, after wiping out the water from the surface of the sample and using a precise 4-digit balance to find out the content of water absorbed. All the samples were dried in an oven until constant weight is reached before immersing again in the water. The percentage of moisture absorption was plotted against the square root of time (hours) as shown in Fig. 5.7 & Fig. 5.12 attributed that for all ratios of composites; moisture absorption becomes stable after 50 h.

LAMINATES	SEQUENCES
S1	G+C+G
S2	G+C+G+NaOH
S3	G+C+G+COLD FAT
S4	G+C+G+HOT FAT

Figure 4.9: Laminates

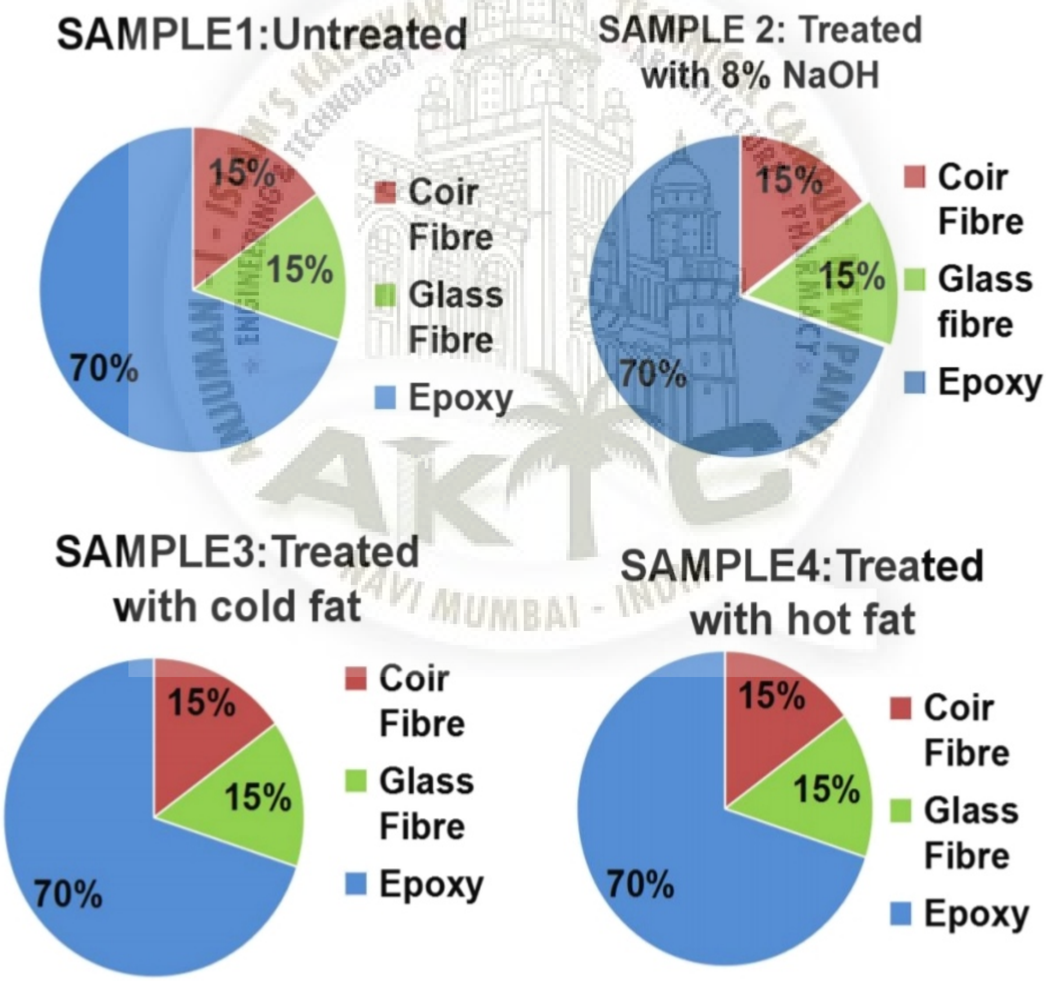

Figure 4.10: Amount Of Materials

Chapter 5

Results & Observations

5.1 Observation Tables

5.1.1 Samples 1

DAY	HOT TREATMENT		UNTREATED		DURATION
	wt.1 (gms)	wt.2 (gms)	wt.1 (gms)	wt.2 (gms)	hours
1	27.478	29.840	28.035	30.125	12
2	30.435	31.600	31.645	31.843	12
3	31.659	31.722	31.960	32.104	12
4	31.745	31.760	32.190	32.225	12
5	31.770	31.775	32.346	32.410	12

Figure 5.1: Weights of samples after successive immersion

DAY	NaOH		COLD TREATMENT		DURATION
	wt.1 (gms)	wt.2 (gms)	wt.1 (gms)	wt.2 (gms)	hours
1	60.648	66.840	29.230	36.190	12
2	68.170	68.785	37.640	38.375	12
3	68.952	69.156	38.419	38.470	12
4	69.266	69.390	38.553	38.684	12
5	69.420	69.470	38.424	38.740	12

Figure 5.2: Weights of samples after successive immersion

Figure 5.3: Samples before immersion in water

DAY	HOT TRT.	UNTREATED
	(%)	(%)
1	8.59	7.44
2	15	13.583
3	15.44	14.512
4	15.558	14.945
5	15.637	15.605

Figure 5.4: Percentage weight of moisture absorbed

DAY	NaOH	COLD TRT.
	(%)	(%)
1	10.209	23.81
2	13.41	31.28
3	14.028	31.61
4	14.414	32.34
5	14.546	32.535

Figure 5.5: Percentage weight of moisture absorbed

Figure 5.6: Samples immersed in water

Graph for First Samples

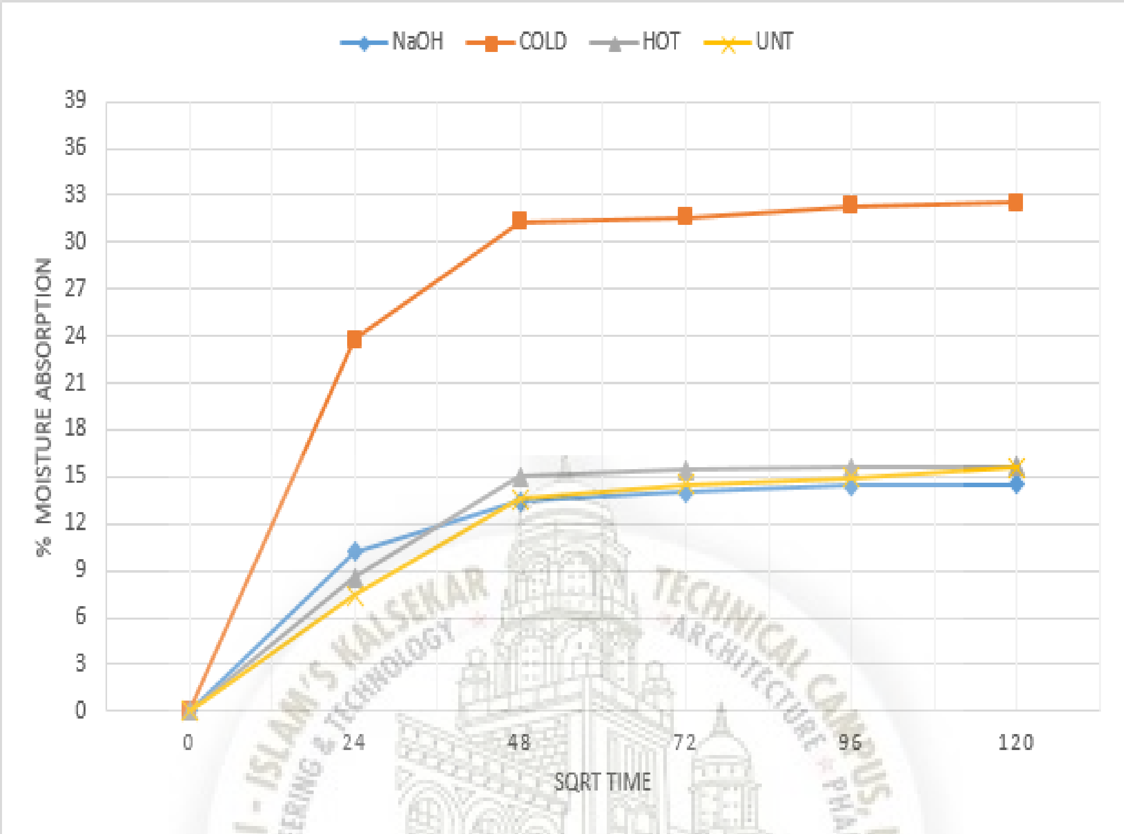

Figure 5.7: Plot of %age moisture absorption Vs Sq. Root of time

5.1.2 Samples 2

DAY	HOT TREATMENT		UNTREATED		DURATION
	wt.1 (gms)	wt.2 (gms)	wt.1 (gms)	wt.2 (gms)	hours
1	29.478	31.350	30.564	32.125	12
2	32.456	32.956	33.645	33.943	12
3	33.259	33.452	34.260	34.404	12
4	33.685	33.756	34.605	34.885	12
5	33.863	33.956	34.995	35.103	12

Figure 5.8: Weights of samples after successive immersion

DAY	NaOH		COLD TREATMENT		DURATION
	wt.1 (gms)	wt.2 (gms)	wt.1 (gms)	wt.2 (gms)	hours
1	58.200	60.540	27.430	28.390	12
2	61.170	61.785	29.640	30.385	12
3	61.952	62.156	30.919	31.670	12
4	62.560	63.706	31.968	32.232	12
5	63.920	64.170	32.424	32.536	12

Figure 5.9: Weights of samples after successive immersion

DAY	NaOH	COLD TRT.
	(%)	(%)
1	4.310	3.499
2	6.15	10.772
3	6.797	15.457
4	9.460	17.506
5	10.257	18.687

Figure 5.10: Percentage weight of moisture absorbed

DAY	HOT TRT.	UNTREATED
	(%)	(%)
1	6.350	5.107
2	11.798	11.055
3	13.481	12.563
4	14.512	14.135
5	15.190	14.850

Figure 5.11: Percentage weight of moisture absorbed

Graph for Second Samples

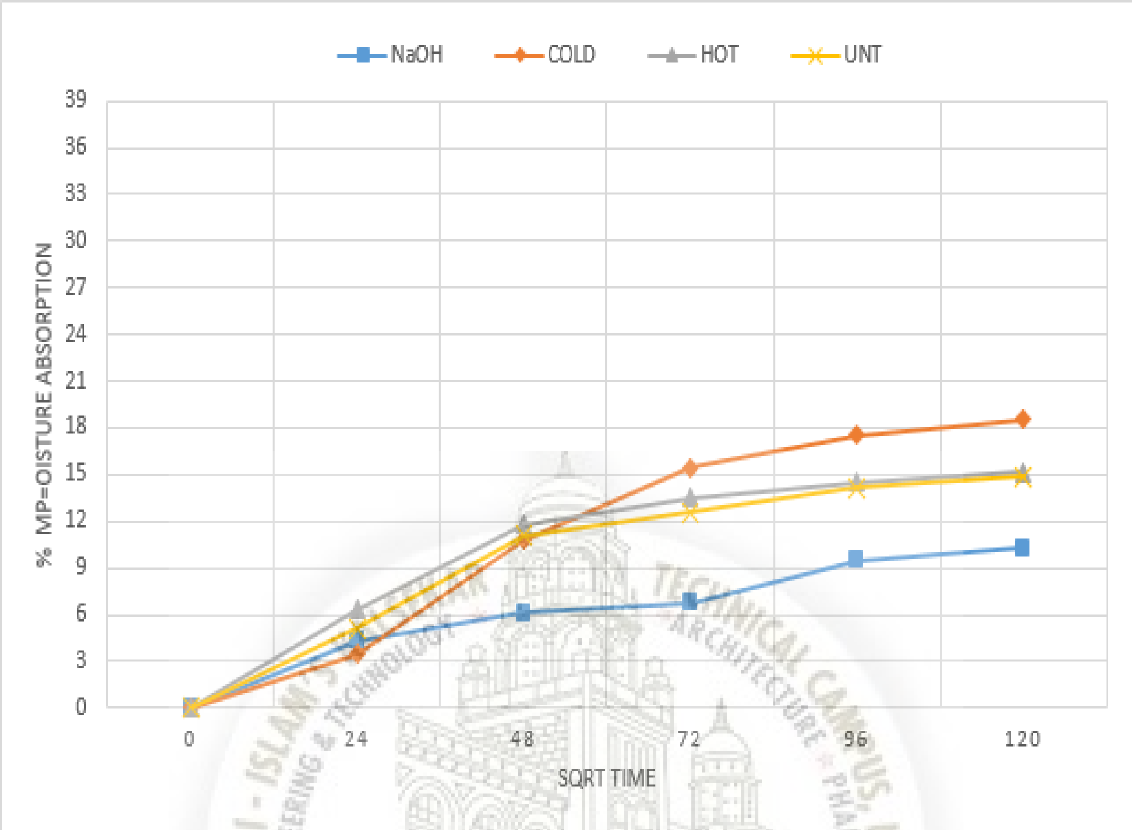

Figure 5.12: Plot of %age moisture absorption Vs Sq. Root of time

Comparison Graph of both Samples

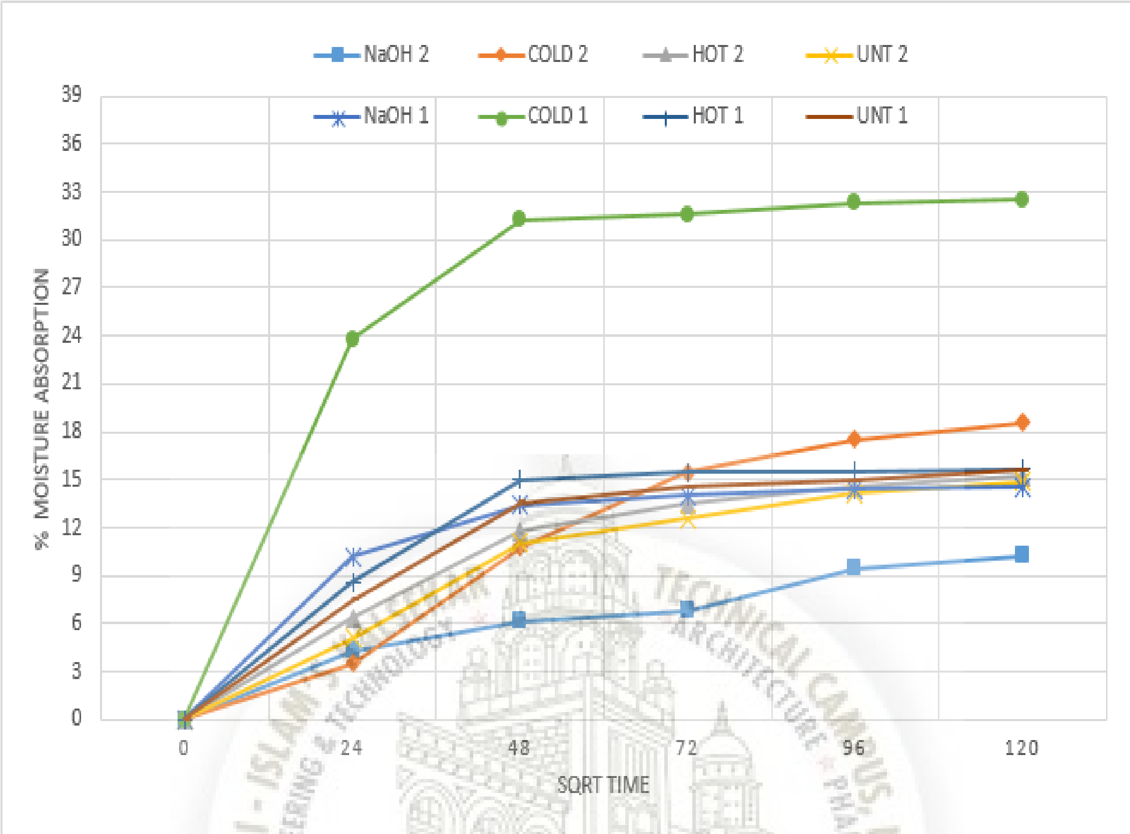

Figure 5.13: Plot of %age moisture absorption Vs Sq. Root of time

Chapter 6

Conclusion

From different pretreatment processes performed and the obtained results it can be concluded that there is not much significant effect of the pretreatment processes as expected . But the percentage of water absorped by different samples is exponential after successive immersions and weighing it can be noted that the samples reach saturation point and further water absorption doesnt takes place and hence following fickian's behaviour. It can be also noted that NaOH treatment show lesser water absoprtion as copmapred to the other treatments.

Chapter 7

Future Scope

If experimentations using different combinations of natural fibres and chicken fat would be made then it is quite possible that the results will be positive, maybe not with reference to water absorption behaviour but with properties such as flexural strength, tensile strength, impact strength, etc. This will further make them available for other applications such as constructions, automobiles, applications in heat transfer and so on. Another important aspect is that the successful future research of natural fibres in properties of impact, tensile and flexural strength will utilise these natural fibres which are now treated as residue and burnt. This will not only replace man made glass fibre but also prove to be a boon in being ecofriendly.

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Achievements

1. Poster Presentation
   (a) *Effect in water absorption properties of NFRPC by treatment of chicken fat*; Siraj Shaikh & Yoosha Tungekar, CALIBRE 2K19 , March 2019 (Venue : F.C.R.I.T)
2. Paper Presentation
   (a) *Evaluation of Moisture Absorption Properties of Coir/Glass-Epoxy Hybrid Natural Fibre Reinforced Polymer Composite (NFRPC) under various Pretreatment Conditions of Natural Fibre*; Mansoor Sakarkar, CALIBRE 2K19 , March 2019 (Venue : F.C.R.I.T)