EXPERIMENTAL STUDY ON EFFECT OF SALT HYDRANTS ON FLAX AND COIR FBRE DEGRADATION

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Abstract: *Due to environmental concern the natural fibres are gaining more importance because of their eco-friendly nature. Natural fibre is abundantly available in nature, the development of natural fibre composites will lead to the replacement of existing materials in various applications. This paper presents results from an experimental study of the mechanical behaviour of coir and flax fibre reinforced acrylic composites after immersion in seawater. First, in-plane design data are presented. Then, seawater diffusion kinetics are shown, the influence of seawater on design properties is quantified and flexural fatigue performance is described. Finally, the results are compared with those for glass reinforced composites. Seawater saturated specimens show a large drop in stiffness (>50%) due to fibre plasticization, but smaller drops in strength (<30%).*

Key words: Natural Fibre, Coir, Flax, Salt hydrants, Mechanical Properties. Degradation

1.0 Introduction

The study aimed to demonstrate the availability, technological processing, and socio-economic aspects of natural fibers. Although many studies have been conducted on this material, it is necessary to revisit their potential from those perspectives to maximize their use. The renewability and biodegradability of natural fiber are part of the fascinating properties that lead to their prospective use in automotive, aerospace industries, structural and building constructions, bio packaging, textiles, biomedical applications, and military vehicles. To increase the range of applications, relevant technologies in conjunction with social approaches are very important. Hence, in the future, the utilization can be expanded in many fields by considering the basic characteristics. Scientists, researchers, and practitioners around the world have recently been working to maximize the potential of natural fibers to create the most sustainable, biodegradable, and high-quality natural fiber products [1–3]. Natural fibers, which are renewable and ecologically acceptable sources of raw materials for producing environmentally friendly products, have played a significant part in human civilization [1]. Natural fibers have many advantages over synthetic fibers, including lower density, lighter weight, lower cost, biodegradability, minimal health hazards during processing, abundant availability and ease of availability, low investment at low cost for production, lower energy requirements, and lower CO2 emissions, indicating that they have great potential as a substitute for glass, carbon, or other synthetic fibers. Natural fibers are desirable bio-sourced materials as an alternative to non-sustainable glass and carbon fiber reinforced composites owing to their availability and technical viability.
From the physical and mechanical properties point of view, natural fiber has relatively high tensile strength and Young's modulus, good thermal, good acoustic insulation characteristics, and high electrical resistant [1–8].
Furthermore, chemical properties of

natural fibers, such as high cellulose content, have a strong relationship with tensile properties, crystallinity, and density [1,7]. Notwithstanding, natural fibers have some drawbacks that need to be enhanced, such as low impact strength, non-uniformity in quality and price, poor moisture resistance, low durability, low compatibility, low adhesion efficiency, moisture absorption, and poor wettability [9–14].

2.0 Factors influencing degradation of fibres

Biodegradability is significant for materials particularly utilised in any part of daily life [4]. Accordingly it becomes essential to assess their biodegradability and possible damage to the environment. The biodegradability behaviour of polymers depends on some physical and chemical properties. The hydrophilic character, crystalline and amorphous structures, the linearity or branching of polymers, molecular compositions and chemical bonds are determinative elements for the biodegradability of polymeric materials [3, 6, 7]. Due to their primary ease of processing, as well as their high weathering resistance and strength, the production and consumption mass of synthetic fibres is increasing steadily [5]. However, these fibres exhibit high resistance to microbial degradation. In the related literature, there are some researches on the biodegradation of textile materials, such as cotton, jute, linen, wool, viscose, polyester and the recent polylactic acid fibres [3, 6, 8-12, 13]. Biodegradation was especially evaluated via visual observation, determination of mass loss, and characterising the chemical structure and surface morphology.

Coir, or coconut fibre, is one NF type which may benefit tremendously from valorisation as a building material since its production rate is very high and it currently accrues mostly as a waste product [8,13]. Fibrous material such as coir may be used in building products such as thin sheets and boards for non-structural applications. Combination of NF with cement forms a NF-cement composite [14,15], which can be used to make a variety of building products such as wood-wool cement board. Composites with other binders, such as polymers, are also available for constructive or automobile applications [16]. These products are greatly enhanced by the inclusion of fibres, which help to increase flexural strength, toughness, and impact resistance [7,14]. Additionally, the resulting product provides some thermal and acoustic insulation [15]. Currently, research is still continuing towards the best practice of application of NF-cement composites and is directed mostly towards the interactions between NF and cement, several niche applications, or environmental benefits of using NF [17,18].

3.0 Fibre fractions and synthesis

As a novel building material, natural fibres have brought a set of limitations and difficulties of their own, which are often the topic of scientific research. Many report the highly heterogeneous nature of the material [4] and water absorption capability, which causes swelling and shrinking and ultimately debonding of the fibres and the binder [10]. An additional disadvantage is the release of saccharides from fibres into the pore solution of a NF-cement composite during curing. These inhibit cement hydration by chelating calcium ions and through surface adsorption to cement grains, therefore preventing the formation. The most challenging element relates to the instability of NF in the alkaline environment of the cement matrix [1,22,23]. This is defined as an interaction of alkali attack on fibres and fibre mineralisation; the latter being greatly enhanced by the high-water absorption capacity of fibres. Alkali attack may affect natural fibres on several structural levels. Whereas degradation often starts as decomposition of lignin and hemicellulose components, which are associated with the fibre surface [22], advanced degradation will affect also the fibre's structural cellulose polymer chains.

3.1 Sample preparation

In this present work, coir and Lenin flax crushed and grinded to get particles with size 0.2 to 0.3 mm diameter are used as natural fibers and mixed with pure polyester resin with volume fraction 25% Vf for sample preparation. As for the solutions used to study the effect of them on the samples are water, salt solution with concentration 13% and Aceic acid (CH3COOH).

The Samples were molding in several steps as below

1. A glass mold of (18 mm diameter and 140 mm length) with unlocked end is used in this work for compression test specimens. Also another glass mold (30mm length and 30 mm width) is used for hardness test specimens.
2. Lubricating the glass molds from inside by oil as shown in figure (1)a&b.

(a) (b)

Figure 1 shows the sample preparation with fibre binders

3. Mixing the coir and flax with the polyster with Vf 25% then adding the hardener finally adding the mixture inside the molding.
4. The composite was left in mold for (24) hours at room-temperature to harden as shown in figure 2.

Figure 2: shaped sample **preparation**

5. Lastly, cutting the test samples by using CNC machine.

The specimens are cut by using a lathe machine (CNC) to get the final shape .The dimensions of specimens for compersion test are a cylindrical sample with 18 mm diameter and 36 mm length accordance with (ASTMD695M-89) standards [8], where Lo/do ratio is 1.5 to 3 and The dimensions of a specimens for hardness test 15mm length and 15mm width ,the final shape of specimen is shown in figure (3).(a) and (b)

Figure **(3).(a) and (b) sample preparation for testing**

After obtaining the final shape of specimens, the specimens were immersed in water,Aceic acid (CH3COOH) and Salt (Nacl) solutions at different period of 18 days. The immersion of specimens is shown in figure

(a) (b) (c)

Figure4; The immersion of specimens. a) Water. b) Salt (Nacl). c) Acetic acid (Ch3COOH).

4.0 Results and discussion

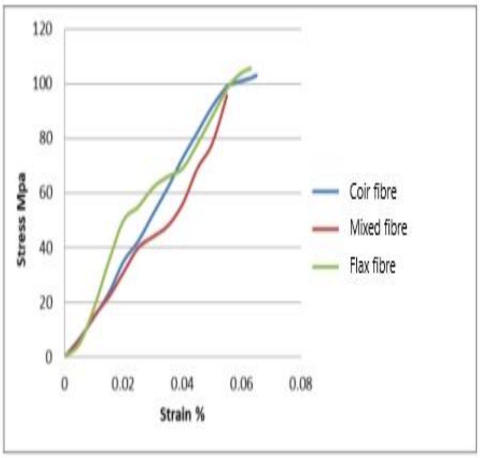

Figure:5 Stress-Strain curves from Compression test

From this figure5, it can be seen that, mechanical properties depends on type of the added natural materials. Where the added peels walnuts improved the mechanical properties (the compression stress increased with percentage 2.3%) while add sawdust reduced the mechanical properties (the compression stress decreased with percentage 7.18 %).

For the effect of Aceic acid (CH3COOH), salt solution (Nacl) and water on pure polyester and natural composite materials for 18 days. From this figures, the compression stress of all samples decreased with immersed water, It was also observed that the mechanical properties properties (compression stress) for samples which immersed 18 days compression stress decreased from 95.6 Mpa to 83.17Mpa with effect water 18 days as shown in Figure6.

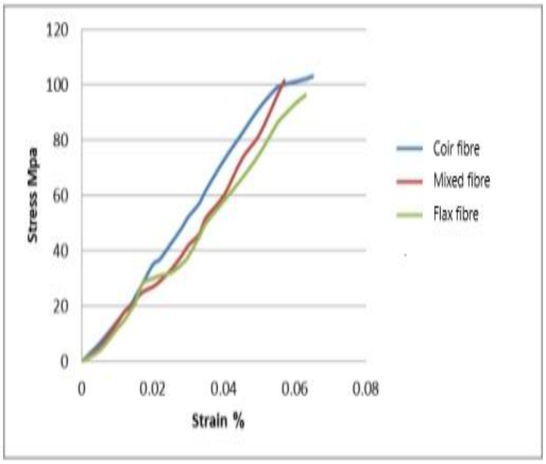

Figure:6 Stress-Strain curves of in water for 18 days

As for the effect of of Aceic acid (CH3COOH) and NaCL on samples can be observed from figure to Figure. Where it can notice the effect of acid stronger than the effect of salt and water, where mechanical properties (compression stress) of samples which immersed CH3COOH are less than samples which immersed in the NaCL and water also note the weakest material was coir polyester composite and the most affected by acid and salt. Where it can notice the stress of saw coir polyester composite decrease by rate 15.54% after immersion in acid for 18 days as shown in figure7

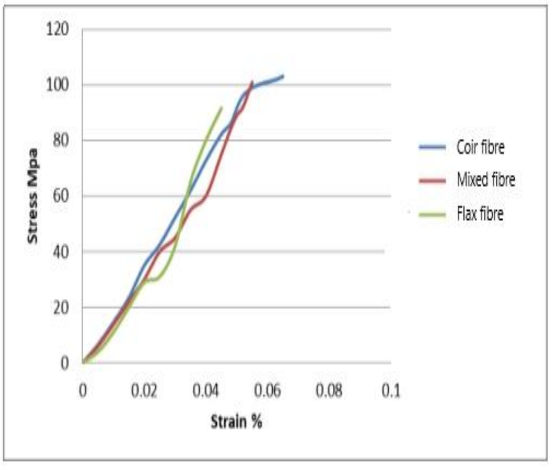

Figure:7 Stress-Strain curves of composites with Acetic acid (CH3COOH) effect

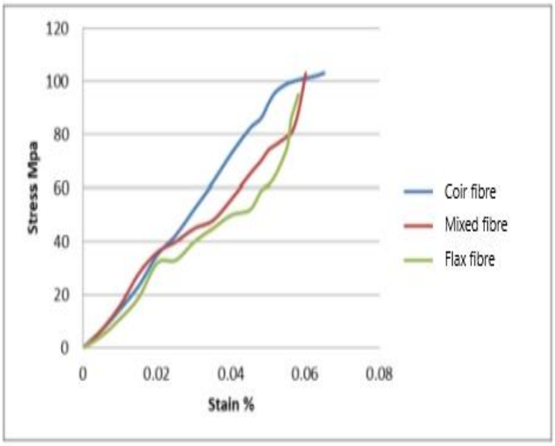

Figure:8 Stress-Strain curves of composites with salt solution (Nacl) effect

Table:1 Results for stress – strain curves for all samples.

Samples	Coir-Polyster		Treated coir polyester composite		Flax polyester composite	
	Stress Mpa	Strain %	Stress Mpa	Strain %	Stress Mpa	Strain %
Without effect	103	0.065	95.6	0.055	105.4	0.063
Water effect 9 days	101.39	0.057	89.56	0.049	103.18	0.058
Water effect 18 days	96.2	0.063	83.172	0.043	93.76	0.051
CH3COOH effect 9 days	100.86	0.055	85.3	0.0421	103.50	0.059
CH3COOH effect 18 days	91.5	0.045	80.74	0.038	90.886	0.05
Nacl effect 9 days	102.8	0.06	88.52	0.052	103.98	0.052
Nacl effect 18 days	94.85	0.058	81.92	0.041	91.49	0.048

In the table (1) it can be seen all the results for stress and strain curve for all samples. also it can be seen the above table that the strain is decreased by different percentage under effect water ,salt and acid.

The Hardness

When reading the values in the Table 2 it can be observed is a different behavior of the samples when adding natural fiber improved the hardness of polyester and also when immersed all samples in the salt where it was noticed that the mechanical properties (hardness) improves while the hardness for the samples that were immersed in (water and salt) reduced.

Table:2 The value of Hardness of all Samples.

	NO steeping	Steeping in water		Steeping in salt (Nacl) day		Steeping inAceic acid (CH3COOH) day	
		9th day	18th day	9th day	18th day	9th day	18th day
Coir polyester	32.68	29.33	27.183	37.3	39.6	31.3	28.16
Coir	36.6	31.233	25.1	33.33	38.2	33.2	26.75
Flax	38.68	34.733	28.967	38.8	38.7	33.8	28.85

5.0 Conclusions

Fibre degradation in salt and acidic affects focused on the experimental study to check the natural fibre sustainability. Addition of natural fibres to concrete needs a clarity about the effects on fibres for economical and sustainable structures preparation. The percentage addition of both fibre addition to concrete have to investigate in future applications as degradability less in treated fibres.

6.0 REFERENCES

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