EXPERIMENTAL INVESTIGATION ON PHYSICAL AND MECHANICAL PROPERTIES OF LOCALLY AVAILABLE NATURAL FIBERS.

Raj Govind Chandrasekaran[1], Dr Gudimella Ramakrishna[2]

1 Research Scholar, Department of Civil Engineering, Puducherry Technological University, Puducherry.

2 Professor, Department of Civil Engineering, Puducherry Technological University, Puducherry.

Abstract

The need of the hour on the growing demand for easy accessibility, availability, strength, less weight, eco-friendly and other human-desired materials for day-to-day construction, had focused the research on natural fibers and their properties. Their arise helped to achieve eco-friendly bioscience by establishing healthy and prolonged life with style. Their abundance existence in nature and especially in the local market of the common man proved them worthy substitutes for manufactured materials on excessive resource consumption. The major disadvantage of natural fibres application was researched to be the bonding between fiber surface and matrix, to overcome such difficulty. The result of treatment on surface roughness and fiber fibril changes was linked to tensile strength improvement and water absorption reduction. Many works were done to study the work of NF based on their tensile strength and absorption properties by altering their medium of immersion or using the medium as a modification. The current work focused on the physical and mechanical properties of locally available economic fibers such as Sisal, Coir, Banana and Palmyra fibers and reported their effect under consecutive 15 cycles immersion of alternate wet–dry cycles on their diameter, water absorption, and tensile strength.

DOI: 10.48047/ecb/2023.12.Si8.629

Introduction

Natural fibers (NFs), the historically prevailing amicable material for human civilization, had found their all-around means in the form of shelter, protection, clothing, materials for communication and commutation, and all walks of day-to-day life support due to their easy availability and ease of use. The ancient sculptures and notes are living examples of NF's impact on the human lifestyle. The civilizational development with an urge for shelter and comfort had also shaped the way these fibers were used in daily life including also the field of medicine and allied fields [9]. The need for sophistication and fashion gave birth to concept-moldable material, concrete, in the construction field. Initially, though the NFs lacked a place of human interest, research works of the later 19th century showed the importance of living and being natural giving rebirth to an innovative way of NF usage [2,21].

These abundantly available, age-old, eco-amicable and human-friendly materials, [14,15], acted as a potentially effective alternative for synthetic fibers in most applications [17]. These readily available fibrous materials are made with low-cost extraction from plant portions [10]. In composites, they decreased non-renewable energy source usage, pollutant emissions and greenhouse gas emissions, and ensured energy recovery and also auto-degradability [12,16,24].

A single NF comprises 10–40 fibrils bounded by pectin in the middle lamella. The **central lamellar portion** includes *lignin, hemicellulose* and *pectin*, the inner portion with cell walls—**at the first level** (*cellulose–hemicellulose* bundle) and **on the secondary level** (*cellulose* — *β*–1,4 bonded glucose subunits with a repeating ***cellobiose*** base unit). This cellulose imparted strength and durability to concrete through microfibril chains integrated with hydrogen bonds [1].

The research investigation identified the root cause, the hydration (excess moisture content), behind fibre degradation, causing gradual degradation of embedded fibre. Primarily this degradation hydrolyzed lignin and hemicellulose, then stripped cellulose microfibril and at last degraded the amorphous portions in cellulose chains [27].

The works on the degradation of fiber observed with XRD analysis, thermal analysis and microstructure analysis, showed that the *non-cellulose impurities* removal from *interfibrillar regions* increased fiber tensile strength. While the latter with close-packed cellulose chains was the reason for better deformation, load sharing and extended pre-break strength; the former dispersed the latter's stiffness and brittleness, crashed the accumulated strength through the mineralization and alkaline hydrolysis [2,6,22] processes and exposed after corroding the cellulose to the high alkaline pore solution [23]. Due to this poor degradation restraint, their lost strength exposed them to aggressive environmental conditions [3,15]. This above loss of fibre was due to the degraded alkaline–mineral environment of the cement. The adhesive grip on the surface due to chemical constituents of natural

fibre paved the solution for future development in their reinforced composites [7,8]. The above issue was addressed by either matrix (medium) modification to reduce or remove alkaline compounds, or by fiber modification with physical and chemical treatment, thereby improving permanency [25,26].

Among the failures of fiber-induced construction materials, the critical one is fiber damage, as NF are ribs of the structure system. Based on the above discussion, the level of water retained or hydrolyzed played a critical role in the reaction to an alkaline medium or substrate in composite deterioration. Hence the focus of this work was exclusively given to understanding NF reaction at basic alkaline, i.e., a neutral, level of medium (portable water with pH ~7) over a prolonged duration of cycles. Here, the absorption behaviour of four notable local fibers, such as coir, sisal, palmyra and banana, with economic consideration was studied. They were exclusively compared for their reaction in water medium from its fully absorbed state and to completely dry state and further diameter was noted both for 15 cycles (before and after each cycle) and at initial–final times of the entire 15 cycles along with diameter for 15 cycles (i.e., physical properties) [5]. The tensile strength (i.e., mechanical properties) was also studied for NFs whose diameter before and after the entire test was noted [20, 28].

MATERIAL AND METHODS

Fibers And Their Processing

The four economical and easily available NF among were selected for this work(viz., Sisal, Palmyra, Coir and Banana). These fibers were purchased from the local markets of Tamil Nadu (Sisal & Coir—Sri Balaji Coir Industries, Dharmapuri; Palmyra fibers—S Pandian Palm fibers and stalks, Tirunelveli; and Banana—Fiber Region, Valsarvakam, Chennai).

Figures 2(a) and 2(d) show the Sisal (Fig. 2(a)) and Banana (Fig. 2(d)) fibers are extraction after fiber decotification and manual (with hand) stripping of raw threads(Sisal and Coir), and figures 2(b) and 2(c) show extraction through retting and defining of fiber (Palmyra and Coir.

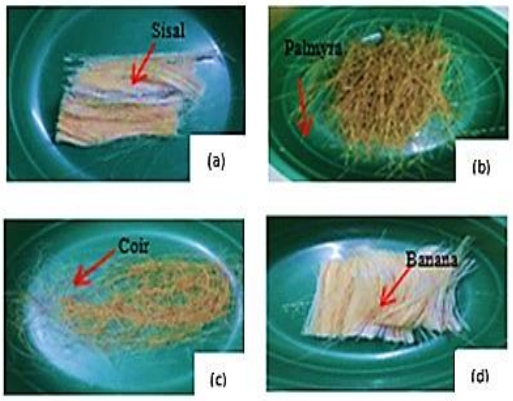


Figure 1. Processed natural fibers (a) Sisal, (b) palmyra, (c) coir, and (d) banana.

The impurities in extracted fibers were washed under tap water and sun-dried for about 8 h.

These processed and dried fibers were deciphered and cut 50 mm length manually and finally weighed (~5 g).

Water

The portable water, used for testing fibers and, was ensured free from corrosive and chlorine content, and noted a pH value of 6.7.

Characterization

Diameter

The diameters of fifty each fiber with 10 cm length were measured with the aid of Digital Vernier Caliper. The diameter was made on each of four fibers at three critical spots—two ends and middle portion, along the length of the fiber. Then the average obtained was from each of fifty numbers of four fiber individually, as produced in below Table 1.

TABLE 1. The 15 cycle-diameter of NFs (Sisal, Palmyra, Coir and Banana) before (B), at 24 hr. (24) and after (A) immersion.

NAME OF FIBER		SISAL			PALMYRA			COIR			BANANA		
IMMERSIO		B	24	A	B	24	A	B	24	A	B	24	A
	1	0.111	0.113	0.112	0.389	0.395	0.393	0.150	0.151	0.151	0.057	0.069	0.061
	2	0.104	0.105	0.104	0.392	0.401	0.395	0.158	0.159	0.166	0.060	0.070	0.064
	3	0.103	0.105	0.104	0.398	0.406	0.402	0.142	0.143	0.144	0.064	0.075	0.069
	4	0.103	0.108	0.103	0.395	0.403	0.398	0.138	0.141	0.141	0.079	0.093	0.085
	5	0.104	0.106	0.105	0.391	0.398	0.395	0.137	0.139	0.142	0.085	0.096	0.090
	6	0.102	0.106	0.113	0.382	0.387	0.395	0.139	0.140	0.140	0.080	0.090	0.087
	7	0.098	0.102	0.101	0.378	0.383	0.390	0.134	0.136	0.153	0.076	0.086	0.082
CYCLE	8	0.092	0.097	0.097	0.374	0.382	0.391	0.128	0.131	0.142	0.072	0.085	0.082
	9	0.086	0.092	0.091	0.370	0.381	0.389	0.123	0.127	0.136	0.068	0.084	0.080
	10	0.081	0.088	0.093	0.365	0.377	0.390	0.117	0.122	0.119	0.062	0.080	0.082
	11	0.077	0.085	0.084	0.361	0.374	0.382	0.113	0.120	0.120	0.058	0.077	0.074
	12	0.071	0.080	0.079	0.355	0.369	0.377	0.108	0.114	0.115	0.053	0.072	0.068
	13	0.069	0.078	0.077	0.353	0.367	0.374	0.105	0.113	0.112	0.050	0.070	0.066
	14	0.064	0.074	0.073	0.348	0.363	0.370	0.100	0.108	0.104	0.045	0.066	0.062
	15	0.057	0.067	0.066	0.341	0.356	0.364	0.094	0.101	0.099	0.039	0.059	0.055

Tensile strength The NFs are tested for their tensile strength with the help of ASTM D3379 guidelines. Initially, the fibers are fixed in a spring testing machine of 1kN capacity and the test was conducted at a constant pace at speed of 2 mm min^{-1}. These fibers are prepared in such a way that their extremes were glue-

fixed on a cardboard sheet, which has a slit open for setting the gauge length, and the place of load impact. The setup image of fiber on the sheet was shown in Figure 2**.** The sheet was cut as shown in the figure after fixing the machine. After setting up, the load at the point where fiber gets broken was noted. The tensile strength of the fiber was calculated subsequently from the formula,

$$\sigma = \frac{A}{P} \qquad (1)$$

where P= load at failure and area of fiber $A = \frac{\pi D^2}{4}$.

Table 1. The 15 cycle-diameter of NFs (Sisal, Palmyra, Coir and Banana) before (B), at 24 hr. (24) and after (A) immersion.

The experiment was conducted on each fiber with various gauge lengths (GL) of fibers, namely 10, 15, 20, 25, 30, 35, 40, 45 and 50 mm with ten specimens for each length.

Water absorption The 24 h oven-dried NFs at 60 °C were cooled down to room temperature before the commencement of the procedure. After that, they were immersed in normal water and their surface was saturated finally the dry weight was taken after 30 minutes. The processed fibers (sisal, coir, palmyra and banana) of 5g dry weight were taken in a clean, dry box with the provision of an airtight lid and checked for their initial weight.

- **Wet cycle**

  The fibers were filled with a soaked-in box such that level of water is slightly above their occupied level in the box, which was maintained throughout the wet cycle for all 15 cycles (Figure 3). The soaked fibers were removed initially after 5 min, and were pressed dry gently with a clean, dry cotton cloth and carefully weighed (W_2 @ 5 min). They were soaked again in water as before and the corresponding time lapse during removing from the box to replacing again was also noted. They were weighed every five minutes up to 60 min, marking the *initial wet state* of cycle 1. After an initial 60 min, they were weighed similarly, with the difference being 1 h interval instead of 5 min, for the remaining seven or eight hours of the day. After the last reading, they were weighed similar manner on the next day at the same time as the beginning of the experiment. This set of weights from the initial 60-minute reading to the final 24-hour reading, was named *final wet state* of cycle 1.

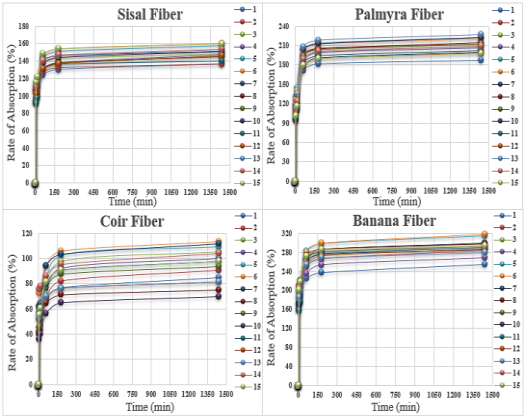


Figure 2. Rate of water absorption in natural fibers. (a)Sisal (b)palmyra (c)coir (d)banana.

- **Dry cycle**

  The 24 h soaked fibers of the wet cycle, were pressed dried lightly with clean dry cotton clothes and weighed giving *initial dry weight* (*@ final wet state*) of cycle 1(Day 1). They were placed in a partially closed box to avoid rapid moisture loss with minimal dry air flow. After five minutes, they were weighed as in the wet stage and placed back inside the partial-closed box. Then similarly weighed for every five-minute interval up to 60 minutes, followed by every one-hour interval after the 60-minute weights till the end of Day 1 (giving value at the end of 24th hour).

The entire process is repeated for 15 cycles of wet–dry cycle (Figure4) until they are completely saturated dry at end of Day 4 dry cycle of the 15th cycle when weighed, i.e., the initial dry value (IDW on Day 1 of cycle 1) and final value after dry cycles were almost same. The water absorption (W_{abs}) of fibers was measured from the formula given below,

$$W_{abs} = \frac{W_T - W_I}{W_I} \times 100 \qquad (2)$$

where W_I is the initial weight of the fiber and W_T is the weight of the fiber at a period T.

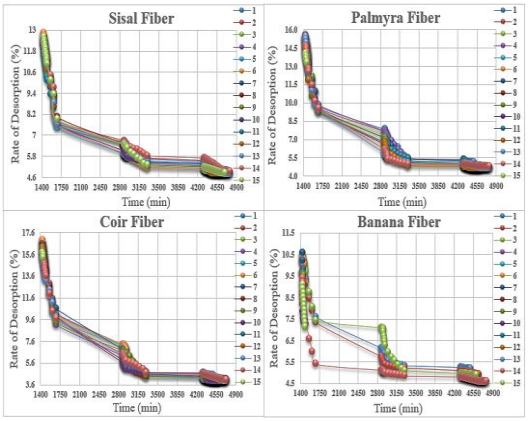


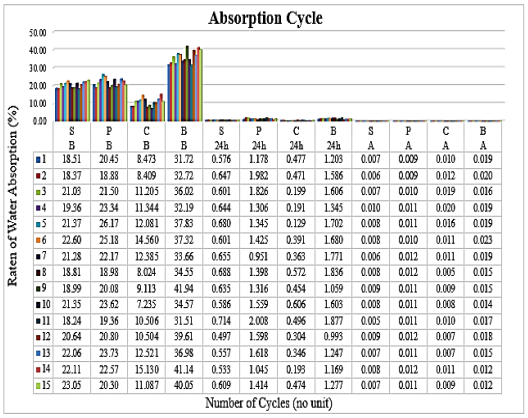
Figure 3. Rate of water desorption in natural fibers. (a)Sisal (b)palmyra (c)coir (d)banana.

Result And Discussion

Water absorption The observation below figures shows the water absorption and desorption periods of 15 cycles of fibers for all three phases of each cycle under normal room temperature. The experimental investigation shows a relative increase in absorption of fibers in the wet state followed by a gradual fall in the rate of moisture content of fibers during the dry state, and with a gradual fall in either absorption and desorption in fibres from those on the initial cycle to those on 15th cycle. Thorough visualization of picto-graphic data is presented in Figure. 5, it is observed that the rate of moisture content possessed an *inverse relation* to that of several cycles from all three phases of

absorption/ desorption. The absorption results are in correlation with the data [4,11,18,19]. The increasing trend with an increase in wet–dry cycles is due to the increase in moisture by the non-cellulose impurities in the interfibrillar region. The drastic falling trend with each phase is due to saturation in the moisture absorption capacity of fiber and the impurities in the interfibrillar region.

The sketch also shows the variation of moisture content rate ranges with values of 18–23%, 0.49–0.71% and 0.0054–0.0099% for Sisal fibres, 18–26%, 0.95–2.006% and 0.0086–0.0123% for Palmyra fibres, 7–16%, 0.12–0.61% and 0.0050–0.0200% for Coir fibres, and 31–42%, 0.99–1.88% and 0.0117–0.0230% for Banana fibres at initial day, after initial up to 24th hour and at after 24th-hour absorption cycle respectively. Further, it shows a minimum absorption of 7.23% for Coir (Cycle 11), 0.1294% for Coir (Cycle 5) and .0050% for Coir (Cycle 8) on the initial day, after initial up to 24th hour and after the 24th absorption cycle respectively, which is closely followed by Sisal fibers. The excess absorption can be noted from Banana fibers followed by Palmyra fibers. This variation is reliant on nature and the number of impurities possessed by each type of fiber.



	S B	P B	C B	B B	S 24h	P 24h	C 24h	B 24h	S A	P A	C A	B A
1	18.51	20.45	8.473	31.72	0.576	1.178	0.477	1.203	0.007	0.009	0.010	0.019
2	18.37	18.88	8.409	32.72	0.647	1.982	0.471	1.586	0.006	0.009	0.012	0.020
3	21.03	21.50	11.205	36.02	0.601	1.826	0.199	1.606	0.007	0.010	0.019	0.016
4	19.36	23.34	11.344	32.19	0.644	1.306	0.191	1.345	0.010	0.011	0.020	0.019
5	21.37	26.17	12.081	37.83	0.680	1.345	0.129	1.702	0.008	0.011	0.016	0.019
6	22.60	25.18	14.560	37.32	0.601	1.425	0.591	1.680	0.008	0.010	0.011	0.023
7	21.28	22.17	12.385	33.66	0.655	0.951	0.363	1.771	0.006	0.012	0.011	0.019
8	18.81	18.98	8.024	34.55	0.688	1.398	0.572	1.836	0.008	0.012	0.005	0.015
9	18.99	20.08	9.113	41.94	0.635	1.316	0.454	1.059	0.009	0.011	0.009	0.015
10	21.35	23.62	7.235	34.57	0.586	1.559	0.606	1.603	0.008	0.011	0.008	0.014
11	18.24	19.36	10.506	31.51	0.714	2.008	0.496	1.877	0.005	0.011	0.010	0.017
12	20.64	20.80	10.504	39.61	0.497	1.598	0.304	0.993	0.009	0.012	0.007	0.018
13	22.06	23.73	12.521	36.98	0.557	1.618	0.346	1.247	0.007	0.011	0.007	0.015
14	22.11	22.57	15.130	41.14	0.533	1.045	0.193	1.169	0.008	0.012	0.011	0.012
15	23.05	20.30	11.087	40.05	0.609	1.414	0.474	1.277	0.007	0.011	0.009	0.012

Figure 4. Rate of water absorption in natural fibers, (B) 0–5 min, (24) 5–60 min, (A) 1–24 h.

The sketch in Figure 7 shows the decreasing variation of moisture content rate ranges with values of 0.0031–0.002%, 0.0062–0.0003% and 0.0037–0.0002% for Sisal fibres, 0.044–0.002%, 0.018–.0002% and 0.0040–0.0001% for Palmyra fibres, 0.04–0.0005%, 0.0197–0.0001% and 0.0019–0.0001% for Coir fibres, and 0.05–0.003%, 0.012–0.0004% and 0.005–0.0002% for Banana fibres at Day 1, Day 2 and Day 3 of each desorption cycle covering including both before (B) and after drying (A).

Further, it shows a minimum absorption of -0.0019% for Coir (Cycle 7) and -0.0007% for Coir (Cycle 2) on Day 3 on both before and after the desorption cycle, which is

closely followed by Sisal fibers. Here also the excess absorption can be noted from the Banana followed by Palmyra fibers. This variation is reliant on the nature and quantity of impurities possessed by each type of fiber.

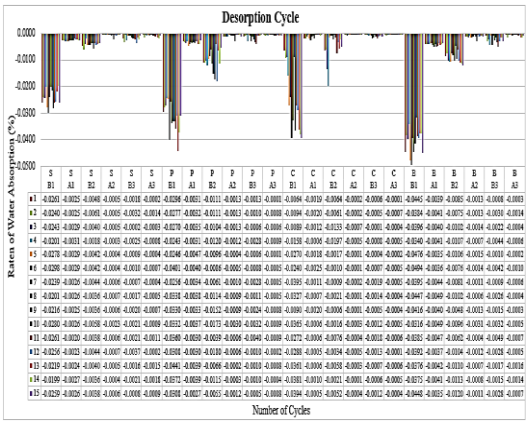
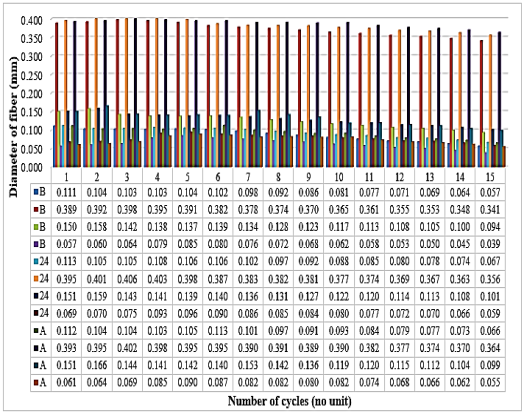


Figure 5. Rate of water desorption in natural fibers, (B) 0–5 min, (24) 5–60 min, (A) 1–24 h.

Diameter

The fibers, fifty numbers each (sisal, palmyra, coir and banana) —marked with special method (1 to 50 without damaging fiber and not peeled or rubbed off (pattern mark))— were averaged with measures at the end and middle with no specific location of measurement, but within same measurement area. The measurement locations were marked with markers to ensure the same measurement location throughout 15 cycles for all 50 numbers on all four fibers.



	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
B	0.111	0.104	0.103	0.103	0.104	0.102	0.098	0.092	0.086	0.081	0.077	0.071	0.069	0.064	0.057
B	0.389	0.392	0.398	0.395	0.391	0.382	0.378	0.374	0.370	0.365	0.361	0.355	0.353	0.348	0.341
B	0.150	0.158	0.142	0.138	0.137	0.139	0.134	0.128	0.123	0.117	0.113	0.108	0.105	0.100	0.094
B	0.057	0.060	0.064	0.079	0.085	0.080	0.076	0.072	0.068	0.062	0.058	0.053	0.050	0.045	0.039
24	0.113	0.105	0.105	0.108	0.106	0.106	0.102	0.097	0.092	0.088	0.085	0.080	0.078	0.074	0.067
24	0.395	0.401	0.406	0.403	0.398	0.387	0.383	0.382	0.381	0.377	0.374	0.369	0.367	0.363	0.356
24	0.151	0.159	0.143	0.141	0.139	0.140	0.136	0.131	0.127	0.122	0.120	0.114	0.113	0.108	0.101
24	0.069	0.070	0.075	0.093	0.096	0.090	0.086	0.085	0.084	0.080	0.077	0.072	0.070	0.066	0.059
A	0.112	0.104	0.104	0.103	0.105	0.113	0.101	0.097	0.091	0.093	0.084	0.079	0.077	0.073	0.066
A	0.393	0.395	0.402	0.398	0.395	0.395	0.390	0.391	0.389	0.390	0.382	0.377	0.374	0.370	0.364
A	0.151	0.166	0.144	0.141	0.142	0.140	0.153	0.142	0.136	0.119	0.120	0.115	0.112	0.104	0.099
A	0.061	0.064	0.069	0.085	0.090	0.087	0.082	0.082	0.080	0.082	0.074	0.068	0.066	0.062	0.055

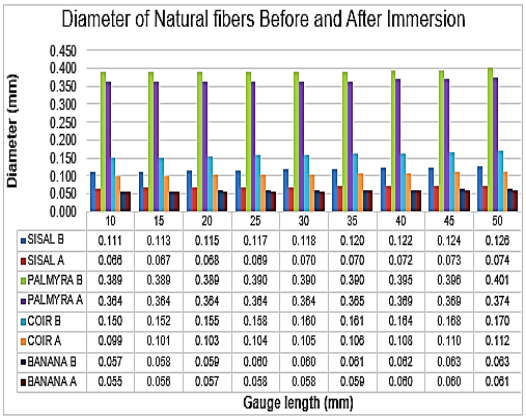
Figure 6. Rate of diameter variation for 15 cycles of natural fibers, (B) 0–5 min, (24) 5–60 min, (A) 1–24 h.

The observation shows the diameter test for fibers for all three stages of each cycle under normal room temperature conditions. The investigational study shows a comparative decrease in the diameter of fibres from the initial cycle of each fiber with corresponding values at the end of the 15th cycle. In the elaborated visualization of graphical data shown in Figure 8, it is noted that the diameter had an inverse relation to that of several cycles and a negligible direct link between stages of immersion. The diameter results are in correlation with the data [4,11,18,19]. The falling trend with a rise in wet–dry cycles is caused by the increase in moisture by the non-cellulose impurities in the interfibrillar region. The drastic falling trend with each phase is due to saturation in the moisture absorption capacity of fiber and the impurities in the interfibrillar region. The declining trend in the fibre content is caused due to severe interlocking by these fibres with the matrix's elevated volume.

The figure also shows the percentage of variation in diameter of -10–13%, 1–15% and -12–7% for Sisal fibres, -5.8–7.0%, 1.2–4.2% and -7–3.5% for Palmyra fibres, 0.2–12.2%, 0.6–7.8% and 10–34% for Coir fibres, and 4.9–29.3%, 10.5–33.8% and -11 to -3.3% for Banana fibres after 24 hours, initial and final days of absorption respectively. The sketch also shows a minimum diameter percentage of -10.63% in Sisal (Cycle 1), 0.60% in Coir and -12.02% for Sisal and a maximum diameter percentage of 29.22% in Banana (Cycle 15), 33.76% in Coir (Cycle 15) and 33.76% for Banana (Cycle 15) after 24 hours, initial and final days of absorption respectively. This variation of diameter is also reliant on impurities contained by the fibers.

Tensile strength

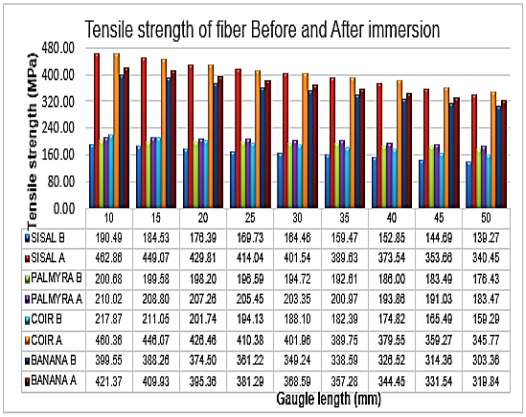
The below data show the tensile strength results of fibers from all three stages/phases of each cycle under normal room temperature. The investigational study showed a ***clear decrease*** in tensile strength in fibres from the prior immersion of each fiber with corresponding values after the 15th cycle. The detailed graphical conception of data shown in Figures 9 and 10 indicated that the strength had an reverse relation to that of gauge span and the least comparison within the length. The results obtained were in correlation with the data [4,11,18,19]. The decreasing trend with an increase in wet–dry cycles and its reason, for both diameter and tensile strength before and after immersion, is due to a similar reason as mentioned for the diameter of all 15 cycles.



	10	15	20	25	30	35	40	45	50
SISAL B	0.111	0.113	0.115	0.117	0.118	0.120	0.122	0.124	0.126
SISAL A	0.066	0.067	0.068	0.069	0.070	0.070	0.072	0.073	0.074
PALMYRA B	0.389	0.389	0.389	0.390	0.390	0.390	0.395	0.396	0.401
PALMYRA A	0.364	0.364	0.364	0.364	0.364	0.365	0.369	0.369	0.374
COIR B	0.150	0.152	0.155	0.158	0.160	0.161	0.164	0.168	0.170
COIR A	0.099	0.101	0.103	0.104	0.105	0.106	0.108	0.110	0.112
BANANA B	0.057	0.058	0.059	0.060	0.060	0.061	0.062	0.063	0.063
BANANA A	0.055	0.056	0.057	0.058	0.058	0.059	0.060	0.060	0.061

Figure 7. Rate of diameter variation for natural fibers using gauge length, (B) 0–5 min, (24) 5–60 min, (A) 1–24 h

The figures show the percentage variation in diameter and tensile strength are in the range of 40.8–41.45% and 142–144.5% for Sisal fibres, 6.4–6.7% and 3.9–4.7% for Palmyra fibres, 33.9–34.2% and 111.2–117.2% for Coir fibres and 3.4–3.7% and 5.4–5.6% for Banana fibres for range of gauge length (10–50 mm). The sketch also shows a maximum percent variation in diameter and tensile strength of **3.421%** (i.e., 0.126 mm before and 0.074 mm after immersion) in Sisal fiber and **142.98%** (i.e., 190.49 MPa before and 462.86 MPa after immersion); similarly minimum values of **3.442%** (0.057 mm before and 0.055 mm after immersion) in Banana and **5.434%** (i.e., 303.36 MPa before and 319.84 MPa after immersion) in Banana fibers. These variations are due to a similar reason for the level of absorption done by the inbound impurities.



	10	15	20	25	30	35	40	45	50
SISAL B	190.49	184.53	176.39	169.73	164.46	159.47	152.85	144.69	139.27
SISAL A	462.86	449.07	429.81	414.04	401.54	389.63	373.54	353.66	340.45
PALMYRA B	200.68	199.58	198.20	196.59	194.72	192.61	188.00	183.49	176.43
PALMYRA A	210.02	208.80	207.26	205.45	203.35	200.97	193.86	191.03	183.47
COIR B	217.87	211.05	201.74	194.13	188.10	182.39	174.82	165.49	159.29
COIR A	460.36	446.07	426.46	410.38	401.96	389.75	379.55	359.27	345.77
BANANA B	399.55	388.26	374.50	361.22	349.24	338.59	328.52	314.36	303.36
BANANA A	421.37	409.93	395.36	381.29	368.59	357.28	344.45	331.54	319.84

Figure 8. Rate of tensile strength variation for natural fibers using gauge length, (B) 0–5 min, (24) 5–60 min, (A) 1–24 h

Conclusions

The experimental investigation forecasted the following outcomes achieved in the following subsequent inferences for all four kinds of fibers:

1. The rate of absorption and desorption, and diameter of fibers studied over a period of 15 cycles showed a falling pattern of Coir followed by Sisal, Palmyra and finally Banana fibers at last. This is due to higher moisture retention capacity achieved by their lesser impurities amount and more elastic cell wall in Coir and Sisal fibres as compared to Palmyra and Banana.
2. The Coir fiber followed by Sisal fibers with maximum absorption rate (capacity) and average desorption rate was best suited for their usage in matrix medium.
3. The diameter of local economic fibre reinforced mortars got reduced both with several cycles and phases of moisture loss or gain.
4. The coir fiber (0.20–33.8%) alone showed a positive % variation in diameter and with maximum moisture retention after immersion, followed by Sisal and Palmyra fibers. The Banana fibers with negative % variation after immersion were observed to have a high risk for corrosion of fiber or sudden failure on the subject to the same load for all four fibers.
5. The diameter and tensile strength of Sisal followed Coir fibers with maximum % variation makes them the best suit for usage in any matrix medium.
6. The fiber on close observation of their gauge length showed that maximum gauge length (50 mm) gave a minimal tensile strength among its peers, and vice versa.

The above findings show that the Coir fibers and Sisal fibers exhibit a notably good tensile strength, excellent moisture retention capacity and lesser diameter-c loss than Palmyra and Banana fibers. Further, the economic range of fiber gauge length was observed to be 10–20 mm. Further research is required in the event of the Palmyra and Banana fibres to regulate their optimal content to the extreme level. Future studies on the minuscule level can forecast immense exposure on the primary cause of strength variation. Future work to be focused on understanding similar concepts in each cycle and studying the microscopical level variation in them.

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