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EVALUATION OF WATER ABSORPTION BEHAVIOUR OF EPOXY-GLASS FIBER COMPOSITES FILLED WITH RICE HUSK ASH

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ABSTRACT

In present work, Rice Husk Ash (RHA) is an industrial waste produced from the combustion of rice husk is used in varying proportions of 0 wt%, 2.5 wt%, 5 wt%, 7.5 wt%, 10wt% as filler material for the fabrication of epoxy based (matrix phase) E-Glass fiber reinforced hybrid composites by manual hand lay-up process. E-Glass fiber composition is kept constant at 50 wt% and epoxy resin composition is varied accordingly. After fabrication, the composite slabs are cut into specimens as per ASTM 570 standard to estimate the water absorption rate of different specimens by immersing them at time intervals of 24, 48, 72, 96, 120 and 144 hours in various waters: distilled water, mineral water and ground water.

The composite filled with 2.5 wt% of RHA has less moisture absorption rate compared to other composites. Pure composite at 0 wt% of RHA has maximum moisture absorption rate, when immersed in distilled water. Similarly, the composite filled with 2.5 wt% of RHA has less moisture absorption rate and the composite filled with 7.5 wt% of RHA has maximum moisture absorption rate compared to other composites when they are immersed in mineral water. Same scenario is observed in the composites when they were immersed in ground water. From the results of water absorption behaviour of composites it is suggested that they can be used for manufacturing the hulls, ships, radiators and submarines.

Keywords: Rice Husk Ash (RHA), Water absorption rate, E-Glass fibre and Epoxy resin

INTRODUCTION

Polymer composites are combination of two (or) more physically distinct materials of different properties to get the tailor made or desired properties. These composites are mainly classified into three types: Polymer matrix composites, metal matrix composites and ceramic matrix composites [1-4]. Coming to the polymer matrix composites, they consist of matrix phase and reinforcements phase. In present investigation work, epoxy resin is considered as matrix phase, E-glass fiber/RHA as reinforcements [5-7]. Here, the matrix phase safeguards the reinforcement from environmental effects and it transfer the load applied on the matrix phase to reinforcement phase and reinforcement phase bears the load [8-11].

Rice husk is an industrial by-product which is used as a fuel to produce the electricity. After combustion of rice husk, RHA is produced. The disposal of RHA causes serious environmental effects and it involves huge costs. To overcome these problems the rice husk ash is being used for construction works such as roads, building and brick preparation. Now, RHA can be used as filler material in the preparation of E-glass fiber reinforced epoxy bases composites. It may enhance the physical, mechanical, thermal and water absorption properties.

MATERIAL AND METHODS

The materials and methods used in this experimentation are represented in Figure 1.

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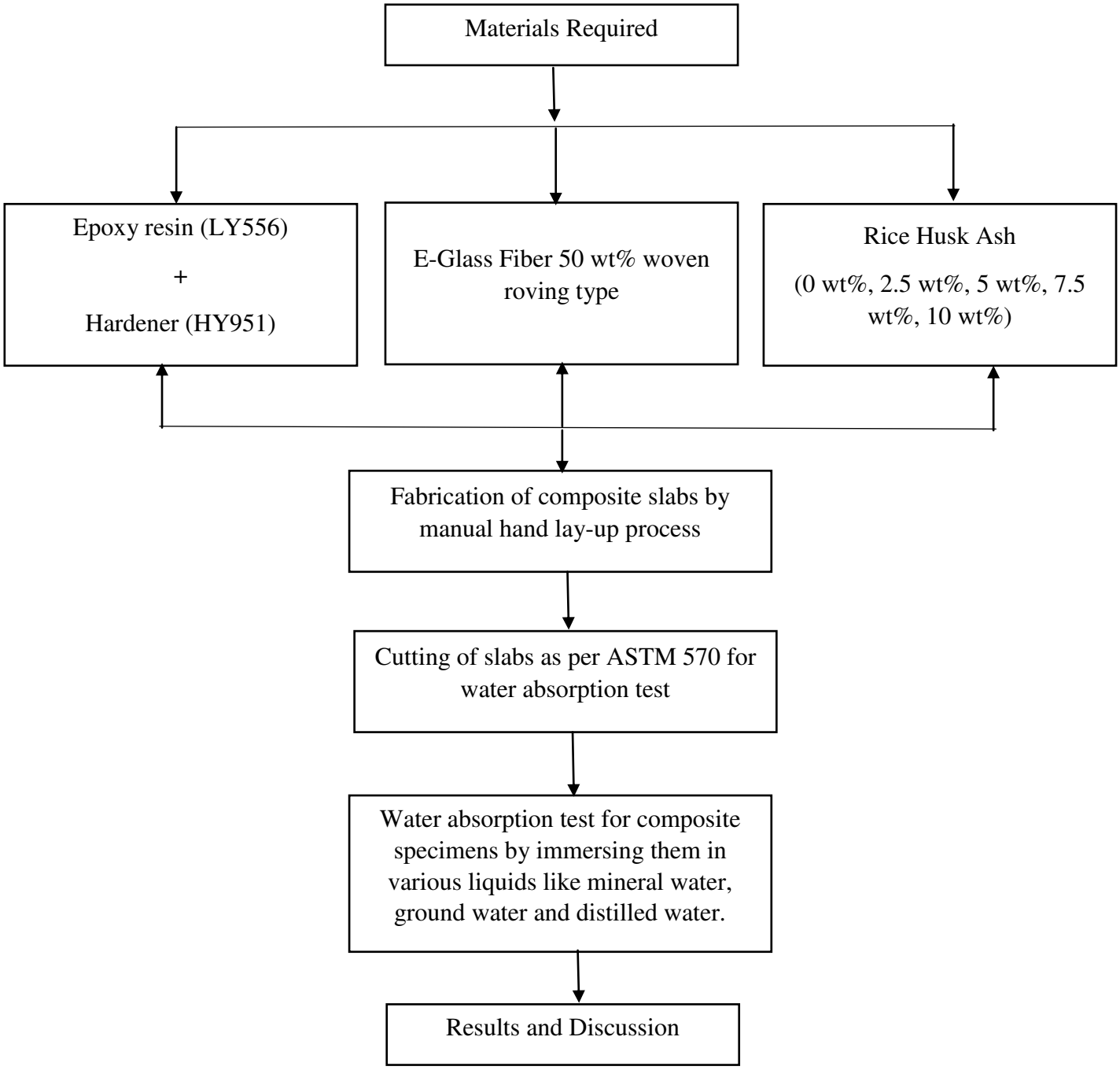

Figure 1: Flowchart for Materials and Methods

- E-Glass fiber and epoxy resin are supplied by the Kotson Engineering Corporation and rice husk is collected from Venkateshwara Rice Industries Limited. The raw materials used for composite preparation are shown in Figure 2.

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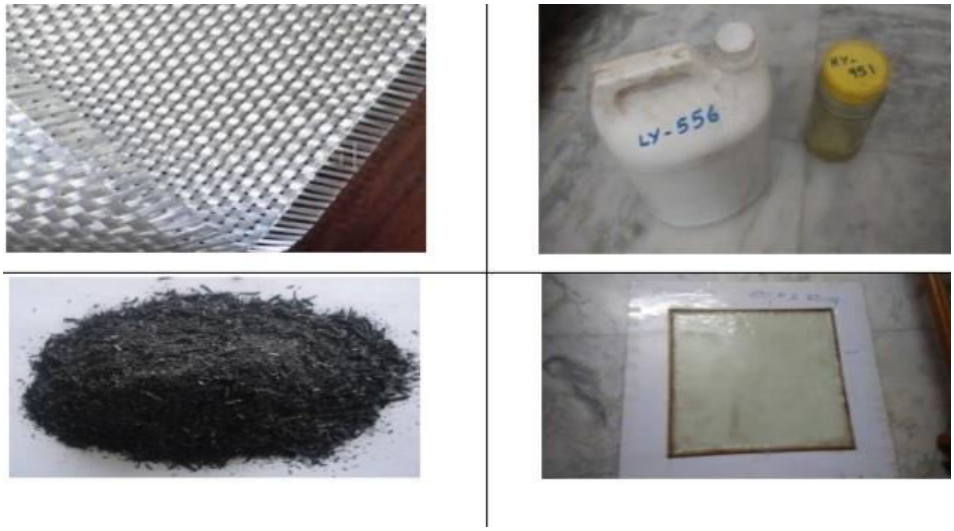

Figure 2: Raw Materials Required for the Preparation of Composite

- As per the composition raw materials are prepared for fabrication. The details of elemental composition are shown in Table 1.

Table 1: Composite Designation and Composition

S.No	Composite Designation	Composition
1	E50G50	50 wt% Epoxy + 50 wt% Glass Fiber
2	EG50RHA2.5	47.5 wt% Epoxy + 50 wt% Glass Fiber+ 2.5 wt% RHA
3	EG50RHA5	45 wt% Epoxy + 50 wt% Glass Fiber + 5 wt% RHA
4	EG50RHA7.5	42.5 wt% Epoxy + 50 wt% Glass Fiber + 7.5 wt% RHA
5	EG50RHA10	40 wt% Epoxy + 50 wt% Glass Fiber + 10 wt% RHA

- Fabrication of composite is done by manual hand lay process as shown in Figure 3 and 4.

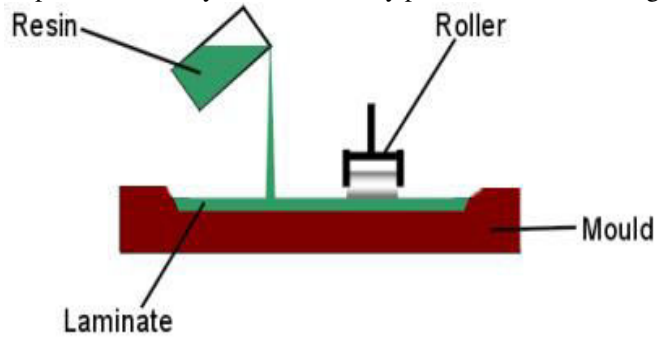

Figure 3: Manual Hand layup process

50wt% epoxy +50wt% glass fiber

47.5wt%epoxy+50wt%glass fibre+2.5wt% Rice Husk Ash

45wt%epoxy+50%glass fiber+5wt% Rice Husk Ash

42.5wt% epoxy +50wt% glass fiber +7.5wt%Rice Husk Ash

40wt% epoxy +50wt% glass fiber +10wt% Rice Husk Ash

Figure 4: Prepared composite slabs

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Composite slabs are cut into specimens of size 25 x 25 x 3.2 mm^3 as per ASTM 570 standards for water absorption test. Distilled water, mineral water and ground water are used to perform water immersion test for various composite specimens in the time intervals of 24 hours, 48 hours, 72 hours, 96 hours, 120 hours and 144 hours. The water absorption rate is the difference of weights of specimen after immersion for particular time interval and before immersion. But here the main concentration is on gain in weight of a particular composite with respect to the time interval of immersion.
The immersed specimens are shown in Figure 5.

Figure 5: Immersion of Specimens in water

RESULTS AND DISCUSSION

From the results of water absorption tests shown in Table 2. It is observed that the composite filled with 2.5 wt% of RHA has less moisture absorption rate compared to other composites. Pure composite at 0 wt% of RHA has maximum moisture absorption rate when immersed in distilled water and from the graph shown in Figure 6, it is observed that maximum gain in weight of the specimen when immersed in distilled water is observed in composites filled with 10 wt% of RHA and minimum weight gain is observed in 2.5 wt% RHA filled composites.

Table 2: Gain in weight of specimen (mg/mm^2) with time when immersed in distilled water

Filler Weight Ratio/Time (Hr)	0%	2.50%	5%	7.50%	10%
0	3.581	3.132	3.266	3.411	3.236
24	3.594	3.139	3.276	3.429	3.256
48	3.607	3.146	3.287	3.448	3.276
72	3.613	3.155	3.302	3.454	3.296
96	3.623	3.163	3.312	3.470	3.311
120	3.639	3.169	3.313	3.467	3.331
144	3.65	3.177	3.314	3.472	3.333

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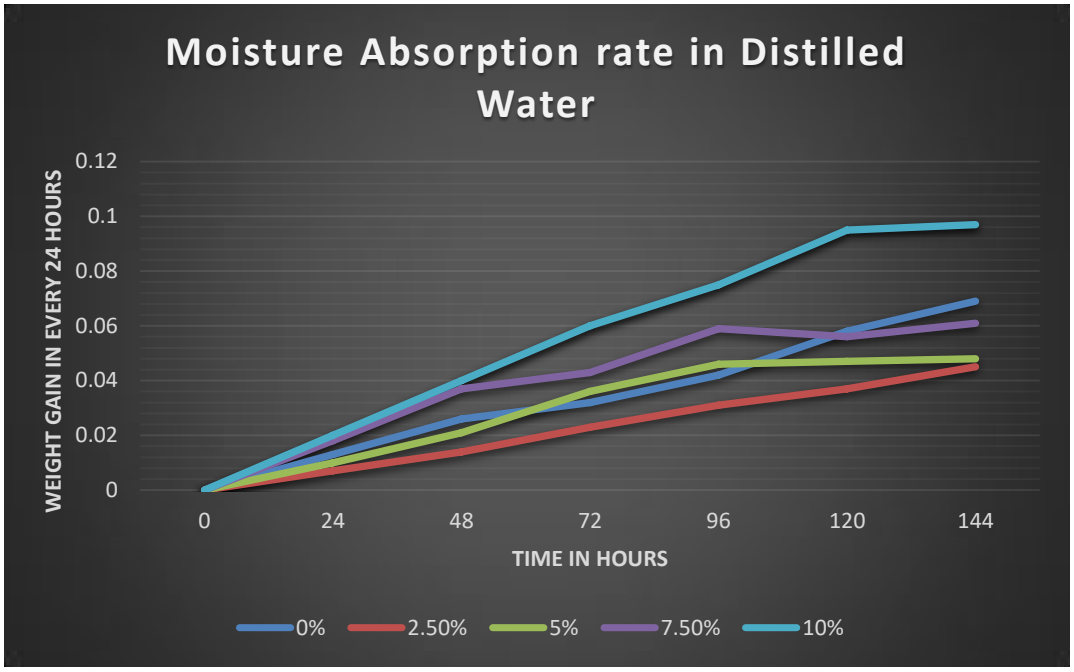

Figure 6: Graph for Time Vs weight gain (mg/mm^2) of specimen due to immersion in distilled water

From the graph shown in Figure 7, it is observed that the maximum gain in weight of the specimen, when immersed in mineral water is observed in case of the composites filled with 7.5 wt% of RHA and minimum weight gain (less absorption) is observed in the composites filled with 10 wt% RHA. Weight of various specimens with RHA wt% and time intervals are shown in Table 3.

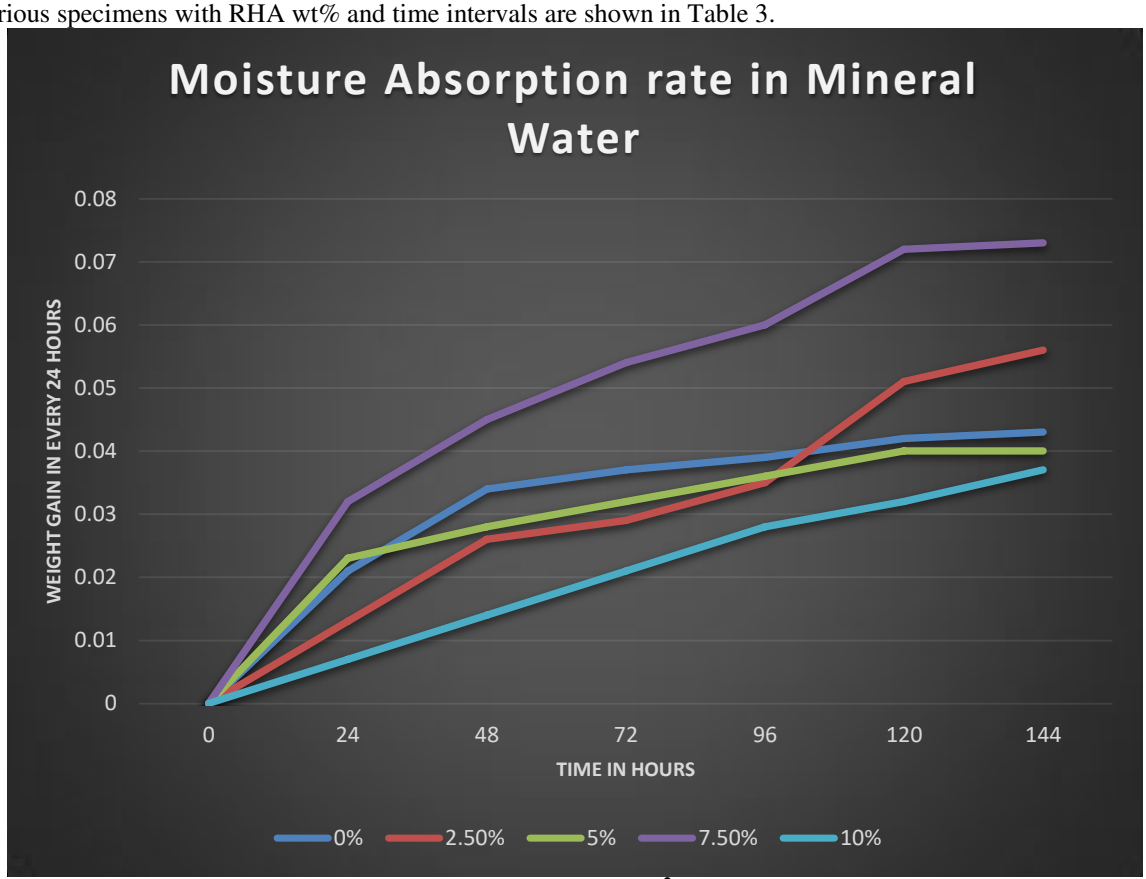

Figure 7: Graph for Time Vs weight gain (mg/mm^2) of specimen due to immersion in mineral water

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Table 3: Gain in weight of specimen (mg/mm^2) with time when immersed in mineral water					
Filler Weight Ratio/Time (Hr)	**0%**	**2.50%**	**5%**	**7.50%**	**10%**
0	3.582	3.064	3.304	3.617	3.338
24	3.603	3.077	3.327	3.649	3.345
48	3.616	3.09	3.332	3.662	3.352
72	3.619	3.093	3.336	3.671	3.359
96	3.621	3.099	3.34	3.677	3.366
120	3.624	3.115	3.344	3.689	3.37
144	3.625	3.12	3.344	3.69	3.375

In the same way water absorption are conducted on the composites by immersing in ground water and test results are tabulated in Table 4. From the graph shown in Figure 8, it is observed that maximum gain in water absorption is observed in the composites filled with 5 wt% RHA and minimum weights gain is observed in the composites filled with 10 wt% RHA.

Table 4: Gain in weight of specimen (mg/mm^2) with time when immersed in ground water					
Filler Weight Ratio/Time (Hr)	**0%**	**2.50%**	**5%**	**7.50%**	**10%**
0	3.223	3.141	3.253	3.799	3.180
24	3.241	3.150	3.276	3.821	3.187
48	3.260	3.160	3.300	3.850	3.191
72	3.265	3.180	3.310	3.858	3.2
96	3.269	3.186	3.314	3.861	3.22
120	3.275	3.190	3.318	3.864	3.233
144	3.278	3.195	3.324	3.864	3.24

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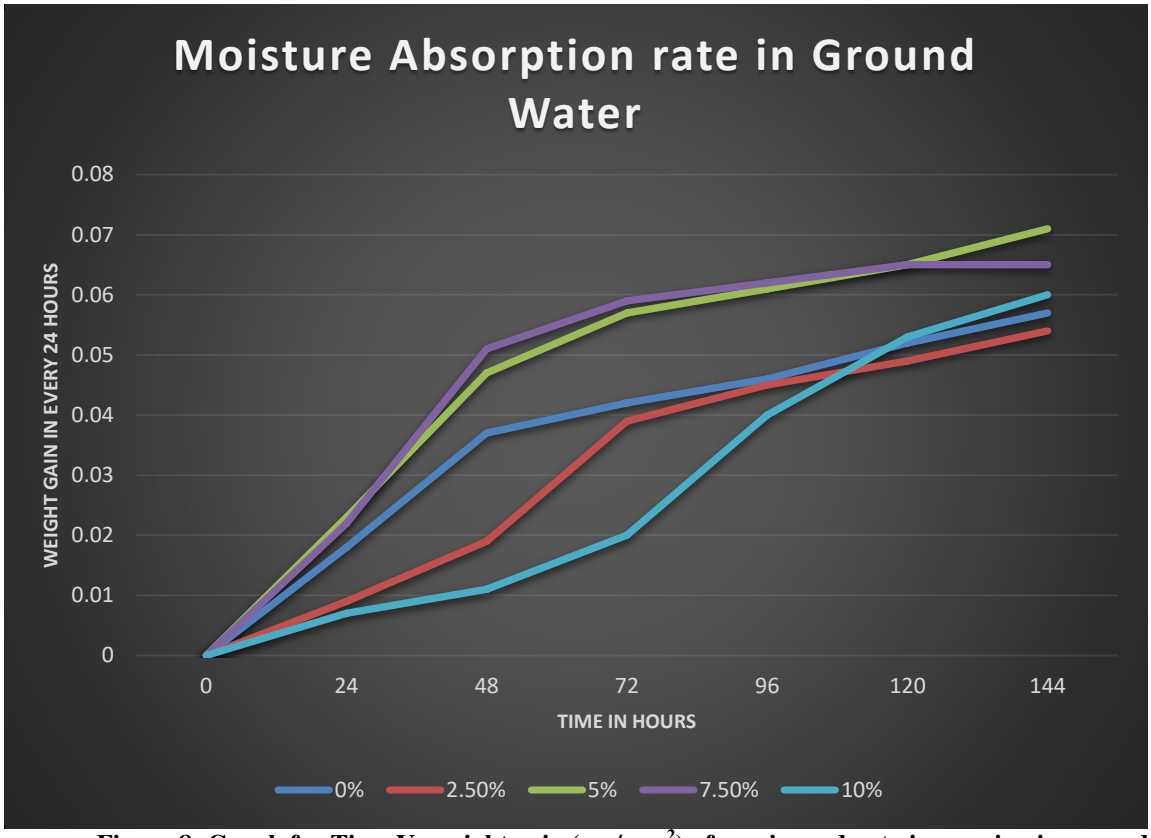

Figure 8: Graph for Time Vs weight gain (mg/mm^2) of specimen due to immersion in ground water

SCOPE FOR FUTURE WORK

- New class of Epoxy based hybrid composites can be prepared by incorporating other bio-wastes of RHA.
- Percentage of water absorption rate can be determined.

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