ABSORPTION AND DESORPTION BEHAVIOR OF SOME CLAY-SANDY PLASTERS REINFORCED WITH NATURAL FIBERS USED FOR STRAW BALE BUILDINGS

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ABSTRACT

The objective of this research work is to study the absorption and dehydration behavior of some clay-sandy plasters reinforced with natural fibers that could be used for straw bale buildings. The plaster materials consisted of soil, sand and chopped straw. Straw is used as a reinforcement fiber for plaster. Three different types of fibers were used; wheat straw, barley straw and sawdust. The dehydration behavior of plaster materials were tested at three different temperatures, 30, 50 and 70°C. The obtained results showed that, the plaster reinforced with fibers dried slower than that without fibers. However, faster drying caused in cracks of the plaster which is not desirable in building surface coating. The moisture absorption rate increased with increasing fibers content and decreased with increased sand content. Moreover, the highest rate of moisture absorption occurred with the plaster reinforced with sawdust. While, the lowest rate of moisture absorption was achieved with the plaster without reinforcement fibers.

Key Words: *drying period, natural plastering materials, soil, sand, straw, straw bale buildings, amount of moisture absorption and moisture absorption rate, reinforcement fibers.*

INTRODUCTION

The reinforcement of mineral binders (cement, concrete or plaster) has been a matter of major concern for several decades. Since then, efforts have been made to replace the usual mineral reinforcing agents (glass or asbestos fibers) by organic agents such as

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sisal, Kraft pulp, or cellulose fibers **(Coutts, 1983 and Coutts et al., 1994).**

Maddison et al. (2009) measured the amount of moisture absorption and desorption in clay–sand plaster mixed with ‘‘fiber-wool’’ from Typha spadixes and chips of Typha and Phragmites. Common cattail (Typha latifolia) and common reed (Phragmites australis) are the most common plants in constructed and semi-natural wetlands for wastewater recipe, as they are highly valued in ecologically oriented construction. The cattail and reed for the experiment were harvested in a wastewater recipe subsurface flow semi-natural wetland and in two free water surface constructed wetlands which showed reliable aboveground phytogenic production over a 5 years period (for Typha, 0.37–1.76 kg DWm^{-2} in autumn and 0.33–1.38 kg DWm^{-2}, and for Phragmites, 0.61–1.32 and 0.61–1.02 kg DWm^{-2}, respectively). The quantity of moisture absorption and desorption was measured in a climatic chamber where the humidity of ambient air was suddenly raised from 50% to 80% (absorption) and reduced from 80% to 50% (desorption). Over 12 h, all of the samples released the same amount of water as they absorbed. The clay–sand plaster samples absorbed slower than they desorbed, whereas the gypsum wallboard required significantly more time for desorption. Added phytogenic fibers gave positive effects by reducing the weight of the clay–sand plaster, accelerating and increasing moisture absorption.

The recommended drying temperatures for gypsum ranged between 35°C and 50°C **(Wirsching, 1984).** Whereas, the gypsum samples after drying over 80°C always exhibited two peaks but separation of these peaks was complicated.

CDI and CRATerre (1995) mentioned that requirements set the material water absorption in the 10–20% range. The gathered data showed that all the processed compressed earth block were in the 10-20% water absorption range. All the fully and partially stabilized materials therefore met the minimum requirements for their use in house construction in respect to this parameter.

Hewlett (1998) reported that the overall absorptivity of aggregates depend either upon a consistent degree of particle porosity or represent an average value for a mixture of variously high and low absorption materials. The higher water absorption of the coarse aggregate resulted from the higher absorption rate of cement mortar attached to the aggregate particles **(Hansen, 1986** and **Lamond 2002)**. Measurement of water absorption using real-time assessment of water absorption (RAWA) was executed by **Vivian et al. (2008)**. The results of the experiment showed that the water absorption rate was high in the first 5 h. This produces up to 80% of the total water absorption. RAWA also helps mix designers in understanding the behavior of recycled aggregate in a concrete mixture.

The main goal of this research work is to utilize three different phytogenic fibers in plasters manufacturing under hot and humid climatic conditions. The objectives of this research work are to study the absorption and desorption behavior of some clay-sandy plasters reinforced with natural fibers that could be used for straw bale buildings.

MATERIALS AND METHODS

Thirty six type recipes of plasters were prepared from different percentages of clay and sand soils mixed with three different types of fibers; wheat straw, barley straw, and sawdust. The percentages of maxing are listed in Table (1). The samples were pressed by hands. Sample dimensions were 5 cm long, 5 cm wide and 5 cm high as shows in Fig.(1).

Table 1: Mixing percentages for experimental recipes.

	Sawdust			Wheat Straw			Barley Straw		
Recipe	Clay (%)	Sand (%)	Reinforcement fibers (%)	Clay (%)	Sand (%)	Reinforcement fibers (%)	Clay (%)	Sand (%)	Reinforcement fibers (%)
A	25	0	75	25	0	75	25	0	75
B	25	25	50	25	25	50	25	25	50
C	25	50	25	25	50	25	25	50	25
D	25	75	0	25	75	0	25	75	0

Fig. (1): Samples prepared for drying test and water absorption.

The materials were put in the drying oven at three different temperatures, 30, 50 and 70^{o}C; and low relative humidity ranged from 2-5%. The sample were weighed each 24 h till reached the constant weight. Moisture content of the materials was measured according to **ASHRAE (1997)** using the following equation:

$$MC.(\%) = \frac{(W_m - W_d)}{W_d} X\ 100 \quad (1)$$

Where, MC, is the moisture content of the materials (%,db), W_m, is the moist weight (kg), and W_d, is the dry weight (kg).

Amount of water absorption:

The samples were dried in the drying oven until reached to a constant weight and then weighed to calculate the dry weight (W_d). The samples were submerged in water for 10 minutes according to **Medjo Eko (2006)** and then taken out and weighed (W_m). The amount of water absorption was calculated using the following equation:

$$\textbf{The amount of water absorption} = W_m - W_d \quad (2)$$

Water absorption rate

Water absorption rate (WAR) was calculated as follows:

$$WAR(\%) = \frac{(W_w - W_d)}{W_d}\ x\ 100 \quad (3)$$

RESULTS AND DISCUSSION

Desorption behavior:

Plaster material reinforced with barley straw fibers

Table (2) shows the moisture content of different recipes of plasters reinforced with barley straw fibres at three different drying temperatures with different times.

Table (2): Moisture content under different drying temperatures for plasters reinforced by barley straw fibers.

Drying time (hr)	Moisture content (%)								
	A			B			C		
	30°C	50°C	70°C	30°C	50°C	70°C	30°C	50°C	70°C
0	70.23	72.04	72.40	34.52	32.70	34.21	20.00	21.02	21.50
24	20.40	7.14	0.60	8.71	1.34	0.32	3.05	0.37	0.09
48	3.45	0.39	0.21	1.25	0.17	0.12	0.40	0.09	0.07
72	0.51	0.18	0.16	0.26	0.06	0.09	0.14	0.08	0.07
96	0.10	0.09	0.08	0.04	0.04	0.03	0.04	0.03	0.07
120	0.08	0.09	0.08	0.03	0.03	0.03	-	-	-

Recipe A

The initial moisture contents (MC) of recipe A at the beginning of the trail were 70.23, 72.04 and 72.40% which dried at 30, 50, and 70°C drying temperatures, respectively. After 24 h, the moisture contents were dramatically decreased and reached to 20.40, 7.14 and 0.60% at the same pervious temperatures, respectively. Meanwhile, the moisture contents after 48 h were reached to 3.45, 0.39 and 0.21%. After 72 h the moisture contents were 0.51, 0.18 and 0.16% at the same conditions. The obtained results revealed that, the moisture content of the plaster material reinforced by barley straw fiber decreased slowly at the lower temperature (30°C), while it sharply declined at temperature of 70°C, for the plasters had lower contents of fibers (recipes B and C) which caused in crakes of the plaster, which is not desirable in the building coating.

Recipe B

The initial moisture contents (MC) of recipe B were 34.52, 32.70 and 34.21 % which were dried at 30, 50, 70°C, respectively. After 24 h, the moisture contents were decreased to 8.71, 1.34 and 0.32% at the same drying temperatures, respectively. While the moisture contents after 48 h were reached to 1.25, 0.17 and 0.12 %. After 72 h the moisture contents were 0.26, 0.06 and 0.09% at the same conditions as shows in table (2). The obtained data evidently showed that, the plaster material reinforced by barley straw fiber dried slowly at temperature of 30°C, while it was faster at 50 and 70°C, with slight differences.

Recipe C

The initial moisture contents (MC) of these plaster types were 20.00, 21.02 and 21.50% which also dried at 30, 50, 70°C, respectively. After 24 h, the moisture contents were decreased to 3.05, 0.37 and 0.09% under the drying temperatures of 30, 50 and 70°C, respectively. After 48 h, the moisture contents were 0.40, 0.09 and 0.07% at the same conditions as shows in table (2). The obtained data indicated that, under drying temperatures of 30, 50, and 70°C, after 24 h, about 48.83%, 64.90%, and 71.80% of the initial moisture contents of recipe A, were, respectively, lost. Whereas, recipe B lost about 25.81, 32.38 and 33.89% of the initial moisture content after the same time at 30, 50 and 70 °C, respectively. Recipe C lost about 16.95, 20.65 and 21.41% of the initial moisture content after 24 h under the same conditions, respectively. At higher temperatures, cracks were observed on the plaster surface, these cracks increased with decreasing the plaster fiber contents.

Plaster material reinforced by wheat straw fibers

The moisture content of three different recipes of plasters reinforced with wheat straw fibers at three different drying temperatures with different times are summarized and listed in Table (3).

Recipe A

The initial moisture contents (MC) of recipe A were 71.71, 72.45 and 72.43% which dried at 30, 50, 70°C, respectively. After 24 h, the moisture contents were decreased to 28.80, 0.78 and 0.48% at the same drying temperatures of 30, 50 and 70°C, respectively. While the moisture contents after 48 h were decreased to 7.82, 0.21 and 0.19% under the same dries temperatures, respectively. The moisture contents after 72 h were 0.92, 0.06 and 0.03% under the same conditions, respectively.

Table (3): Moisture content under different drying temperatures for plasters reinforced by wheat straw fibers.

Drying time (h)	Moisture content (%)								
	A			B			C		
	30°C	50°C	70°C	30°C	50°C	70°C	30°C	50°C	70°C
0	71.71	72.45	72.43	39.24	38.10	38.40	19.78	19.32	20.30
24	28.80	0.78	0.48	14.41	0.81	0.41	2.38	0.23	0.18
48	7.82	0.21	0.19	3.10	0.14	0.12	0.61	0.11	0.10
72	0.92	0.06	0.03	0.42	0.07	0.07	0.34	0.07	0.06
96	0.06	0.04	0.03	0.08	0.07	0.07	0.04	0.03	0.03

Recipe B:

The initial moisture contents (MC) of recipe B were 39.24, 38.10 and 38.40 % which dried at the same drying temperatures, respectively. After 24 h, the moisture contents were reduced to 14.41, 0.81 and 0.41 % under the same drying temperatures, respectively. While, the moisture contents after 48 h were decreased to 3.10, 0.14 and 0.12%, respectively. Whereas, the moisture contents after 72 h, were reached to 0.42, 0.07, and 0.07%, respectively. The obtained results revealed that, the moisture content of the plaster material reinforced by wheat straw fiber decreased slowly at temperature of 30 °C. It seems also that, there was almost no difference between MC obtained under drying temperatures of 50 and 70°C, particularly after 48 h.

Recipe C:

The initial moisture contents (MC) of recipe C were 19.78, 19.32, and 20.30% which dried at the same drying temperatures, respectively. After 24 h, they were decreased to 2.38, 0.23 and 0.18%, respectively. While, the moisture contents after 48 h were reduced to 0.61, 0.11, and 0.10%, respectively.

The obtained results showed that, at 30, 50 and 70°C after 24 h, about 42.91%, 71.67% and 71.95% of the initial moisture contents of recipe A, were, respectively, lost. Recipe B after 24 h lost about 24.83%, 37.29% and 37.99% of the initial moisture contents at 30, 50 and 70°C drying temperatures, respectively. Whereas, Recipe C lost about 17.40%, 19.09 and 20.12% of the initial moisture content after 24 h at the same conditions, respectively.

Plaster material reinforced by sawdust fibers

The moisture content of three different recipes of plasters reinforced with sawdust fibers at three different drying temperatures with different times are summarized and listed in Table (4).

Table (4): Moisture content under different drying temperature for plaster reinforced by sawdust fibers.

Drying time (hr)	Moisture content (%)								
	A			B			C		
	30°C	50°C	70°C	30°C	50°C	70°C	30°C	50°C	70°C
0	75.85	73.50	74.60	36.94	37.49	37.70	19.74	20.10	21.10
24	23.53	1.20	0.58	8.53	0.29	0.21	2.42	0.28	0.18
48	3.22	0.07	0.20	1.34	0.17	0.10	0.40	0.16	0.09
72	0.57	0.02	0.07	0.29	0.10	0.07	0.17	0.11	0.07
96	0.18	0.05	0.05	0.06	0.06	0.06	0.10	0.07	0.07

Recipe A

The initial moisture contents (MC) of recipe A were 75.85, 73.5 and 74.60% which dried at 30, 50, 70°C, respectively. After 24 h, the moisture contents were decreased to 23.53, 1.20 and 0.58% at the same drying temperatures of 30, 50 and 70°C, respectively. While the moisture contents after 48 h were decreased to 3.22, 0.07 and 0.20% under the same dries temperatures, respectively. The moisture contents after 72 h were 0.57, 0.02 and 0.07% under the same conditions, respectively. The obtained results indicated that, the moisture content of the plaster material reinforced by sawdust fiber were slowly reduced at drying temperature of 30°C, while it decreased quickly at temperature of 70°C. It seems that, the drying period at 70°C was very short which caused more crakes on the surface of the plaster.

Recipe B

The initial moisture contents (MC) of recipe B were 36.94, 37.49 and 37.70%, which dried at 30, 50, 70°C, respectively. After 24 h, the moisture contents were decreased to 8.53, 0.29 and 0.21% at the same drying temperatures, respectively. While, the moisture contents after 48 h were, respectively, reduced to 1.34, 17 and 0.10% under the same dries temperatures. The moisture contents after 72 h were 0.29, 0.10 and 0.07% under the same conditions, respectively. The obtained results revealed that, the moisture content of the plaster material reinforced by sawdust fiber were slowly reduced at drying temperature of 30°C, while it decreased quickly at temperature of 70°C. It seems that, the drying period at 70°C was very short which caused more crakes on the surface of the plaster.

Recipe C

The initial moisture contents (MC) of recipe C were 19.74, 20.10 and 21.10% which dried at 30, 50, 70°C, respectively. After 24 h, the moisture contents were decreased to 2.42, 0.28 and 0.18 % at the same drying temperatures, respectively. Whereas. The moisture contents after 48 h were 0.40, 0.16, and 0.09% under the same dries temperatures, respectively. The obtained results showed that, the moisture content of the plaster material reinforced by sawdust fiber decreased slowly at temperature of 30°C. It seems that, there was no big difference between the moisture lost at drying temperatures of 50 and 70°C.

These data also revealed that, under drying temperatures of 30, 50, and 70°C, after 24 h, about 52.32%, 72.30%, and 74.02% of the initial moisture contents of recipe A, were, respectively, lost. Whereas, recipe B after 24 h lost about 28.41%, 37.20% and 37.49% of the initial moisture contents at the same drying temperatures, respectively. While, recipe C lost about 17.32%, 19.82% and 20.92% of the initial moisture contents after 24 h under the same conditions, respectively. Under high drying temperatures, cracks were observed on the plaster surface, these cracks increased with decreasing the plaster fiber contents.

Regression analysis showed that the best relationship between the plaster desorption (D) and fiber contents (FC) was described exponentially as follows: $\mathbf{D = a\,(FC)^{b}}$ **(4)**

The equation constants (a and b) under different drying temperatures for the three different plasters are listed in Table (5) and Figs. (2 – 10).

Plasters without fibers

The average density of the plasters without reinforcement fibers was 1629 kg/m³ for the recipes A, B and C. The initial moisture contents (MC) of recipe C were 15.5, 15.3 and 15.6% which dried under the drying temperatures of 30, 50, 70 °C, respectively. After 24 h, the moisture contents were decreased to 1.6, 0.2 and 0.1 % under the same drying temperatures, respectively. While the moisture content after 48 h were less than 0.1% under all thermal conditions. The obtained results revealed that, under drying temperatures of 30, 50, and 70°C, after 24 h, about 13.90%, 15.10%, and 15.50% of the initial moisture contents, were, respectively, lost. More cracks were observed on the surface of this type of plaster as compared with the other plasters reinforced with fibers.

Table (5): Equation constants and coefficient of determination (R^2) of the relationship between desorption and plaster fiber content under different drying temperatures.

Time, h	Constants								
	30°C			50°C			70°C		
	a	b	R^2	a	b	R^2	a	b	R^2
	Wheat straw fibers								
24	1.287	0.042	**0.94**	0.148	0.026	**0.90**	0.082	0.026	**0.93**
48	0.237	0.047	**0.95**	0.048	0.020	**0.91**	0.047	0.019	**0.92**
72	0.137	0.025	**0.98**	0.043	0.008	**0.92**	0.043	0.008	**0.92**
	Barley straw fibers								
24	1.448	0.035	**0.97**	0.164	0.034	**0.95**	0.058	0.030	**0.95**
48	0.215	0.035	**0.96**	0.040	0.029	**0.99**	0.040	0.022	**0.99**
72	0.103	0.019	**0.94**	0.037	0.019	**0.95**	0.041	0.017	**0.98**
	Sawdust								
24	1.28	0.037	**0.97**	0.108	0.027	**0.83**	0.074	0.026	**0.94**
48	0.22	0.035	**0.97**	0.054	0.023	**0.82**	0.043	0.019	**0.93**
72	0.11	0.020	**0.98**	0.044	0.014	**0.95**	0.043	0.008	**0.92**

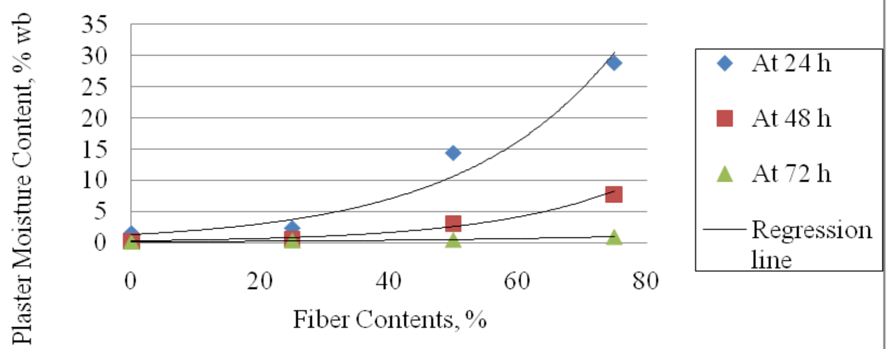

Fig. (1) Moisture content of clay plasters reinforced with different percentages of wheat straw fibers at 30 °C drying temperature.

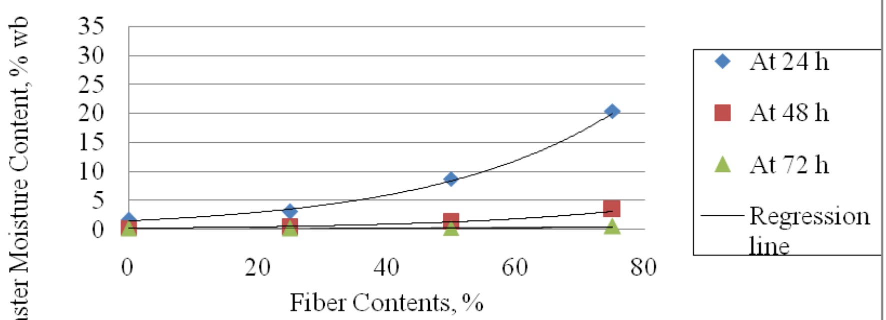

Fig. (2) Moisture content of clay plasters reinforced with different percentages of barley straw fibers at 30 °C drying temperature.

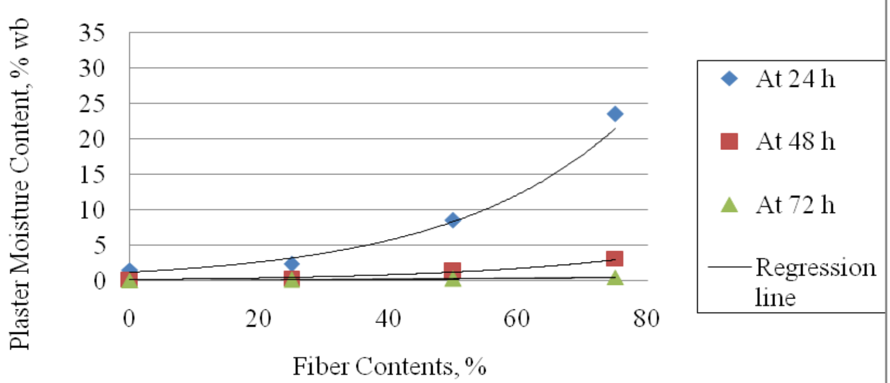

Fig. (3) Moisture content of clay plasters reinforced with different percentages of sawdust fibers at 30 °C drying temperature.

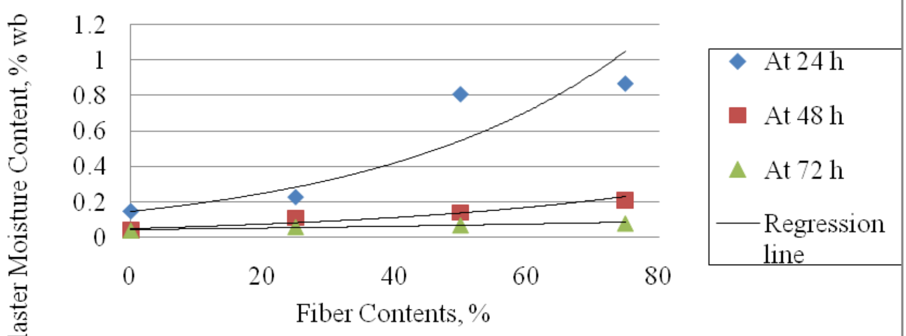

Fig. (4) Moisture content of clay plasters reinforced with different percentages of wheat straw fibers at 50 °C drying temperature.

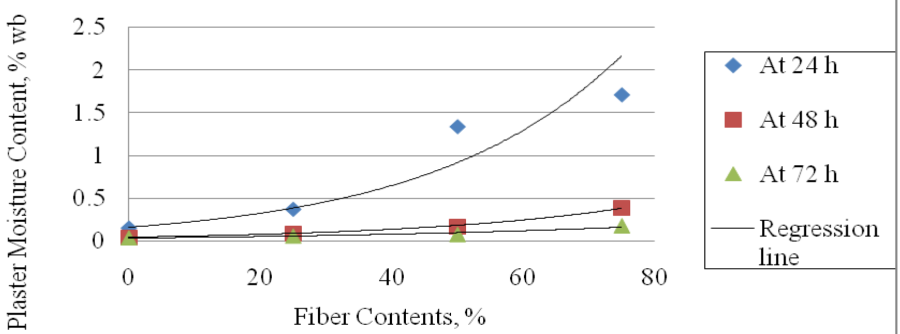

Fig. (5) Moisture content of clay plasters reinforced with different percentages of barley straw fibers at 50 °C drying temperature.

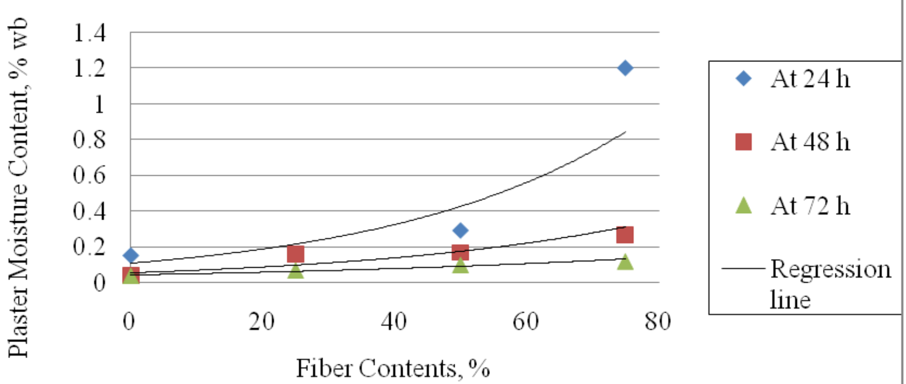

Fig. (6) Moisture content of clay plasters reinforced with different percentages of sawdust fibers at 50 °C drying temperature.

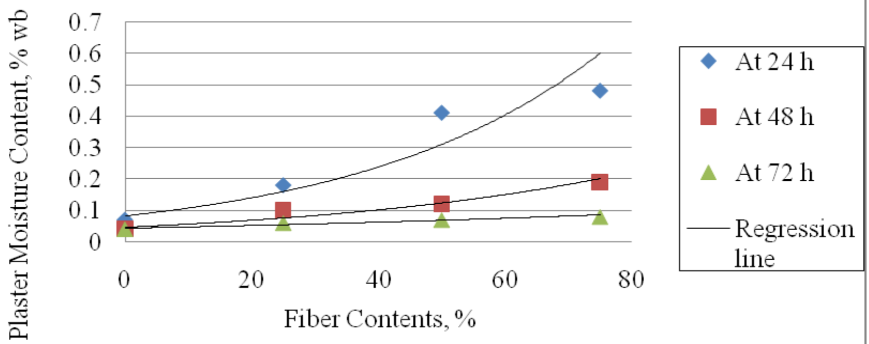

Fig. (7) Moisture content of clay plasters reinforced with different percentages of wheat straw fibers at 70 °C drying temperature.

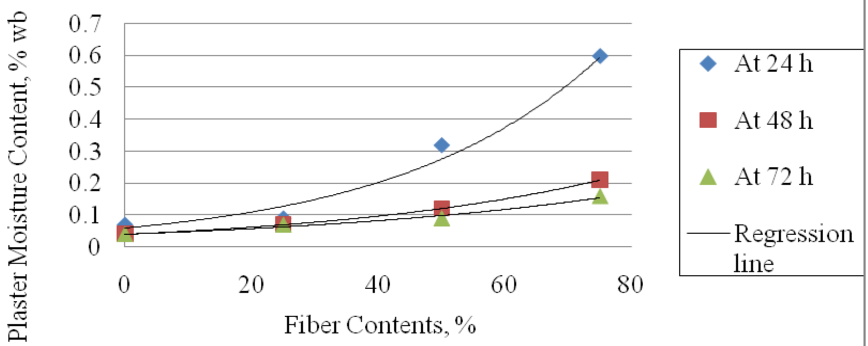

Fig. (8) Moisture content of clay plasters reinforced with different percentages of barley straw fibers at 70 °C drying temperature.

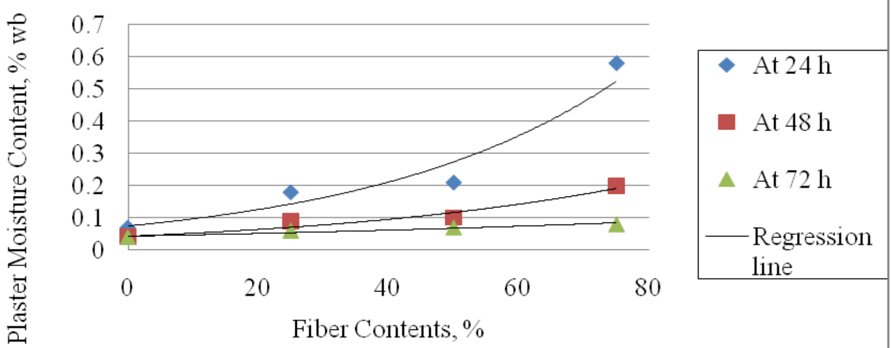

Fig. (9) Moisture content of clay plasters reinforced with different percentages of sawdust fibers at 70 °C drying temperature.

Table (6): Moisture content under different drying temperatures for the plaster without reinforcement fibers

Drying time (hr)	Moisture content (%)		
	30°C	50°C	70°C
0	15.49	15.30	15.60
24	1.56	0.15	0.13
48	0.26	0.10	0.07
72	0.12	0.04	0.04
96	0.08	0.04	0.04

Amount of water absorption:

The average amounts of water absorption by recipe A were 73.4, 76.1, 83.9 and 38.2 g for the plaster reinforced with barley, wheat, sawdust, and without reinforcement fibers, respectively. While, the amounts of water absorption by recipe B were 61.7, 59.5, 60.4 and 38.2 g for the plaster reinforced with barley, wheat, sawdust, and without reinforcement fibers, respectively. The amounts of water absorption by recipe C were 40.1, 50.1, 46.1g for the plaster reinforced with the same reinforcement fibers, respectively (Fig. 11). The obtained results showed that the amount of water absorption increased with increasing fibers content and decreased with increasing sand content. Moreover, the highest value of the amount of water absorption was achieved with the plaster reinforced with sawdust, while, the lowest amount of water absorption was obtained with the plaster without reinforcement fibers.

Regression analysis was carried out to find a relationship between fiber content and water absorption (WA) for the four different plasters, the best form of the relationship was as follows:

$$\mathbf{WA = a\,(FC)^{b}} \qquad \mathbf{(5)}$$

Table (7) shows the lists of constants of the relationship between water absorption and fiber content of clay plaster reinforced with natural fibers

Table (7): Constants and coefficient of determination of the relationship between water absorption and fiber content of clay plaster reinforced with natural fibers.

Recipes	Constants		R^2
	a	b	
Plaster with barley fibers	35.85	0.009	0.92
Plaster with wheat fibers	38.77	0.009	0.99
Plaster with sawdust fibers	36.83	0.010	0.99

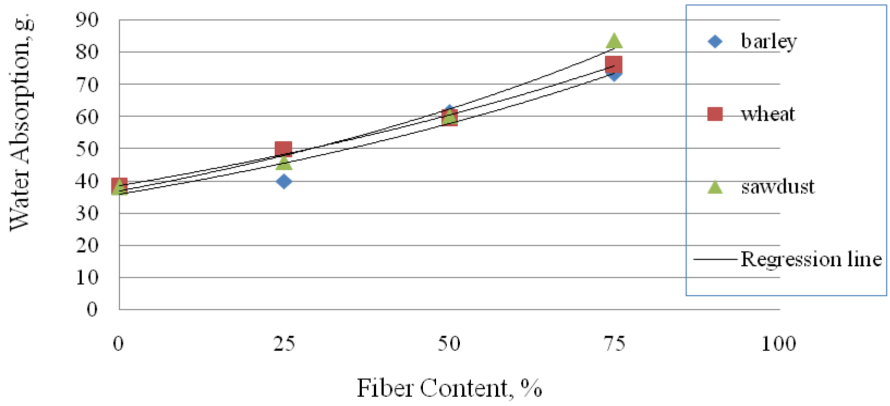

Fig. (10). The water absorption as influnced by fiber content of different types of plasters reinforced with different fibers.

Water absorption rate:

The average water absorption rates for recipe A were 85.4, 79.7, 90.7 and 18.3 % for the plaster reinforced with barley, wheat, sawdust, and without reinforcement fibers, respectively. While for recipe B water absorption rates were 37.9, 32, 44.3 and 18.4% for the plaster reinforced with barley, wheat, sawdust, and without reinforcement fibers, respectively. The water absorption rates for recipe C were, respectively, 19.9, 22.9, 29.3 and 18.4% for the plaster reinforced with barley, wheat, sawdust, and without reinforcement fibers as shown in Fig. (12).

The results showed that water absorption rate increased with increasing fibers content and decreased with increased sand content. Moreover, the highest value for the water absorption rate was achieved with the plaster reinforced with sawdust. While, the lowest value of water absorption rate was obtained with the plaster without reinforcement fibers.

Regression analysis was carried out to find a relationship between fiber content and water absorption rate (WAR) for the plasters under study, the best form of the relationship was as follows:

$$\mathbf{WAR = a\,(FC)^{b}} \qquad \mathbf{(6)}$$

Table (8) shows the lists of constants of the relationship between water absorption rate and fiber content of clay plaster reinforced with natural fiber.

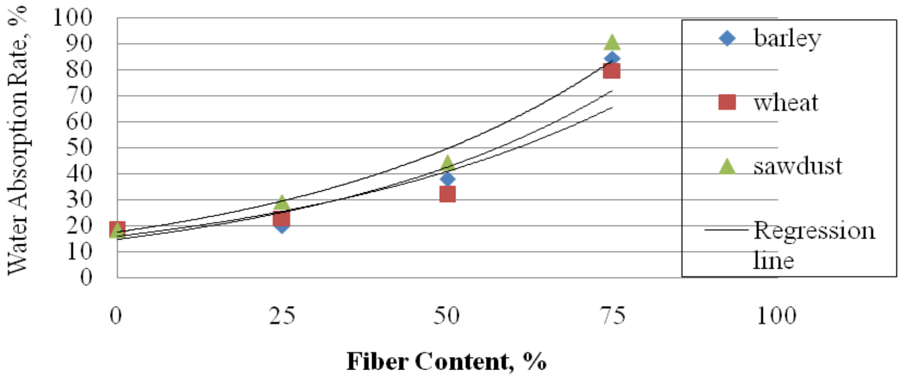

Fig. (11). The water absorption rate as influnced by fiber content of different types of plasters reinforced with different fibers.

Table (8): Constants of the relationship between water absorption rate and fiber content of clay plaster reinforced with natural fiber.

Recipes	Constants		R^2
	a	b	
Plaster with barley fibers	**17.58**	**0.020**	**0.98**
Plaster with wheat fibers	**15.85**	**0.018**	**0.90**
Plaster with sawdust fibers	**14.98**	**0.020**	**0.91**

CONCLUSIONS

The absorption and desorption behavior of some clay-sandy plasters reinforced with natural fibers that could be used for straw bale buildings was studied. Desorption behavior was studied at different temperatures (30, 50 and 70°C) for clay-sandy plasters reinforced with natural fibers. Water absorption of these types of plaster was also investigated. The most important results could be summarized as follows:

(a) For plaster reinforced with wheat straw fibers:

The results indicate, at 30 °C, about 70% of the initial moisture content of recipe A, 90 and 99% of the moisture content of the same recipe at 50 and 70 °C were lost after 24 h.Recipe B lost 74, 95 and 99% of the initial moisture content after 24 h at 30, 50 and 70 °C, respectively. Recipe C lost 85, 98 and 99% of the initial moisture content after 24 h at the same conditions, respectively.

(b) For plaster reinforced with barley straw fibers:

At 30 °C, about 60% of the initial moisture content of recipe A, and 99% of the moisture content of the same recipe at 50 and 70 °C were lost after 24 h. Recipe B lost 63, 97 and 99% of the initial moisture content after 24 h at 30, 50 and 70 °C, respectively. Recipe C lost 89, 98 and 99% of the initial moisture content after 24 h at the same conditions, respectively.

(c) For plaster reinforced with sawdust fibers:

At 30 °C, about 69% of the initial moisture content of recipe A, 98 and 99% of the moisture content of the same recipe at 50 and 70 °C were lost after 24 h. Recipe B lost 77, 99 and 99% of the initial moisture content after 24 h at 30, 50 and 70 °C, respectively. Recipe C lost 88, 99 and 99% of the initial moisture content after 24 h at the same conditions, respectively.

At higher temperatures, cracks were showed on the plaster surface, these cracks increased with decreasing the plaster fiber contents.

(d) For plaster reinforced without fibers:

At 30 °C, about 88% of the initial moisture content of this recipe and 99% of its moisture at 50 and 70 °C were lost after 24 h. More cracks were observed on the surface of this type of plaster compared to the other plasters reinforced with fibers.

The results showed that water absorption rate increased with increasing fibers content and decreased with increased sand content. Moreover, the highest value for the water absorption rate was obtained for the plaster reinforced with sawdust. While, the lowest value of water absorption rate was obtained for the plaster without reinforcement fibers.

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الملخص العربى

سلوك الامتصاص والجفاف لبعض أنواع المحارة الطميية-الرملية المدعمة بألياف طبيعية لاستخدامها فى البيوت المبنية بالقش

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يهدف البحث الى دراسة طبيعة الامتصاص والجفاف لبعض انواع المحارة الطميية-الرملية المدعمة بالياف طبيعية لاستخدامها فى البيوت المبنية بالقش عند تعرضها لظروف جوية متباينة من درجات الحرارة والرطوبة. ولاتمام ذلك تم عمل محارة من خليط من الطين والرمل بنسب مختلفة مع خلطها بالياف طبيعية من مخلفات نباتية (قش القمح ، قش الارز ، نشارة الخشب). وتم دراسة الامتصاص والجفاف لهذه الانواع من المحارة. وكانت اهم النتائج المتحصل عليها كالاتى:

بالنسبة لطبيعة المحارة المدعمة بقش القمح عند تعرضها للجفاف على درجات حرارة مختلفة: فقد اظهرت النتائج ان هذا النوع من المحارة (A) المدعم ب ٧٥% الياف يفقد ٧٠% من رطوبته الابتدائية بعد ٢٤ ساعة على درجة حرارة ٣٠ درجة مئوية ، بينما يفقد ٩٠ ، ٩٩% من هذه الرطوبة اذا تعرض لدرجات حرارة ٥٠ ، ٧٠ درجة مئوية على التوالى. اما المعاملة (B) والمدعمة ب ٥٠% من مكوناتها الياف تفقد ٧٤ ، ٩٥ ، ٩٩ % من رطوبتها عند تعرضها لدرجات حرارة ٣٠ ،٥٠ ، ٧٠ درجة مئوية على التوالى. اما المعاملة (C) والمدعمة ب 25% من مكوناتها الياف تفقد 85 ، 98 ، ٩٩ % من رطوبتها عند تعرضها لدرجات حرارة ٣٠ ،٥٠ ، ٧٠ درجة مئوية على التوالى.

بالنسبة لطبيعة المحارة المدعمة بقش الشعير ، فقد اظهرت النتائج ان هذا النوع من المحارة (A) المدعم ب ٧٥% الياف يفقد ٦٠% من رطوبته الابتدائية بعد ٢٤ ساعة على درجة حرارة ٣٠ درجة مئوية ، بينما يفقد ٩٩ ، ٩٩% من هذه الرطوبة اذا تعرض لدرجات حرارة ٥٠ ، ٧٠ درجة مئوية على التوالى. اما المعاملة (B) والمدعمة ب ٥٠% من مكوناتها الياف تفقد ٦٣ ، 97 ، ٩٩ % من رطوبتها عند تعرضها لدرجات حرارة ٣٠ ،٥٠ ، ٧٠ درجة مئوية على التوالى. اما المعاملة (C) والمدعمة ب 25% من مكوناتها الياف تفقد 89 ، 98 ، ٩٩ % من رطوبتها عند تعرضها لنفس الظروف ، على التوالى.

بالنسبة لطبيعة المحارة المدعمة بقش بنشارة الخشب ، فقد اظهرت النتائج ان هذا النوع من المحارة (A) المدعم ب ٧٥% الياف يفقد ٦٩% من رطوبته الابتدائية بعد ٢٤ ساعة على درجة حرارة ٣٠ درجة مئوية ، بينما يفقد ٩٨ ،

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٩٩% من هذه الرطوبة اذا تعرض لدرجات حرارة ٥٠ ، ٧٠ درجة مئوية على التوالى. اما المعاملة (B) والمدعمة ب ٥٠% من مكوناتها الياف تفقد ٧٧ ، 99 ، ٩٩ % من رطوبتها عند تعرضها لدرجات حرارة ٣٠ ،٥٠ ، ٧٠ درجة مئوية على التوالى. اما المعاملة (C) والمدعمة ب 25% من مكوناتها الياف ، حيث ٩٩ % من رطوبتها عند تعرضها لنفس الظروف ، على التوالى بعد ٢٤ ساعة.

وقد لوحظ وجود تشققات على سطح المحارة مع الجفاف ، حيث زادت هذه التشققات مع انخفاض نسبة الالياف بالمحارة ، حيث كانت المحارة الغير محتوية على الياف اكثرهم تشققا وهذا غير مرغوب فيه فى محارة اسطح المبانى.

اما فى حالة تعرض المبانى للرطوبة العالية فقد كان معدل امتصاص الرطوبة مرتفعا مع زيادة نسبة الالياف ، وكانت المحارة المدعمة بالياف نشارة الخشب اكثرها قدرة على امتصاص الرطوبة.