PHYSICAL AND MECHANICAL PROPERTIES OF CONCRETE INCORPORATING INDUSTRIAL AND AGRICULTURAL TEXTILE WASTES

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Abstract

To reduce the impact on the environment, industrial and agricultural waste products such as carpet waste, sisal and flax have been added to the concrete. Usage of these materials in concrete does not only improve the strength of concrete but also leads to the proper disposal of these materials that leads to reduce the impact on environment. Fiber admixture can effectively improve the mechanical and physical properties of concrete. Utilization of recycled fibers from post-consumer, industrial waste and agricultural waste offer some benefits such as waste reduction, resource conservation, also low-cost materials and reduced need for land filling. Concrete is a tension weak building material, which is often cracked not ridden in plastic and hardened states, drying shrinkage and so on, low tensile strength limited ductility and resistance to cracking. In order to improve attempt has been made to study the effect of these materials on ordinary Portland cement concrete. In the experimental work, glass fibers, sisal, flax and waste carpet waste in different percentage (0.5%, 1% and 2 %) has been added by volume of concrete volume. The hardened concrete properties compressive strength, dry Shrinkage, Impact stress, The effect of temperature and Thermal conductivity of Concrete) were carried out. A total of Thirteen concrete mixtures were performed with cement content of 350 Kg/m^3 at water - cement ratio = 0.525 , The amount of water was adjusted according to cement content, The super plasticizer dosage varied from 0.8% to 2.5% of cement content to achieve the required level of workability defined by a slump value of 10± 2cm.

KEYWORDS: *Percentages added, concrete mixes, (sisal, flax, glass fiber and Carpet wastes fiber), Coarse Aggregate (CA), Fine Aggregate (FA), compressive strength test, dry Shrinkage, Impact energy , The effect of temperature and Thermal conductivity of Concrete test.*

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1. INTRODUCTION

The addition of carpet fiber leads to enhance the splitting tensile strength, flexural strength and reducing the crack-size and a smoother mode of failure, unlike the brittle failure behavior of plain concrete [1]. Flax fiber is a natural fiber which has a look in the like jute fiber, but this fiber is used extremely in textile industries for its rough texture and has higher cellulose content and has better elasticity and strength. The chemical composition includes cellulose, lignin and hemicelluloses. Strength of this fiber is very high and this property makes it a chief geo-synthesizer fiber for it has smaller elongation coefficient [2]. Use of Fibers (Sisal and flax) are one of the most widely used natural fibers in yarns, ropes, twines, cords, rugs, carpets, mattresses, mats, and handcrafted articles [3]. Previous investigation glass fibers in different percentage 0 to 0.1% has been studies for the effect on mechanical properties of concrete by carrying compressive strength test, flexural strength test and splitting tensile strength test. The results have shown improvement in mechanical and durability properties with the addition of glass fibers [4]. This investigation aim to study the effect of sisal fiber addition on the different Properties of concrete, Sisal fiber was used at three percentages of total mix volume. (0.5%, 1.0% and 1.5%) by volume of concrete volume, found that concrete reinforced with1.0% of sisal fiber give the best results, The water absorption was increased due to the addition of sisal fiber. For mixes contain (0.5%, 1.0% and 1.5%) sisal fiber by volume of total mix the increase in water absorption was (5.9%, 16.1% and 23.8%) respectively [5].

2. EXPERIMENTAL WORK

To test the physical-mechanical properties of concrete with addition of (sisal, flax, glass fiber and Carpet waste fibers) to concrete by ratio (0.5%, 1% and 2 %) by volume of concrete volume, concrete cubs were made the specific and materials tests were performance to choose the best one for concrete cubes .

2.1 MATERIALS

CEMENT: Ordinary Portland cement was used. Testing of cement was carried out according to Egyptian Standard Specification (ESS 4756-1, 2007) [6] .

FINE AGGREGATE: Natural sand composed of siliceous materials was used as Fine Aggregate (FA) in this study. Testing of sand was carried out according to the (ESS 1109, 2002). Specific Weight of used sand was 2.6 and bulk Density 1.78 t/m^3 [7] .

COURSE AGGREGATE: Course Aggregate (CA) was used as gravel Aggregate in this study. Testing of gravel Aggregate was carried out according to the (ESS 1109, 2002). Specific Weight of used gravel was 2.64 and bulk Density 1.56 t/m^3 [7].

MIXING WATER: Drinking water was used for mixing.

PLASTICIZER: In this study, In order to obtain same workability without increased water, plasticizer admix Sicament 163 was used. Sicament 163 is a plasticizer and flowing concrete Admix. (Complies with ASTM C 494 type f, B.S.5075 PART 3).

3. PROPERTIES OF FIBERS

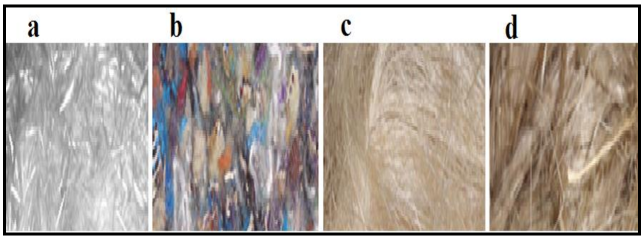

Fig - 1: THE FIBERS : (A) GLASS FIBER, (B) Carpet Waste , (C) Sisal

3.1 Water Absorption For Fibers (Moisture Content%) :

The water absorption for concrete made of fibers is much higher than normal concrete, fiber concrete need more water to mixture than normal concrete ,because of the content of fiber added to it , The ratio of Water absorption for fibers (0%, 4.29%, 7.1% and 7.8%) of fiber glass, carpet waste , flax and sisal respectively and more water content in the mixture decreased the compressive strength of the fiber concrete ,because of the more water content for workability and mixing fiber concrete, as shown in figure (2).

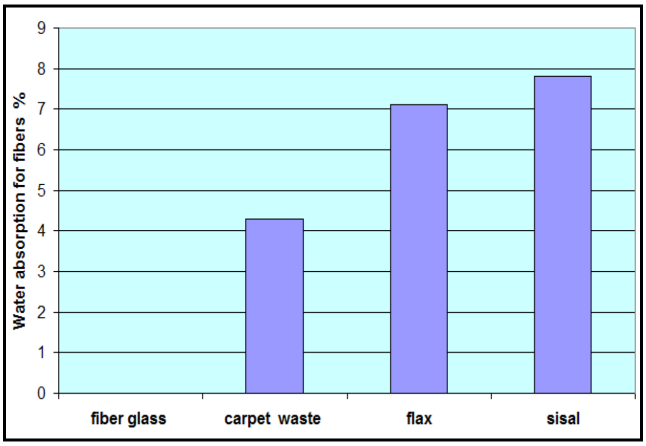

Fig - 2: Water Absorption For Fibers

3.2 Tensile Strength And Elongation For Fibers

Due to the large amount of fibers and cement content , Their Tensile strength will be (59, 52.3, 41.1) gm/text for fiber glass , flax and sisal and Tensile strength for carpet waste were depended on the components as follows (Polypropylene, Canvas and Polyester) and Tensile strength are (50,36 and 45) Respectively, Elongation is(3.5%,12.8% 1.7%,3.1%) for fiber glass ,carpet fiber, flax and sisal . It is obvious that the bundle strength for sisal is the largest strength and the fiber glass is the largest Elongation, as shown in figures (3) and (4).

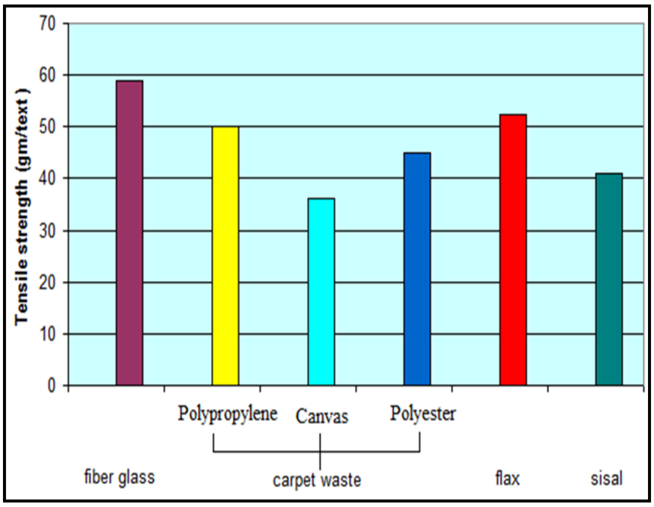

Fig - 3: Tensile strength and Elongation

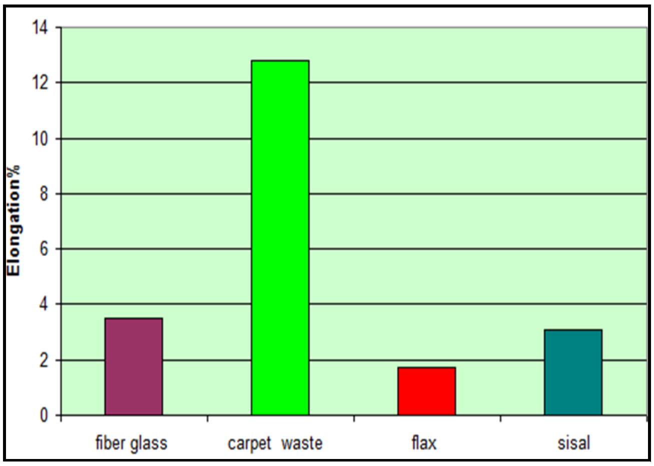

Fig - 4: Elongation for fibers

3.3 Density For Fibers:

The density of fibers is (25.4 ,13, 15and 13.2) kg /m^3 for fiber glass ,carpet fiber, flax and sisal. It is obvious that the density for fiber glass is the largest density and it density effect on the properties of concrete , as shown in figure (5) .

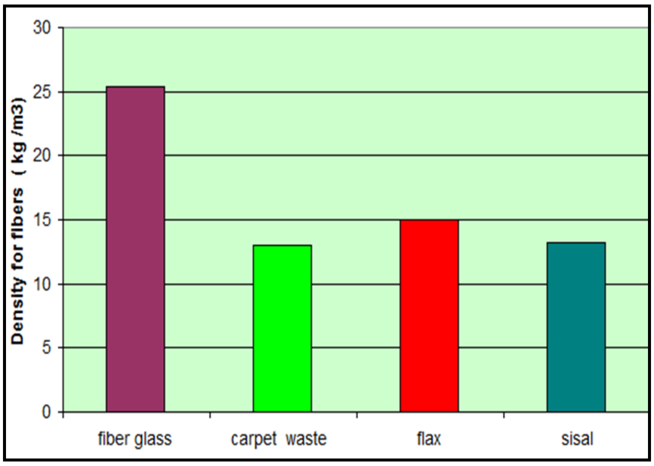

Fig - 5: Density for fibers

Table - 1 : Concrete Mixes

Mix No	Designation	C Kg/m³	W litter/m³	SP %of Cement content	FA Kg/m³	CA Kg/m³	F (4 types) % by volume
Control (2)	M14(350)	350	184	0.8	779	1168	0
G_2	M15:18(350)*	350	184	1.3	773	1160	0.5
	M19:22(350)*	350	184	1.8	768	1152	1
	M23:26(350)*	350	184	2.5	767	1136	2

*Four mixes means fiber glass, carpet wastes, sisal and flax respectively.

3.4 CONCRETE MIXES

Mixes were made with cement content (350kg/m^3) and water - cement ratio = (0.525). Thirteen (One group) mixes were made, with plasticizer dosage ranges between 0.8 % to 2.5% of cement content to achieve the required level of workability defined by a slump value of 10± 2cm. fibers added such as (fiber glass, carpet wastes, sisal and flax) amounting (0%, 0.5%, 1% and 2% by volume of concrete volume) to the mix. the ratio of fine to coarse aggregate was about (1:1.5), This experimental study demonstrates the properties of concrete containing Percentages added from fiber. Composition of designed Mixes have been shown in Table (1). All the concrete mixes were mixed at many institutions such as: laboratory of Properties of Laboratory materials - Faculty of Engineering- Assiut University, textile consolidation fund- Alexandria and also laboratory of properties of Laboratory materials - Faculty of Engineering- Mansoura University.

4. CONCRETE TESTS

All the concrete mixes were carried out at Laboratory of properties of materials - Faculty of Engineering- Assiut University, Textile consolidation fund - Alexandria and Laboratory of Properties of materials - Faculty of Engineering - Mansoura University. It is through these labs available, It was material processing, and work samples, and then processed, the samples are as follows:

For each concrete mix, six 150×150×150 mm cubes were casted to determine the compressive strength at 7 and 28 days. one 500×500×50 mm plate was casted to determine the impact stress 28 days .four 25mm × 25mm× 280 mm prism were casted for the determination of the average drying shrinkage 4,11,18 and 25 days. two 100mm × 100mm× 30mm plats were casted for the determination of the thermal conductivity 28 days. three 150×150×150 mm cubes were casted to determine the effect of temperature at 28 days as shown in table (2), All casted specimens were covered by plastic sheets and water saturated burlap and left in the laboratory for 24 hour.

5 . RESULTS AND DISCUSSION

5.1 Hardened Concrete Properties

Compressive Strength: The Compressive test results of concrete mixes were presented. The Compressive strength after 28 days of mixes groups were shown in Figures (6 and 7) and table (2). Samples were poured and tested during the period from 7and 28 days. The results were as follows:

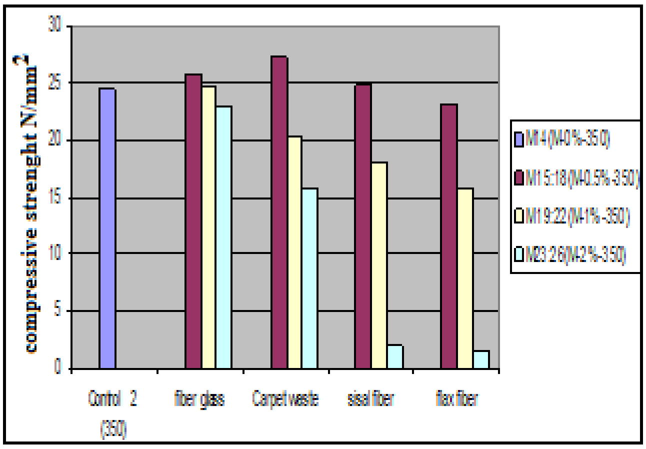

Fig - 6: Compressive strength at 7days with cement content 350 kg/m^3

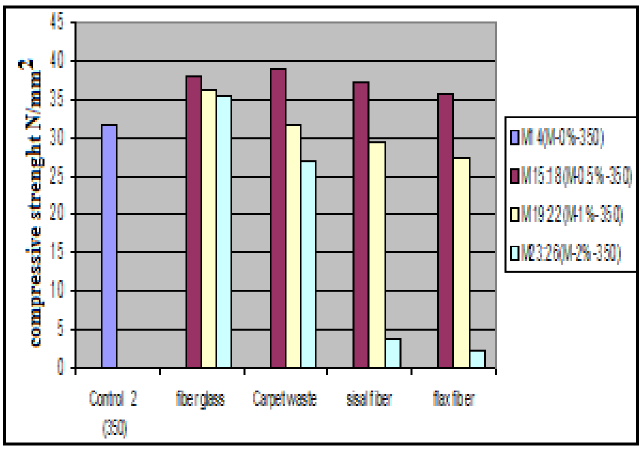

Fig - 7: Compressive strength at 28 days with cement content 350 kg/m^3

Table - 2: Compressive strength of concrete mixtures at 20 ^{0}C (after 28 days)

Mix. No. Impact Energy Test	Designation	fiber glass		Carpet waste		sisal fiber		flax fiber	
		No. of blows for cracks1 st	No. of blows for failure	No. of blows for cracks1 st	No. of blows for failure	No. of blows for cracks1 st	No. of blows for failure	No. of blows for cracks1 st	No. of blows for failure
Control	M5 (M-0%-350)	9				13			
G_2	M6 (M-0.5%-350)	6	32	6	33	5	31	5	30
	M7 (M-1%-350)	6	35	6	36	6	34	6	33
	M8 (M-2%-350)	7	39	7	38	1	5	1	3

From obtained results can be concocted four points: *first*, when cement content increases, strength increases. Glass fibers have the highest compressive strength, textile fibers is the second, sisal is the third and flax is the last one. *Second*, Flax fibers have the least compressive strength because they don't interact with concrete mix and effect on strength negatively. *Third*, Sisal fibers strength is more than flax fibers because sisal fibers have strength and hardness, so they have more homogeneity than linen fibers. *Fourth*, Compressive strength of concrete without fibers is higher than that has fibers because of fibers increase air bubbles and voids [8,9].

Impact energy

Impact test was conducted on the concrete samples dimensions 500 *500* 50 mm, The test was conducted on impact machine which proposed for this test in the College of Engineering, Mansoura University. Figure (4-26) shows the test machine and high device mass, which fall from the height of 120cm with a mass weight 3.36kg. After conducting the test: The cubes containing fibers have the largest capacity in the bearing the loads and shape of the failure varies from sample to the other by fibers Type as shows in figures (9) and table (3).

Group three (G_3): different types of fibers (fiber glass, carpet waste , sisal and flax) at ratios 0.5%, 1% and 2% by volume of concrete volume and cement content 350kg/m3. The Impact test at 28 days of mixtures with percentage ratios of fibers 0.5% ,1 % and 2% were shown in Figures (from 10 to13) .

Table - 3 : Impact energy (After 28 days)

Mix. No. Compressive strength	Designation	fiber glass	Carpet Waste	sisal fiber	flax fiber
Control	M5 (M-0%-350)	31.8			
G2	M6 (M-0.5%-350	37.88	37.88	37.88	37.88
	M7 (M-1%-350)	36.27	36.27	36.27	36.27
	M8 (M-2%-350)	35.34	35.34	35.34	35.34

Fig - 8: Impact energy

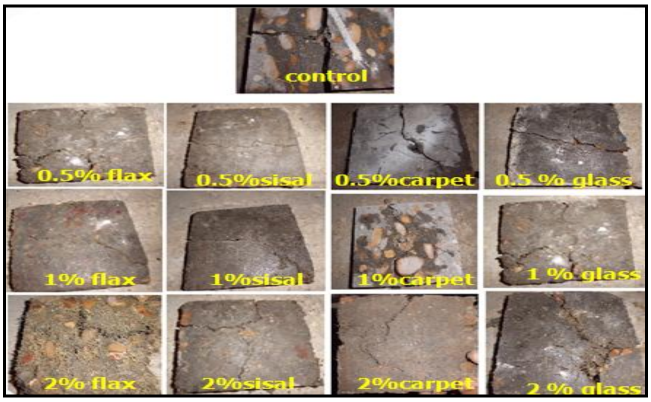

Fig - 9: Impact energy - samples

It was observed that the Impact blows for failure of concrete mixtures with percentage ratios of fibers 0.5% ,1 % and 2% were increased by (146.15%,120.11%,138.46% and 130.76 %) for fiber glass, carpet waste , sisal and flax when adding 0.5% fibers , Increased by (169.23%,176.92%,161.53% and 153.84%) for fiber glass carpet waste , sisal and flax when adding 1 % fibers by volume of concrete volume and increased by(200% and 192.30 %)for fiber glass carpet waste , sisal when adding 2% fibers and decreased by (62%and 77%) for sisal and flax when adding 2% fibers for cement content of 350 kg/m^3 for 28 days. Figures (10) to (13) show the concrete mixtures added of fibers at ratios (0.5%, 1% and 2%) by volume of concrete volume .

It can be noticed that at ratio (0.5 ,1 and 2)% by volume of concrete volume fibers increased the Impact ,comparing with control mixtures at 28 days , Impact increased for 0.5% to 2% by volume of concrete volume for all used fibers but decreased for sisal and flexural fiber when adding 2% fiber because the high Humidity , for cement content of 350 kg/m^3 at 28 days comparing with respect to control mixtures and The result in agreement with Kawkab and Moslih, [5].

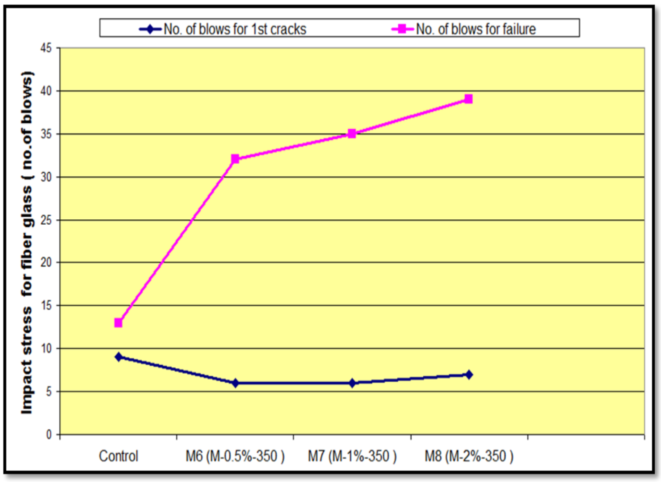

Fig - 10: Impact stress for fiber glass

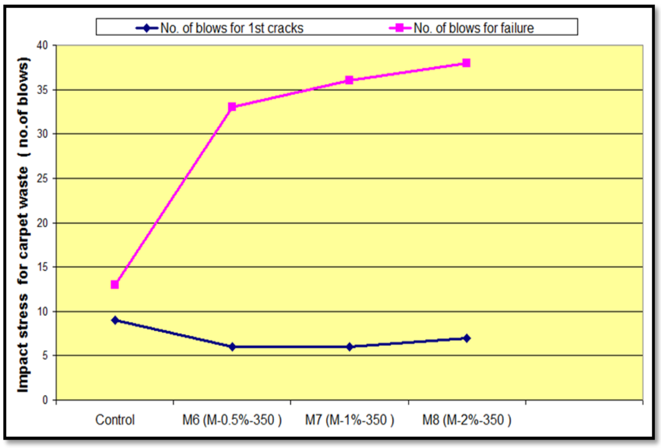

Fig - 11: Impact stress for carpet waste

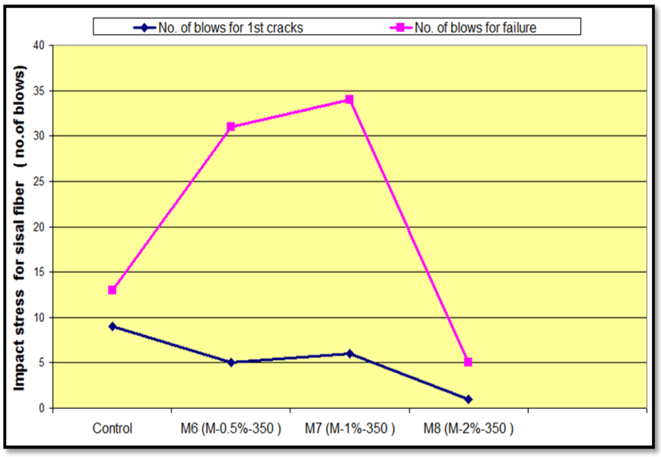

Fig - 12: Impact stress for sisal fiber

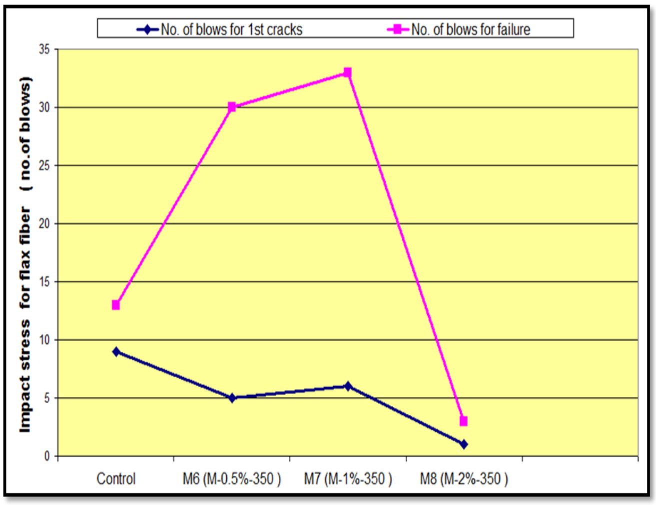

Fig - 13: Impact stress for flax fiber

-Drying Shrinkage of cement mortar containing fibers

Drying Shrinkage test was conducted on the concrete samples dimensions 25x25x280 mm after 4,11,18 and 25 days , the test was conducted on Drying Shrinkage machine which stomach for this test in the College of Engineering, Mansoura University, as shows in figure (14,15)and table (4). After conducting the test:

The cubes containing fibers have the greatest impact energy in reducing the shrinkage of concrete, the results of the test, as the figures (16) to (19) and The results in agreement with Ikram Pharaoh Mullah , [10].

Table - 4: Drying Shrinkage strain $x10^{-6}$

Mix. No. Drying Shrinkage	Designation	fiber glass				Carpet waste				sisal fiber				flax fiber			
		4	**11**	**18**	**25**	**4**	**11**	**18**	**25**	**4**	**11**	**18**	**25**	**4**	**11**	**18**	**25**
Control	**M5 M-0%-350**	45	54	110	195												
G_2	**M6 M-0.5%-350**	35	37	41	95	36	38	42	96	37	39	44	98	38	41	45	99
	M7 M-1%-350	34	36	40	92	35	37	41	94	36	43	42	96	37	45	44	97
	M8 M-2%-350	33	35	38	90	34	36	39	93	35	37	41	94	36	38	42	95

Fig - 14: Drying shrinkage machine

Fig - 15: Drying shrinkage - samples

Group two (G₂): Different types of fibers (fiber glass, carpet waste , sisal and flax) at ratios 0.5%, 1% and 2% by volume of concrete volume and cement content 350 kg/m^3. The test results of concrete mixtures added of fibers at ratios (0.5%, 1% and 2%) were shown in figures (16 to19). The Drying Shrinkage strain at (4,11,18and 25) days of mixtures with percentage ratios of fiber 0.5% ,1 % and 2% were shown in Figures (16) to (19) . It was observed that the Drying Shrinkage strain of concrete mixtures with percentage ratios of fibers 0.5% ,1 % and 2% were decreased by (28%,26%,20%and 19%)for fiber glass ,carpet waste ,sisal and flax fiber when adding 0.5% fibers , while decreased by (38%,37%,33 %and 32%) for fiber glass ,carpet waste ,sisal and flax fiber when adding 1% fibers and decreased by(58 %,56 %,54 %and52%) for fiber glass ,carpet waste ,sisal and flax fiber when adding 2% for cement content of 350 kg/m^3 for (4,11,18 and 25) days. Figures (16) to (19) shows the concrete mixtures added of fibers at ratios (0.5%, 1% and 2%) , Drying Shrinkage strain increased when adding fiber glass ,carpet waste ,sisal and flax for cement content of 350 kg/m^3 at (4,11,18 and 25) days comparing with respect to control mixtures.

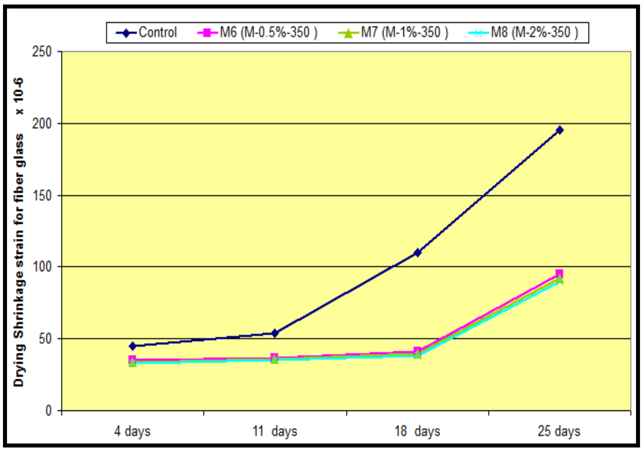

Fig - 16: Drying shrinkage for fiber glass

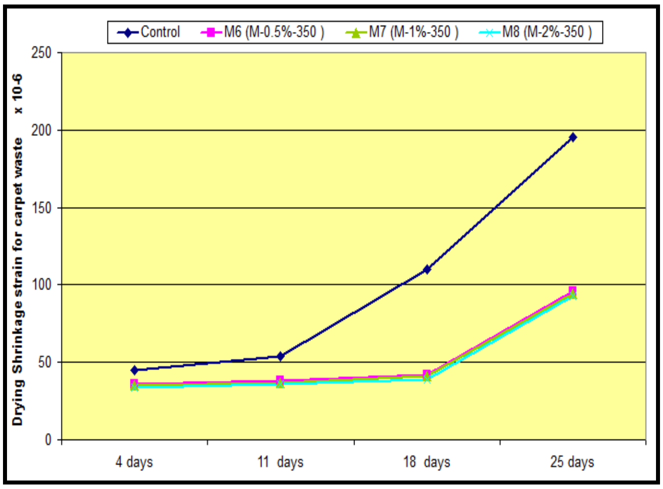

Fig - 17: Drying shrinkage for carpet waste

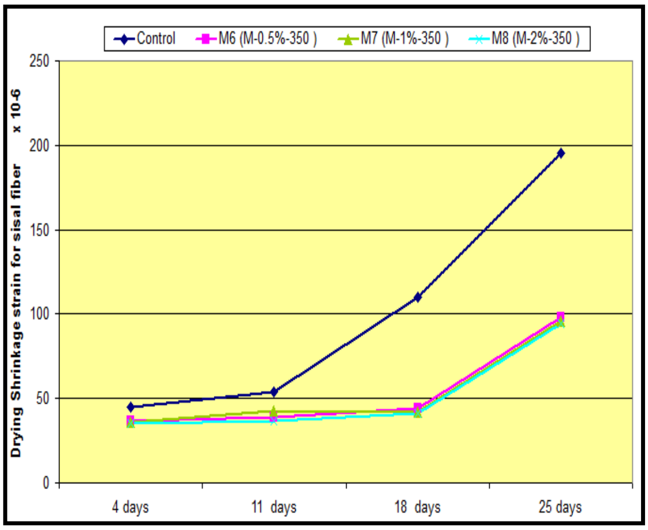

Fig - 18: Drying shrinkage for sisal fiber

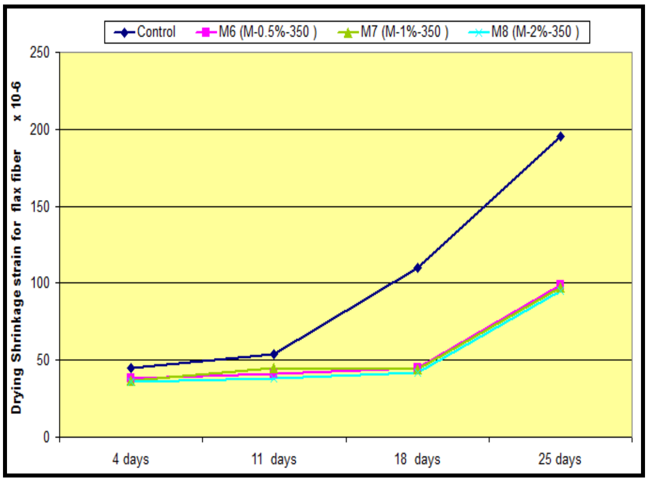

Fig - 19: Drying shrinkage for flax fiber

- Thermal conductivity of concrete

The present study includes an experimental work to find out the benefit arises from fibers (glass fiber , carpet waste , sisal and flax) addition to concrete mix in reducing the whole thermal conductivity and the heat transfer through construction elements, Which increase thermal insulation and reduce consumption of electricity used for air conditioning equipments, Figure (20) shows machine test and test samples.

Fig - 20: Thermal conductivity machine

Calculation of the coefficient of thermal conductivity of different concrete mixes as the following : The experiments done on a concrete specimens has the dimensions, 100*100*30 mm using an electric heater as a source of heat The volt and current which applied to the heater is controlled by variable voltage transformer. The two steel faces and the two faces of heater are provided by four thermo - couples which are connected to a temperature recorder to record the heat at four faces to get the difference in a temperature between two faces of the specimen (ΔT). The different readings of temperature at the four faces (T_1, T_2, T_3, and T_4) taken at a different period of time until we reach the (steady state) note that T_2 , T_3 at inner faces & T_1 , T_2 at outer faces . The coefficient of thermal conductivity is get from the following equation.

$$\mathbf{Q = K \times A \times \Delta T/t}$$

Where:

Q (power) = I x V= $(V)^2/R$

K = the coefficient of thermal conductivity

A = the area of the two faces of specimen ($0.1*0.1\ m^2$)

ΔT = the difference in heat between the faces of specimens.

$$\Delta T = \left(\frac{T2 + T3}{2}\right) - \left(\frac{T1 + T4}{2}\right)$$

t = thickness of specimen (0.03 m)

Table - 5 : Thermal conductivity after 28 days (W/m.K)

Mix. No. Thermal conductivity (W/m.K)	**Designation**	**fiber glass**	**Carpet waste**	**sisal fiber**	**flax fiber**
Control	M5 (M-0%-350)	1.41			
G_2	M6 (M-0.5%-350)	1.324	1.305	1.275	1.265
	M7 (M-1%-350)	1.30	1.24	1.235	1.215
	M8 (M-2%-350)	1.10	1.08	1.05	1.01

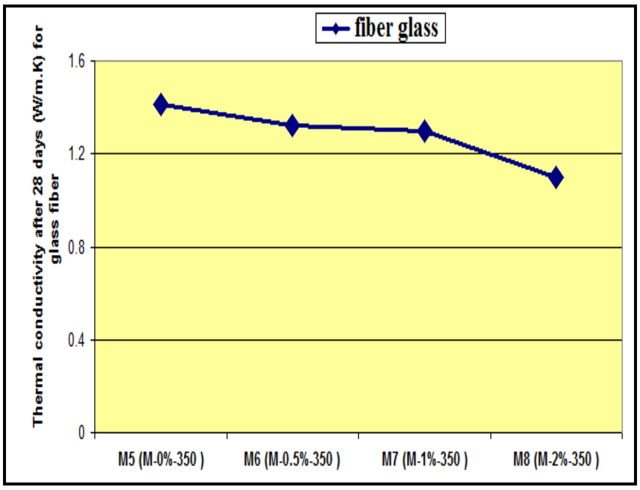

Fig - 21: Thermal conductivity for fiber glass

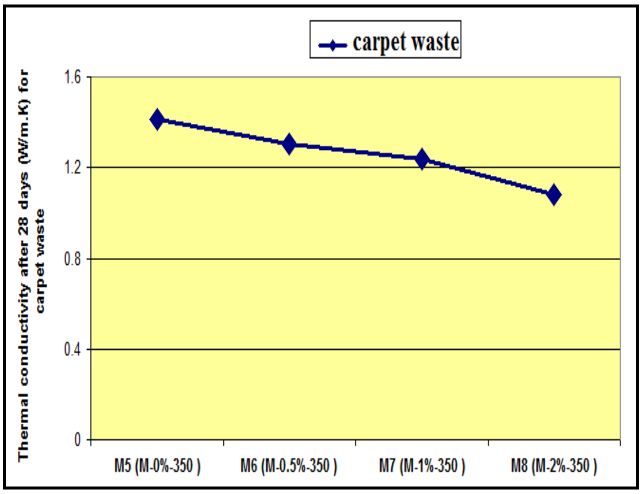

Fig - 22 : Thermal conductivity for carpet waste

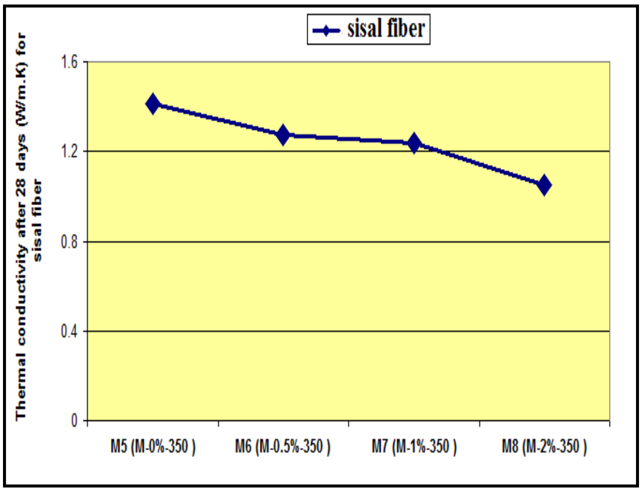

Fig - 23: Thermal conductivity for sisal fiber

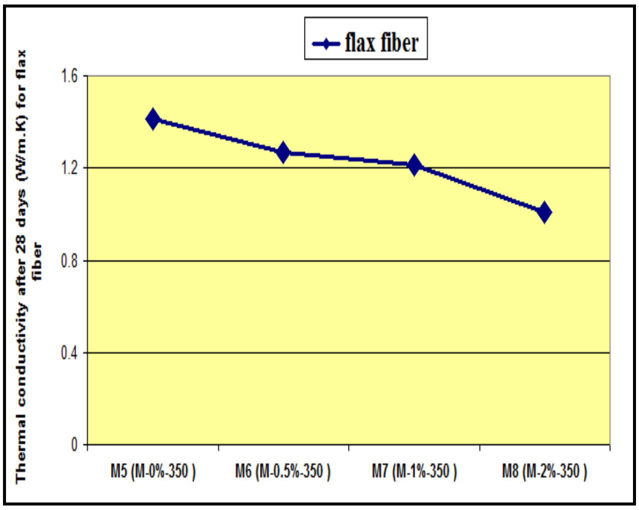

Fig - 24: Thermal conductivity for flax fiber

Group two (G_2): different types of fibers (fiber glass, carpet waste , sisal and flax) at ratios 0.5%, 1% and 2% and cement content 350 kg/m^3. The test results of concrete mixtures added of fibers at ratios (0.5%, 1% and 2%) were shown in figures (21 to 24). The Thermal conductivity at 28 days of mixtures with percentage ratios of fiber 0.5% ,1 % and 2% were shown in Figures (21) to (24) . It was observed that the Thermal conductivity of concrete mixtures with percentage of replacement ratios of fibers 0.5% ,1 % and 2% were decreased by (7%, 8%, 10%and 11%)for fiber glass ,carpet waste ,sisal and flax fiber when adding 0.5% fibers , while decreased by (8%,12%,13%,14%) for fiber glass ,carpet waste ,sisal and flax fiber when adding 1% fibers and decreased by(21%,23%,25% and 28%) for fiber glass ,carpet waste ,sisal and flax fiber when adding 2% for cement content of 350kg/m^3 at 28 days and The results in agreement with Ahmed Mohamed Diab ,[11,12]. Figures (21)to (24) show the concrete mixtures added of fibers at ratios (0.5%, 1% and 2%) by volume of concrete volume , Thermal conductivity increased when adding fiber glass ,carpet waste ,sisal and flax for cement content of 350 kg/m^3 at 28 days comparing with control mixtures.

- The Effect of Temperature.

The effect of temperature test was conducted on the concrete samples dimensions 150 * 150 * 150 mm, Then, the test was conducted after 28 days of cubes casting , Samples were burned in the furnace at different temperatures (200 ,350 and 500) °C For one hour , The test results as figures (25to 28) and tables (6:8), The results in agreement with C. He and D. J. Naus, [13],[14] , Through the results it is clear that :***first*** , In the case the burn at temperatures of 200°C: The effect was apparent on the cubes as through: reducing the humidity in cubes, increasing compressive resistance between (5:7) % from the original resistance and without changing the color cubes. ***second***, In the case the burn at temperatures of 350°C: The effect was apparent on the cubes as through: reducing the humidity in cubes, decreasing compressive resistance between (15:30) % from the original Resistance and with changing the color cubes to Slant to red color. ***Third*** ,In the case the burn at temperatures of 500°C: The effect was apparent on the cubes as through: reducing the humidity in cubes, decreasing compressive resistance between (53:80) % from the original Resistance and with changing the color cubes to Slant to red color.

Table - 6 : Compressive strength of concrete mixtures at temperatures (200°C) for heat duration (1) hour.

Mix. No. Compressive strength	Designation	fiber glass	Carpet Waste	sisal fiber	flax fiber
Control	M5 (M-0%-350)	32.93			
G_2	M6 (M-0.5%-350)	39.22	40.25	38.45	36.87
	M7 (M-1%-350)	37.56	32.92	30.33	28.44
	M8 (M-2%-350)	36.59	27.76	3.90	2.34

Table - 7: Compressive strength of concrete mixtures at temperatures (350°C) for heat duration (1) hour.

Mix. No. Compressive strength N/mm^2	Designation	fiber glass	Carpet Waste	sisal fiber	flax fiber
Control	M5 (M-0%-350)	26.58			
G2	M6 (M-0.5%-350)	34.10	32.49	31.04	29.77
	M7 (M-1%-350)	32.60	26.58	24.48	22.96
	M8 (M-2%-350)	31.80	22.41	3.15	1.89

Table - 8: Compressive strength of concrete mixtures at temperatures (500ºC) for heat duration (1) hour.

Mix. No. Compressive strength N/mm²	Designation	fiber glass	Carpet Waste	sisal fiber	flax fiber
Control	M5 (M-0%-350)	18.55			
G₂	M6 (M-0.5%-350)	30.70	22.67	21.66	20.77
	M7 (M-1%-350)	29.34	18.54	17.08	16.02
	M8 (M-2%-350)	28.62	15.64	2.20	1.32

Researchers and investigators differ in their opinion regarding the changes in the properties of concretes, particularly in the range of (100 :300) ^oC. Whereas for temperature above 300 ^oC, There is uniformity in opinion concerning a decrease in mechanical properties [13],[14].

Group two (G2): different types of fibers (fiber glass, carpet waste , sisal and flax) at ratios 0.5%, 1% and 2% and cement content 350kg/m3. The test results of concrete mixtures added of fibers at ratios (0.5%, 1% and 2%) were shown in figures (25) to (28). The effect of temperature at 28 days of mixtures with percentage ratios of fiber 0.5% ,1 % and 2% were shown in Figures (25) to(28) .

It was observed that the effect of temperature of concrete mixtures with percentage ratios of fibers 0.5% ,1 % and 2% were increased by (5:7%) at temperature 200 oC from the original Resistance, while decreased by (15:30) % at temperature 350 ^oC from the original Resistance and decreased by (53:80) % at temperature 500 ^oC from the original Resistance for cement content of 350kg/m3 at 28 days. Figures (25) to(28) show the concrete mixtures added of fibers at ratios (0.5%, 1% and 2%) , effect of temperature increased when adding fiber glass ,carpet waste ,sisal and flax at temperature 200 ^oC , decreased in the effect of temperature when adding fiber glass ,carpet waste ,sisal and flax at temperature 350 oC and 500 ^oC for cement content of 350 kg/m^3 at 28 days comparing with control mixtures.

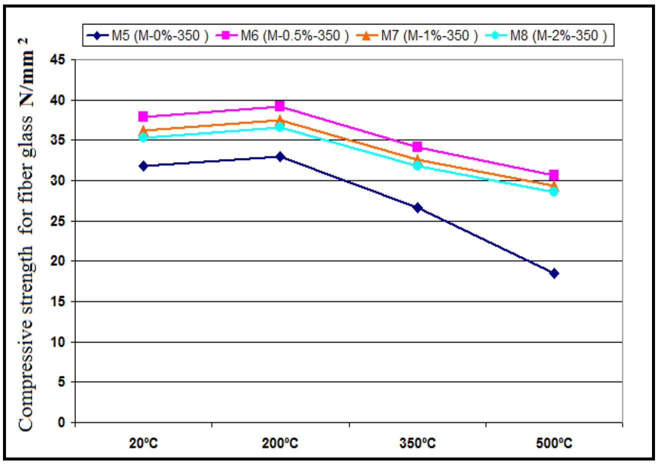

Fig - 25 Thermal conductivity for fiber glass

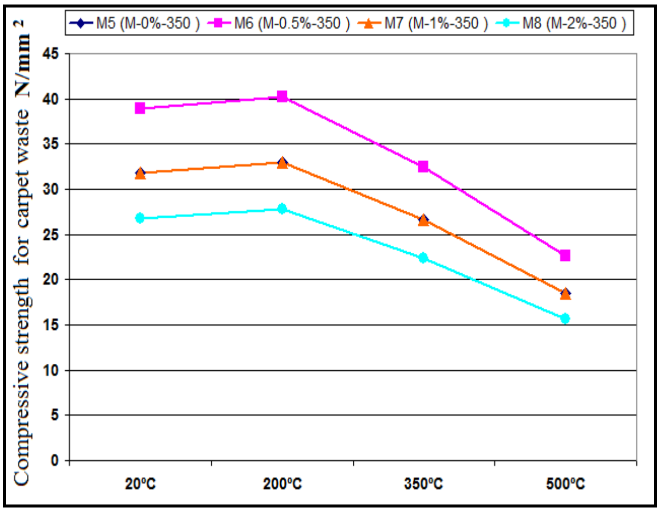

Fig. 26: Thermal conductivity for carpet waste

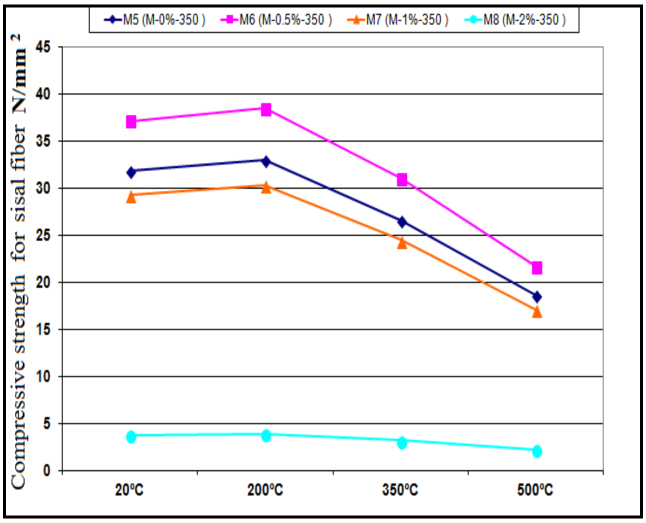

Fig - 27: Thermal conductivity for sisal fiber

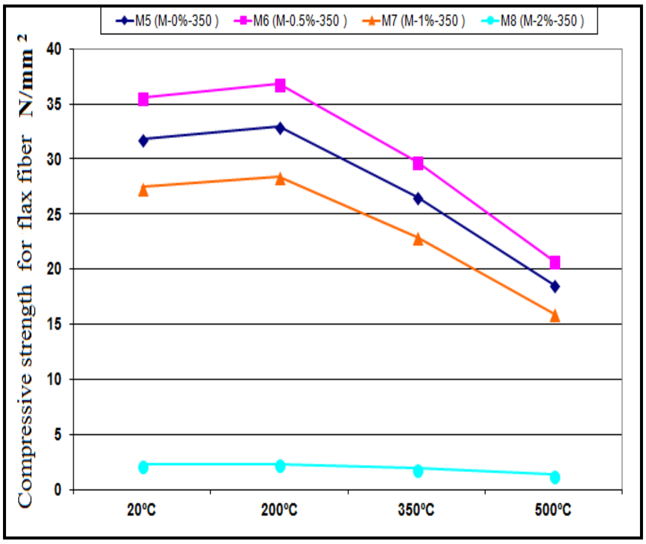

Fig - 28: Thermal conductivity for flax fiber

6. CONCLUSIONS

For protecting environment and good utilizing of wastes and improve concrete properties. A destructive test were carried on concrete specimen mixed with these waste (sisal, flax, glass fiber and Carpet wastes fiber) with variant ratios, the results of tests can be brief in the following points:

[1] The variations in density and water absorption ratio of Natural fibers are much higher than that of Industrial Fibers. The variations are mainly due to the properties of fibers as reported by many other researchers. This may cause quality control problems.

[2] To achieve the required level of workability defined by a slump value of 10± 2 cm, the dosage of super plasticizer should be significantly increased by increasing the percentage of replacing fibers in the concrete mixtures.

[3] Concrete mixed with fibers needs more water mixes and plasticizers, fibers concrete needs a long time to cure. Fibers added to concrete mixes which absorb much water contain flax, followed by sisal, then waste carpet and finally glass fibers.

[4] Compressive strength increased for all mixes containing 0.5 % fibers (glass fiber, carpet waste, sisal fiber and flax fiber) increased by 11:20 %, When adding a cement content of 350 and 400 kg /m^3.

[5] Concrete, containing fibers, shows good resistance the impact energy. Glass fiber and carpet waste resistance is eight times higher than sisal and flax.

[6] Fibers added to concrete decrease thermal conductivity by about (20,23,25 and 28) % for fiber glass , carpet waste , sisal and flax, respectively.

[7] Concrete, containing fibers has the highest resistance to cracks produced by dry shrinkage. Fiber glass and carpet waste have higher resistance to cracks produced by shrinkage compared those mixed with sisal and flax fibers.

[8] Compressive strength at 200 ºC increased by (5:7) %, and without changing the color of the concrete. At 350 ºC, The Compressive strength decreased by nearly 15-30%, With concrete color being red. At 500 ºC, the Compressive strength decreased by nearly 53-80% with color of concrete changing from Slant to red.

REFERENCES

[1] H. Mohammad hosseini, A.S.M. Abdul Awal, "physical and mechanical properties of concrete containing fibers from industrial carpet waste", International Journal of Research in Engineering and Technology, 2(12), (2013), pp(464:468).

[2] Saswat Mohapatra, "evaluation of performance of flax fiber in the SMA Mix using slag as aggregate replacement", National Institute of Technology, Rourkela,(2013).

[3] Flavio de Andrade Silva, Nikhilesh Chawla and Romildo Dias de Toledo Filho," tensile behavior of high performance natural (sisal) fibers", Composites Science and Technology, 68, (2008), pp (3438:3443)

[4] Deshmukh S.H , Bhusari J. P and Zende A. M. ," Effect of Glass Fibers on Ordinary Portland cement Concrete", IOSR Journal of Engineering, 2(6), (2012), pp (1308:1312).

[5] Kawkab Habeeb Al Rawi and Moslih Amer Salih Al Khafagy, "effect of adding sisal fiber and Iraqi bauxite on some Properties of concrete", Technical Institute of Babylon, (2009), pp (16).

[6] ESS 4756-1 / (2007,"b"), Egyptian standard specification -Cement-physical and mechanical tests.

[7] ESS 1109/ (2002), Egyptian standard specification -Aggregates for concrete.

[8] D. Sedan, C. Pagnoux, A. Smith and T. Chotard, "Mechanical properties of hemp fiber reinforced cement: Influence of the fiber/matrix interaction ", Journal of the European Ceramic Society, 28 (2008), pp (183:192).

[9] Libo Yan, Nawawi Chouw and Krishnan Jayaraman, "Flax fiber and its composites–A review", Composites Journal: Part B, 56,(2014), pp (296:317).

[10] Ihram Pharaoh Mullah , "Use fiber manufacturer of concrete reinforcement in the parts is exposed to loads of construction " , Faculty of Engineering, University of Baghdad , pp(1:8).

[11] Ahmed Mohamed Dab ," Basics of Concrete Technology", College of Engineering , University of Alexandria, 2010, Egypt.

[12] ACI 224.1R-93, "Causes, Evaluation and Repair of Cracks in Concrete Structures", Reapproved 1998,pp (1:15).

[13] C. He, E. Makavicky and B. Osback, "Thermal stability and pozzolanic activity of calcined kaolin" ,(Appl. Clay Sci. 9), pp. 165–187, (1994).

[14] D. J. Naus, "The Effect of Elevated Temperature on Concrete Materials and Structures — A Literature Review" , pp (5:20) , 2005.

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