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STUDY THE EFFECT OF ADDITION GLENIUM 51AND SILICA FUME ON THE MECHANICAL AND PHYSICAL PROPERTIES OF ORDINARY PORTLAND CEMENT

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Abstract

This research includes a study of the effect of adding Glenium 51 polymer and silica fume on the mechanical and physical properties, which included compressive, flexural and tensile strength of cement mortar and comparing the results with reference cement mortar. Glenium 51 and silica fume were added in different weight ratios as a percentage of the cement weight, and the results showed increase in compressive strength, flexural and tensile strength.
All experiments were conducted with different temperatures of 7C°, 20C°, 55C° respectively to demonstrates the effect of different temperatures on cement strength and the polymers behaviour and the results showed that the compressive, flexural and tensile strength of the cement mortar reached its maximum value at the temperature of 20 C° for the moulds and there is increase in the compressive, flexural and tensile strength after adding the additives in all temperature. The values of the compressive and tensile strength used the standard specimens at the age of (2& 28) days.

Keywords: Glenium 51, Silica Fume, Compressive Strength, Tensile Strength, Flexural Strength, Cement Mortar.

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Introduction

Continuous wars, increasing in the population, urban expansion and the decline of lands suitable for construction of buildings and the rise in prices, the increase in the cost of construction has led to a trend towards vertical construction which requires the use of cement with special specifications and thus the use of additives to increase the compressive and tensile strength of cement used in construction [1]. One of the important basic properties that must be taken into consideration when choosing building materials are the mechanical and physical properties, after the great development in the cement industry and the discovery of many materials and additives that are added in specific proportions to cement to change its mechanical properties and give it desirable qualities, whether in terms of colour or strength. Durable, tensile and permeable, a trend has been made to use polymers with cement mortar [2].

A study by **[3]**, documented that adding cockles shell powder and its effect on cement strength and thermal conductivity. The results showed that adding cockles shells by 50% of the weight of cement mortar increases compressive strength and reduces the thermal conductivity of the final product. [4] also indicated that adding a weight percentage of glass to cement mortar at a ratio of (2-2.5%) produces concrete with acceptable specifications, and with an increase in the replacement ratio, the compressive and flexural strength decreases, and the compressive and bending resistance increases at low substitution concentrations.

Other previous studies studied the effect of adding unsaturated polyesters to cement mortar in different proportions, which led to the improvement of the operational properties, adhesion, toughness, and hardening faster, and the increase in the percentage of polyesters leads to an increase in mechanical properties. A water ratio of 0.34 and the use of Calinium 505 with a ratio of 0.36 water led to an increase in compressive strength on the third day by 30%. Plasticizers were used at temperatures of 20C ° & 40C ° C, also he was found that the use of 1.5% of Calinium from the weight of cement increases the elasticity and compressive strength and when raising the degree The temperature of the medium reached 40 ° C, where the compressive strength increased to (90,54 MPa with a lifespan of (150,28) days in consecutively **[5]**. Mohammed [6] indicated that the weighted substitution of black tea residues with cement in different proportions leads to an increase in the compressive strength and bending at the ratio of 7.5%.

Another study documented the effect of acrylic styrene emulsion on water percentage, cohesion time, water retention, permeability, and mechanical properties of cement mortar, and the results showed that acrylic styrene reduces the percentage of water required to reach the standard dough, reduces the initial and final cohesion time, and improves Significantly the water retention rate [8]. While the two scholars Saidu & Lawa [9] indicated that the addition of limestone increases the compressive strength, by increasing the concentration of emiston or limestone to 15% of the weight of the cement, the compressive strength decreases

Practical part:

1-Used material:

1-1- Cement:

Ordinary portland cement was used, produced by the Badoush expansion factory on 6/9/2020, and it was stored in sealed plastic boxes to prevent moisture absorption, provided that the material of the boxes did not react with the cement or affect its properties. All chemical and physical tests were performed according to Iraqi Standard No. (5) for the year 2019 [10], see Table (1,2).

Table (1): The Chemical Composition of the Ordinary Portland Cement

Oxides	Iraqi Standard	Results
In. R	less%1.5	0.85
MgO	Less 5%	4.04
SO_3	2.8% Max for O.P.C* 2.5% Max for S.P.C**	2.40
CaO	-	62.47
SiO_2	-	20.68
Al_2O_3	-	5.96
Fe_2O_3	-	2.34
L.O.I	4% max	1.35
Fr. L	-	1.48
L.S.F	-	91.29
C_3S	-	40.75
C_2S	-	28.55
C_4AF	-	7.18
C_3A	-	11.80

*O.P.C: Ordinary Portland cement **S.P.C: Sulphate Portland cement

Table (2): The physical properties for the Portland Cement

Physical tests	Iraqi standard specification	Results
Specific gravity	-----	3.12
Blain's finess (cm^2/gm)	250for S.P.C $\leq$ $\geq$ 280 for O.P.C	313.5
Initial setting time (min)	45min $\leq$	145
Final setting time (hour)	$\leq$10 hours	3:05
Expansion: Autoclave	$\leq$0.8%	0.06
Compressive strength (2days)	10 N/mm$^2\leq$	20.00
Compressive strength(28days)	N/mm^2 32.5 $\leq$	45.25

2- Fine aggregate: Turkish sand was used which is imported according to the European standard EN 196-1/ 2016 [11] from the Turkish company Limak, with plastic bags with weights of 1350 ± 5 g. The moisture content is less than 0.2%. The humidity is determined by the decrease in mass. For the sample after putting the sand in Oven which temperature is (110-105) C° for two hours, expressed as a percentage of the dry mass. the gradation of sand grains is shown in Table (3).

Table (3) The Sieve Size Of Sand Analysis

Sieve Size (mm)	Residue(gm)
2.0	0
1.6	7±5
1.0	33±5
0.5	67±5
0.16	87±5
0.008	99±1

3- Water used in cement mortar:

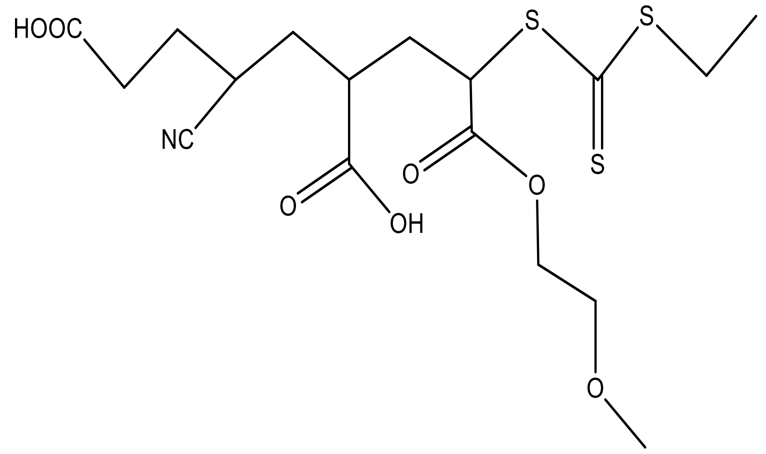
The water used in cement mortar must be free of fatty, acid, alkali and plant materials, and it must be suitable for civilian uses [10]

4-Glenium 51: is an innovative admixture based on modified polycarboxylic ether (PCE) polymer, it is complied with EN 934 – 2[12] and is compatible with all types of cement,Figure (1) explain the chemical structure of Glenium51, Table (4) contains the properties of the polymer[13]

Table (4): The properties of Glenium 51

Properties	Datum
Chemical Structure	poly carboxylic ether
Colour	Brown Liquid
Specific gravity at 20 C°	1.10±0.03 g/cm^3
PH- value	7.0±1
Alkali content %	≤ 3.00
Chloride content %	≤ 0.10
Corrosion behaviour	Contains only components according to BS EN 934-1:2008 , Annex A.1
Compatibility	It is suitable for use with all types of cement, Silicafume,Fly-ash, slag
Water reduction	≥ 112% of Reference mix
Increase inconsistence	Increase of ≥ 120mm from initial slump or ≥ 160mm from intial flow
Retention of consistence	At 30 mins ≥ Reference mix at initial
[14] https://www.master-builders-solutions.com	

*The properties at 20C°, Relative Humidity 50%



4-cyano-2-(2-(((ethylthio)carbonothioyl)thio)-3-(2-methoxyethoxy)-2-methyl-3-oxopropyl)-2,4-dimethylheptanedioic acid
Chemical Formula: $C_{20}H_{31}NO_7S_3$

Figure(1) The chemical structure of Glenium 51

5-Silica fume (SF): It was supplied from(BASF) -the properties explained in table (5). It was used with dosage(0.11-0.88)% from the weight of cement in this research.[15]

Table (5) The Physical properties of Silica fume

Physical properties	Value or Description	ASTM C1240 [16]
State	Nano powder	Sub-micron powder
Partical size	Amorphous	-
Density	Kg/l 0.7-0.55	
Colour	Grey	
Allowed Dosage	(5-15)% by weight of cement	
Compatibility	It is suitable for use with all types of cement,cementation materials and superplasticizer	
Blaine	gm / cm^2 3600	
Surface area	cm^2/gm 200000	
https://www.master-builders-solutions.com [17]		

2. Used mixtures

1. The mixture used in the test of compressive and flexural strength.

The ratio (3: 1) (cement: sand) and water/cement ratio is equal to (0.5) is adopted in specimens preparation to test the compressive and flexural strength, and all physical and chemical tests were conducted at the Badoush Laboratory, the temperature was established at 20C° through the ponds in an amazing oven. Then, evaluate the compressive strength and flexural at (28, 2) days.

2. The mixture used in the test of tensile strength:

The mixture adopted (3: 1) (cement: sand) and water/cement ratio is equal (0.45) and all the mixture carried out in the material laboratory in the Department of Civil Engineering / University of Mosul for the period between March and September. the temperature was established at 20C° through the ventilated oven. Then, measurement the Tensile strength at (2, 28) days. It included a series of experiments:

The first series: Adding Glenium 51 by different percentage from cement weight with reducing water content as added Glenium 51 to obtain high compressive and flexural strength of cement and high tensile strength at the optimum value Glenium 51.

The Second Series: Addition the Silica fume alone to the cement mixture without Glenium 51 and keep a fixed water/cement ratio. Then, study the effect of this material on cement properties.

The third series: Addition the optimum value of Silica fume obtained from the second series to the optimum value of the Glenium 51 obtained from the first series and add the mixture to cement mortar. Then, study the effect of these materials on cement properties.

3. Method of mixture:

1. Mixing method for testing the compressive and flexural strength of cement moetar

Cement mortar was mixed according to Iraqi specification No. (5) /2019 [10] using a mechanical mixer and the standard sand and cement are placed in the mixer's bowl and slowly mixed at the slow speed for 30 seconds. Then, increases to the high speed for 60 seconds and stops the mixer for 90 seconds. After that, remove what all precipitated on the walls of the bowl by rubber and returned to the mixture for homogeneity.

2- Mixing method for testing the tensile strength of cement moetar

Cement mortar was mixed according to (ASTM C150) /2015[18]:

Dry material mixed for 60 seconds then added Glenium 51 at a percentage of cement weight after reducing water content as much as the amount of Glenium 51 added and added an aqueous solution (Glenium 51 + water)to the dry materials within 30 seconds and mixing the mixture for 90 seconds for homogenization.

4. Molds used:

1. Molds used in compressive and flexural strength of cement mortar :

The prisms with a dimension of (40 * 40 * 160) mm were prepared for compressive and flexural strength. The inner surface of the molds is lubricated after tightening their parts with a thin layer of mineral oil to prevent cement mortar from sticking to the molds , The molds have been filled with half the amount of cement mounces in a thin layer and sucked by vibrator for 60 seconds. Placed in box with relative humidity 95% and 20±1 C° for 24 hours. Then, opening the molds continue to be treated in water at 20 ± 1C° for (2, 28) Day. All tests were done according of Iraqi Specification No. (5) /2019[10]

2. Molds used in tensile strength of cement mortar:

Iron brackets were used as the Figure (1) and according to ASTM C150 /2015[18]. The inner surface of the brackets was lubricated with a thin layer of mineral oil to prevent cement mortar from sticking to the brackets and filling the brackets with one layer of cement and compression by the thumbs (6) times from the top layer and then turning the bracket and repeat the process again and then leave 24 hours at room temperature before opening the bracket.

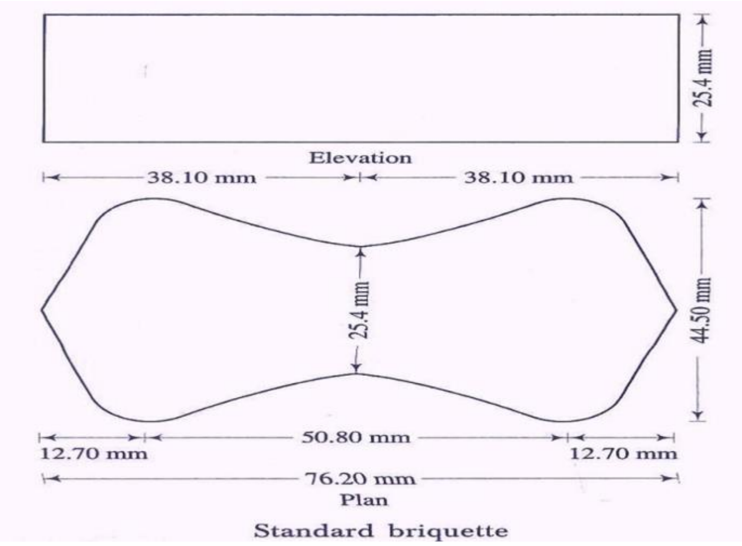


Figure (1): the shape of the tensile bracket

Process of treatment : Two methods used to treat cement molds

1- Continuous standard treatment with water. Then, immersion

1. compressive, flexural, and tensile prisms in a special tank after opening them from the molds till to be tested. The models of each group are isolated from other group models. The salt concentration in the water was fixed by adding water to the basin to compensate for the evaporated water and fixed at 20 C°.

2- The molds were treated at room temperature after the opening of

the molds until they were tested after being taken out of the refrigerator at 7 C° and in the oven at 55C.°

6- Tests:

1- Compressive strength of cement mortar:

The SERVO PLUS / EVOLUTION machine was used which have 400 kg and 300KN capacity according to Iraqi specification No. (5) / 2019[10]. The Prisms were tested at (2, 28) days in 6 halves of prism per mixture.

2-Flexural strength of cement mortar:

The same machine in (1) is used to test flexural strength and according to Iraqi specification No. (5) / 2019[10], The prisms were tested at (2, 28) days in 3 prisms per mixture.

3- Tensile Strength of Cement Mortars

Uses machine of tensile strength type (ULITEST), USA origin has a capacity of 100 tons and speed loaded 40 kg / 10 seconds to measure the strength of tensile according to ASTM C 150 / 2015[18]at (2, 28) day in three brackets per mixture.

Results and discussion

1- Compressive Strength Of Cement Mortar:

It is considered one of the easy and reliable tests to know the quality of cement and the extent of its strength. The compressive strength was calculated for cement mortar and not for the cement alone.

1- Effect of addition of Glenium 51 on compressive strength of cement mortar at 20 °C, 7 °C, 55 °C

Glenium 51 was added with different percentages of the cement weight and as shown in Table (6). The results showed that the compressive strength increased when using Glenium 51 by (0.66%) of the weight of the cement by (71.25, 24.66%) at the age of (2, 28) days respectively, as shown in Figure (2), where Glenium 51 suffers a unique mechanism and greatly improves the diffusion efficiency of the cement and wraps around the cement grains at the beginning of the mixing processes, and the sulfonate groups of the polymer chains increase the negative charge of the surface of the cement particles and these particles are dispersed by repulsion Electrostatic, this electrostatic mechanism causes the cement paste to spread and disperse, and it has positive properties as it requires less mixing water to prepare the mortar. Glenium 51 has a chemical structure different from the rest of the superplasticizers as the polymer consists of polycarboxylic ether with long side chains. These side chains are connected to the column. The backbone of the polymer creates a steric obstrucle that leads to the dispersion and separation of cement particles significantly. This a steric obstacle provides a physical barrier between the cement grains, which reduces the water content uses. [19].

When adding the optimum percentage of Glenium 51 (0.66%) of the cement weight to the cement mortar at 7 C°, the compressive strength increased by (16.63, 50.24%) at (2, 28) days, respectively, compared to the reference mixture as in Table (6).

And when the optimum percentage of Glenium 51 0.66% was added to the cement mortar at 55 C° the compressive strength increased by (24.07, 20.06)% at (2 , 28) days, respectively, compared to the reference mixture as in Table (6).

Table (6) The effect of adding Glenium51 in the compressive, Flexrual &Tensile strength to the cement mortar at 20C°,7C°,55C°

% Glenium	Temp.C°	Compressive strength (Mpa)		Flexural strength (Mpa)		Tensile strength (Map)	
		2days	28days	2days	28days	2days	28days
0.00	20	20.00	45.25	10.31	22.23	1.7	3.3
	7	10.46	30.20	6.26	15.27	1.50	2.59
	55	14.00	32.15	8.11	18.36	1.59	2.62
0.11	20	20.39	45.80	11.96	22.50	1.8	3.36
0.22	20	22.14	46.00	13.30	22.55	1.86	3.40
0.33	20	22.68	47.24	14.60	22.90	1.89	3.42
0.44	20	25.68	48.24	16.86	23.28	2.07	3.45
0.55	20	28.34	52.88	17.00	23.66	2.12	4.00
0.66	20	34.25	54.41	18.10	24.80	2.97	4.60
	7	12.20	37.60	9.47	19.91	12.10	23.41
	55	17.37	38.60	12.10	23.41	2.67	2.88
0.77	20	27.02	50.09	14.30	21.66	1.79	2.12
0.88	20	10.39	23.28	10.00	15.80	1.2	1.40

2- The effect of adding silica fume to the compressive strength of cement mortar at (20,7,55) C°

Silica fume was added in different percentages of cement weight and as shown in Table (7). The results showed an increase in compressive strength at 0.44% of cement weight, as in Figure 3, as it increased by (36, 5.5)% at (2, 28) days f age, This can be explained by the fact that the granules of silica fume have a diameter of a hundred times smaller than the granules of ordinary Portland cement and therefore they fill the spaces between the granules of Portland cement, and the spherical shape of the grains of silica fume increases the effect of sliding in the cement, which increases the physical effect of silica fume on Mortar to produce a dense and cohesive mortar. These effects are increased due to the low specific weight of silica fume, which increases the size of the cement sample leading to the reduction of voids and areas of weakness, such as dewatering channels from the transition zone. The reaction often begins within 24 hours, producing large quantities of secondary aqueous calcium silicate and greatly improving the microstructure. For cement dough in the area near the transition zone. As it reduces the porosity of the transition zone, which leads to an increase in the compressive and tensile strength [20].

When adding the optimum percentage of silica fume at 0.44% of the cement weight to the cement mortar at 7C°, the compressive strength increased (33.36, 26.68)% at the age of (2, 28) days, respectively. When adding the optimum percentage silica fume by 0.44% of the cement weight to the cement mortar at 55 C°, the compressive strength increased by (20, 12.16)% at the age of (2,28) days, respectively. As shown in Table (7). When adding the optimum percentage of silica fume , 0.44% to the optimum percentage of Glenium 0.66% at 20 ° C, the compressive strength increased (44.45, 17.79%) at (2, 28) days, respectively.

When adding the optimum percentage of silica fume 0.44% to the optimum percentage of Glenium 0.66% at 7 ° C, the compressive strength increased (101,21.98) % at the age of (2, 28) days, respectively. And when the optimum percentage of fume was added 0.44% of the cement weight to the optimum percentage of Glenium 0.66% at 55 C°, the compressive strength increased (59.28, 19.44)% at the age of (2, 28) days, respectively, as shown in Table (7).

Table (7) The effect of adding Silica fume in the compressive, Flexural &Tensile strength to the cement mortar at 20C,7C°,55C°

% Silicafume	Temp. °C	Compressive strength (Mpa)		Flexural strength (Mpa)		Tensile strength (Map)	
		2days	28days	2days	28days	2days	28days
0.00	20	20.00	45.25	10.31	22.23	1.7	3.3
	7	10.46	30.20	6.26	15.27	1.50	2.59
	55	14.00	32.15	8.11	18.36	1.59	2.62
0.11	20	22.80	46.23	11.80	22.66	1.88	3.65
0.22	20	23.22	47.00	13.35	22.96	2.35	3.80
0.33	20	25.11	47.33	14.65	23.55	2.60	4.19
0.44	20	27.20	49.73	17.10	25.13	2.85	4.37
	7	13.95	36.26	11.60	16.77	11.30	21.09
	55	16.80	38.06	11.30	21.09	2.35	3.20
0.55	20	23.05	46.60	16.80	23.00	2.51	3.72
0.66	20	21.83	46.22	16.00	22.62	2.47	3.36
0.77	20	20.80	45.11	15.63	22.53	2.11	2.90
0.88	20	20.09	43.82	13.50	20.55	2.04	2.50

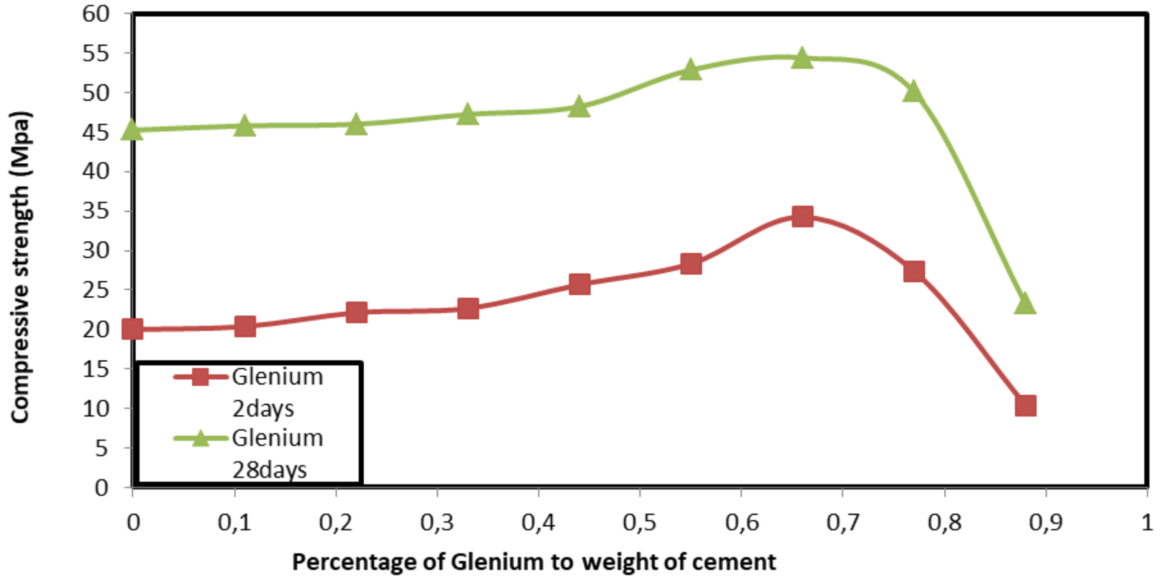


Figure (3) The effect of adding Glenium 51 to the compressive strength 2&28 to cement mortar at 20C°

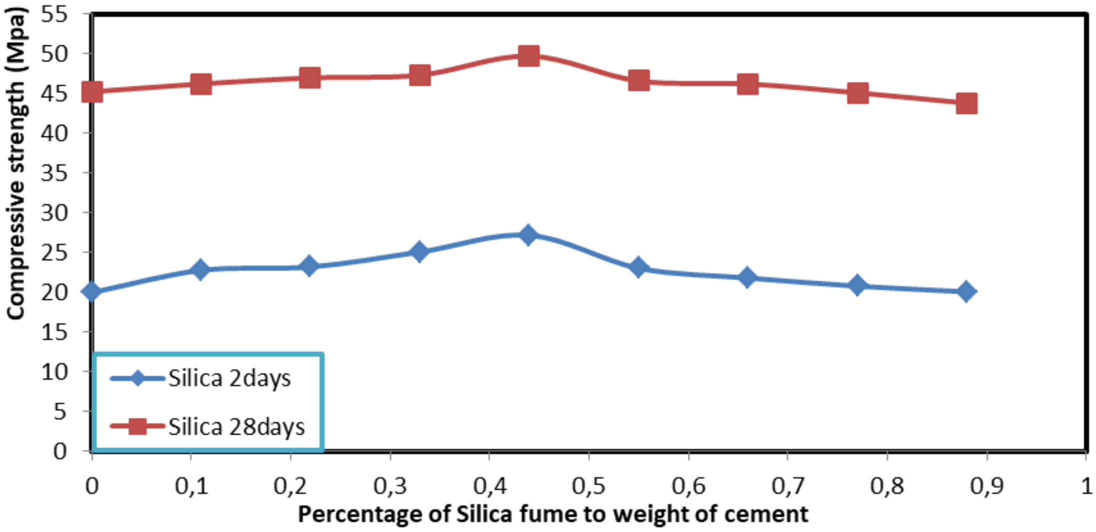


Figure (4) The effect of adding silica fume to the compressive strength 2&28 to cement mortar at 20 C°

2. Flexural strength

The Flexural strength is slightly higher than the tensile strength and the same compressive strength prisms are used in measuring the flexural strength according to the Iraqi Standard specification No. (5) / 2019 [10], where the molds are opened after 24 hours and placed in the treatment ponds at the time of (2,28) days and the result is taken at a rate of 3 prisms.

a. A- Effect of addition of Glenium 51 on the flexural strength of cement mortar at (20,7,55) C°

Glenium 51 was added in different percentages of cement weight as in Table (6), and the highest value of flexural strength was at 0.66%, with a (76.43%, (13.90 %) at the age of (2, 28) days, respectively, as in Figure (3). When adding Glenium with optimum value to cement mortar at 7 C°, the flexural strength increased by(51.27,30.38)% at age of (2,28) days, respectively. When adding the optimum percentage of Gleinium 0.66% to the cement mortar at 55 C°. The compressive strength increased by (49.19, 27.50)% at the age of (2, 28) days, respectively.

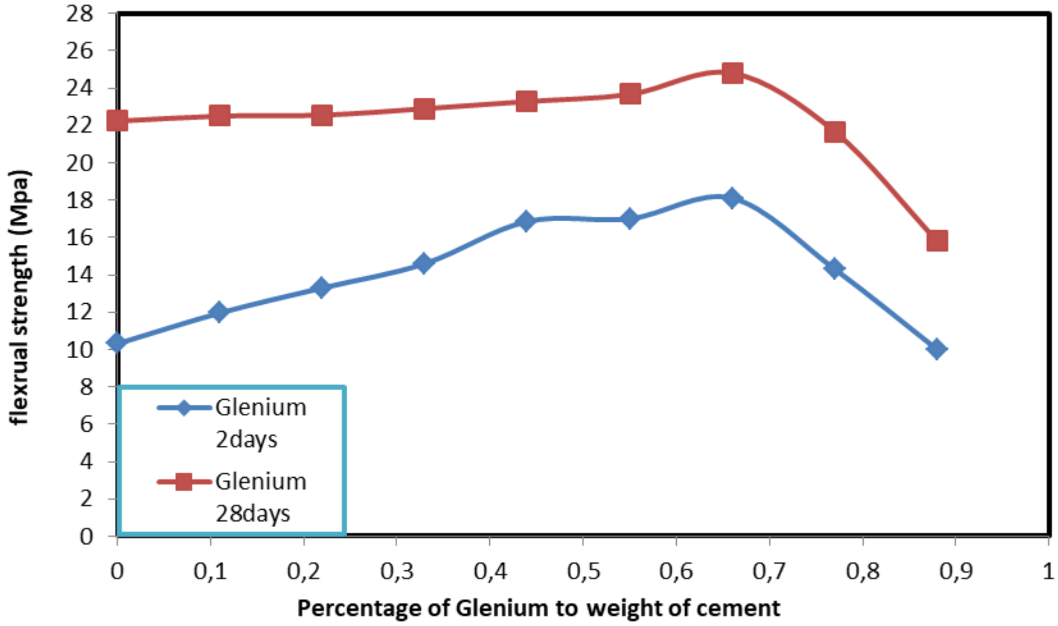


Figure (5) The effect of adding Glenium 51 to the flexrual strength of cement mortar for 2&28days at 20 C°

B- The effect of adding Silica fume to the flexural strength of cement mortar at (20,7,55) C°

Silica fume was added in different percentages of the cement weight as shown in Table (7). The highest flexural strength was at 0.44% of the cement weight (65.85, 3.71)% with an age of (2, 28) days, respectively, as shown in Figure (4) and when adding the optimum percentage of silica fume 0.44% to the optimum percentage of Glenium 0.66% at 20 C°, the flexural strength increased by (35.59, 10.56)% at the age of (2,28) days, as shown in Table (7). Also, the optimum percentage of silica fume was added to the cement mortar at 7 C°. The flexural strength increased by (13.06, 9.82%) at (2, 28) days, respectively.

And when adding the optimum percentage of silica fume to the optimum percentage of Glenium at 7 C°, the flexural strength increased by (54.95, 20.82)% at age of (2, 28) days, respectively, as shown in Table (7). Also, the optimum percentage of silica fume was added to the cement mortar at 55 ° C. The flexural strength increased by (39.33, 14.95)% at (2, 28) days, respectively. And when adding the optimal percentage of silica fume to the optimum percentage of Glenium at 55 C°, the flexural strength increased by (47.71, 25.81) % at age of (2,28) days, respectively.

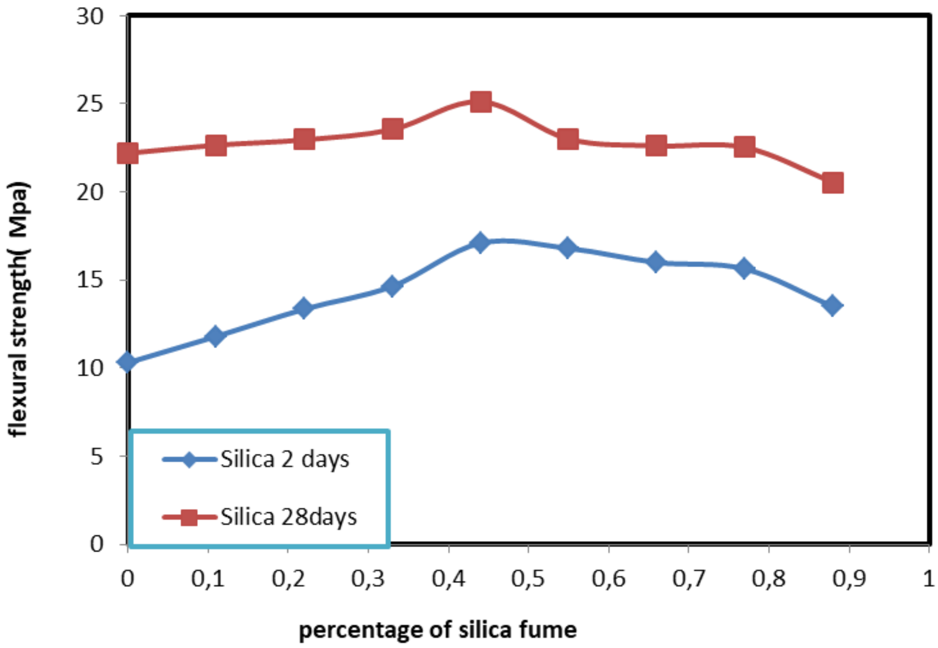


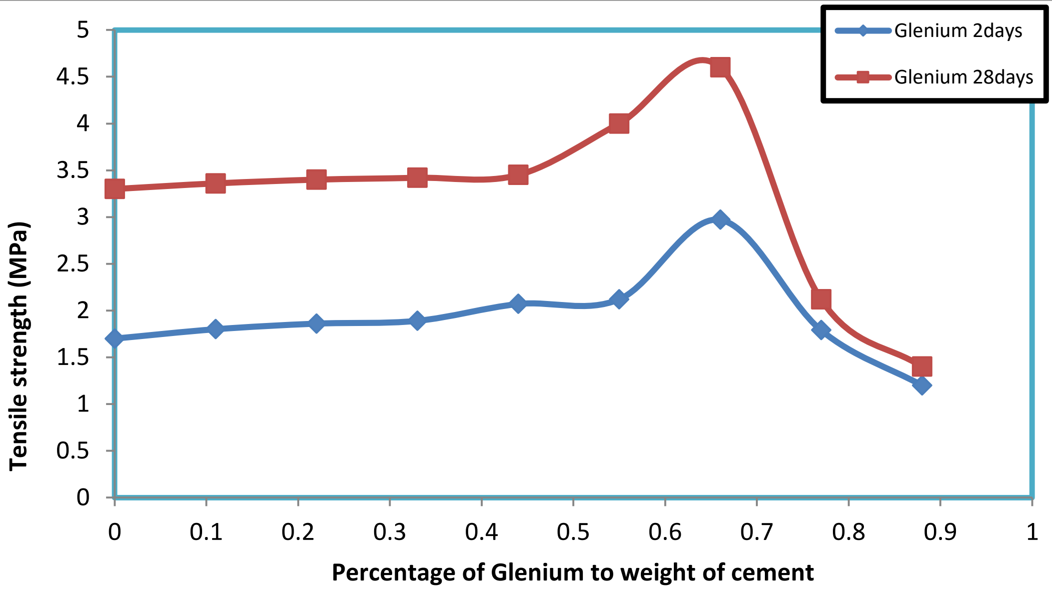
Figure (6) The effect of adding silica fume to the flexrual strength 2& 28 days at 20 C°

3- Tensile strength of cement mortar:

It is a measure of the amount of stress that the material is subjected to when it reaches the point of collapse, and the direct tensile strength test is used widely, but it is one of the tests that give fluctuating and scattered results and cannot be relied upon accurately and is not an accurate indication of the extent of cement strength, Therefore, it depends on the compressive strength when testing the cement more than on the tensile test.

1. The effect of Glenium 51 addition on the tensile strength of cement mortar at (20,7,55)C°

Glenium 51 was added with a different percentage of cement weight at 20C° as in Table (6) the tensile strength increased at 0.66% of the cement weight by (74.70, 39.39%) at age of (2, 28) days, respectively. When Glenium 51 was added by 0.66% of the weight of the cement to the cement mortar at 7 C°, the tensile strength increased by (63.33, 22)% by the age of (2,28) days, respectively. When adding Glenium 51 at 55C° the tensile strength increased by (63.33, 22)%. By (67.92, 9.92)%, at (2, 28) days lifetime, respectively.

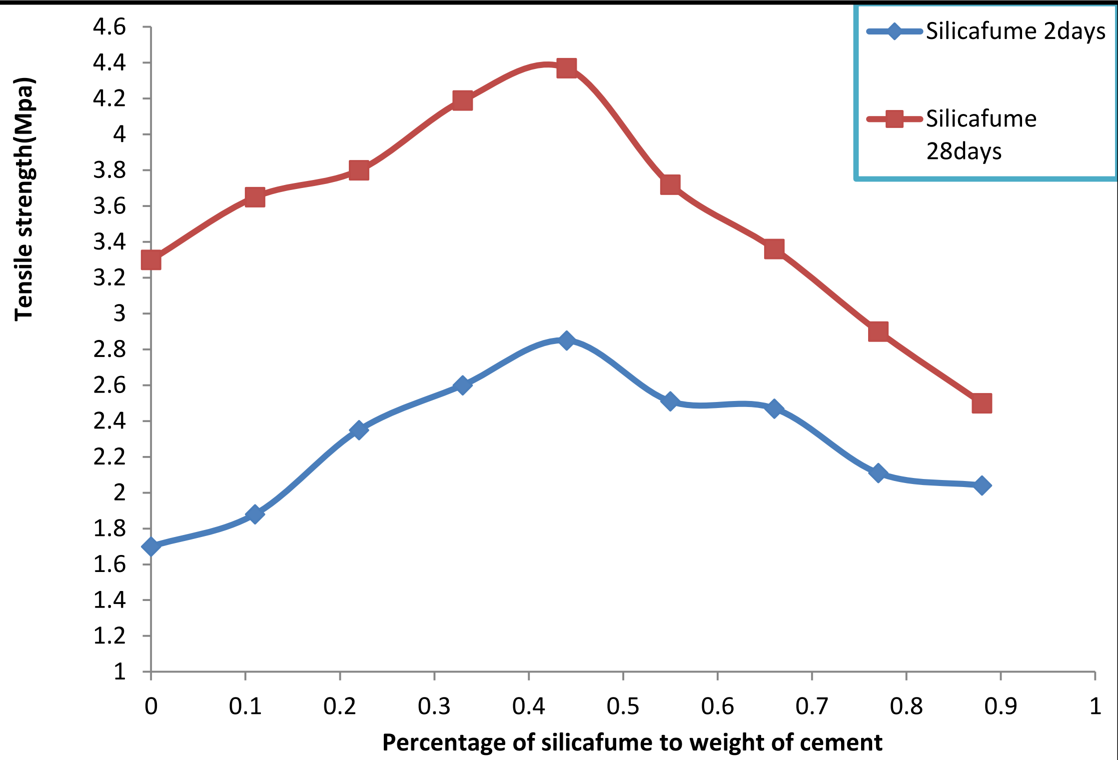


Figure(7) The effect of adding Glenium 51 to the tensile strength 2&28days to the cement mortar at 20C°

2- The effect of adding silica fume to the tensile strength of cement mortar at (20,7,55) ° C.

When silica fume was added with different percentages of cement weight at 20C°, the tensile strength increased at the percentage of 0.44% by (67.64, 32.42)% at age of (2, 28) days, respectively, as shown in Figure (7).

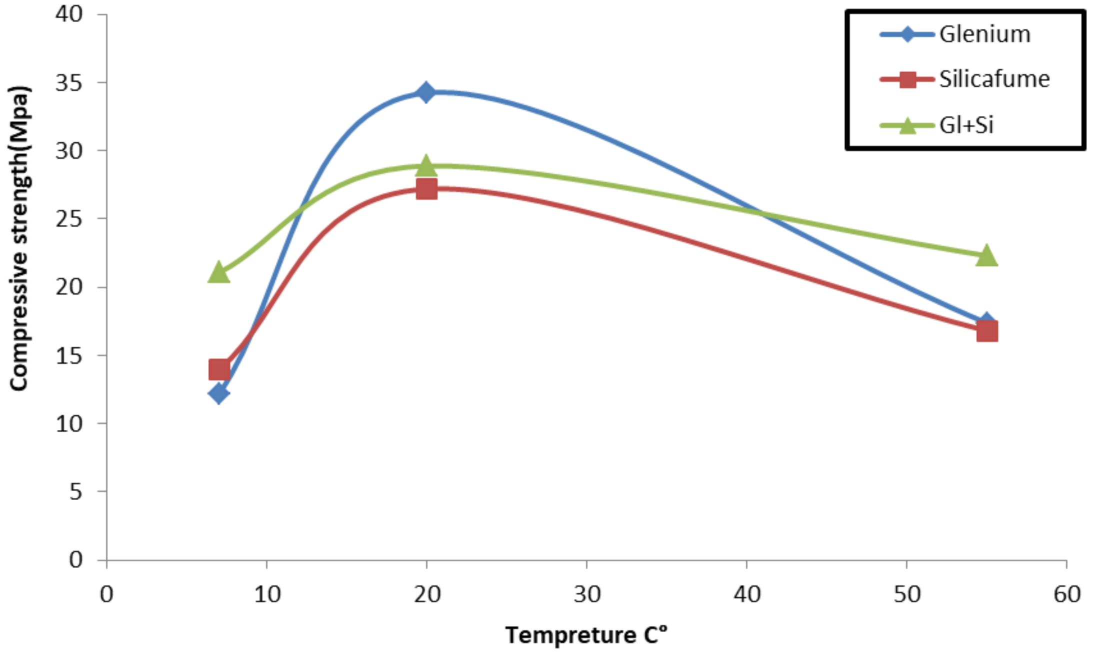
When adding the optimum percentage of silica fume to the optimum percentage of Glenium-51, the tensile strength increased compared to the reference mixture by (58.82%, 15.42%) at age (2, 28) days, respectively. The optimum percentage of silica fume was added to the cement mortar at 7 C° The tensile strength increased by(41.33,15.83) % At the age of (2, 28) days, respectively. The optimum percentage of Glenium 0.66% was added to the optimum percentage of silica fume by 0.44% of the cement weight at 7 C° The tensile strength increased by (23.33, 8.10) % at the age of (2,28) days respectively. Also, the optimum percentage of silica fume was added by 0.44% of the cement weight to the cement mortar at 55 C°, The tensile strength increased (47.80, 22.13)% at the age of (2.28) days, respectively. When adding the optimum value of silica fume by 0.44% to the optimum value of Glenium 0.66% at 55 C°, the tensile strength increased (57.86, 26.33%) with an age of (2.28), respectively.



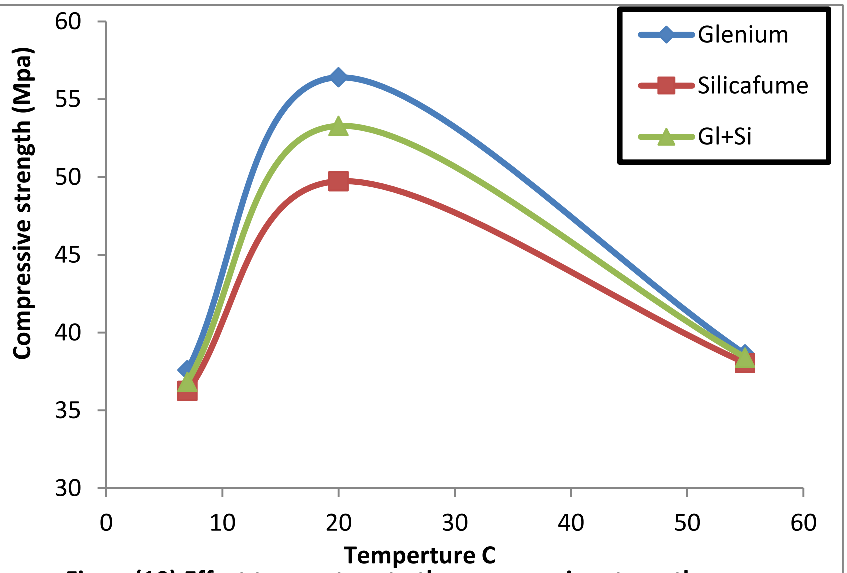
Figure(8) The effect of adding silica fume to the tensile strength 2&28days to cement mortar at 20C°

4. The effect of temperature on compressive, flexural and tensile strength of cement mortar:

The present study showed that the compressive strength of the molds was treated at 20C° was higher than the compressive strength of the molds that were treated at 55 C° and in turn was higher than the compressive strength of the models that were treated at 7C° as shown in Figure (7, 8) where the compressive strength of the molds was containing Glenium-51 at 20C° (34.25, 56.41) MPa at age (2, 28) days respectively [21] while the molds that were treated at 55 C° had compressive strength (17.37, 38.60) MPa, and the molds treated at 7C° were (12.20, 37.6) MPa compared to the reference mixture that was treated at the same temperature [22]. The same interpretation applies to the flexural and tensile strength of each of the molds when adding silica fume to Glenium 51, as well as when adding silica fume to cement mortar alone [23] or adding Glenium to cement mortar also, and as in Figure (9, 10), we notice that with a rise in temperature, the compressive strength increases for early ages of cement containing silica fume, but after a week and four weeks, the situation changes completely, as the molds that have been treated at degrees 4C° up to 23 C° and until the age of 28 days gave strength It is higher than the molds that gave strength from the models that were treated between 32 C° to 49 C°, and we note that the decrease in strength is greater the higher the degree of treatment, and the reason is that increasing the temperature leads to the acceleration of chemical reactions of hydration, which in turn has a positive effect on compressive strength for early ages, and negative impact and decreases at the age of 7 days onwards and to clarify that the rapid primary hydration is with products with a weaker physical structure and this structure has many pores and leads to less compressive strength resulting from slow hydration. The effect of temperature on the flexural and tensile strength of cement mortar is the same as on the compressive strength [24] as shown in Fig. (11,12).



Figure(9) The effect of temperture on the compressive strength 2days of (Glenium+Silicafume) in cement mortar



Figure(10) Effect temperture to the compressive strength 28days contain Glenium&Silica fume

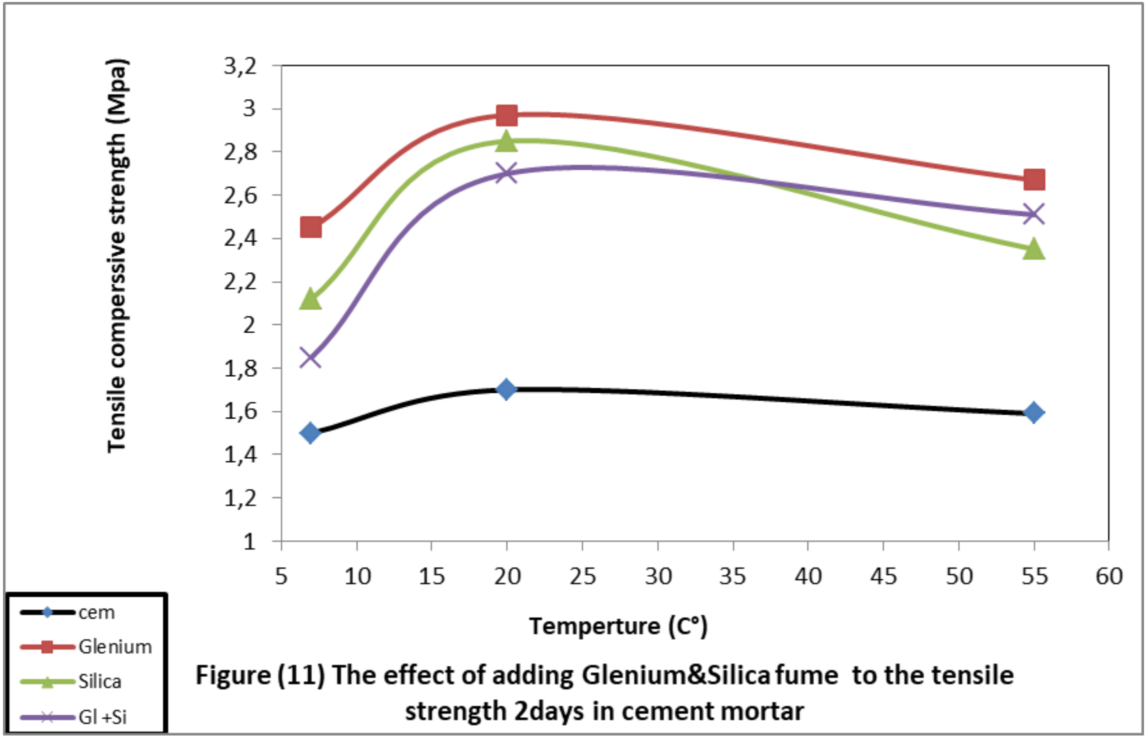
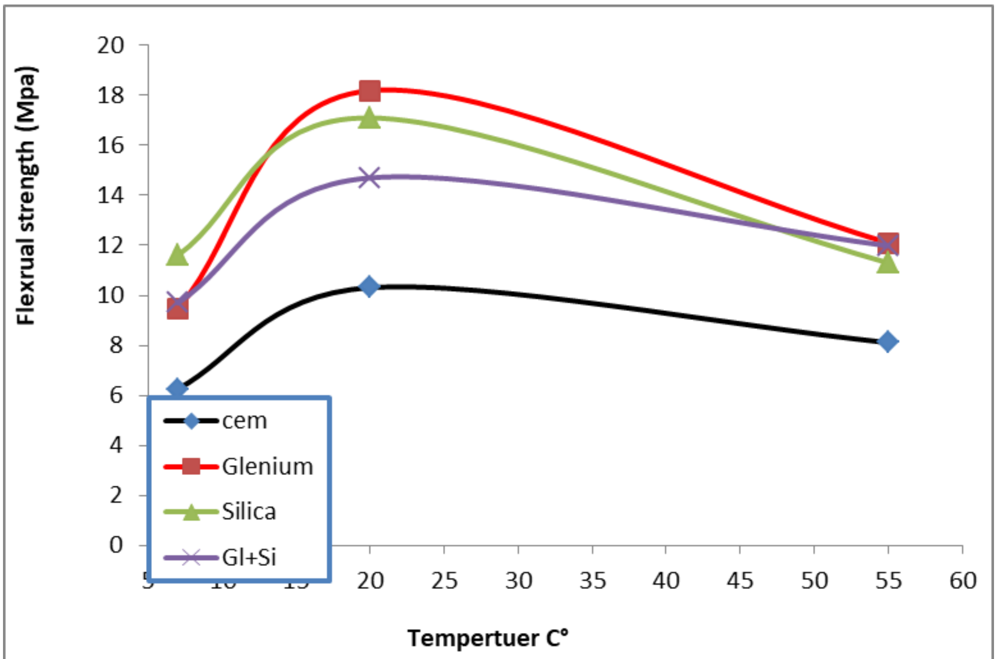


Figure (11) The effect of adding Glenium&Silica fume to the tensile strength 2days in cement mortar



Figure(12) The effect of adding Glenium&Silica fume to flexural strength 2days in cement mortae

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