Evaluation Using New Products Types of Superplasticizers (Type Glenium) and Its Effect on Workability and The Compressive Strength of Concrete in Medium Hot Weathers

Haitham Z. Hussein
Dams and water Resources Department
College of Engineering – University of Anbar
al_raad55@yahoo.com

ABSTRACT.

This research, an attempt is carried to explain the use of new products of superplasticizers type (Glenium) locally recent period used in normal concrete strength,espeacailly in precast concrete. and the effect of medium hot weather climates on compressive strength of normal concrete made with various percentages of Glenium dosages , and to evaluate the dosages on workability of fresh concrete. Concrete mixes with two types containing of Glenium, G51 and G21. and different dosages of Gelnium, namely 0.8 and 1.2 liter per 100 kg of cement and reduction in water quantity about 25% Five mixes are made with 90 specimens, each mix contains 18 cubes ,half of specimens are cured by moist curing in normal condition, the other half of specimens are exposed to temperatures of 40^{o}C.which is transferred to moist medium of hot water.

The properties which are covered in this work consist of workability which represented by slump test, and strength represented by compressive strength and ultrasonic pulse velocity(UPV) tests. It is obtained that using the two types of Gelnium will improve the slump about (157% to 183%) compared with reference mix .The concrete cured at medium hot weather condition, show improves in compressive about (19.2 to38.12%) at 3 days age. The use Glenium type 51 is to be more suitable for normal concrete works in medium hot weather .

Keywords: Normal Concrete Mixes, Superplasicizers , Glenium ,Compressive Strength, workability , Medium Hot Weather.

1. INTRODUCTION.

Superplasticizers belong to a class of water reducers chemically different from the normal water reducers and capable of reducing water contents by about 30%. The admixtures belonging to this class are known as superplasticizers, superfluidizers, superfluiddiers, super water reducers, or high range water reducers. They were first introduced in Japan in the late 60's and in Germany in early 70's. In North America they were used from 1974.[1]

The advantages derived by the use of superplasticizers include production of concrete having high workability for easy placement, and production of high strength concrete with normal workability but with a lower water content. A mix having a combination of better normal workability and lower normal amount of water, or that with less cement but having the normal strength and workability are other possible applications. Reliable statistics on the extent of the use of superplasticizers are not available. The data provided by Malhotra [2] in 1989, provides some indication in industrialized countries, the percentage of ready mix concrete utilizing superplasticizers varied between 1 and 20%. In precast concrete however, the use varied between 20 and 100%.

In Iraq , impiteous weather suffers long period of hot climate during the year and concreting under hot weather conditions involves many problems that need to be solved. Hot weather influences the properties of both fresh and hardened concrete. It increases the water demand for required workability, shrinkage and creep, and decreases the final compressive and tensile strengths of concrete, and other strength-related properties (e.g. modulus of elasticity, resistance of abrasion, etc.).[3]

The superplasticizers are broadly classified into four groups: sulfonated melamine-formaldehyde condensate (SMF); sulfonated naphthalene-formaldehyde condensate (SNF); modified lignosulfonates (MLS), and others including sulfonic acid esters, such as polyacrylates, polystyrene sulfonates,etc. Blends of different superplasticizers have also been investigated. For example, lending of lignosulfonate with superplasticizers has economical and technological advantages. A blend of SNF and SMF-based superplasticizer may be used to realize certain benefits [4].

2. LITERATURE REVIEW.

The workability of concrete is measured by means of slump, flow table spread, compacting factor, or modified flow table method. Lessard [5] explained that ,these methods are not satisfactory for the concrete of flowing consistency. The slump test, although used extensively, reaches its practical limit at about220-250 mm. The ability of the superplasticizers to increase the slump of concrete depends on the type, dosage, and time of addition of the super plasticizer, w/c ratio, nature and amount of cement, aggregate, temperature, etc. Generally, the superplasticizers are used at higher dosages than are conventional water reducing admixtures.

Ramachndran [6] stated that, the chemical nature of the superplasticizer determines its effectiveness in increasing the slump. For example, to obtain a slump of about 260mm from an initial value of 50 mm, it may be necessary to add 0.6% SMF or MLS-based superplasticizer, whereas this could be accomplished with only 0.4% SNF. Lessard [5] obtained data on the relative amounts of SMF and SNF needed to attain the same slump value, for example, to obtain slump of 185-190 mm (w/c = 0.3), the dosage required for SMF and SNF were 1.9 liter and 1.3 liter ,respectively .Also for obtaining slump of 230-240 mm at w/c of 0.22,the corresponding dosages were 2.3 liter and 1.6 liter. Some conclusions were state by Ramachndran [6] had show that, the calcium salt of polystyrene sulfonate at dosage of 0.1%,increase the slump from 8cm to 18 cm whereas 0.15% sodium salt of SNF would be needed to achieve the slump gain.

Kantro and Popescu [7] concluded that, the amount of water reduction (15-35%) achievable with a particular superplasticizer depends on the dosage and the initial slump. There is evidence that, beyond a particular dosage, further water reductions not possible. In all types of Portland cements, water reduction occurs, but to different extents. Generally, water reduction increases with the increasing the cement content. It has been reported that, for equal water reductions, more SMF than SNF type admixture is required. In addition Kantro and Popescu [7] investigated the water reduction capabilities of ammonium salt of SNF, sodium-based SMF, and admixtures of lgnosulfonate sulfonate. Compared to the w/c ratio of 0.25 for the reference, the values for the above admixtures were 0.21, 0.23, and 0.22 respectively.

The most important property of a superplasticizer is its ability of dispersing the cement particles. Electron microscopic examination reveals that in water suspensions of cement, large irregular agglomerates of cement particles form. Malhotra [2] stated that, by the addition of a superplasticizer, the material is dispersed into small particles, cement has a much higher percentage of fine particles than that treated with water 50°C Compared to cement suspension without the admixtures that with plasticizers shows better dispersion with the formation of finer particles. The ability of superplasticizers to reduce water and achieve very high strengths is of special importance for the precast concrete industry where high early strengths are needed for rapid turn over of formwork

The slump and slump flow of the concrete were 250 mm and 580 mm, which are indicatives of very good workability. The air content was 2.3%, which was used to enhance the workability of the concrete. The fresh concrete flowed in a body and there was no segregation in the form of mortar separation or bleeding. However, the water demand of the concrete mixture was high due to greater specific surface area of fine materials. The increase in water demand as reduced in presence of adequate superplasticizer**.**

3. MECHANISM OF GLENIUM ACTION.

Conventional suprerplasticizer at the time of mixing, become absorbed on to the surface of the cement particles .This absorption takes place at very early stage in hydration process. The sulphonic groups of polymer chains increase the negative charge on the surface of the cement particles and dispersion of the cement occurs by electrostatics repulsion. The different between the conventional products and the new products of Glenium in the contains the chain of carboxylic ether polymer chains which make the concrete more and provides flowable with greatly reduced water demand.[8]

This flowability up build through, the side chains linked to polymer backbone generate a steric hindrance which greatly stabilizes the cement particles ability to separate and disperse. The same different between the two Glenium products take the more advantage because the long lateral chains take more workability and suitable in aggressive climate with making normal concrete mix especially in precast concrete.

TheGlenium51 is different from conventional superplastizier ,such based on sulfonated melamine and naphthalene-formaldehyde condensate it is based on unique carboxylic ether polymer with long lateral chains. This greatly improves cement dispersion. While Glenium21 it contains of carboxylic ether polymer with long side lateral chains.[8]

4. MATERIALS & TEST METHODS.

4.1. Cement.

The Cement used in this work is Kubaisa Ordinary Portland cement manufactured type(I). This Cement checked and tested according to Iraqi standard specifications (I.Q.S 5:1984). **Table (1) & (2)** show physical properties and chemical analysis of this cement and the limits of I.Q.S 5:1984 for each one . Physical properties and chemical analysis were made by Consulting Engineering Bureau- University of Baghdad.

4.2. Coarse Aggregate.

Graded crushed gravel (5-20) mm from Al-Nibaee region is used in this work. The **table (3)** show the grading of this aggregate, which conforms to Iraqi standard specifications(I.Q.S 45:1984).the specific gravity, sulfate content and absorption of coarse aggregate are illustrated in the same table.

4.3. Fine Aggregate.

Natural sand from al-Akheder region was used . It is graded sand (within zone 2) according to IQS No.45-1984shown in **Table(4)**, Other properties are listed in the same Table .

4.4. Superplastizicers.

Two of the most used types of high water reducing and accelerators were used locally as admixtures .These types were based on polycaroxylic, represented new generation of copolymer-based superplasticizer designed is the usage of Glenium 51& Glenium 21.

The typical properties of these type according to BASF (manufacturer editions) are shown in **table(5)** .The two types are free from chloride and complies with ASTM C-494 –Type F.

4.5 .Water.

Ordinary Tap water was used in this work for all concrete mixes and curing of specimens .

5. MIX DESIGN.

The concrete mix proportions used in this work are calculated according to American Concrete Institute (ACI -211:1991). All mixes are designed to have a 28-day compressive strength of 35 MPa with slump ranging between (30-50) mm. The proportions were adjusted after reduction water quantity 25% and added superplastizicers dosages(Glenium dosage) in (0.8 &1.20) liter per 100kg of cement in mix with three ages 3,7 & 28 days. Ninety cubes with dimensions(150×150×150mm) are casting for all mixes ,five mixes are preperted,each mix contain 18 cubes half of them for mist curing ,and others for dry curing. **Table (6)**shows the weights of materials used in the mixes**.**

6. MIXING AND CURING.

All batches are prepared and tested in Laboratory of Nabdh Al-Rafidain Factory for Product Concrete Girders & Precast Units, All batches are mixed in under laboratory conditions (temperature: 20-25^{0}C) and the concrete is mixed in a laboratory pan mixer, with a capacity of 0.05m^3.

Two types of curing are simulated. Normal curing is characterized by adjusting temperature of water at 25 $\pm 1^0$C. Medium Hot weather curing is represented by placing the specimens in a curing tank standing in a controlled-temperature room. The curing temperatures is 40^{O}C (with an accuracy of $\pm 2^0$C).

After two days of curing, these specimens are air cured in the laboratory at temperature rang between (20-25 ^{o}C) until they are tested.

7. TESTS.

7.1. Slump Test.

Part of each mix prepared is used for running slump test according to ASTM C143 -1986.

7.2. Compressive Strength Test.

Compressive strength test is conducted to B.S 1881: part 4-1992. Test cubes of (150*150*150) mm are prepared according to B.S 1881: part 3-1992. Three cubes are tested in each batch at 3,7,28 days age and the average value of compressive strength is obtained.

7.3. Ultrasonic Pulse Velocity (UPV) Test.

This test is carried out according to B.S 4408: part- 5-1992 using the portable Ultrasonic Non-destructive Digital Indicating Tester (pundit). The test is conducted for cubes intended for compressive strength. Three cubes are tested for each batch at specified age. Pulse velocity (V) in Km/Sec is calculated as fellow:

$$V = L / T \quad (1)$$

Where:

L: Path length, (mm).

T: Transit time in microsecond (μs).

8. RESULTS AND DISCUSSION.

The results of tests which is carried out on the fresh and hardened concrete are explained as shown below:

8.1. Workability Test.

Results of workability concrete test are tabulated in **table(7)** . Results show that ,the add dosage to reference mix increase workability ,the slump is proprtianal to increase amount of dosage of each type of Glenium increase the slump quntity. The low daosge(0.8 liter) for G21 and G51 respectivly improve slump 159% and 163% copmared with refernce slump.Medium doage(1.2 liter) of each G21 and G51 respectivly state widely increaing in workability according to the slump results,about 182% and 183% increase in slump test .**Figs. (1) and (2)** show the relationship between the slump and quantity of dosage ,it can be seen that the results accomplished with explitation of Ramachndran [6],that the dosage of increase superplasticizer dosage make the concrete more workable and take high fludity with out have any segregation in mix.On other hand ,the increase the dosage propotinal with increase the finer partciles in mix or cementetious materails required high surface area of hydration to improve the flowbiltiy**.**

8.2. Compressive Strength.

The compressive strength results are tabulated in **Table (8)** for two types of Glenium with different ages and two exposed curing temperatures. These results are plotted against the age in **figs. from (3) to (6)**.

It is clear from these results that, as the curing temperature and age increase the compressive strength increases as follows:

- For the references mix, specimens cured at temperature of 40 ^{o}C, the 3, 7 and 28-day compressive strength increase by 5.7, 5.0 and 4.10% respectively, in comparison with those cured at normal temperature (20 ^{o}C). On the other hand, specimens with low dosage (0.8 liter) cured at 40 ^{o}C for G51 have significant increase in their 3, 7 and 28-day compressive strength of about 38.12, 32.1 and 31.4% respectively. Similarly, those cured at normal conditions; show a low increase of about 19.2, 20.9 and 17.9% respectively. And for the same dosage for G21 at (40 ^{o}C) have lower increasing in compressive strength , the 3, 7 and 28-day compressive strength increase by 12.5, 7.1 and 5.3% respectively, compared with the same dosage in normal conditions .The compressive strength have increase about 10.5 ,6.8 and 7.2 respectively. Insufficient SO_3 content as well as the physical structure of the hydration products may be responsible for a reduction at the later age strength of dry or accelerated cured concrete compared with that of normally cured concrete.[9]

- It can be seen from the results, when used G51 with dosage (1.2 liter)that there is an increase in 3 ,7 and 28 days compressive strength of concrete cured at (40 ^{o}C) with respect to those cured at (20 ^{o}C),the increase is about 34.8 ,28,9 and 27.5% respectively for specified ages compared with 17.5,19.8and 18%.

With whereas, it tends to be slighter improve in strength when use G21 with the same dosage (1.2 liter).the increase in compressive strength is about 12, 6.8and 6.1% respectively at specified ages. While the increase in compressive strength is about 2.0, 4.9 and 10.4% respectively at 3 ,7and 28 days. The Similar observations were reported by Cebeci[10] ,who stated that the concretes cured in water within (37 ^{o}C), have higher compressive strength up to 28 days and lower ultimate strength (56 days) compared with those cured in water within (17 ^{o}C).

- The concrete cured at temperature of 40 ^{o}C, show higher increase in compressive strength with age (up to 3 days) when use G51than G21.
- The highest 3, 7 and 28-day compressive strength was found in concrete cured at temperature of medium hot weather. These results are in agreement with the results found by Barnett sited by Al-Rawi [11] who reported that for "rapid hardening" Portland cement, "ordinary" Portland cement and "low heat cement", the maximum 28-day compressive strength were obtained when the maximum accelerated curing temperature was about moderate hot weather climate.

It seems from the results, that mixing and casting of concrete at temperature range between (20-25^{o}C) and moist curing for 3 days, play a significant role in reducing the harmful effect of hot weather on compressive strength. There is also an increase in 7, 28 and 90-day compressive strength of concretes cured in hot weather compared with those cured in normal weather, which can be attributed to the increase in the hydration rate due to relatively high curing temperature.

Harrison[12] explained that ,the reason for the loss of strength and increase believed to be due to the hydration products forming close to the original cement grains and not spreading uniformly throughout the space between the cement grains. If the peak temperature during accelerated curing does not exceed 65°C**.**

8-3. Ultrasonic Pulse Velocity (UPV).

The results for ultrasonic pulse velocity have been tabulated in **table (9)**, The ultrasonic pulse velocity of the concrete increased with increasing age. The ultrasonic pulse velocity of the concrete ranged from 3.21 to 5.2 km/s, which indicates 'good to very good' physical condition of the concrete. The differences of levels pulse velocity have been stated by Zain and Matsufuji [13] that, for various curing of concrete, producing the higher of ultrasonic pulse velocity depend on the concrete matrix which become denser due to greater amount of calcium silicate hydrate produced from cement hydration.

Fig. (7) show the best correction between the compressive strength and the ultrasonic pulse velocity (U.P.V) for all mixes, the figure shows the relation obtained from the correlation of all data mixes (with correlation coefficient R^2 = 0.916) ,as in the following:

$$F_{cu} = 4.141 \, Exp(0.488V) \qquad (2)$$

Where F_{cu}= Cube compressive strength(MPa).

V = Ultra sonic pulse velocity (Km/s).

In comparison with the following relationship stated by Raouf .Z [14] for normal strength of concrtet,the relationship seems to be some what nearly close.

$$F_{cu}= 2.8 \text{ Exp } (0.53V) \quad (3)$$

9. CONCLUSIONS.

1- Using The new types of Glenium, G51 and G21 improving the workability of normal concrete mixes with low slump about 157% to 183%.This increasing will be more valuable when adding high amount of dosages for two types, with attention that, the dosage don't cause segregation for the mixes.

2- Compressive strength of concrete mixed with G51 and low dosage(0.8 liter) and cast at normal temperature and moist cured under hot medium weather for 3 days, take best increases compared with reference mix. The increase ranges between (19.2-38.12%) with respect to mixes cured at normal weather conditions.

3- The normal concrete that contains G21 with low and medium dosage (0.8 and 1.2 liter per 100kg of cement) and cured under hot weather conditions, having lower 3,7 and 28-day compressive strengths ranging between (2-12.5%) when compared to reference mixes..

4- Using G51 with low dosage is more suitable for precast normal concrete because its take more development strength gain at various conditions of curing.

5- The effect of medium hot weather curing on compressive strength for mixes with G51 improve the strength higher than mixes when use G21 at specific age. The increase related with requirements of normal mixes and conditions of produced the concrete .especially in pre-cast concrete.

10. RECOMMENDATIONS.

1- It be recommended for future works ,that explain the effects of using the two types of Glenium on mechanical properties of concrete with high strength levels at aggressive condition of hot weather up to 60° C.

2- Evaluate efficiency of each type when using with finer cementations materials or mineral admixtures, such as silica fume.

11. REFERENCES.

[1] Whiting, D. and Dziedric, W., "Effects of Conventional and High Range Water Reducers on Concrete Properties", PCA Researches. and Dev. Bull., 107T:24. 1992.

[2] Malhotra, V. M., " Advances in Concrete Technology", Energy, Mines and Resources, pp. 991, Ottawa, Canada -1992 .

[3] Ibrahim,A.J "The Effect Of Hot Weather On Concrete Properties". Ph.D Thesis, Hungarian Academy of Sciences, Budapest, Hungary, 1990.

[4] Jolicouer, C., Perreault, F., Simard, M. A., and Nuyt, A., "The Chemistry of Concrete Super plasticizers, Rheology and Hydration kinetics of Portland Cement Pastes Containing Mixture of Naphthalene and Melamine Based Superplasticizers", Concrete Admixtures Course, Ottawa, Canada -October 13-14, 1993.

[5] Lessard,M.,"Using Superplasticizers in High Performance Concrete" Processing Cons., Sherbrook, Canada, pp. 65-83 ,2002.
[6] Ramachandran, V. S.," Hydration of C_3A in the Presence of Admixtures", 7th International Congress. Chemicals Cements, Paris, part IV : pp 520-523 , 1998.
[7] Kantro, D. L., Popescu, " Effect of Superplasticizers on Portland Cement Mortars and Pastes" , Materials and structures Magazine, Volume79. pp107-114 ,1982.
[8] Degussa,Costruction Chemical (Glenium 51 & Glenium 21 Technical Data Sheet):06/97 MBT-ME revised 06/2008.
[9] A. M. Neville "Properties of Concrete", 4th edition, Pitman, 2000.
[10] Z. Cebeci: "Strength Of Concrete In Warm And Dry Environment". Materials and Structures Magazine, volume 20. pp 270-272 ,2004.
[11] R. S. Al-Rawi: "Choice Of Curing Temperature For Accelerated Cured Concrete". Cement and Concrete Research, Volume 6,pp. 603-612, 1976.
[12] Harrison, T.A. "Formwork Striking Times – Criteria, Prediction And Methods Of Assessment" .CIRIA Report 136, ISBN 0 86017 431, pp. 71, 2002.
[13] Zain, M.F.M. and Y. Matsufuji,. "The Influence of Curing Methods on the Physical Properties of High Strength Concrete Exposed to Medium Temperature (20°C-50°C)". In the Proceedings of the Fifth International Conference on Concrete Engineering and Technology, Kuala Lumpur, Malaysia, pp: 57-66. 1997
[14] Raouf .Z. "Introduction to Testing of Concrete by Ultrasonic Pulse Velocity" Building Research Magazine Public volume4 pp.68-75 , Baghdad ,1983.

NOTATIONS.

G51 : mix made with use Glenium type 51.
G21 : mix made with use Glenium type 21.
Ref. : References Mix.
$G_{51-0.8}$: mix made with Glenium type 51and dosage amount (0.8 liter/per 100 kg cement).
$G_{51-1.2}$: mix made with Glenium type 51and dosage amount (1.2 liter/per 100 kg cement).
$G_{21-0.8}$: mix made with Glenium type 21and dosage amount (0.8 liter/per 100 kg cement).
$G_{21-1.2}$: mix made with Glenium type 21and dosage amount (1.2 liter/per 100 kg cement).

Table (1): chemical compositions of cement.

Compound Compositions	Chemical Composition	Percentage by weight	Limit of IQS 5: 1984
Lime	CaO	62.4	---
Silica	SiO_2	20.56	---
Alumina	Al_2O_3	6.7	---
Iron Oxide	Fe_2O_3	2.16	---
Magnesia	MgO	3.44	< 5
Sulfur Trioxide	SO_3	1.51	< 2.8
Loss on ignition	L.O.I	2.28	<4
Insoluble Residue	I.R	1.41	<1.5
Lime Saturation Factor	L.S.F	0.95	0.66 -1.2
main compounds (Bogue Equations) % by weight			
Tricalcium Silicate (C_3S)			54.26
Dicalicum Silicate (C_2S)			16.7
Tricalcium Aluminates (C_3A)			11.4
Calcium Alumina Ferrite (C_4AF)			6.56

Table (2): physical properties of cement.

Physical Properties	Test results	Limit of IQS 5:1984
Fineness (m^2/kg): Blaine	290	>230
Soundness:Autocalave(%)	0.06	<0.8%
Compressive strength (cube 70.7mm) at		
3 days(MPa)	16.3	>15
7days(MPa)	25.6	>23
Time of setting (Vicat's instruments)		
Initial set (min)	95	>45 min
Final set(min)	280	<600 min

Table (3): physical properties and sieve analyses of coarse aggregate**.**

Sieve size (mm)	Percentage passing (by weighting %)			
	Max. 20 (mm)	Limited required by I.Q.S No.45		
		(5-40)mm	(5-20)mm	(5-14)mm
37.5	100	95-100	100	---
20	95	30-70	95-100	100
14	----	---	----	90-100
10	39	10-40	30-60	50-85
5	4.0	0-5	0-10	0-10
2.63	0	----	----	-----

Physical Properties	Test Results
specific gravity	2.68
sulfate content(B.S. 882- part118-1992)	0.035%
Absorption	0.58%

Table (4): physical properties and sieve analyses of fine aggregate.

Sieve size (mm)	Percentage passing (by weighting %)	
	Test Results	Limits of I.Q.S No.45-1984 (Zone 2)
9.5mm	100	100
4.75mm	95	100 -90
2.36mm	88	100 -75
1.18mm	72	90 -55
600µm	48	59 -35
300µm	19	30 -8
150µm	5	10 -0

Physical Properties	Test Results
specific gravity	2.66
sulfate content(B.S. 882- part118-1992)	0.37%
Absorption	2.2%

Table (5): technical properties of superplastizicers.[8]

Glenium 51		Glenium 21	
Technical Properties		Technical Properties	
Form	Viscous Liquid	Form	Viscous Liquid
Color	Light Brown	Color	Brown
Relative Density	1.1 g/ml@20°C	Relative Density	1.038-1.078 g/ml@20°C
pH	6.6		
Viscosity	128 ± 30 cps@20°C		
Transport	Not classified as dangerous		
Labeling	Not hazard label required		

Table (6) : mix proportions.

Mix No.	Mix Code	Cement (Kg/m^3)	Fine aggregate (Kg/m^3)	Coarse aggregate (Kg/m^3)	Water (Kg/m^3)	Reduction in water quantity	Glenium dosage (liter/100kg cement)
1	R1	400	690	1075	185	---	---
2	$G_{51-0.8}$	400	736	1075	140	25%	0.8
3	$G_{51-1.2}$	400	736	1075	140	25%	1.2
4	$G_{21-0.8}$	400	736	1075	140	25%	0.8
5	$G_{21-1.2}$	400	736	1075	140	25%	1.2

Table (7): results of slump test for mixes.

Mix No.	Mix Code	Slump (mm)	Increasing in Slump (%)
1	Ref.	35	--
2	$G_{51-0.8}$	86	159
3	$G_{51-1.2}$	196	183
4	$G_{21-0.8}$	93	163
5	$G_{21-1.2}$	188	182

Table (8): results of compressive strength values of mixes.

Mix No.	Mix Code	Compressive Strength (MPa)			
		Curing	Age		
			3 (day)	7 (day)	28 (day)
1	Ref.	Moist.	15.82	24.6	35.2
		dry	16.8	25.82	36.7
2	$G_{51-0.8}$	Moist.	19.6	31.1	42.9
		dry	25.6	36.2	51.3
3	$G_{51-1.2}$	Moist.	19.2	30.7	43.9
		dry	24.3	34.6	48.6
4	$G_{21-0.8}$	Moist.	16.1	26.4	39.3
		dry	18.13	23.4	37.15
5	$G_{21-1.2}$	Moist.	17.73	26.2	37.8
		dry	18.1	23.9	36.5

Table (9): results of upv for all mixes at specified age.

Mix No.	Mix Code	Ultrasonic Pulse Velocity (Km/s)			
		Curing	Age		
			3 (day)	7 (day)	28 (day)
1	Ref.	Moist.	3.24	3.68	5.2
		dry	3.37	4.3	4.6
2	$G_{51-0.8}$	Moist.	3.35	3.9	4.68
		dry	3.6	4.6	5.1
3	$G_{51-1.2}$	Moist.	3.26	3.82	4.88
		dry	3.32	3.76	4.91
4	$G_{21-0.8}$	Moist.	3.21	3.52	4.8
		dry	3.28	3.7	4.75
5	$G_{21-1.2}$	Moist.	3.38	3.8	4.58
		dry	3.37	3.64	4.36

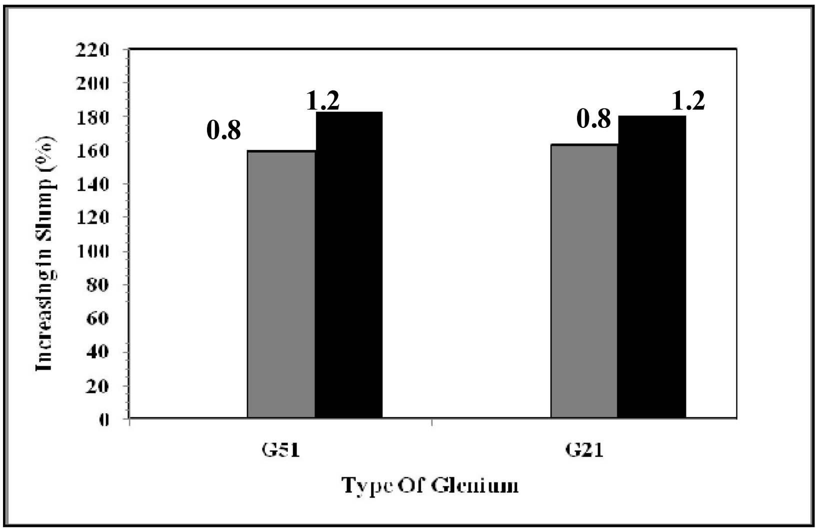


Figure (1): Effect of quantity dosage of Glenium types on increasing the slump.

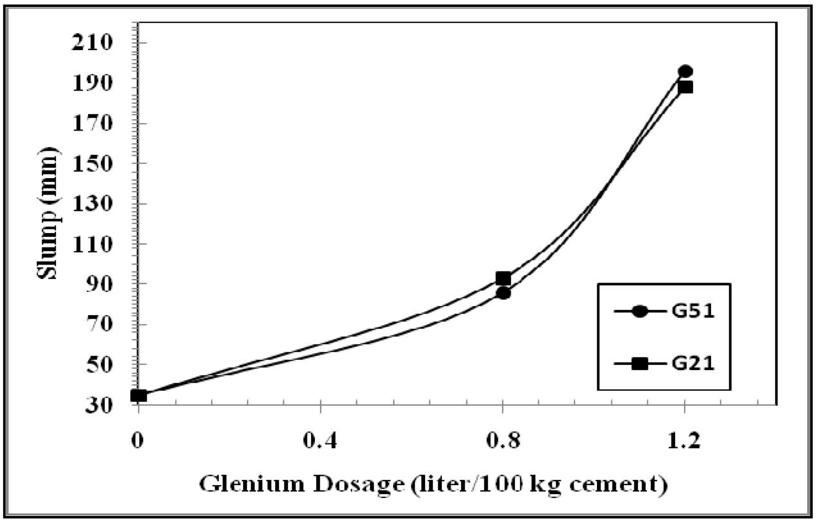


Figure (2): Relationship between quantity dosage of various Glenium types and the slump.

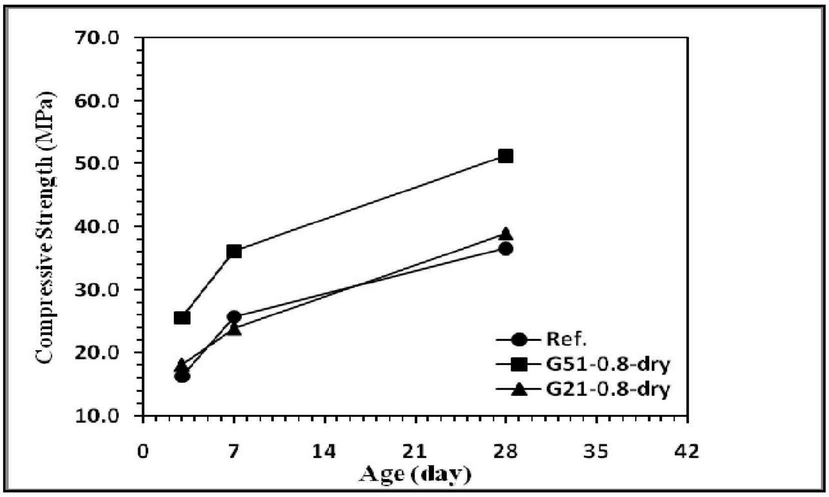


Figure (3): The Relationship between compressive strength development and the age with various type of Glenium with (0.8 liter) dosage cured at 40°C.

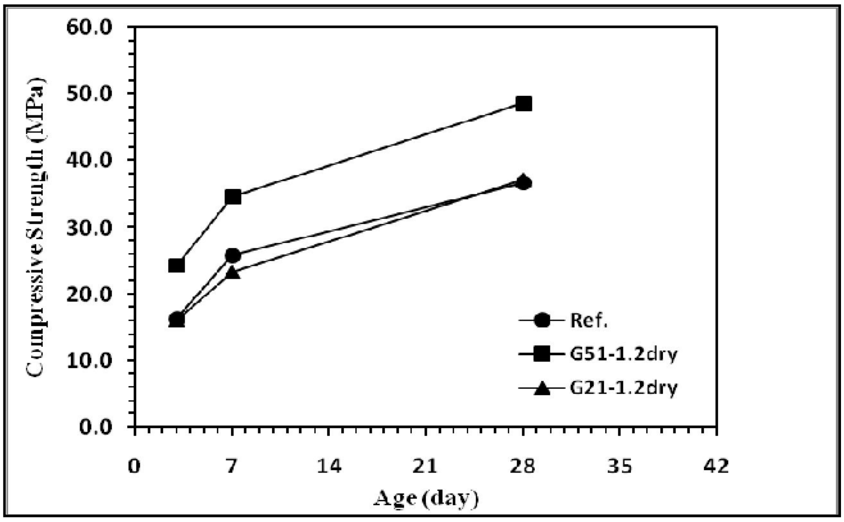
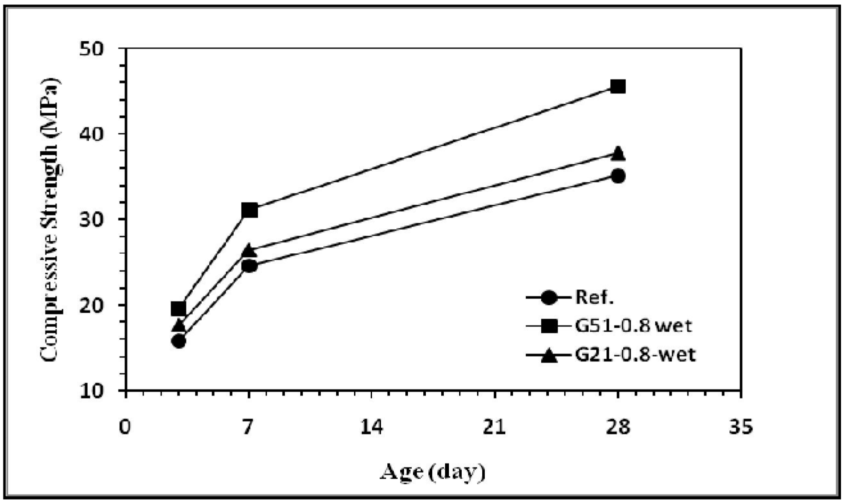


Figure (4): The Relationship between compressive strength development and the age with various type of Glenium with (1.2 liter) dosage cured at 40°C.



Figure(5) : The Relationship between compressive strength development and the age with various type of Glenium with (0.8 liter) dosage cured at normal conditions.

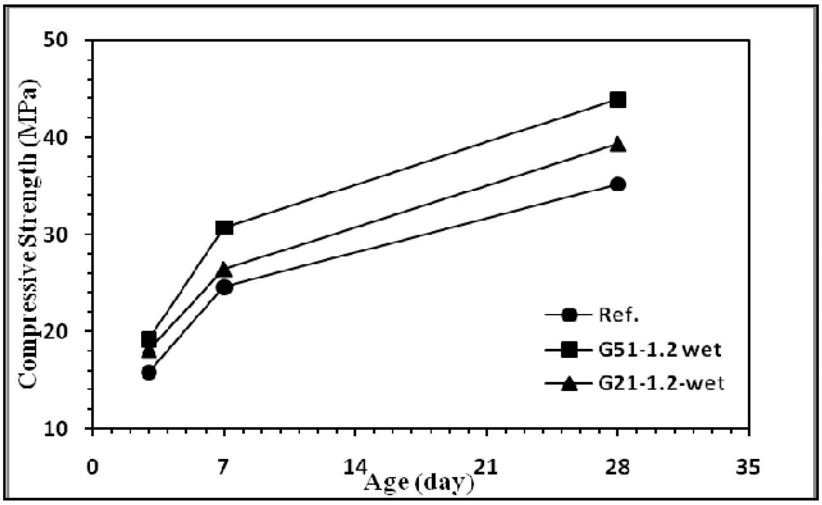


Figure (6): The Relationship between compressive strength development and the age with various type of Glenium with (1.2 liter) dosage cured at normal conditions**.**

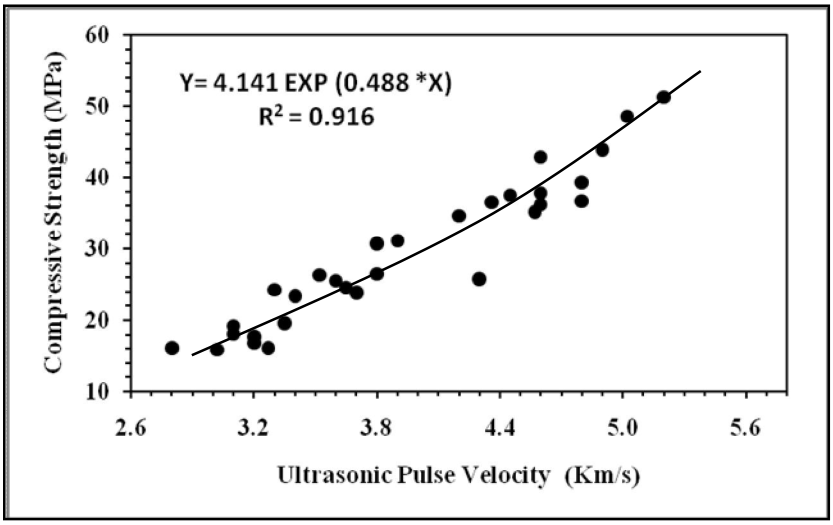


Figure (7): Relationship between compressive strength and ultrasonic pulse velocity.

تقييم استخدام بعض المنتجات الجديدة للملدنات الفائقة(نوع جلينيوم) وتأثيرها على قابلية التشغيل ومقاومة الانضغاط للخرسانة في الأجواء المتوسطة الحرارة

هيثم زيدان حسين
قسم هندسة السدود والموارد المائية
كلية الهندسة – جامعة الانبار

الخلاصـة.

في هذا البحث هو محاولة توضيح استخدام أنواع جديدة من منتجات الملدنات الفائقة نوع الجلينيوم مستخدمة في الفترة الأخيرة لإنتاج خرسانة اعتيادية و خاصة الخرسانة المسبقة الصب وبيان تأثير الأجواء الحارة على مقاومة الخرسانة الاعتيادية المنتجة باستخدام تلك المضافات و بنسب متنوعة من الجرعات المضافة و تقييم إضافة الجرعات على قابلية التشغيل للخرسانة الطرية . تم عمل الخلطات الخرسانية باستخدام نوعين من تلك المنتجات هي الجلينيوم 51 والجلينيوم21 ، وبنسب إضافة معينة هي (0.8 و1.2 لتر لكل 100 كغم من الاسمنت) وتقليل كمية الماء بحدود 25% . تم عمل خمسة خلطات و90 عينة فحص (مكعبات) وكل خلطة تضم 18 عينة نصفها تتم معالجتها بالطريقة الرطبة الاعتيادية أما النصف الآخر فيكون معالجتها بتعريضها لدرجة حرارة 40 درجة مئوية والتي تمثل الأجواء الرطبة المتوسطة الحرارة.

الخواص التي تمت دراستها هي قابلية التشغيل ويمثلها فحص الهطول للخرسانة الطرية، ومقاومة الخرسانة ويمثلها فحص مقاومة الانضغاط و فحص الأمواج فوق الصوتية. باستخدام النوعين المذكورين تم تحسين قابلية التشغيل بشكل كبير وبنسبة زيادة في الهطول تتراوح بين(157% إلى 183%) بالمقارنة مع الهطول في الخلطة المرجعية . الخرسانة المعالجة في الأجواء المتوسطة الحرارة أظهرت تحسن في المقاومة يتراوح بين(19,2 إلى 38,12%) بعمر 3 أيام.ان استخدام الملدن الفائق نوع (جلينيوم 51) هو أكثر ملائمة للاستخدام في أعمال الخرسانة الاعتيادية في الأجواء المتوسطة الحرارة.

الكلمات الرئيسية:الخلطات الخرسانية الاعتيادية،الملدنات،جلينيوم،مقاومة الانضغاط،قابلية التشغيل،الجو الحار والمعتدل.