

Investigate the Characteristics of Different Types of Cement used to produce the Concrete Mixtures in Iraq.

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Abstract:

Cement is the main ingredients of constructions and one of the basic element in the concrete mixtures as plain and reinforced concrete applications. It is also used for different finishing applications. Moreover, the quality of the used cement is the main key for the safety and durability of the concrete facilities. However, in industry applications, there are many local and imported types of cements which do not have associated manufactured certificates and do not subjected to Iraqi specifications of Central Organization for Standardization and quality control. Therefore, it is so essential to carry out some study involving comparison test for the imported cements that have been used in many applications in Iraq and compare them with local types of cements. Cement mixtures which have cement content of 300 kg/m^3 and 0.5 water cement ratio and mix proportion of (1:1.5:3) have been prepared. Slump, initial and final setting time for fresh concrete and compressive strength for harden state have been investigated. The results indicate that the local produced cement (Almuthana) is considered the best among the available types in the industry based on its compressive strength. The results also indicate that the local produced cement (Almuthana) is performing better than the other types in term of slump and fineness which led to the less consumption of water.

Keywords: Cement types, Cement Quality, Cement Specifications.

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I. Introduction

In this research, concrete mixtures with constant cement content of 300 kg/m^3 w/c of 0.4, fine aggregate (sand) compatible with the Iraqi Specifications No.5 in 1984[5], course aggregates compatible with the Iraqi Specifications No.45 in 1984[5], of sieve analysis zone of (5-20m), and mix proportion of 1:1.5:3 for cement, sand and aggregates respectively have been prepared.

II. Experimental Work

The cement

The tested cement is the Portland cement. The reported tests have been carried out on six most

used types cement in the Iraqi construction applications. Almuthana and Tasludga which are the local produced types. Whereas, the imported types are Kuati, Bahbhan, Banjurdand Falcone. Tests were carried out on the basic compounds and oxides involved in the cement composition for the types of cement used in the study according to Iraqi Specifications No.5 in 1984[5]. By observing the results illustrating in tables 1 and 2, it can be concluded that all used cements are adequate and compatible with the mentioned specifications [5].

Table 1 Chemical Properties of the Cement

Cement Type	%C3 S	%C2 S	%C3 A	%C4A F	Cement Fineness (Cm ² /gm)
B.S.12.1972	54.1	16.6	10.8	9.1	2200
Almuthana	48.8	27.2	10.8	10.6	2900
Kuati	44.5	25.4	10.5	10.8	2780
Bahbhan	41	22.8	10.1	10.3	2500
Banjurd	42.3	23.6	10.3	10.5	2660
Falcon	46.5	27.1	10.72	10.8	2830
Tasludge	43.6	24.4	10.8	10.4	2710

The aggregates

The fine aggregates are naturally produced which is compatible with Iraqi Specifications No.45 in 1984 [5], sieve analysis zone of No.3. whereas, the course aggregates fractured natural stones and are also compatible with Iraqi Specifications No.45 in 1984 [5], sieve analysis zone (5-20mm).

Fresh Concrete Tests

The main following tests have been carried out on the fresh concrete mixes which are basically made out of the mentioned cement types.

Table 2 Chemical Properties of the Cement

Cement Type	%Cao	%Sio2	%Al2o3	%Fe2o3	Mgo	So3
B.S.12.1972	(60-67)	(17-25)	(3-8)	(0.5-6)	(0.1-4)	(1-3)
Almuthana	62.4	23.6	8	3.8	3.1	2.9
Kuati	63.4	21.7	8	3.7	2.6	3
Bahbhan	61.3	22.5	7.8	2.8	2.7	3
Banjurd	62.4	21.9	6.5	2.7	2.3	2.7
Falcon	63.1	20.6	8	1.9	2.2	3
Tasludge	60	23.3	7.6	2.8	3.1	3

Table 3 Properties of Fresh Concrete

Cement Type	Slump (mm)	Initial setting time (hr:min)	Final setting time (hr:min)	Iraqi Specification No.5 in 1984
Almuthana	22	1:35	5:41	Initial setting time is not less than 1:0 hr.
Kuati	29	1:43	6:23	
Bahbhan	41	2:29	6:48	
Banjurd	35	2:17	5:51	Final setting time not more than 10:0 hr.
Falcon	32	2:23	6:45	
Tasludge	26	2:28	6:35	

Initial and final setting time test

This test involves specifying the initial and final setting time for the fresh concrete. The setting time is considered as a reference time for pouring the fresh concrete in the moulds¹. This test is carried out by using Vicat apparatus. Table 3

illustrates the results of initial and final setting time for the whole tested cement types. The results show that the setting times are within the Iraqi specification No.5 in 1984 [5], for Portland cement type I.

Slump test for the fresh concrete

This test was done according to the British Specifications Part 2 1970 and B.S 1881. Table 3 also illustrates the slump result values for the tested specimens.

Hardened Concrete Test

Compressive strength test

This test was carried out according to the British Specifications B.S 1881 PART4 1971[3]. TAK AZMA COM 2000 compressive machine with a loading rate of 15 MN/m²/ min. was used to test

the concrete cubic specimens which have dimensions of 150 *150 *150 mm. Table 4 shows the results of compressive strength for specimens of age 7 and 28 days.

III.Results

By observing table 3 and figure 2, it can be noticed Almuthana type cement has the lowest initial and final setting time among the other types. This low setting time could be because the increase in the three compounds of the cement which are the C3S, C2S and C3A. on the other hand Bahbhan type cement has the higher setting time among all the types of cement. This could be attributed to the fact that the Bahbhan type cement has low amount of the three basic compounds C3S, C2S and C3A. The essential hydrates for hydrations are C3S and C2S which are the main compounds for cement composition. Therefore, the physical behavior of the cement during the hydration is similar to the behavior of these compounds. The ultimate strength of the cement harden paste is significantly influenced by the hydrated calcium silicates. More than that, the compounds of calcium silicates are approximately 75% of the weight of Portland cement. Therefore, it is expected that theses compounds form the main part of cement paste at any stage of the hydration process. As the C3A content increases, the fineness and gypsum content is also increase. Therefore, the surface area of C3A is also increases which leads to mature reaction and make the other compounds surface area to have contact with water and eventually a better hydration process and chemical activity for the fine particles.

As the C3S increases in Almuthana cement type, the compressive strength of the corresponding specimens is significantly higher than the other types specially at earlier ages. This can be concluded that increasing the C3S results in increase the inner temperature of the cement paste whereas the other types have less progress

in term of early hydration and compressive strength which can be observed by the results in table 4 for 7-day age compressive strength. On the other hand, the high cement fineness for Almuthana cement type results in acceleration of the hydration for this particular type of cement and enhance its workability of the cement paste and finally led to high compressive strength in early age. The high content of C2S in Almuthana type cement results in high final compressive strength at 28 days which can be observed by the results in table 4 for 28-day age and figures 3 and 4.

The slump test value for Almuthana cement was less tan the values of other types. Therefore, the voids result from the hydration is less which led to high density and high compressive strength and durability. On the other hand, the other types of cement have high slump test values which result in less compressive strength.

Table 4 Properties of hardened Concrete

Cement Type	Compressive Strength at 7.0 days age (MPa)	Compressive Strength at 28 days age (MPa)
Almuthana	17	28.3
Kuati	14	27.7
Bahbhan	12	27.5
Banjurd	16	24.5
Falcon	13	24.8
Tasludge	14	26.6

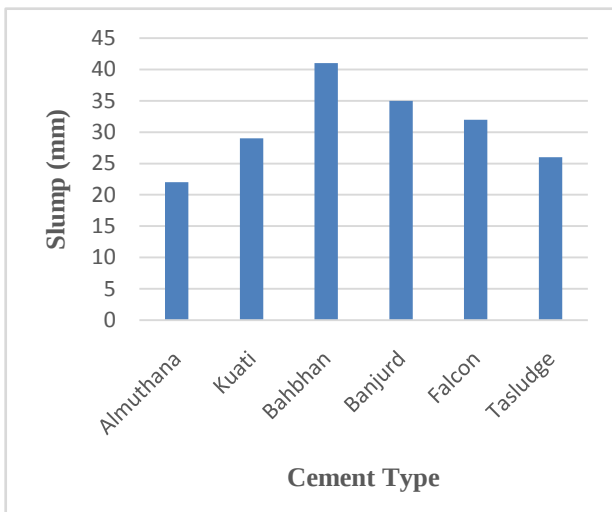


Fig.1 Relationship between Type of Cement and Slump

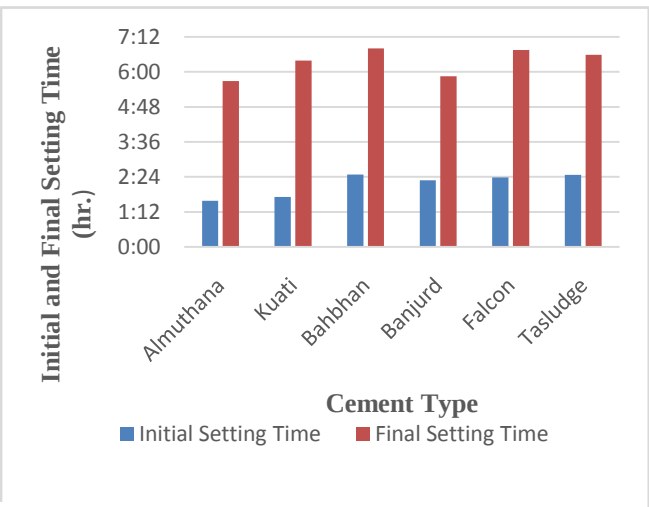


Fig. 2 Relationship between Initial and Final Setting Time and Type of Cement.

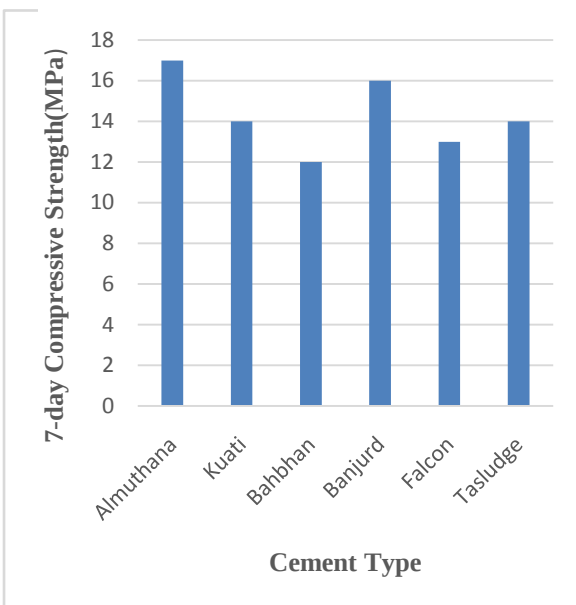


Fig.2 Early Age compressive strength for Different Cement Type

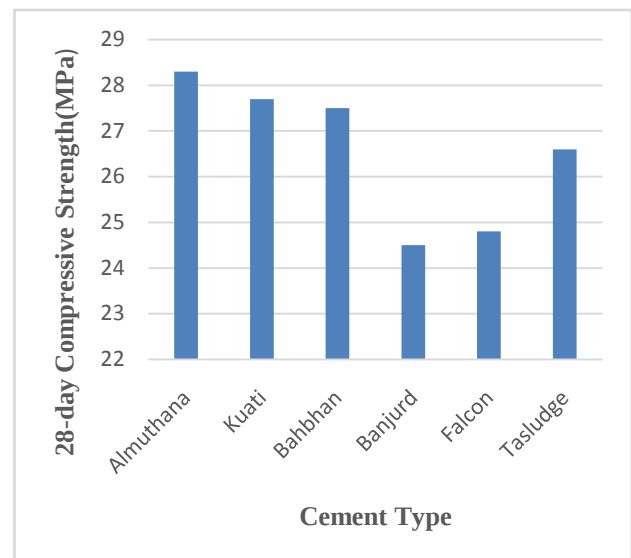


Fig. 4 28-day Age compressive strength for Different Cement Type

These attributes of software, for example, complexity and imperceptibility make the advancement of SQA approach and its effective execution a profoundly expert test.

IV. Conclutions

From the results of the fresh and hardened concrete specimens for different types of cement, the following points can be drawn.

1. Almuthana cement type which is a locally produced cement is considered the best type among the other investigated types in term

of 7- day and 28 -day compressive strength and also the main compounds contents specially C3S which responsible for the compressive strength in early stages and results in early molds removal and accelerate the construction process.

2. Bahbhan type cement which is an Imported product is worst type among the other investigated types in term of 7 -day and 28-day compressive strength and also the main compounds contents and fineness.

The development of a structure of authoritative techniques and principles that lead to great quality software. The QA period of SQM includes the genuine structure of the software program. With great SQM set up, item execution will be checked en route to guarantee that all measures are being pursued. Reviews might be performed and information will be gathered all through the aggregate of the procedure.

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