A NEW APPROACH FOR CONTROLLING THE SLUMP LOSS IN READY MIXED CONCRETE

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ABSTRACT

A new approach for restoring the slump of concrete mixes using admixtures was examined. A number of admixtures (i.e. a water reducer, a water reducer and retarder, a superplasticizer and a self compacting admixture) were individually added to OPC, 10% silica fume and 30% fly ash concrete batches after 1 or 2 hours from being originally mixed. The original mixes did not contain any admixtures. As a result of this process a slump increase usually occurs, but then disappears within an hour giving enough time for casting the concrete. The compressive strength, initial surface absorption and porosity of the concrete treated in this manner were evaluated and compared to the control concrete, which did not have any slump restoration, or to concrete in which water was used to restore its slump. It was found that the use of water to restore slump had an adverse effect on the properties of concrete especially the mixes with pozzolanic materials. The application of the new approach (i.e. slump restoration by admixtures) did not adversely affect, or in some cases improved the properties of the different concrete mixes. The admixture, which gave the best results in that respect, was the self compacting admixture. The recommendation to the ready mixed concrete industry is to add this admixture to the concrete on arrival at the site in order to restore the lost slump.

KEY WORDS : Ready mixed concrete; slump loss; workability loss; admixtures; silica fume; fly ash; initial surface absorption test, porosity; hot weather.

INTRODUCTION

Slump loss of fresh concrete can be defined as the loss of fluidity with elapsed time. It is a normal phenomenon that occurs when free water from a concrete mixture is emoved by hydration reactions, by adsorption on the surface of hydration products and by evaporation [1]. In hot weather, slump loss, especially in ready mixed concrete, will be evident earlier after initial mixing and pogresses at a more rapid rate and may cause difficulties with handling and placing operations. ASTM C 94/C 94M (clause 11.7) [2] states that: “No water from the truck water system or elsewhere shall be added after the initial introduction of mixing water for the batch except when on arrival at the job site the slump of the concrete is less than that specified. Such additional water to bring the slump within the required limits shall be injected into the mixer under such pressure and direction of flow to satisfy the uniformity requirements for ready mixed concrete. The drum shall be turned for 30 revolutions or more if necessary, at mixing speed, to ensure the complete dispersion of water. Water shall not be added to the batch at any later time." However, ACI Committee 305 [3] indicates that adding water to restore slump during hot weather conditions, is acceptable provided that the maximum allowable water content (clause 3.5) and the maximum w/c ratio (clause 3.7) are not exceeded.

Adams et. al. [4], carried out tests on truck mixed concrete having an initial slump of 75 mm in order to study the amount of water needed to restore the original slump for up to 4 hours after mixing. The ambient temperature during the tests varied between 25 and 38 °C. They found that the percentage increase in mix water was 6.4, 14.0, 20.4 and 26.4 % when the slump was restored at 1, 2, 3 and 4 hours after initial mixing, respectively. Gaynor and Bloem [5] redosed a laboratory mixed concrete batch at 26 °C with water every hour for 8 hours. The mix had an initial slump of 150 mm. They found that after 1, 2, 3, 4 hours the mix water was increased by 6, 18, 39 and 65%, respectively. Ravina [6] studied the slump loss of different concrete mixes at 30°C and found that water, as a percentage of initial mixing water, required to restore the original slump of 100 mm after 60 to 90 minutes from mixing, was 4.2 to 8.5 %. In general, ACI 304R [7] indicates that the tolerance for batching mix water is $\pm$ 1%. It is clear from the results of the above investigations that restoring the slump with additional water means that the limit on the maximum mixing water content of a mix shall be exceeded. Therefore, this approach for restoring the slump is not acceptable. In fact, BS 8110 : Part 1 : 1985 (clause 6.5.1.2) [8] states that: "All placing and compacting should be carried out under suitable supervision and as soon after mixing as practicable. Delays in placing may be permitted providing that the concrete can still be placed and fully compacted without the addition of further water".

Traditionally, set retarders are used for hot weather concreting to prolong the setting time shortened by the high temperature and in preventing the formation of cold joints between successive lifts [9]. Some water reducing admixtures also have a retarding effect on the concrete mixes (Type D) [9]. A number of investigations have tried to employ retarders and water reducing retarders as a means for controlling the rate of slump loss. Gaynor and Bloem [5], Ravina [10] and Hersey [11] found that all such admixtures increased the rate of slump loss compared to the reference concrete without the admixtures. Meyer and Perenchio [12] found that the addition of these admixtures could upset the balance between the soluble sulfate and the tri-calcium aluminate contents in Portland cement. Tuthill [13] concluded that a suitable water reducing set retarding admixture for hot weather does not exist.

Superplasticizers or high range water reducers are sometimes used to produce flowing concrete in situations where placing is inaccessible or where very rapid placing is required [9]. Punkki et. al. [14] found that the increase in the dosage of a sulfonated naphthalene formaldehyde superplasticizer from1.9 to 3.1% reduced the rate of slump loss over a period of 1 hour. However, all his mixes contained the superplasticizer and the rate of slump loss was not compared to concrete without the admixture. Data from Lewandowski and Peterfy (1976) cited in the Cement and Concrete Association report [15] indicated that the rate of loss of slump in mixes containing sulfonated melamine formaldehyde superplasticizer is higher than the concrete without the admixture. In fact after 1.5 hours of strong agitation, mixes with and without the superplasticizers had the same slump. Ravina and Mor [16] found that the addition of a sulfonated melamine formaldehyde condensate at a rate of 1 to 3 % by weight of cement increased the slump for up to 35 minutes after mixing. After 65 minutes, the slump for all mixes was the same and only slightly higher than the mix without the superplasticizer.

Vollick [17] was first to suggest late addition of hydroxylated carboxylic acid type retarder in order to restore the slump of mixes when the delivery of ready mixed concrete has been delayed. He added water with the retarder if the retarder alone could not restore the original slump of the mix. He found that the w/c ratio was increased from 0.56 to 0.66 after prolonged mixing for 6 hours if water alone was used to restore the slump. However, with the use of the retarder the w/c ratio became only 0.6. He also reported that including retarder with added water after prolonged mixing increased the compressive strength of the concrete.

After a series of trials with prolonged mixed concrete at a temperature of 31 ºC, Ravina and Mor [16] recommended that during hot weather conditions the superplasticizer dosages should be higher than normal and that the incorporation of the superplasticizer should take place on site as close as possible to the moment of discharge. Guo [18] found that a set cement paste can resume its plasticity, even at a time beyond the limit defined as final set, when a late addition of sulfonated naphthalene formaldehyde superplasticizer then vigorous agitation takes place.

The aim of this investigation was to suggest a new technique for slump restoration by adding an admixture immediately prior to casting and up to two hours after initial mixing. The added admixture was not part of the original mix design, and therefore this proposed technique is different from "delayed admixture addition" exercised by the ready mixed concrete industry in some situations and as investigated by some of the studies cited above. The effect of this process on some hardened concrete properties (i.e. compressive strength, initial surface absorption, porosity and sorptivity) was examined. These properties were chosen as they are known to be adversely affected by hot climate conditions [19], where slump restoration is more likely to be exercised [20]. Moreover, the durability related problems of concrete structures are mainly dependent on the ingress of water containing deleterious ions into the first 50 mm of concrete surface [21]. Therefore, it is crucial to study the effect of any new work procedure on the ISAT and porosity of the concrete to be used in hot climates.

Many specifications now call for the use of pozzolanic materials for concrete produced in hot climates [e.g. 20 and 22]. Therefore, mixes containing either OPC only, OPC and 10% silica fume or OPC and 30% fly ash were used in this investigation in order to study the effect of the new technique on the properties of such mixes. No studies were cited in the literature where admixtures were added to concrete with pozzolanic materials after initial mixing. A range of chemical admixtures were tried hoping that a recommendation can be made to the ready mixed concrete industry to overcome the problem of slump loss after long hauls.

EXPERIMENTAL PROGRAM

Materials, mix proportions and sample preparation

The cement used was Ordinary Portland Cement (OPC) conforming to E.S.S. 373/1991 [23]. The coarse and fine aggregates used were crushed Dolomite and desert sand conforming to E.S.S. 1109/1971 [24]. Tap water was used in mixing, curing and testing the samples. The silica fume and fly ash used were from local sources. Chemical analysis of the OPC, Silica Fume and Fly Ash are shown in Table 1. The chemical analysis of the fly ash used conforms to ASTM C 618-85 Type F ash [25].

Table 1 Chemical analysis of OPC, silica fume and fly ash

Oxide	OPC	Silica fume	Fly ash
SiO_2	21.21	94.38	46.66
Al_2O_3	4.32	0.46	25.60
Fe_2O_3	3.40	1.50	9.08
CaO	63.51	0.60	4.80
MgO	1.84	0.72	1.81
SO_3	2.31	0.30	1.17
Loss on ignition	2.15	1.05	4.4
Insoluble residue	0.54	-	-
Na_2O	0.46	0.30	2.01
K_2O	0.26	0.58	2.48
P_2O_5	-	0.11	0.51
TiO_2	-	0	1.08

Mix proportions for the concrete mixes used in this investigation are shown in Table 2. Control samples were prepared in which no water or admixture was added to restore the slump at 1 and 2 hours from initial mixing. Other samples were prepared at these times with slump restored to original value using either the water or admixture. The dosage of water or admixture required for this process is shown in Table 3. All Samples were 100 mm cubes and were water cured at 21 °C for 28 days prior to testing. ISAT and Porosity testing was carried out immediately on oven dried samples at 105 °C to constant weight. The room temperature during the test period was 20 to 23 °C. Each reported test data point is the mean of the results for three samples.

Table 2 Mix proportions of concrete mixes

Type of Mix	**OPC**	**Silica fume**	**Fly ash**
Cement (Kg/m^3)	400	360	280
% Pozzolan (p)	0	10	30
Silica fume (Kg/m^3)	-	40	-
Fly ash (Kg/m^3)	-	-	120
Water (w) (l/m^3)	200	200	200
w/(c+p)	0.50	0.50	0.50
Fine Aggregates (Kg/m^3)	700	700	700
Coarse Aggregates (Kg/m^3)	1000	1000	1000

The slump of the fresh concrete was measured initially. After 1 hour from the start of the initial mixing process, either water or admixture was added to the mix in order to restore its original slump. The mix was agitated for 2 minutes to ensure the complete dispersion of the added liquid. The dosage of water or admixture required was determined by trial and error. After 2 hours from original mixing the process was repeated on a fresh portion of the mix (i.e. to which no water or admixture was added previously at 1 hour). The types of admixtures used are shown in Table 3 and the required dosages of water or admixture at 1 or 2 hours are shown in Table 4. All admixtures used were manufactured by Sika.

Table 3 Types of admixtures used in this investigation.

Admixture Type	**Specification**	**Chemical Base**
Water Reducer	ASTM C494-81 Type A BS 5075 Part 1	Modified lignosulphonate
Water Reducer and Retarder	ASTM C494-81 Type A +B + C + D BS 5075 Part 1	Special organic agent
Superplasticizer	ASTM C494-81 Type F BS 5075 Part 3	Naphthalene formadehyde sulphonate
Self Compacting	----	Carboxylated copolymer mixture and modified cellulose product

Table 4 Dosage of water or admixtures (lit/m^3) required to restore slump

Type of Mix	**OPC**		**Silica fume**		**Fly ash**	
Initial slump (mm)	100		80		75	
Type of addition	**1 hour**	**2 hours**	**1 hour**	**2 hours**	**1 hour**	**2 hours**
Water	38.25	63.00	27.00	34.20	54.00	90.00
Water Reducer	2.07	2.93	0.99	1.31	1.58	2.30
Water Reducer and Retarder	0.59	1.13	0.54	1.17	0.77	1.28
Superplasticizer	0.59	0.90	0.54	1.08	0.68	1.12
Self Compacting	0.36	0.54	0.41	0.52	0.59	0.70

Test Techniques

Slump Test

The test was carried out in accordance with E.S.S 1658: part 2 [26]. The test was carried out when mixing is completed in order to determine the original slump of each mix. After 1 and 2 hours from mixing, either water or an admixture was added to each mix to obtain a slump values $\pm$ 1 cm of the original slump.

Compressive Strength Test

The compressive strength test was carried out in accordance with BS 1881: Part 116 [27]. Samples were prepared for compressive strength testing from the original mix, and after water or admixture addition were added later in order to study the effect of this process on the concrete mixes of this investigation.

Initial Surface Absorption Test (ISAT)

The initial surface absorption is defined as the rate of flow of water (under a constant applied pressure and temperature) into concrete per unit area at stated intervals from the start of the test. The theory is based on the assumption that oven dried concrete absorbs water by capillary action at a rate that is initially high but decreases as the water filled volume of the capillaries increases. The test was carried out in accordance with BS 1881 : Part 122 [28]. The amount of water absorbed by the concrete surface per second (ISA value) is measured at 10 minutes. Oven dry concrete samples were prepared from the original mix and after 1 or 2 hours, when water or admixture addition took place, for ISAT testing.

Porosity Test

To perform the porosity test, the weight of evaporated water, from water cured saturated samples that were oven dried to constant weight at 105 °C, was determined. This weight was then divided by the volume of the sample, in order to obtain the porosity of concrete. This method was suggested by Parrott [29]. The porosity of the original and mixes with water or admixture addition was studied.

RESULTS AND DISCUSSION

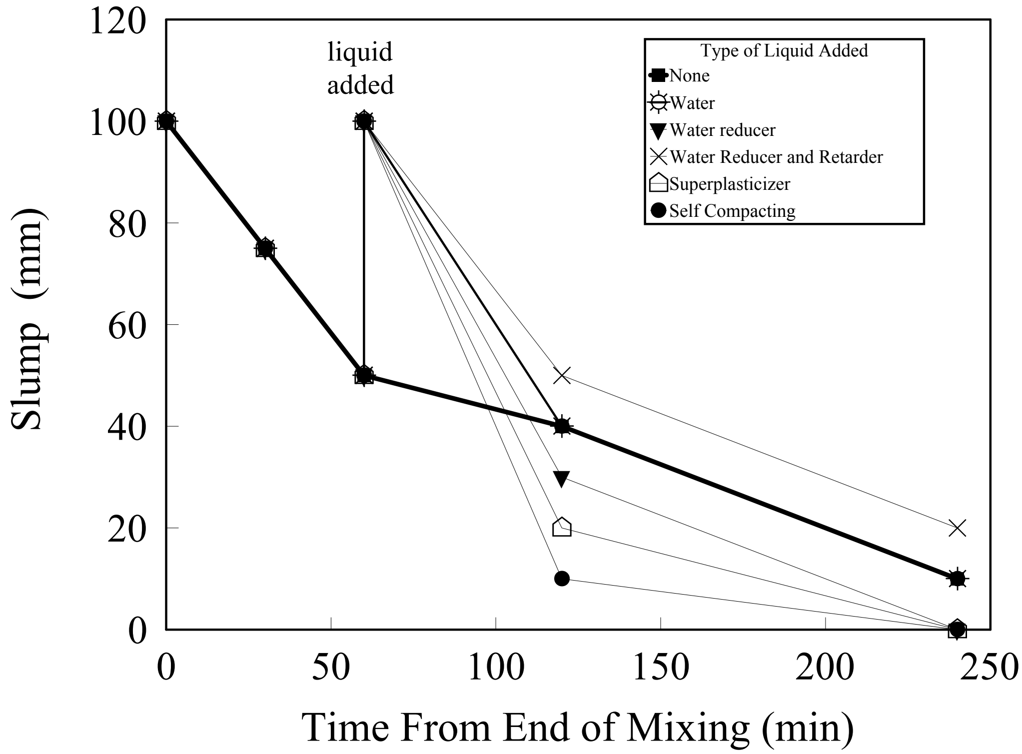
Acceptability of Admixture Addition Technique From the Mix Proportions Point of View

Mixes in this investigation had a water content of 200 l/m^3 (see Table 2). ACI 304R [7] and the Egyptian code for the design of reinforced concrete structures [31] specify that the tolerance for batching mix water is $\pm$ 1%. The use of modern equipment in ready mixed concrete industry would result in measuring the original mix water with great accuracy. As a result, in this study, the tolerance value for mix water shall be assumed to be the upper limit for an acceptable addition of liquid to the mixes. Hence, the maximum allowable addition of liquid for the mixes in the current investigation is 2.00 l/m^3. Table 4 shows the increase in the liquid content of the mix due to the late addition of water or admixtures, in order to restore the lost slump after either 1 or 2 hours of mixing. It can be seen that the addition of water to all mixes causes an unacceptable increase in the mix water content. The use of admixtures, however, in all but at 2 hours for OPC and fly ash mixes with the water reducer admixture, resulted in an increase less than 2.00 l/m^3 of added liquid to the mix. Therefore, the maximum specified w/c ratio of the mixes shall not be exceeded by the addition of admixtures. In other words, from the mix proportions point of view, the late addition of water to restore original slump would dramatically change the w/c ratio and therefore would not be an acceptable work procedure. The use of most admixtures, however, does not have such effect on the mix proportions.

Time Line of Slump Values Before and After Liquid Addition

The time line for slump of the OPC mix is shown in Figures 1 and 2 for liquid addition at 1 hour and 2 hours, respectively. For the silica fume mix and the fly ash mix the time lines are plotted in Figures 3 to 6. It can be seen from Figures 1 to 6 that when either water or an admixture is added to restore the original slump of the mix after 1 or 2 hours from the end of mixing, the gain in slump is lost within an hour. Certain admixtures seem to even increase the rate of slump loss after they are added, rendering the slump line of the concrete with the admixture lower than the slump line of the original mix. The only admixture, which consistently helped in lowering the rate of slump loss, was the water reducer and retarder.

Only two studies, (namely Vollick [17] and Ravina and Mor [16]), investigating late admixture addition were cited in the literature. Vollick [17] was concerned with the effect of the retarder added on the compressive strength and the amount of water needed with the retarder to restore the original slump. He did not monitor the slump after the retarder was added. Ravina and Mor [16] added a superplasticizer at a rate of either 1 or 3 % by weight of cement in order to


120
100
80
60
40
20
0
Slump (mm)
0
50
100
150
200
250
Time From End of Mixing (min)
liquid
added
Type of Liquid Added
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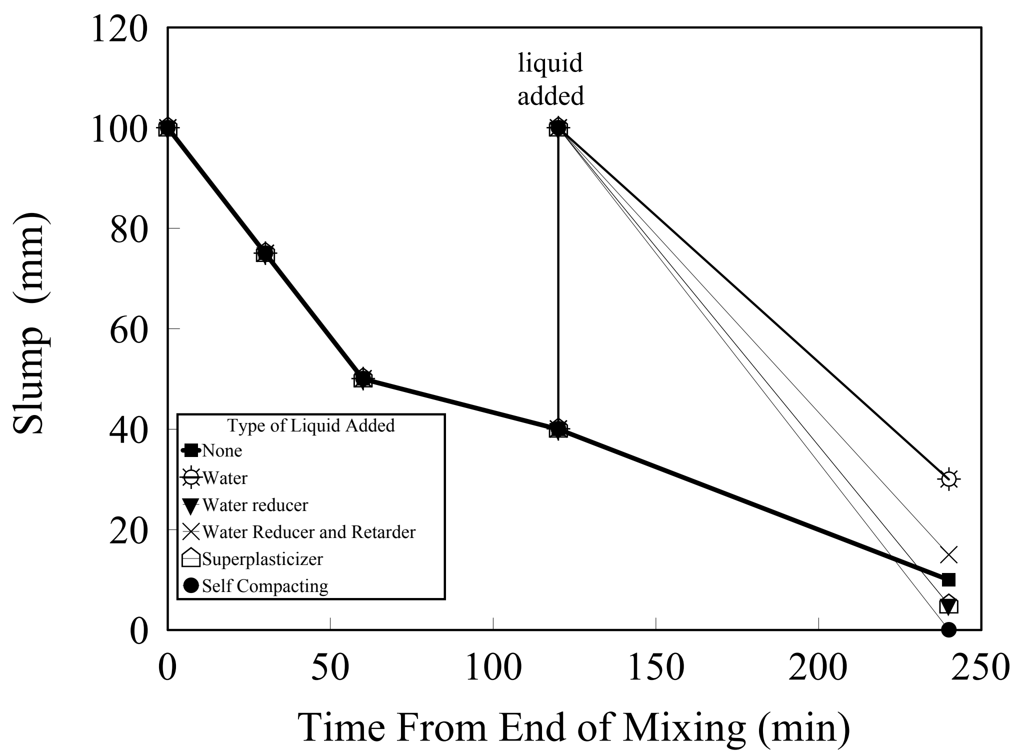
Water
Water reducer
Water Reducer and Retarder
Superplasticizer
Self Compacting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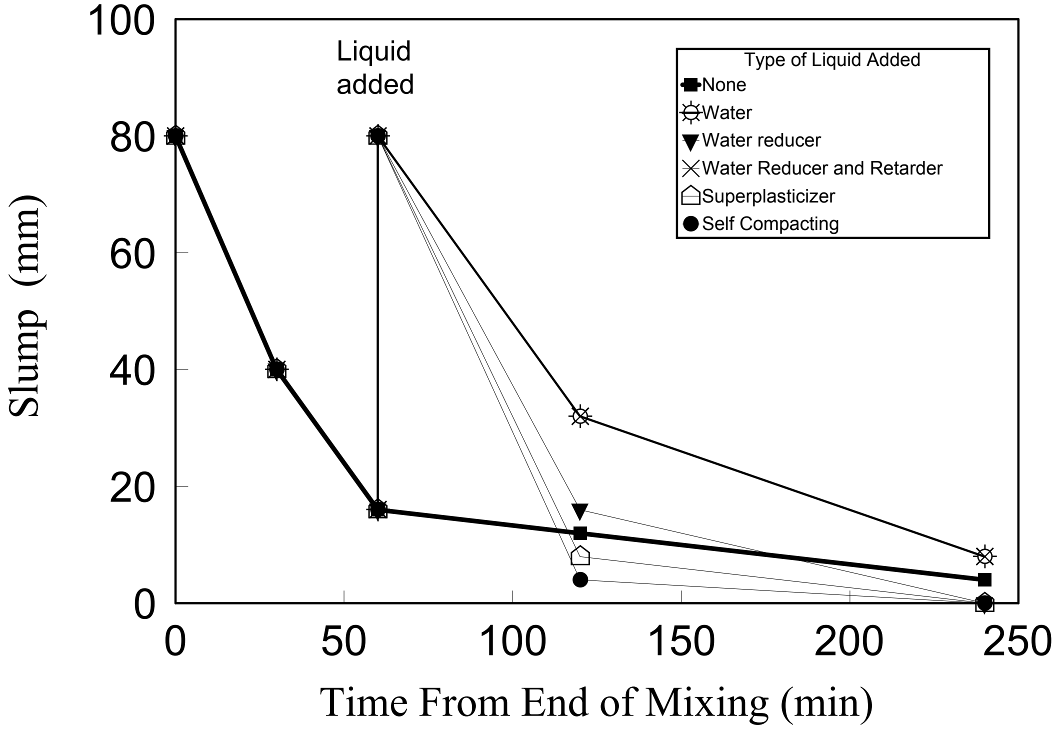


Figure 3 Time line for slump of Silica Fume concrete (liquid added at 1 hour)

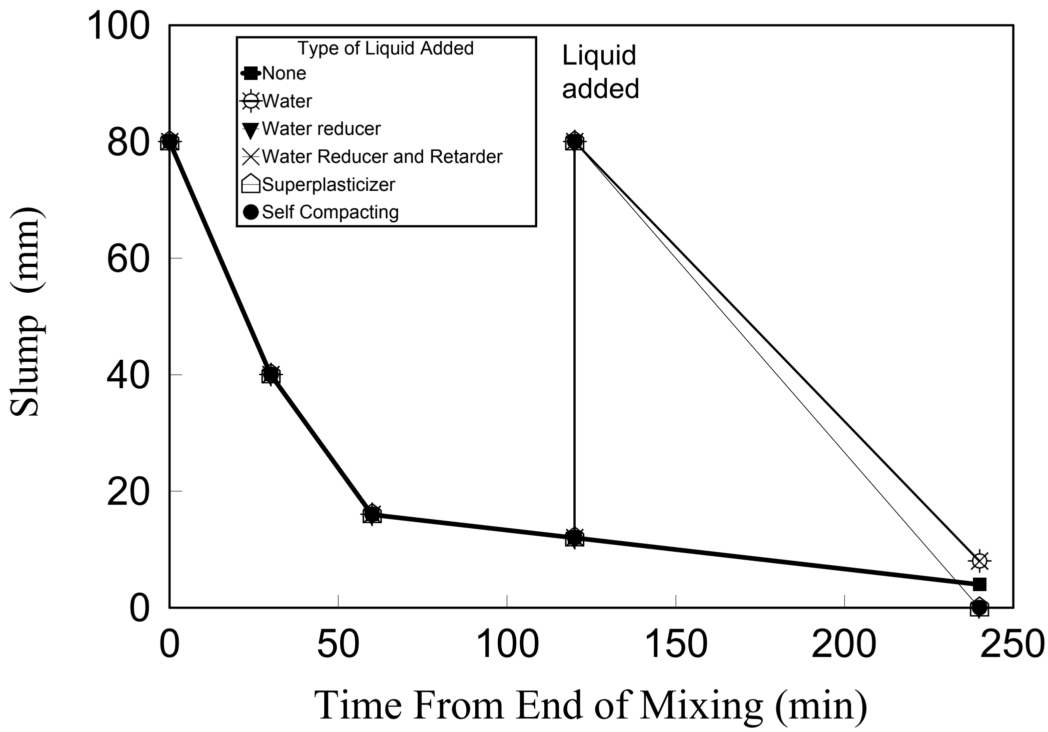


Figure 4 Time line for slump of Silica Fume concrete (liquid added at 2 hours)

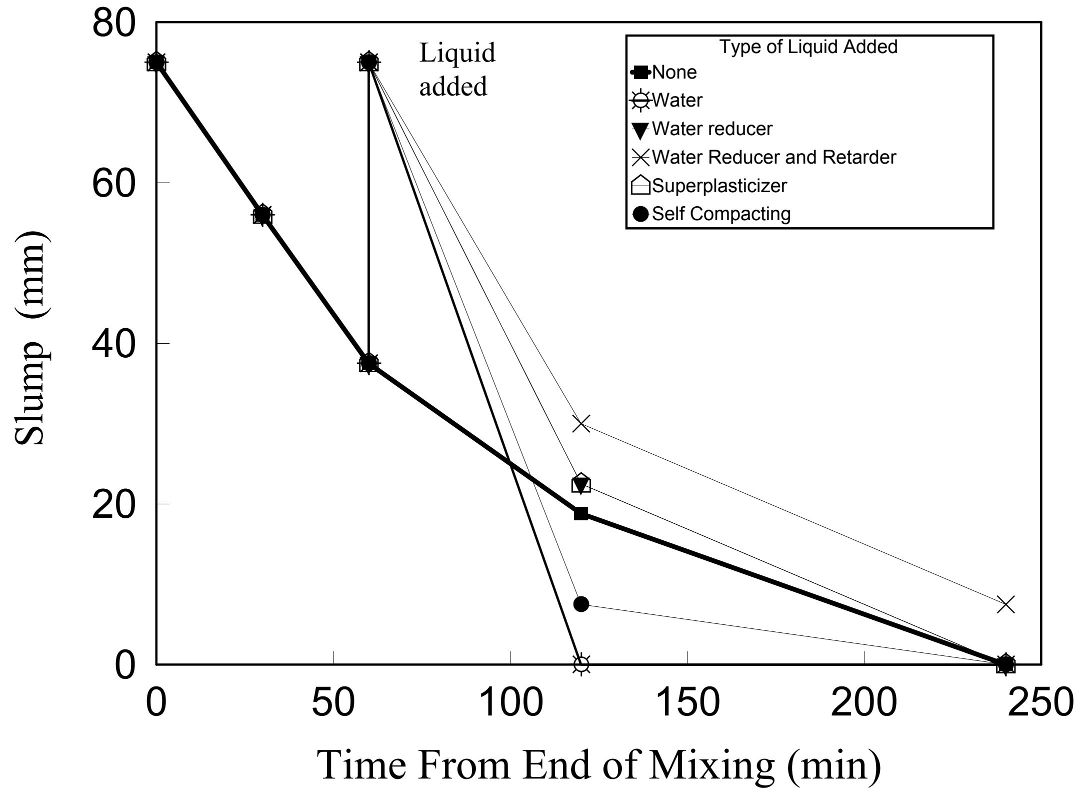


Figure 5 Time line for Slump of Fly Ash concrete (liquid added at 1 hour)

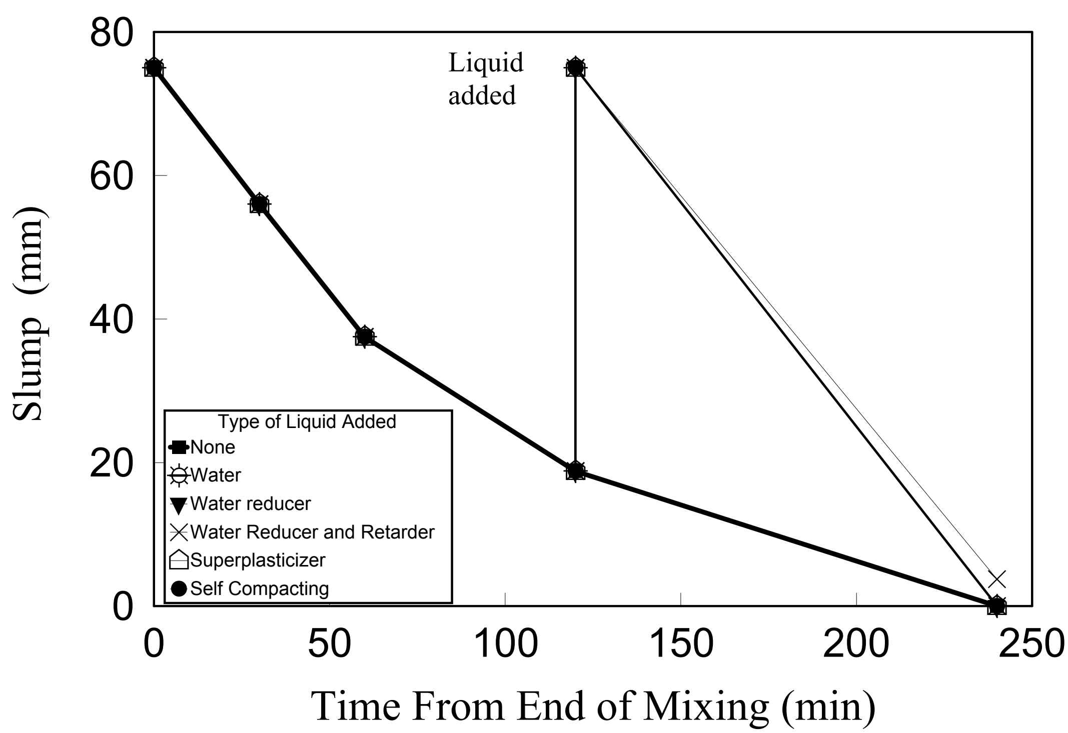


Figure 6 Time line for Slump of Fly Ash concrete (liquid added at 2 hours)

increase the slump of the mix after 30, 60 or 90 minutes from mixing. Their aim was not to restore the original slump of the mix, but to simulate the situation where a slump increase is needed in order to place the concrete when delivery has been delayed. As a result of the addition of 1 or 3 % of superplasticizer by weight of cement, the slump became slightly or appreciably higher than the slump of the mix immediately after mixing, respectively. The superplasticizer used (a sulfonated melamine formaldehyde) also gave a short increase in slump, but the slump of the concrete with admixture was never below the slump of the original mix without the admixture. In the current study the dosage of the superplasticizer (Naphthalene formadehyde sulphonate) used was 1.48 and 2.25 % by weight of cement in the OPC mix, at 1 and 2 hours addition, respectively. The observation in the current study of the increased rate of slump loss may be characteristic for this generic type of admixture at this dosage range, since a similar observation was noted by Lewandowski and Peterfy [15], when an admixture from the same type was added at the start of mixing.

Effect of Liquid Addition on the Compressive Strength of the Concrete

The compressive strength of the different mixes with and without liquid addition at either 1 or 2 hours is represented in the bar chart of Figure 7. It can be seen that the addition of water resulted in a decrease in the compressive strength of all mixes. For the OPC concrete, the decrease in strength was only 13 % at both 1 and 2 hours when water was added to restore slump. However, with the silica fume and fly ash mixes, the decrease in strength was 25 and 34.6 % when water was added at 1 hour and 34.2 and 42.3 % when water was added at 2 hours, respectively. Therefore, the use of water to restore slump affects the mixes with pozzolanic materials to a greater degree than the plain OPC mixes. It should be noted that the increase in w/(c+p) ratio, for the silica fume concrete due to water addition for slump restoration, was lower than that for the OPC mix. The reverse was true for the fly ash mix, but as can be seen from the results the pozzolanic mixes suffered greater loss in strength compared to the OPC mix. It may be argued that the addion of water was deterimental to early pozzolanic reactions due to diluting the $Ca(OH)_2$ in the mix, but the actual reasons for this behavior need closer investigation by detailed microstructure investigations in order to fully understand the observed phenomenon which was noted for the first time in the current study.

The use of admixtures to restore the original slump of the mixes seem to have a relatively small effect on the compressive strength of the OPC and Silica fume mixes, but the fly ash had a reduced compressive strength when treated in this manner. For the OPC mix the reduction in compressive strength when the admixtures were used ranged between 1.9 and 9 %, whereas the silica fume mix exhibited a slight increase in compressive strength of 1.3 or a maximum reduction of 10.5 %. On the other hand the reduction in compressive strength in the fly ash mix ranged between 20.7 and 34.6 % when admixtures were added to restore the slump.

As was discussed above, Vollick [17] observed an increase in compressive strength when a retarder was added with water to restore the original slump after 2, 4 and 6 hours from the end of first mixing. In the current investigation, a water reducer and retarder, not a pure retarder, was tried. No increase in the compressive strength upon the late admixture addition was observed with this type of admixture, but as was stated above, the compressive strength was, in some cases, only slightly affected by the process. It may be possible that the findings of Vollick [17] can be reproduced if a pure retarder is used or when different admixtures or combination of admixtures are employed.

Effect of Liquid Addition on the ISAT value of Concrete

Figure 8 shows the effect of liquid addition on the ISAT values of the different mixes used. The use of water to restore the original slump in the OPC, silica fume and fly ash mixes has resulted in an increase in the ISAT value of 14.6, 24.0 and 26.7 %, respectively when the water was added after 1 hour of initial mixing. The increases were 16.7, 44.6 and 45.0 %, respectively, when addition took place at 2 hours. Again, the effect of water addition is more pronounced for the mixes containing pozzolanic materials.

When admixtures were used to restore the slump of OPC concrete, the ISAT value was unchanged in one case (2 hour addition of a water reducer), or a maximum increase in the ISAT value of 8.3 % was observed. As opposed to that a reduction in the ISAT value of 13.2 and 26.6% was observed with the silica fume and fly ash mixes, respectively, when the self compacting admixture was used to restore the slump at 1 hour. The use of the water reducer and retarder admixture or the superplasticizer also caused a reduction in the ISAT values for the fly ash mix, but the water reducer caused a slight increase in the ISAT value. The maximum increase in the ISAT value for the mixes with pozzolans was for the silica fume mix when the water reducer and retarder admixture was used to restore the slump after 2 hours from initial mixing (i.e. 23.6%). Therefore, it is clear that the different admixtures interacted in a different way with each of the mixes used in the current investigation. As a result of that the ISAT value was increased, decreased or remained unchanged when the admixtures was used for slump restoration. However, in all cases, the increase in the ISAT value, when the admixtures were used, was less than that observed when water was utilized for the same purpose.

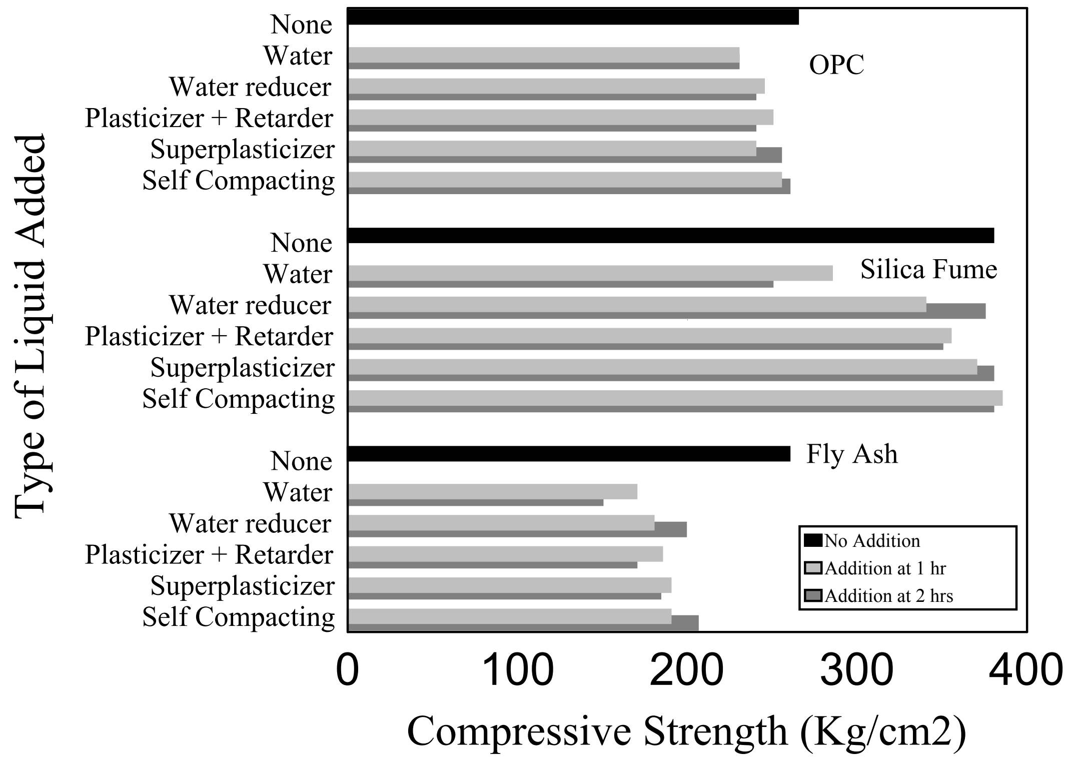
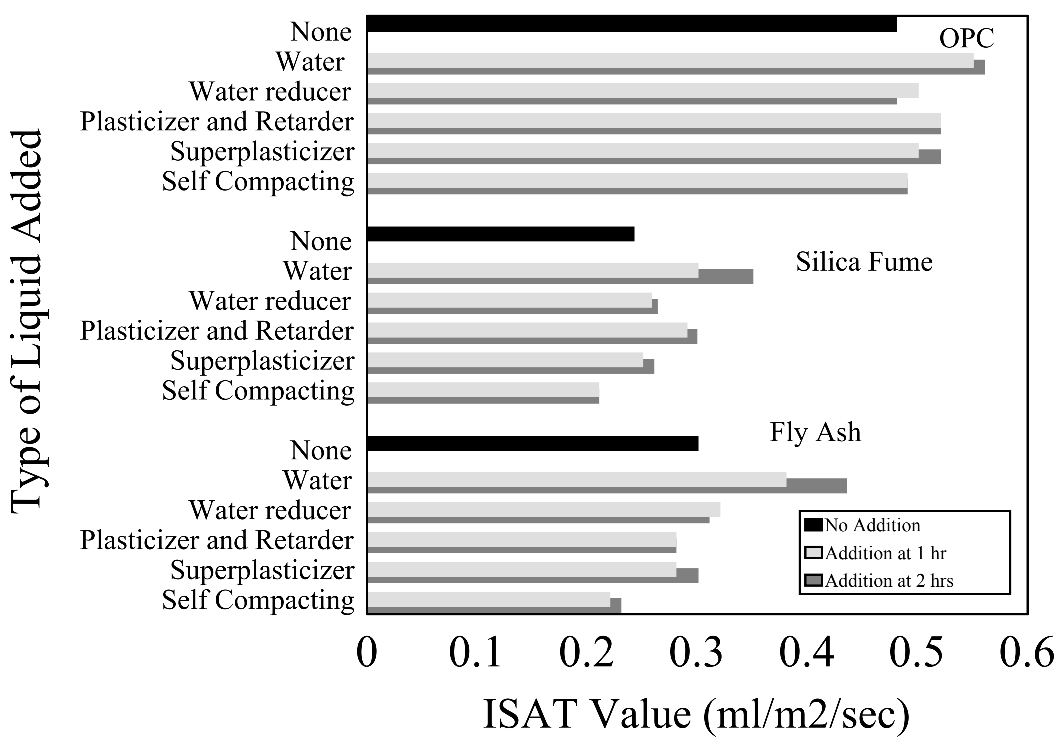


Figure 7 Effect of delayed liquid addition on compressive strength of Concrete



Effect of Liquid Addition on the Porosity of Concrete

The porosity results with and without late liquid addition are shown in Figure 9. The beneficial effect of the inclusion of pozzolanic materials on the porosity value of concrete is clear. When 10% silica fume or 30% fly ash replaced OPC in the concrete mix the reduction in porosity was 47.9 and 27.8 %, respectively. However, some of the benefits of pozzolanic materials inclusion were lost when water was used to restore the slump of these mixes. The data shows that the porosity of the silica fume and fly ash mixes was increased by 22.7 and 20.2 %, respectively, when water was added after 1 hour from initial mixing. The corresponding increase in porosity for the OPC mix was only 1.4%. Therefore, it would appear that the porosity of the pozzolanic mixes is particularly sensitive to late water addition.

When the admixtures were used to restore the slump, the water reducer gave a similar (i.e. for OPC concrete) or higher (i.e. for the pozzolanic mixes) increase in the porosity than that exhibited when water was used. The water reducer and retarder and the superplasticizer did not seem to have a marked effect on the porosity of OPC and silica fume mixes, however, the use of these admixtures produced a pronounced increase in the porosity of the fly ash concrete. The self compacting concrete decreased the porosity of all mixes. Therefore, it would appear that this admixture causes an improvement to the microstructure of the concrete.

CONCLUSIONS

The proposed new approach, for restoring the slump of ready mixed concrete, when a delay in placing occurs or where hot weather causes the slump to be lost quickly, was evaluated. The procedure involves the addition of an admixture, followed by agitation to ensure the complete dispersion of the admixture, immediately prior to placing. The results were compared with those for mixes which had their slump restored using water and control mixes, which were placed without delay. The following conclusions can be drawn based on the reported results:

1. Any liquids introduced to the concrete mix after initial mixing can be considered as an addition to water content of the mix. The use of water to restore the slump of the concrete mixes in this investigation, increased the water content of the OPC mix by 19.1 and 31.5%. The corresponding increases for the mixes with pozzolanic materials was 13.5 and 17.1 % for the silica fume mix and 27 and 45 % for the fly mix at 1 and 2 hours addition, respectively. The proposed approach, which utilizes admixtures for that purpose, increased the liquid content of the mix by up to 1.46 % only. Therefore, the late addition of the admixtures does not appreciably affect the mix proportions.

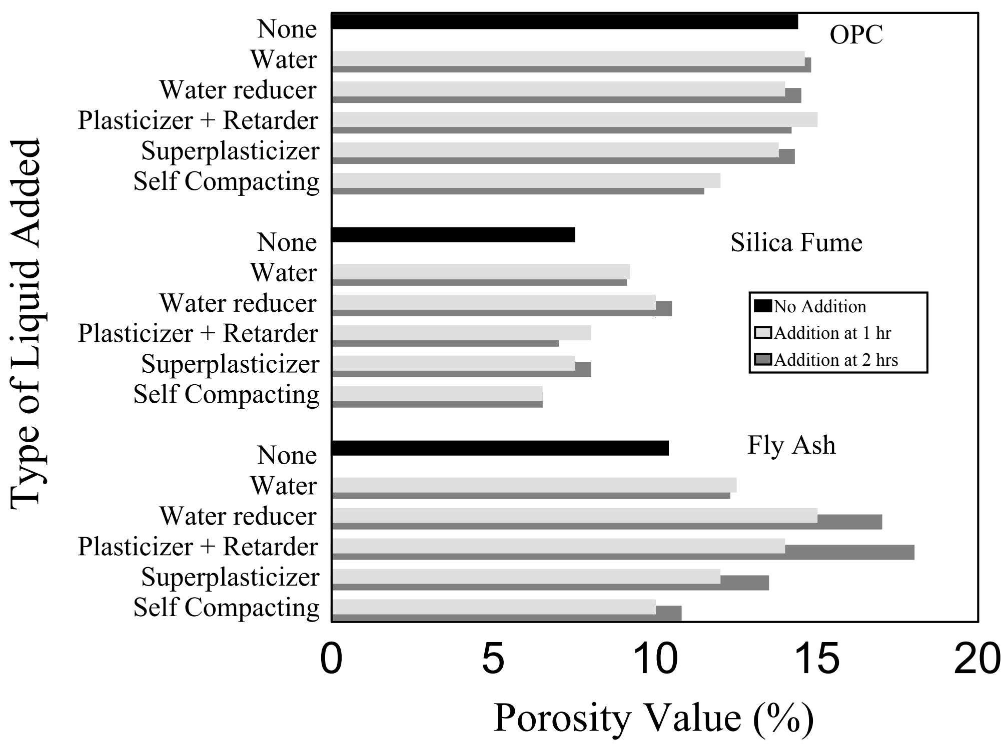


Figure 9 Effect of delayed Liquid addition on porosity of Concrete value of Concrete

2. The slump increase by either water or an admixture disappears within the hour. Concrete should be placed without delay once the addition was made. The rate of slump loss, after the admixture addition, may be reduced when a water reducer and retarder admixture is utilized. However, this reduction is only marginal and of no practical significance.

3. In spite of the fact that that the silica fume mix required less water for slump restoration, its compressive strength, initial surface absorption and porosity were affected in a more severe manner by late water addition compared to the pure OPC mix. For example, the OPC and silica fume mixes with added water after 1 hour, had 1.4 and 22.7 % higher porosity than the values for the corresponding mixes without slump restoration, respectively. The fly ash mix required more water to be added for slump restoration and its properties were also more severely damaged by the process. The reasons for this behaviour, first to be noted in this study, need further investgation on the microscopic level.

4. Different admixtures, which were tried in the course of examining the new approach, affected the compressive strength, initial surface absorption and

porosity of the various mixes. Sometimes this effect was favorable and in other cases it was detrimental, but in no case the effect was worse than when water was used for the same purpose.

5. When used for slump restoration, the self compacting admixture consistently improved the properties of the concrete mixes studied in this investigation,. The recommendation for the ready mix concrete industry is to use this admixture for that purpose which is perhaps a new application for this type of admixture.

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اسلوب جديد للسيطرة على فقدان هبوط الخرسانة الجاهزة في الأجواء الحارة

ملخص:

في البلدان الحارة، كثيرا ما تفقد الخرسانة السيولة اللازمة لاتمام عمليات الصب و الدمك. تم اقتراح العديد من الوســائل للسيطرة على ظاهرة فقدان الهبوط في دراسات أخرى و لكن بعد اختبار هذه الطرق بواسطة باحثين آخرين وجد أن هذه الطرق غير مناسبة. في هذا البحث تم اقتراح و اختبار اسلوب جديد لحل هذه المشكلة و هــو اضافة القليل من الاضافات الكيميائية و ذلك بعد ساعة أو ساعتين من نهاية عملية الخلط الأولي و في هذه الحالــة لا يشـــترط وجود هذه الاضافات مبدئيا في الخرسانة. تم بعد ذلك اختبار أثر هذه العملية على مقاومة الضغط و الامتصاص السطحي المبدئي و المسامية للخرسانة المتصلدة التي أضيف اليها هذه المواد و مقارنة النتائج بالقـــيم الـــناتجة من خرسانة لم يتم اضافة أية مواد لها أو خرسانة أضيف لها الماء لاستعادة التشغيلية المفقودة. و خلص البحث على أن استخدام الماء لاستعادة التشغيلية المفقودة له أثر سلبي على خواص الخرسانة خصوصا تلك الـــتي تحتوي على بدائل الأسمنت. لم يؤثر استخدام الاضافات تأثيرا سلبيا على خواص الخرسانة و بعض الأحيان تحسنت الخواص المدروسة نتيجة استخدام الاضافات. و قد وجد أن اضافات الدمك الذاتي تعطي أفضل النتائج مع جميع أنواع الخرسانات المستخدمة و لذلك نوصي باستخدامها بهذه الطريقة في صناعة الخرسانة الجاهزة.