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Research article

A COMPENSATION OPTION FOR SLUMP LOSS DURING HOT - WEATHER CONCRETING

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ABSTRACT

Pre-pour planning and preparation minimizes hot - weather concrete handling and finishing problems. However, undesirable field practices, such as adding water to compensate for slump loss are not uncommon. Such practice is commonly called "retempering"

Delay between the time of mixing and placing of the concrete may compound the existing hot weather conditions, resulting in partial setting and undue stiffening of the mixed concrete, due to considerable slump loss. One option is to reject and waste the concrete without regard to cost. Another option, which is the subject of this paper is retempering of the concrete by water and a little cement.

This paper presents an evaluation of compressive, tensile and flexural strength of concrete subjected to different retempering times of 15 to 90minuites. It is concluded that, instead of wasting enormous bulk concrete, retempering can be recommended with or without retarding admixture.

Keywords: Slump loss, retempering; compressive strength; tensile strength; flexural strength; retempering times; admixture.

INTRODUCTION

Slump loss in hot weather concreting combined with delay in delivery of ready mixed concrete may lead to undesirable field practices, such as adding water to compensate for slumps otherwise known as 'retempering' in order that the concrete may not stiffen to an unacceptable degree, which may be rejected for work, on the grounds of insufficient workability (Alhozainy 2007).

If abnormal slumps loss in anticipated, by way of hot weather concreting conditions or by way of delay in delivery, it is usual to modify the normal concrete placing and finishing procedures accordingly. However, if unexpected slump loss occurs resulting to poor workability, then retempering of the concrete, normally considered to be bad practice, may in reality, be the only way

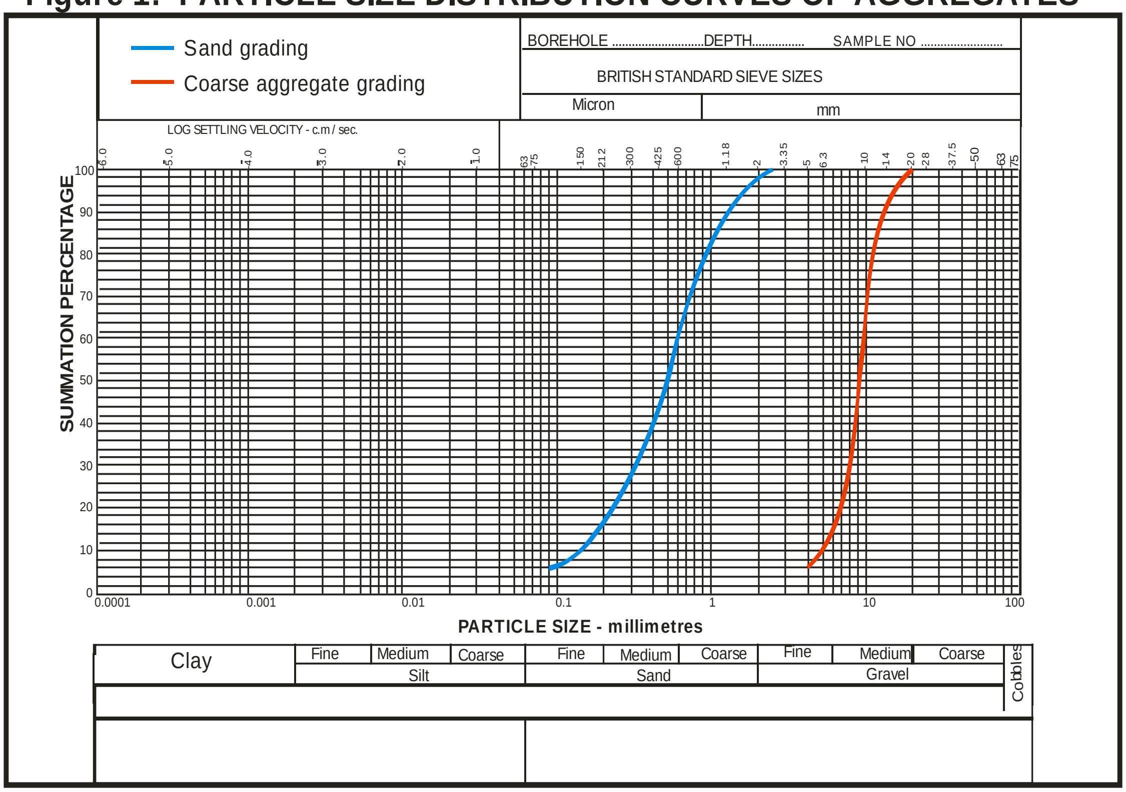
forward. However, by adding water without adding cement, increases the water-cement ratio which, inturn, lowers concrete strength and durability (Colleperdi 1998; Onderkirca et al 2002). Therefore small amount of cement may usually be required for proper retempering.

When the slump unexpectedly decreases to an unacceptable level during concreting, the concrete is either discarded or used with little addition of extra water and cement, so that part of the lost plasticity is regained. In big projects, such large amount of concrete cannot be wasted, retempering is the only option; but must be done with great caution i.e just enough to increase slump by 50 or 60mm (Gunduz et al 2007; Sakir 2007).

EXPERIMENTAL PROCEDURE

The principal aim of the study is to find the effect of retempering on the properties of retempered concrete with or without retarding admixture. Concrete was generally made with ordinary Portland cement, fine aggregate which is natural river bed sand with specific gravity of 2.50 and maximum size passive sieve 2.66mm, coarse aggregate of crushed granite with specific gravity of 2.67 and size ranging from 5.0 - 19.0mm, and mixing water from the tap. The materials were batched by weight and mixed manually. The particle size distribution of the sand and coarse aggregate are given in fig 1.

Figure 1: PARTICLE SIZE DISTRIBUTION CURVES OF AGGREGATES



The aggregates were washed in order to get rid of organic and other deleterious materials which might react with the concrete constituents, thereby affecting the finished hardened concrete strength. A mix ratio of 1:2:4 and water cement ratio of 0.5 were chosen for all the 150mm concrete cubes casted.

After mixing the concrete, retarding admixtures were added and a homogenous concrete mix obtained, which was covered with gummy bags for 15, 30, 45, 60, 75 and 90 minutes before casting. Compaction was by vibration. The retarder used was hydroxylated carboxylite acids (0.4% of weight of cement). A different set of retempered concrete, specimens were cast by adding 5% extra cement and the required extra amount of water to make up a water cement ratio of 0.5. All specimens were cured for 28 days before testing for their compressive strength, tensile strength, and flexural strength.

Standard calibrated cube crushing machine was used to crush 150mm x 150mm x150mm hardened concrete cubes to failure, in order to determine its compressive strength in accordance with BS 1881 - 116:1983 and defined by:

$P = F/A$

where F is the failure load and A is the cross sectional area of the specimen whereas, the splitting tensile strength was determined by using the same crushing machine to crush a concrete cylinder specimen of 50mm diameter and 300mm height in accordance with BS EN 12390-6:2009 and defined by:

Splitting tensile strength = $2F/\pi dL$

Where F is the failure load, L is the cylinder length and d is the diameter of the cylinder. For flexural strength test the beams of dimensions 100 x 100 x 500mm were tested on an effective span of 400mm with point loading in accordance with BS EN 12390-5:2009.

Table 1: Result of Compressive Strength Test (MPa)

Retempering time (min)		15	30	45	60	75	90
Control mix without Admixture	Without addition of 5% extra cement & water	21.25	22.15	24.95	27.50	23.75	23.25
	With addition of 5% extra cement & water	22.45	23.25	24.15	25.50	23.00	23.20
With addition of 0.4% retarder	Without addition of 5% extra cement & water	25.95	26.50	27.00	29.20	24.50	23.90
	With addition of 5% extra cement & water	26.80	27.25	28.25	29.75	24.15	24.30
Percentage difference w.r.t control mix	Without addition of 5% cement & water	22.1	19.6	8.2	6.2	3.2	2.8
	With addition of 5% cement & water	19.4	17.2	17.0	16.7	5.0	4.7

Table 2: Results of Split Tensile Strength Test (MPa)

Retempering time (min)		15	30	45	60	75	90
Control mix without	Without addition of 5% extra cement & water	3.95	4.10	5.30	6.25	5.20	5.00

Admixture	With addition of 5% extra cement & water	4.20	4.30	5.45	6.95	5.85	5.15
With addition of 0.4% retarder	Without addition of 5% extra cement & water	4.97	5.30	6.00	7.20	6.15	5.95
	With addition of 5% extra cement & water	5.15	5.40	7.00	7.40	6.55	6.00
Percentage difference w.r.t control mix	Without addition of 5% extra cement & water	25.8	29.3	13.2	15.2	18.3	19.0
	With addition of 5% extra cement & water	22.6	25.6	28.4	7.2	12.0	16.5

Table 3: Results of Flexural Strength (MPa)

Retempering time (min)		15	30	45	60	75	90
Control mix without Admixture	Without addition of 5% extra cement & water	1.95	2.30	3.35	4.60	3.60	3.10
	With addition of 5% extra cement & water	2.10	2.45	3.42	5.25	4.15	3.25
With addition of 0.4% retarder	Without addition of 5% extra cement & water	2.35	3.50	4.90	5.50	4.80	3.75
	Without addition of 5% extra cement & water	2.43	3.63	4.95	5.65	4.92	3.96
Percentage difference w.r.t cement mix	Without addition of 5% extra cement & water	20.5	52.2	46.3	19.6	33.3	21.0
	With addition of 5% extra cement & water	15.7	48.2	44.7	7.6	18.6	21.8

RESULTS AND DISCUSSION

Tables 1, 2 and 3 show the compressive, tensile and flexural strength test results, together with percentage differences with regards to the control mix respectively while fig 1, 2 and 3 shows the variation of compressive, tensile and flexural strength with different tempering time respectively.

From figures 1, 2, and 3, it is clear that the concrete without any admixture has maximum compressive, tensile and flexural strength at a tempering time of 60 minutes and yielded more strength at all tempering time on addition of 5 % extra cement and water.

This may be that evaporate of water up to 60minutes may bring down the w/c ratio resulting in an enhanced strength, but beyond which time the strength drops considerably. Adding water without adding cement increases the water- cement ratio which in turn lowers concrete strength and durability. So on addition of 5% extra strength increased generally; and further more strength was gained on addition of retarder admixture for all the tempering times. This is probably that the admixture reduced setting time and workability for a longer time to allow adequate compaction of the concrete, which in turn, increased the concrete strength.

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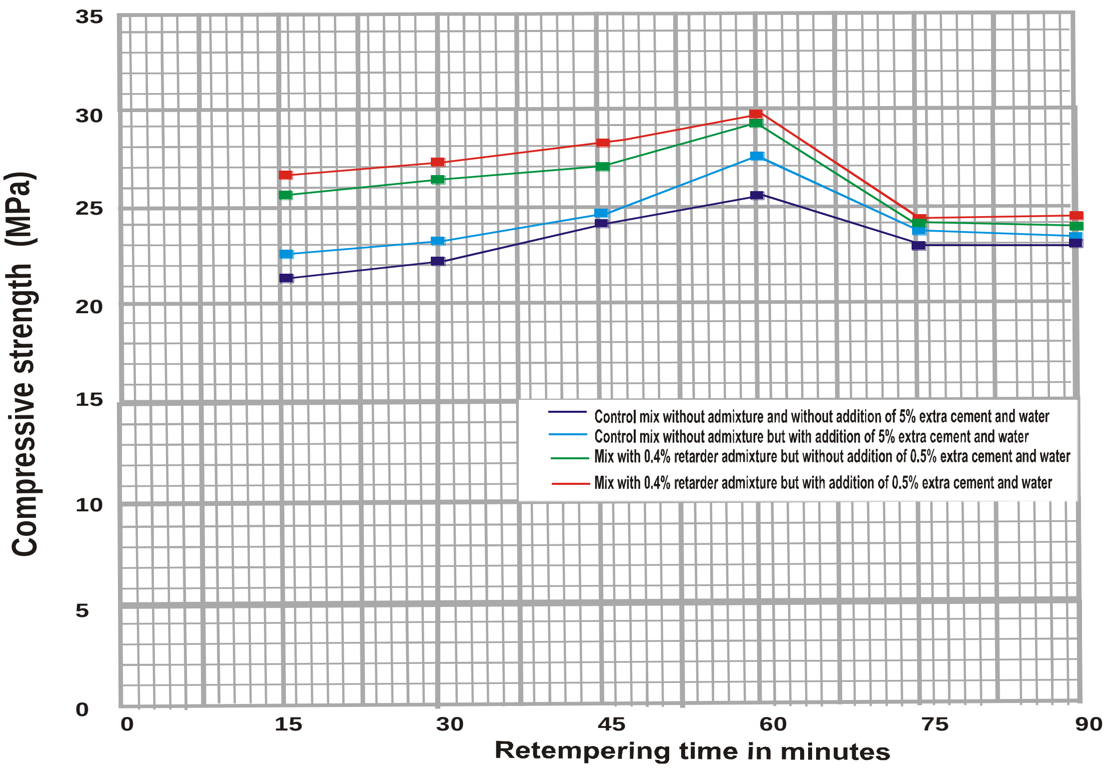

Figure 1: Variation of compressive strength with various retempering times

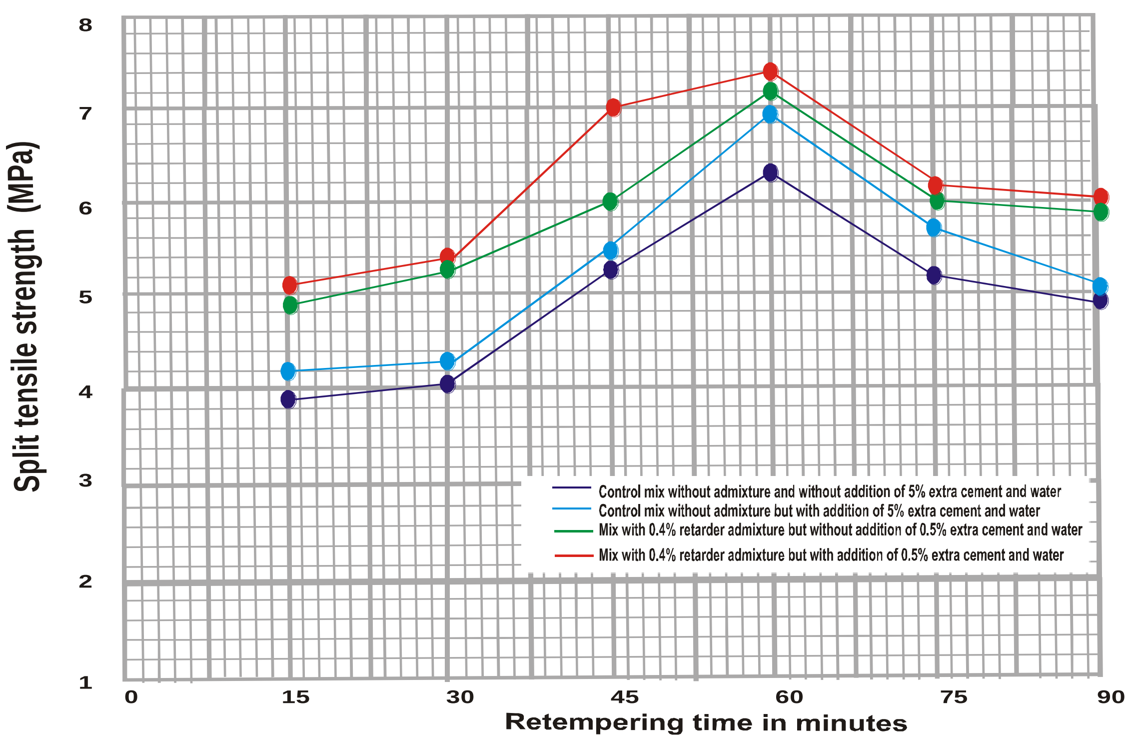

Figure 2: Variation of Split tensile strength with various retempering times

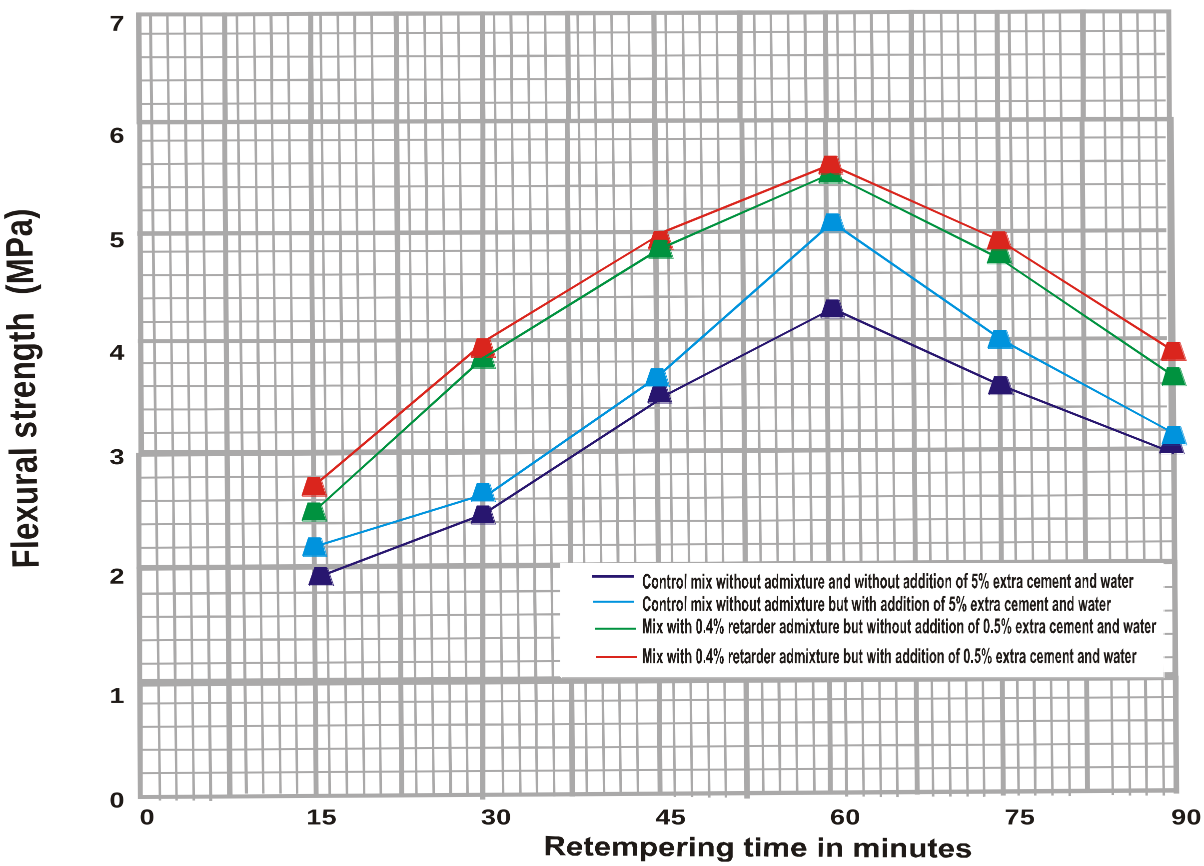

Figure 3: Variation of flexural strength with various retempering times

CONCLUSION

This study shows that there can be slump loss in mixed concrete resulting from hot weather conditions; which can be compounded, and worsen condition, when there is undue delay between mixing and placing of the concrete. In extreme condition the mixed concrete gets partially set and unduly stiffened. One object is to reject and waste the concrete without regard to cost. Another option which is presented in this paper is retempering of the concrete by water and a little cement with or without admixture.

Concrete without admixture show maximum strength at a retempering time of 60minutes. On addition of 5% extra cement and water, the concrete yielded more strength. The highest strength was observed on addition of a retarding admixture. It is concluded that instead of wasting bulk mixed concrete, the concrete should be retempered with or without admixtures.

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