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Effect of Retempering on the Property of Concrete Subjected to Sulphate Attack

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***Abstract*— Loss of workability and undue stiffening of concrete may take place at the time of placing on work site, due to delayed in delivery of concrete. Many times resulting in rejection of the concrete partially set and unduly stiffened due to the time elapsed between mixing and placing on the site. However this mixed concrete is a costly material, would not be wasted without any regard to cost. So its need to see whether such a stiffened concrete could be used on work without undue harm with use of retempering. 'Retempering of concrete' means the process of remixing of concrete, if necessary with addition of just the required quantity of water. Sometimes, to maintain water cement ratio, a small quantity of extra cement is also added while retempering.**

In this paper, the aim of the study is to investigate the effect of durability property of concrete at different retempering time of 15 minutes up to 90 minutes with respect to 0minute concrete of without retempering subjected to sulphate attack.

Author concluded that the higher strength of concrete is obtained with concrete produced with addition of five percent extra cement and water with retempering at time 15 minutes to 90 minutes when subjected to sulphate attack for 30 days, 60 days and 90 days.

***Keywords*— durability, retempering, sulphate attack**

I. INTRODUCTION

Properties of fresh concrete are important only when they achieve the desired properties of the hardened concrete, where as it is based on sufficient workability of concrete. Generally, full compaction with fewer amounts of entrapped air voids can be obtained with more workable concrete mixes. This consequently results in an increase in compressive strength of concrete. [1], [4]

Concrete manufactured at mixing plant and it is required to deliver in unhardened and plastic stage to construction site. The long time involved of the handling and delayed placing of concrete, their can be many problems about concrete, like slump loss. As a result of a slump loss and which turns in to considerable losses in consistency, fluidity and workability. To maintain the consistency, fluidity and workability of the concrete some quantities of water to be add in the mixture. Addition of water for retempering concrete is the usual procedure, but addition of water without proper adjustment in mixture proportions, adversely affects compressive strength.[6], [7]

Sometimes, a small quantity of extra cement is also added while retempering to maintain water cement ratio. Many specifications do not permit retempering. However, many research workers are of the view that retempering with the addition of a small quantity of water and cement may be permitted to obtain the desired slump provide the designed water/cement ratio is not exceeded. [1], [5]

However, adding of water to concrete mix to increase slump is an extremely common practice, even though it is not recommended because it increases the porosity of concrete. But on the site, concrete often arrives an half an hour after initial mixing and the placement operation take time 15 minutes to 90 minutes and then they become partially harden which is un-usable. So we need adding some water and cement to maintain w/c ratio. When the slump decreases to an unacceptable level during the operations, water is added to the mix and very often, experienced site engineers will accept what can be termed 'reasonable' retempering, i.e., enough to increase slump by 50 mm or 60 mm. [2], [3], [5].

II. RESEARCH SIGNIFICANCE

When the situation arises like suddenly erupted strikes on the construction site or breakdown of any concreting equipment or quarrels between the labours may put the green concrete into difficult situation. In such above situations the concrete which is already mixed may have to wait for a longer time before placing. This causes the loss of plasticity and when this concrete is used, the strength, durability and other characteristics of concrete are affected. Such concrete has to be either useless or used with little addition of extra water and cement so that a part of plasticity is regained this concrete is called retempered concrete. The main important properties of concrete are Strength and durability. Now it is recognized that strength of concrete is not alone sufficient, the degree of harshness of the environmental condition to which concrete is exposed over its entire life is equally important.

Therefore, to study the durability properties of retempered concrete subjected to sulphate attack is also essential.

III. EXPERIMENTAL PROGRAMME

During in this study, the effect of different retempering time on the properties of concrete subjected to sulphate attack is observed.

Ordinary Portland cement of 53 grades is used in the experimentation. Locally available river sand conforming to zone II is used. For Coarse aggregate the nominal maximum size of 20mm is used which supplied by local quarry. The concrete mix is designed as per IS: 10262:2009. The specific gravity of fine and coarse aggregate was 2.50 and 2.86 respectively. The experiments are conducted on a mix proportion of 1:2.15:3.26 with w/c= 0.45 which corresponds to M_{20} grade of concrete.

All the ingredients in dry state thoroughly mixing and the required quantity of water is added in the mix and thoroughly mixed. This forms the fresh concrete for 0 minute. This concrete mix is poured into the moulds and the specimens are cast with sufficient compaction as shown in Photo 1. Similarly for another sets, all the ingredients in dry state after thoroughly mixing, the required quantity of water is added in the mix and thoroughly mixed. In the mixer, the concrete mix is cover with gunny bags for 15 minutes. This time is reckoned, at this moment the five percent extra cement and water is added to the concrete mix. After 15 minutes the mix is poured into the moulds and the specimens are cast with sufficient compaction. This forms retempered concrete for 15 minutes. Similarly the specimens are prepared with retempered concrete with a retempering time of 30 minutes, 45 minutes, 60 minutes, 75 minutes and 90 minutes.

After 12 hours, all the specimens are de-moulded of their casting and are transfer to curing tank to cure them for 28 days. After 28 days of curing the specimens, for test of durability like sulphate attack the specimens immerse in 10% Na_2SO_4 solution for 30 days, 60 days and 90days as shown in Photo 2. Cube after removing from sulphate solution is shown in Photo 3. Specimens after removing from the solution weights are noted and the specimens are tested for compressive strength.

For compressive strength test as per IS 516: 1959, the cubes of dimensions 150 X 150 X 150 mm are cast and are testing under compression testing machine as shown in Photo 4.

Photo 1 Cube Casting

Photo 2 Specimen's immersed in Sulphate Solution

Photo 3 Cube after removing from Sulphate Solution

Photo 4 Specimen testing under compressive testing machine

IV. RESULTS AND DISCUSSIONS

The compressive strength test results for different retempering time of concrete when immersed in sulphate media tabulated in Table 1. It also gives percentage increase or decrease of compressive strength w. r. t. without retempering concrete of 0 minute.

The variation of these strengths is depicted in the form of graphs as shown in figure 1.

a) It has been observed that the concrete produced from the retempering shows higher strength as compared to without retempering of 0 minute concrete. The concrete produced at different retempering time of 15 minutes, 30 minutes, 45 minutes, 60 minutes, 75 minutes, and 90 minutes strength are reduced when subjected to sulphate attack for 30 days, 60 days and 90 days.

b) This may be due to the evaporation of water up to 75 minutes resulting slump loss and reduction in w/c ratio. Thus the concrete well compacted thus not allowing any sulphate media to penetrate. Thus it can be concluded that the retempering can produced a concrete of higher strength as compared to without retempering when subjected to sulphate attack.

TABLE 1

Results of compressive strength for different retempering time when immersed in sulphate media

Retempering Time (Minutes)	30 days immersion		60 days immersion		90 days immersion	
	Compressive strength MPa	% increase of comp. strength w. r. t. 0 min.	Compressive strength MPa	% increase of comp. strength w. r. t. 0 min.	Compressive strength MPa	% increase of comp. strength w. r. t. 0 min.
0	25.11	-	24.67	-	24.37	-
15	28.89	15.04	27.93	13.21	27.11	11.25
30	29.26	16.52	28.81	16.82	28.30	16.11
45	30.44	21.24	29.63	20.12	28.96	18.84
60	30.59	21.83	29.85	21.02	29.33	20.36
75	31.11	23.89	30.59	24.02	29.19	19.76
90	28.59	13.86	27.78	12.61	26.81	10.03

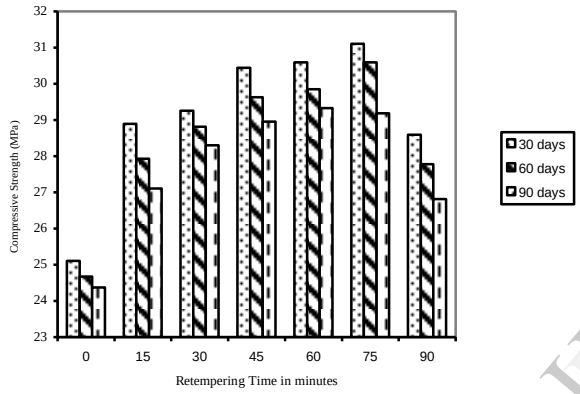

Figure 1 Variation of compressive strength w. r. t. different retempeing times

V. CONCLUSIONS

The higher strength of concrete is obtained with concrete produced with addition of extra five percent cement and water with retempering at 15 minutes to 90 minutes when subjected to sulphate attack for 30 days, 60 days and 90days. The percentage increase in compressive strength for the retempering time of 15 minutes, 30 minutes, 45 minutes, 60 minutes, 75 minutes, and 90 minutes are 11.15%, 16.11%, 18.84%, 20.36%, 19.76%, 10.03% as compared to without retempering concrete of 0 minute concrete. Hence it can be recommended to use the retempered concrete has to resist sulphate attack of 10% Na_2SO_4.

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