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EFFECT OF CHEMICAL ADMIXTURES ON FRESH AND HARDENED PROPERTIES OF CONCRETE: A REVIEW

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Abstract*— Concrete is the most widely used man-made construction material in the world. It is a composite material. The strength, durability, workability and other characteristics of the concrete depending on the properties of its ingredients. The use of admixture has become inevitable in terms of improving the characteristics of concrete in both fresh and hardened states to achieve the desired results. In recent years, the demand for admixture mixes has been frequently experienced in the ready-mix concrete industry owing to longer delivery distances or to delays in placing because of problems at the site. A good number of researches are been carried out to study the effect of different type of admixtures on the properties of concrete. This paper helps to achieve an understanding of how a normal concrete mix may behave under different admixture conditions. It helps to investigate the effects of different admixtures one water reducer and other retarders on fresh and hardened properties of concrete. Journal aims at suggesting methods to improve the quality of concrete and thus reducing the cost of overall construction.

***Keywords*— concrete, workability, admixtures, fresh properties, hardened properties, quality of concrete**

I. INTRODUCTION

Admixtures have been recognized as important components of concrete used to improve its performance. Admixtures are those ingredients in concrete other than cement, water, and aggregates which are added in the concrete during mixing. Chemical admixtures are used to enhance the properties of concrete and mortar in the plastic and hardened state. An admixture or combination of admixtures may be the only feasible means of achieving the desired results. The admixtures interact with the hydrating cementitious materials by physical and chemical actions modifying one or more of the properties of concrete in the fresh and hardened states: to accelerate the initial set of concrete, i.e. to speed up the rate of development of strength at early ages, to retard the initial set, i.e. to keep concrete workable for a longer time, to enhance the workability to increase the strength of concrete by reducing the water content and by densification of concrete, to increase the durability of concrete, i.e. to enhance its resistance to special exposure conditions, to inhibit the corrosion of reinforcement in concrete, to increase the resistance to chemical attack, to maintain the quality of concrete during the stages of mixing, transporting, placing, and curing in adverse weather conditions or to overcome certain emergencies during concreting operations. The effectiveness of an admixture depends upon the following factors as type, brand and amount of cementing materials, water content, aggregate shape, gradation, proportions and mixing time. The retarder molecule chemically absorbs onto the cement particle in a mechanism quite similar to that of water reducers. This bond links the retarder molecule onto the cement surface, blocking and slowing down the rate of initial hydration of the cement.

The choice of the different types of retarding/ water reducing admixtures is often determined by properties such as mix cohesion. Selection may, therefore, be based on the particular mix characteristics of the concrete. Retarding, water reducing admixtures based on sucrose and other similar polysaccharides are very powerful, and their retarding effects are rarely linear so that small increases on the intended dosage can lead to large increases in retardation. They are very cost effective with typical dosages in the range 0.1% to 0.6% by weight of cement to yield a delay of a set of 3 hours to 50 hours. Retarders are quite sensitive to temperature. At low temperatures, retardation will be further extended. At very high temperatures, the converse is true, and it may be difficult to achieve the required workability retention and extension of stiffening time. Due to the potential sensitivities of retarding admixtures, it is strongly suggested that trials be undertaken. The level of retardation or reduction achieved is related to the dosage used. Any overdose will result in an increase in setting time and this can be significant for some admixture types. Large overdoses of retarders can produce very long setting times. Provided the overdose is not more than double that which was intended, and the concrete is well cured to prevent it from desiccation, accidentally retarded concrete will normally set and recover strength within two to three days. If the concrete remains fluid for an extended period, re-vibration may be advisable to close any settlement cracks before the concrete stiffens. Where large, accidental overdoses occur or where large overdoses of water reducing retarders have been used without a correspondingly large water reduction, the concrete may not recover its strength in a reasonable time. As a general rule, if concrete contains an overdose of a retarding admixture and has not set hard in 5 days, then it may not gain useful mechanical strength.

II. LITERATURE REVIEW

Tarrek ud din, tanvir, shariar ah. [2017] Effects of different chemical admixtures on fresh and hardened properties of well-mixed concrete has been carried out so as to identify the best type of chemical admixture and their cost-effectiveness were investigated. Influence of s/a volume ratio (0.4 and 0.45), cement content (340kg/m3 and 380kg/m3) and use of chilled mixing water on properties of well-prepared concrete was studied as well. Five different admixtures and seven different mixtures were prepared for this study. Results showed that Superplasticizers show better performances in improving fresh and hardened properties of concrete compared to water reducers.

Anitha J, Pradeep, Lalit [2016] In this investigation on performance with GGBS and different PCE based water reducing admixture the tests on compressive strength and workability of concrete with OPC and PPC with GGBS and admixtures are carried out at different periods for M45 Grade of concrete to conclude its behaviour. The concrete added with PCE based superplasticizers generally showed higher workability in terms of performance and efficiency in terms of water reduction. Compressive strength at 1,7,28 days of PCE based concrete is higher than of normal concrete and independent on cement type and admixture.

Yilmaz U.S, Turken.H [2011] In this study, some chemical curing materials recently used in concrete production, to provide and facilitate the curing conditions of concrete, were investigated experimentally, in terms of their effects on the compressive strength values of the concrete specimens produced with more than one chemical admixture. The results were compared with those of the specimens produced under the same conditions but cured with water in order to determine which curing materials gave which sort of results for which kinds of concrete. In conclusion, each chemical curing material used in this study presented various results, differing from each other, for concrete specimens produced with no admixture and different chemical admixtures. While curing material increases the strength of concrete produced with any type of admixture, it can reduce the strength of concrete produced with another type of chemical admixture.

Abalaka A.E [2011] worked on the effects of sugar on physical properties of ordinary Portland cement paste and concrete. This paper presents results of an experimental study carried out to investigate Effects of sugar at concentrations of 0, 0.05, 0.06, 0.08, 0.10, 0.20, 0.40, 0.60, 0.80 and 1% by weight of cement on cement paste and grade C35 concrete cured at 3,7,14 and 28 days was investigated using ordinary Portland cement in the laboratory. The initial setting time of cement paste was longest at 0.06% sugar content with soundness value of 0.35 mm. The compressive strength test results show some marginal strength gains at all ages but peaks at 11.84% at 3 days at 0.05% sugar content. It was reported that Sugar content of 0.06% by weight of cement can improve the compressive strength of concrete by 3.62% at 28 days and delay initial setting time by 1.556 hours (94 minutes).

Kiran Mane, Dr. D K [2010] The main aim of this experimentation work is to find the effect of the addition of retarding admixtures on the properties of retempered concrete. The concrete produced with the retarding admixture shows higher strengths than that of without admixtures for all the retempering times. Thus, instead of wasting the bulk concrete, the retempering can be recommended either the use of Retarding admixture or without admixture.

Satiyawira.B et al. [2010] studied effects of lignosulfonate and temperature on compressive strength of cement. A study observed the effect of Lignosulfonate on cement. Lignosulfonate has a function as a retarder which can extend the compressive strength of the cement concrete. Laboratory experiments were carried out at several temperature conditions. The temperature is varied from 28°C to 80°C. The experiment showed that the compressive strength of the concrete increased as the temperature during the curing time increased within the range studied. The laboratory experiment also indicated that the compressive strength of the concrete increased due to an addition of the Lignosulfonate. It reached a maximum value at the addition of Lignosulfonate as much as 0.2% of the cement weight at various temperatures. Addition of the additive at a higher level resulted in a decrease in the compressive strength of the cement.

Khan.B and Ullah.M [2004] worked on Effect of a Retarding Admixture (ASTM C 494 Type D) on the setting time of cement pastes in hot weather to prevent concrete from the adverse effects of hot weather, admixtures are usually incorporated in it. The objective of this paper was to investigate the effects of a retarding admixture (ASTM C 494 Type D) on setting time of cement pastes. The setting time tests were performed under three different curing conditions (temperature & relative humidity). The admixture was added to pastes made from three different types of cement. Dosages higher than 0.25% caused set retardation of the three different types of cement used, but with one type of cement it accelerated, the initial setting time and retarded the final setting time. It was reported that high temperature and low humidity accelerated the setting of cement pastes for all mixes with and without the retarding admixture.

Jumadurdiyev.An et.al [2004] studied that Molasses, a byproduct of the sugar industry, increases the fluidity of fresh concrete, and also delays the hardening time of cement paste. In this study, the molasses was determined from three different sugar production factories. A normal water-reducing admixture, based on lignosulphonate, has been used in the control mixture. Setting times of cement paste prepared with molasses at three different dosages (0.20, 0.40, and 0.70 wt. % of cement content) was determined and it was found that molasses addition causes a considerable increase in both initial and final setting times. Workability tests, as well as bleeding tests, were carried out on fresh concretes prepared with three molasses and also with lignosulphonate-based admixture. Flexural and compressive strengths were determined on hardened concretes at both early ages (1, 3, and 7 days), and moderate and later ages (28, 90, 180, 365, and 900 days).

Bazid Khan.B and Baradan.B [2002] studied the objective of this research has investigated the influence of sugars of different origins (Beet & Cane) on the setting times of cement pastes. Sugar is incorporated with three different types of cement under three different curing conditions (Temp. & R.Humidity). The test results revealed that, under normal curing conditions (Temp. = 22°C & R.H.P60%), the efficiency of sugar in retarding cement setting becomes higher with increasing sugar content up to a certain limit. However, with further increase in sugar content, its retarding efficiency started to decrease, until at certain higher content it showed reverse effects (i.e. it accelerated the cement setting). Furthermore, sugar causes higher retardation when added a few minutes after the mixing of water and cement.

Brooks.J.J et.al [2000] studied the effect of silica fume (SF), metakaolin (MK), fly ash (FA) and ground granulated blast-furnace slag (GGBS) on the setting times of high-strength concrete was investigated using the penetration resistance method (ASTM C 403). In addition, the effect of a shrinkage-reducing admixture (SRA) on the setting times of normal and high-strength concrete was also studied. The setting times of the high strength concrete were generally retarded when the mineral admixtures replaced part of the cement. While the SRA was found to have a negligible effect on the setting times of normal strength concrete, it exhibited a rather significant retarding effect when used in combination with superplasticizer in high-strength concrete. The inclusion of GGBS at replacement levels of 40% and greater resulted in significant retardation in setting times. In general, as replacement levels of the mineral admixtures were increased, there was greater retardation in setting times.

Baskoca.An et.al. [1998] worked on Effect of chemical admixtures on workability and strength properties of prolonged agitated concrete. Lignosulfonate-based water reducer, a dextrin-based water reducer, and a gluconate-based retarder were used in concrete. Workability, compressive strength, flexural strength, and initial & final setting time measurements were carried out for six reference mixtures in which the W/C ratio was kept constant and only admixture dosage varied. Slump loss in gluconate-based retarder and combined lignosulfonate and gluconate mixes was less than those of other mixes. Compressive and flexural strengths of samples taken initially and after different agitation times were determined. The strength change obtained after prolonged agitation was slight but retempering by water to bring the workability to the initial level reduced the strengths; however, the strength loss in gluconate retarder-added mixes was smaller than those of others. The maximum dosages of admixtures proposed by manufacturers were as follows: R:2%, WR1:0.35% and WR2:0.5%, by weight of cement.

III. **CONCLUSIONS**

On the basis of present day study, it can be concluded that the fresh and hardened properties of the concrete and cement will increase on addition of any chemical admixture, used at varying dosages. In other words, quality of the concrete enhances on use of admixtures to it. Furtherrmore, on increasing the admixture dosage, workability, compression strength, flexural strength and other fresh and hardened properties of concrete will improve accordingly thus reducing the cost of overall construction and helps to identify the best type of admixture

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