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A REVIEW ON EFFECT OF DIFFERENT CHEMICAL ADMIXTURES ON HIGH STRENGTH CONCRETE.

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Abstract- In today's developing countries work with concrete is not a big deal but to find various admixtures which will help in improving various properties of concrete is a work to be focused. Mineral and Chemical admixtures are generally used to increase the various properties of concrete. Here various properties of concrete are workability, strength which includes compressive strength, tensile strength and bending strength and durability of concrete. This paper discusses the benefits of using different types of chemical admixtures and their effect on the different properties of concrete. The effect of using chilled water for preparing concrete and the effect of high temperature on the concrete is also discussed in this paper. The admixture is generally added in relatively small quantity ranging from 0.005% to 2% by weight of cement. Over use of admixtures have detrimental effects on the properties of concrete.

Keywords—concrete, high strength concrete, chemical admixtures, strength, mass loss

1. INTRODUCTION

High strength concrete can also be known as superb concrete. Superb concrete is routinely observed as concrete with a 28-day chamber compressive quality more basic than 6000 psi or 42 MPa. This type of concrete proves to be safer than the normal one because it can take load more than the normal concrete. It is vital to decide all benefits and faults that can happen subsequent to utilizing this kind of concrete. Subsequent to concentrate the benefits and negative marks of utilizing this solid we set up the blend plan and discover the strategies for making the solid with high quality. Materials used to deliver the high quality concrete ought to be appropriately checked. Quality tests are performed to check whether the structure blend we have arranged gives the ideal outcomes. It is vital to think about every single fringe aftereffect of choosing high-quality.

1.1 Chemical admixtures

Synthetic admixtures are the fixings in concrete other than Portland cement, water, and total that is added to the blend preceding or amid blending. Makers use admixtures basically to diminish the expense of solid development; to adjust the properties of solidified cement; to guarantee the nature of cement amid blending, transporting, putting, and restoring; and to defeat certain crises amid solid activities.

Fruitful utilization of admixtures relies upon the utilization of proper techniques for clumping and cementing. Most admixtures are provided in prepared to-utilize fluid frame and are added to the solid at the plant or at the jobsite. Certain admixtures, for example, colors, far reaching operators, and siphoning helps are utilized just in to a great degree little sums and are typically clustered by hand from premeasured compartments. The viability of an admixture relies upon a few variables including: type and measure of bond, water content, blending time, droop, and temperatures of the solid and air. Once in a while, impacts like those accomplished through the option of admixtures can be accomplished by modifying the solid blend lessening the water-concrete proportion, including extra bond, utilizing an alternate kind of concrete, or changing the total and total degree.

1.1.1 Uses

- To expand the quality of cement
- To quicken the underlying setting time of cement
- To impede the underlying setting time of cement
- To enhance usefulness of cement
- To expand solidness of cement
- To diminish warmth of hydration
- To make light weight concrete
- To lessen porousness of cement
- To control the salt total extension
- To expand the bond among cement and steel support
- To decrease isolation and seeping of cement
- To deliver hued cement or mortar
- To control the erosion of cement

1.1.2 Adverse effect

- One of the normal plasticizer by and large utilized is lignosulphonic corrosive as calcium or sodium salt. At higher measurements it might cause impediment in setting time.
- Higher measurements of super-plasticizer influence the shrinkage and creep properties of cement.
- Higher dose of plasticizer may cause isolation and untimely solidifying under certain conditions.
- Higher measurement of super-plasticizer may build rate of loss of usefulness.
- Perhaps the most generally utilized retarder is gypsum. Expansion of abundance measure of gypsum may cause bothersome development and inconclusive postponement in setting of cement.
- Excess utilization of quickening agents cause more warmth development and there are odds of breaks in the solid.

1.1.3Chemical admixtures as per IS 9103:1999

- Accelerating admixtures,
- Retarding admixtures,
- Water-reducing admixtures,
- Air-entraining admixtures,
- And Super plasticizing admixtures.

Accelerating Admixture or Accelerator: - An admixture when added to concrete or mortar increases the rate of hydration of hydraulic cement, shortens the time of set, or increases the rate of hardening or strength development.
Retarding Admixture or Retarder**: -** An admixture which delays the setting of cement paste, and hence of mixtures, such as mortar or concrete containing cement.
Water Reducing Admixture or Workability Aid**:-** An admixture which either increases workability of freshly mixed mortar or concrete without increasing water content or maintains workability with a reduced amount of water
Air-Entraining Admixtures:- An admixture for concrete or mortar which causes air to be incorporated in the form of minute bubbles in the concrete or mortar during mixing, usually to increase workability and resistance to freezing and thawing and disruptive action of de-icing salts.
Superplasticizing Admixtures**: -** An admixture for mortar or concrete which imparts very high workability or allows a large decrease in water content for a given workability.

1.2 Difference

1.2.1 Mineral admixture

Mineral admixtures are the fine ground strong materials I.e. Fly cinder, slag and silica smoulder. It is added to the solid for the most part in bigger sum than some other sort. Since mineral admixtures have a capacity to improve functionality and in addition complete capacity of naturally laid cement. Mineral admixtures are additionally used as a substitution of concrete. As bond is the most costly material in cement. Consequently, with the utilization of mineral admixtures diminishing solid expense is likely conceivable.

1.2.2 Chemical admixture

Chemical admixtures are the admixtures that are added to concrete in a little sum for an explicit capacity to concrete. In the event that concoction admixtures are included more than the characterized than it has an extensive variety of negative impacts on the properties of crisp and solidified cement. Substance admixtures are bound to be included as a water lessening admixtures, as a hindering setting time, quickening setting time, as a super plasticizer or included as an air-entrainment.

2. FRESH CONCRETE PROPERTIES

Erdogdu (2004) studied about the effect of retempering with super plasticizer admixtures on slump loss and compressive strength of concrete subjected to prolonged mixing. The admixture used in the investigation was Type F melamine-based superplasticizer with a specific gravity of 1.21 kg/l, which has an extensive use in the construction industry. The present investigation was intended to assess the effect of retempering operation with a super plasticizer on the compressive strength of a concrete subjected to prolongd mixing and compare the result with those obtained from concrete retempering with water. Comparisons were also carried out with respect to reference concrete that was subjected to retempering.
The slump loss of concrete produced with a superplasticizer of 1% by weight of the cement with respect to the elapsed time indicates the very same trend that of the plain concrete does with the exception that the trend of slump loss is a little steep for plain concrete up to 30 min of mixing and then slows down later on. This implies that when prolonged mixing is involved, the time that required for an equal slump for such concretes is about 90 min. Overall, the magnitude of slump loss is quite high for a mixing period of 90 min and it does decrease slightly for longer mixing duration whether admixture is used or not. Whether admixture is used or not, concrete subjected to prolong mixing resulted in rather a quick slump loss up to 90 min of mixing. It is then slowed down beyond that age. This clearly indicates that a mixing period of 90 min seems to be a turning point with regard to proper placement, compaction, and subsequent operations of concrete.

Mohammed *et al.* (2017) Studied the Influence of Chemical Admixtures on Fresh and Hardened Properties of Prolonged Mixed Concrete**.** Different concrete mixtures were prepared using five different types of chemical admixture (one water reducer based on lignosulfonate and four superplasticizers based on sulfonated naphthalene polymer, polycarboxylic ether, second-generation polycarboxylic ether polymer, and organic polymer) and using chilled mixing water. The concrete prepared with sulphonated naphthalene ansd 2nd generation polycarboxylic either polymer show best performance in both hardened and fresh state. The concrete mixture prepared with sulpfonated naphthalene polymer is more workable than others. The second best performance is found by using second generation polycarboxylic either polymer. Performance of concrete with superplasticizer was better in comparison with the water reducers. Also concrete with chemical admixture have more performance than concrete without chemical admixture. Concrete remain workable for longer duration when the dosage of admixture was increased. Concrete would remain workable for longer duration when the dosage of admixture is applied in two stage instead of applying the entire dosage at the beginning of mixing.

Maanser *et al*. (2018) studied the effect of high temperature on strength and mass loss of admixture concretes**.** The admixtured concretes may present different behaviour at high temperature than at normal conditions. In this study, five different types of chemical admixtures – Superplasticizers (SP), hardening accelerators (HA), setting retarders (SR), air entrainers (AE) and water repellents (WR) – Were incorporated with different fraction of cement mass (0.5, 1.0, 1.5 and 2.0%), to investigate their influences on the strength and mass losses of concretes under high temperature. This study concerns the behaviour of admixtured concretes at ambient temperature 20C (normal conditions) and those subjected to temperatures 105C (oven dry) and 300C with a rate of 2C/min. The incorporation of admixtures into concrete resulted in modification of the workability, depending on dosage and chemical properties. Increase of the slump was proportional to dosage, except for HAC admixture concrete for which there was a slight decrease of the slump. Maximum values occur at the maximum dosage. All concretes showed greater slump than the control concretes except the concretes HAC and WRC.

1. HARDENED CONCRETE PROPERTIES

2.1 Compressive strength

Erdogdu (2004) studied about the effect of retempering with super plasticizer admixtures on slump loss and compressive strength of concrete subjected to prolonged mixing. The strength of concrete with no retempering revealed a slight increase even for a rather long mixing period of 150 min. The reason for this is preferably attributed to the reduced air content in addition to the esteemed effect of proper placement and compaction of concrete. The strength of concrete retempered with water decreased considerably with mixing time. The reduction is rather sharp for up to 90 min of mixing and then a slight decrease is observed later on. At the end of 150 min of mixing, a strength loss of over 40% is observed with regard to the initial strength of concrete. The strength gain of concrete retempered with superplasticizer for a mixing duration of 90 min is about 30% with respect to the initial strength of concrete and it is slightly over 10% compared to the strength of reference concrete, corresponding to the same mixing duration. The decrease in the strength observed beyond 90 min of mixing implies that mixing duration longer than 90 min causes a considerable strength loss due to the possible existence of bleeding and segregation even when a superplasticizer admixture is used for retempering.. Overall, there is a strong relationship between the water used for retempering and the strength loss of concrete. The relationship is quite straight forward a water addition of 30 kg/m^3 to the concrete mixture to restore the initial slump of 19 cm resulted in a strength loss of slightly over 30% with respect to its initial strength.

Mohammed *et al.* (2017) studied the Influence of Chemical Admixtures on Fresh and Hardened Properties of Prolonged Mixed Concrete. In all cases, concretes with chemical admixtures resulted in higher compressive strengths compared to the concrete without chemical admixture. Concretes with sulfonated naphthalene polymer based SP1 and second-generation polycarboxylic ether based SP3 exhibited better hardened performances in comparison with the concretes with other types of chemical admixture. Concretes with lignosulfonate-based water reducer WR exhibited lower compressive strengths concretes with superplasticizers.
For all types of chemical admixture it is indicates that the hardened performance of concrete would improve when the dosage of admixture is increased. It can be inferred that the hardened performance of a concrete having dosage of chemical admixture applied at the beginning would be better compared to the concrete having dosage of chemical admixture applied in two stages. Results show that the 28-day compressive strengths of concrete are almost similar to those of prepared with chilled water concrete. So, the 28-day hardened properties of concrete did not change significantly
when chilled water was used instead of plain water.

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Table1 Evolution of the strength of concrete with temperature (MPa) Maanser *et al.*2018]

Admixture concrete							
T^0C	C.C	Dosage	SRC	HAC	SPC	WRC	AEC
20	32.20	0.5	32.32	29.63	36.95	31.95	22.70
105	31.55		31.42	29.16	36.17	31.02	22.30
300	31.39		30.85	28.82	35.98	30.64	22.03
20	32.20	1.0	34.53	30.35	38.45	32.13	21.95
105	31.55		33.23	30.05	37.95	31.20	21.41
300	31.39		32.73	29.71	37.63	30.85	21.29
20	32.20	1.5	35.95	31.94	40.16	32.07	20.30
105	31.55		34.67	31.32	39.52	32.31	19.98
300	31.39		34.31	31.13	39.42	31.92	19.68
20	32.20	2.0	36.72	28.36	43.06	33.95	18.74
105	31.55		35.77	28.09	42,45	33.11	17.78
300	31.39		35.42	29.85	42.28	32.76	17.11

Baskoca *et al*. (1998) studied the effect of chemical admixtures on workability and strength of prolonged agitated concrete. A lignosulfonate-based water reducer, a dextrin-based water reducer, and a gluconate-based retarder were used in concretes.
The following mixes were prepared:

1. Reference mix 1: Initially contained no admixture and 1 1⁄2h later gluconate based R in 2% was added.

2. Reference mix 2: 10% increased cement and water contents, no admixture.

3. Mix with gluconate based R in 1%.

4. Mix with gluconate based R in 2%.

5. Mix with dextrin based WR.

6. Mix prepared initially with lignosulfonate based WR, and after 1 1⁄2h agitation gluconate R in 2% was added.

Initial $1^{1/2}$ h agitation caused 7.7% reduction in strength for Reference mix 1, while, on the contrary the same period of mixing increased the strength 7% for the Reference mix 2. (with incrased cement and water content). One percent gluconate R mix showed almost no change in strength after 4 h agitation. When the dosage was doubled for the same admixture, even after 6 h extended mixing, strength loss was less than 5%. The mix, which had initially WR2 and $1^{1/2}$ h later gluconate R added, gave the best result with respect to strength, i.e., after $6^{3/4}$ h agitation the increase obtained in strength was as much as 18%. When the same retarder after 1 $^{1/2}$ h agitation time was added to the mix that contained no admixture initially, further agitation up to $4^{3/4}$ h caused 13% reduction in strength. On the other hand, the dextrin WR mix showed a slight increase (3.6%) after agitation of 4 h. Retempering of Reference mix 2 to restore the initial slump caused only 5% reduction in strength, indicating that the added water after $1^{1/2}$ h agitation was not greater than the evaporated water during mixing. This period of time coincides with the limit given in ASTM C94. For 1% gluconate R mix, retempering after 4 h agitation caused the greatest strength loss among the mixes tested, as much as 35%; however, when the same retarder was used in double dosage, the reduction in strength was less than 13% even after the agitation time of 6 h, because the amount of retempering water for the latter mix was smaller than that of the former. When the same retarder was added to the mix that had initially had WR and was mixed for $1^{1/2}$ h, the result was even better, and the strength loss was only 1% after 28-days compressive strengths normalized by those of initially taken samples.

2.2 Flexural strength

Baskoca *et al*. (1998) studied the effect of chemical admixtures on workability and strength of prolonged agitated concrete. The results show that $1^{1/2}$ h agitation increased the flexural strengths of both Reference mix 1 and 2 as well as that of the mix which had initially WR2 and later gluconate R added. The same period of agitation, on the other hand, reduced the strengths of gluconate R mixes in both 1% and 2% dosages, as well as of the one with dextrin based WR. However, for the latter mix further agitation up to 4 h increased the strength over the initial value. The prolonged agitation reduced the strengths of gluconate R mixes, in both dosages, about the same percentage, i.e. 9%, of which mixing times were 4 h for the former and 6 h for the latter.

2.3 Mass loss

Maanser *et al* (2018) study the effect of high temperature on strength and mass loss of admixture concretes. Increasing the temperature up to 105^0C causes the accessible open water to evacuate, causing a loss of mass. All of the concretes exhibited a loss of mass from an ambient temperature to 105^0C and then to 300^0C. The mass losses for control concrete at 105^0C and 300^0C were 3.32% and 5.53%, respectively. The concrete admixtured by the superplasticizer (SPC) exhibits the lowest mass losses of the four admixture dosages, which confirms the results of the resistances. These losses at temperatures of 105^0C and 300^0C are 2.40% and 4.18%, respectively, and they are obtained by the maximum dosage of 2.The hardening accelerator (HA) leads to greater losses than those of the control concrete. The most important losses are obtained by the concrete added by air entrainer. The highest losses at 105^0C and 300^0C are 5.49% and 10%, respectively, for the maximum dosage (2%).

3. CONCLUSION

1. The concrete mixture prepared with Sulphonated Napthalene Polymer are more workable than those prepared with Polycarboxylic either and Second generation Polycarboxylic Either.
2. Performance of concrete with superplasticizer was better in comparison with the water reducers.
3. The workability, compressive strength and tensile strength shows better results by increasing the dosage of chemical admixtures within the limits.
4. Concrete would remain workable for longer duration when the dosage of chemical admixture is applied in two stages instead of applying the entire dosage at the beginning of mixing but the compressive strength and the tensile strength results were lower than that adding the entire chemical admixture at the beginning.
5. The most harmful admixture for the strength is the air entrainers type of admixture.
6. The mass of a concrete decreases slowly as the temperature increases from ambient to 105^0C and from 105^0C to 300^0C the mass of a concrete increases rapidly.
7. The compressive strength is high in case of retempering withhold water and is maximum in this case, While the compressive strength decreases in case of retempering with superplasticizer, the compressive strength is least in case of retempering with water.
8. The temperature of water plays an important role in concrete use of chilled water in concrete improves the workability of the concrete but the early compressive strength of the concrete decreases however the long term strength of the concrete improves.

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