Sugarcane Molasses As An Admixture In Concrete

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Abstract— The production cost of concrete we use in construction is very high so we use different methodology to bring down the high prices for example we use different type of admixtures to change the properties of concrete the admixture can be retarders as well as accelerator. There are so many admixtures which can be used from ancient but in this project we can study the use molasses in the concrete. The admixture are used to bring special properties to the fresh or hardened concrete; these special properties are related to the reduction of water consumption, increased resistance to compression or extension of the setting time, and others, they also can improve the durability, workability and to increase strength of a concrete mixture and also is used to overcome difficulties in situations construction like as casts in hot or cold weather, pumping of concrete, early strength requirements or specifications of a water/cement ratio very less. Considering these advantages, this study aims to give idea about the viability of molasses as admixture in cement paste and concrete.

KEYWORDS: High strength concrete, admixture, cost.

I. INTRODUCTION

Cement concrete is probably the most widely used construction material in the world. The reason for its widely use is that it offers good workability and can be moulded in any shape.

Concrete consumption is everywhere 10 billion tons per year, which is similar to 1 ton per every living person. Production of Cement and Steel has environmental hazards due to emission of CO_2 and dust particles in the atmosphere. Hence prudent use of cement and steel has different economic and environmental impacts.

Plain concrete is a hard material. Under impact and dynamic loading plain concrete shows extensive cracking and undergoes hard failure. The concrete is weak in tension and hence to overcome this problem cement concrete is reinforced using steel bars and thus called as reinforced cement concrete (R.C.C.) In this modern age, civil engineering constructions have their own structural and durability requirements. Every structure has its own intended purpose and hence to meet this purpose, modification in traditional cement concrete has become compulsory.

Definition of Concrete

"Concrete is obtained by mixing cementing materials, water and aggregate, and sometimes admixture in required proportion."

"The most widely used construction material is concrete, commonly made by mixing Portland cement with sand, crushed rock, and water."[2]

"The concrete has to be satisfactory in its hardened state and also in its fresh state while being transported from the mixer and placed in formwork."[3]

Admixture - General Consideration

Admixture is the material used in the concrete for modifying one or more of its properties in the plastic or hardened state of the concrete. Instead of using special cement for particular purpose, the use of admixture is beneficial for achieving the desired effect. As the cement is most expensive ingredient in concrete mix the use of admixture makes the construction work economical.

Definition of Admixture

"Admixture are the chemical compound in concrete other than hydraulic cement (OPC), water and aggregates, mineral additives that are added to the concrete mix immediately before or during mixing to modify one or more of the specific properties of concrete in fresh or hardened state."[1]

"ASTMC 125 defines an admixture as a material other than water, aggregates, hydraulic cements, and fiber reinforcement that is used as an ingredient of concrete or and added to the batch immediately before or during mixing."[2]

"An Admixture can be defined as a chemical product which, except in special cases, is added to the concrete mix in quantities no larger than 5% by mass of cement during an additional mixing operation prior to the placing of concrete, for the achieving a specific modification, or modifications, to the normal properties of concrete."[3]

"Admixture is defined as a material, other than cement, water and aggregates that is used as an ingredient of concrete and is added to the batch immediately before or during mixing."[4]

Necessity of Admixtures

The concrete should be effective, finishable, strong, tough, waterproof, and wear resistant. These qualities can regularly be obtained easily and economically by the selection of proper admixtures.

The major reasons for using admixtures are:

1. To decrease the cost of concrete construction.
2. To accomplish certain properties in concrete more efficiently than by other means.
3. To maintain the quality of concrete during the stages of mixing, transporting, placing, and curing in adverse weather conditions.
4. To overcome certain emergencies during concreting Operations.
5. To accelerate the rate of strength development at early stage.
6. To increase bonding between concrete and steel.
7. To increase the bond between existing concrete and new concrete.

II. MATERIALS AND METHODS

Materials

1.Cement:

Cement is a material, usually in powdered form that can be made into a paste usually by accumulation of water and, when moulded or poured, will set into a solid mass. Numerous carbon-based compounds used for observing, or fastening materials, are called cements, but these are confidential as adhesives, and the term cement unaccompanied means a construction material.

2. Fine aggregates

The sand used in this present study is ordinary river sand. The sand passing through 4.75 mm size sieve is used in the preparation of concrete mix. The sand confirms to grading Zone II as per IS: 383-1970.The properties of sand such as fineness modulus and specific gravity were determined as per IS: 2386-1963. The specific gravity of fine aggregate is found to be 2.63. The water absorption is 0.5%. The bulk density of fine aggregate in loose and compact state is 1579 kg/m3 and 1689 kg/m3 respectively

3. Coarse aggregates

The coarse aggregate used in this present study is 20 mm down size locally available crushed stone obtained from local quarries. The physical properties have been determined as per IS: 2386-1963. The specific gravity of coarse aggregate is found to be 2.65. The water absorption is 0.25%. The bulk density of coarse aggregate in loose and compact state is 1471 kg/m3 and 1565 kg/m3 respectively. The hardened concrete tests proposed for the project were compressive strength and indirect tensile tests, modulus of rupture and elasticity and the skid resistance test. This testing includes determining the void ratio and calculating the permeability of the previous concrete.

4. Water

Water for drinking is generally considered fit for making concrete. Water should be free from acids, oils, alkalies, vegetables or other organic impurities. Soft waters also produce weaker concrete. Water has two functions in a concrete mix. Firstly it reacts chemically with the cement to form a cement paste in which the inert aggregates are held in suspension until the cement paste is hardened. Secondly, it serves as a vehicle or lubricant in the mixture of fine aggregates and cement.

5. Admixture – Sugarcane Molassses

Sample collection

Sugarcane molasses which is going to be used as an admixture for concrete is collected from the following sugar factory.

Factory Name : Vighnahar Sahakari Sakhar Karkhana Ltd.
Addres :At-shirauli,Po-junnar Tal-junnar Dist-pune.
Status : Cooperative
Guide : Prof- Gadekar.P.B

compressive strength

The compressive strength tests are conducted to ensure a maximum strength is achieved by the concrete mix. Casted cylinder and cube testing are methods of determining the compressive strength of the prepared concrete. The cylinder testing is as per an Australian Standard for testing compressive strength, while cube testing is as per an British Standard. Both methods of determining compressive strength will be used as it may be easy to achieve a good result when using the cylinders and cubes.

The cube test, due to the method by which it is implemented, should give a more stable test specimen than the cylinders. This test will determine the strength of the concrete sample along the entire length of the sample and eliminate problems occurred with the edge aggregate dislodging or failing. The cube method usually determines a concrete strength increased by 10 and 40 percent in comparison to the equivalent cylinder test.

Determination of initial setting time:

1. Place this mould together with the non-porous plate under the rod bearing the initial setting time needle. Adjust the needle so that it touches the surface of test block.
2. Release needle quickly allowing it to sink in the cement paste in the mould. Note down the penetration of the needle in the paste.
3. Repeat this procedure after every 2 minutes until the needle fails to penetrate the block up to about 33 to 35mm from the top of block.
4. Note the time shown by the stop watch at this instant, as Initial setting time.

Determination of final setting time:

1. Replace the needle of Vicat's apparatus by the needle with an annular attachment.
2. Apply the needle gently to the surface of the test block. Repeat this procedure, until the needle makes an impression while the attachment fails.

Note the time shown by the stop watch at this instant, as Final setting time.

Slump test

The slump test is a method of testing the fresh concrete for calculating the workability of concrete which is prepared. It is a simple method of determining if different batches of concrete are the same. This is determined if the same constituents in the same proportions do not vary the characteristics of the concrete sample.

The slump is determined by filling concrete in a slump cone with fresh concrete in three layers. For each layer tamping is done 25 times by tamping rod. The slump cone is removed and the vertical subsidence of the fresh concrete sample is measured. Pervious concrete has very little cohesion due to its structure and may collapse on removal of the cone resulting in a poor result with little value.

III. MATH AND EQUATION

Concrete Mix Design

Characteristic strength of concrete = 20 N/mm^2
Expected slump = 60 - 180 mm
Uncrushed aggregate = 20 mm
Cement type = Ordinary Portland Cement (OPC)
Age of loading = 7, 14 and 28 days

A. Determine the target mean strength

$$Fm = Fc + Ks$$

Where,
s = standard deviation (Figure 1 in the appendix)
Fm = target mean strength
Fc = characteristic strength (as specified)
K = Constant depending on the defective level associate
The specified strength (1.64 in this case)

Therefore:

$$Fm = Fc + 1.64s$$

Adopted standard deviation = 8 (more than 20 test samples)

$$Fm = 20 + (1.64 \times 8) = 33.12 \text{ N/mm}^2$$

B. Determination of water-cement ratio

Water-cement ratio = 0.5

C. Determination of free water content

Specific gravity of aggregates = 2.65
Wet density of normal concrete = 2600 kg/m^3
Free water-content = 225 kg/m^3

D. Determination of cement content

W/c ratio = 0.5
Water content = 225 kg/m^3
Cement content = 225/0.5 = 450 kg/m^3

E. Determination of total aggregate content

Total aggregate content = wet concrete mix density – (free water content + cement content)
= 2600 kg/m^3 – (225 + 450) kg/m^3
= 1925 kg/m^3

F. Determination of coarse and fine aggregate content

Free water/cement ratio = 0.5
Proportion of fine aggregates = 33 %
= 33/100 x 1925 = 635.25 ≈ 640 kg/m^3
Coarse aggregate = (1925 – 640) kg/m^3 = 1289 ≈ 1300 kg/m^3

G. Quantity of Constituents

No of cubes to be cast = 36
Volume of cube (each) = 150mm x 150mm x 150mm = 3,375,000 mm^3
Total volume = 3,375,000 x 36
= 121,500,000 mm^3 (equal to 0.1215 m^3)
Total batch volume = 0.1215 m^3

H. Total required constituents

Including wastage (10%) = 1.1 x 0.1215 m^3 = 0.13365 ≈ 0.140 m^3
Volume of constituents = Calculated amount (kg/m^3) x 0.140 m^3 required volume of constituents

Table 3.6 – Total Required Constituents

Constituent	Volume (kg/m3)	Weight (kg)
Cement	450	63
Fine Aggregate	640	89.6
Coarse Aggregate	1300	182
Water	225	31.5

A. Abbreviations and Acronyms

s = standard deviation (Figure 1 in the appendix)
Fm = target mean strength
Fc = characteristic strength (as specified)
K = Constant depending on the defective level associate

B. Equations

$$Fm = Fc + Ks$$

Scope of the work:

1. By using molasses as an admixture in concrete it will enhance the initial and final setting time of the concrete.
2. The workability and compressive strength of concrete is also increased when molasses is used as admixture in composition of concrete.
3. The binding properties of molasses will reduce the water content in concrete mix to enhance the properties of concrete.
4. In urban areas where the construction is mainly carried out by masons with their experience. They can also use the molasses as this can easily available in the market and they are well known to the masons. Being cheaper in cost it can be used in low budget construction
5. .At present, molasses are used as raw material in ethyl alcohol distilleries. This distilleries are having high polluting potential. If we utilize some quantity of molasses as an admixture in concrete, it will release some burden on environment. We can consider sugarcane molasses as 'Eco-admixture' in concrete

IV. Conclusion

1. Molasses are effective on retarding of setting times. The high retarding effect should be taken into consideration of molasses concrete.
2. Molasses used as admixture increase the workability
3. Molasses enhance the compressive strength
4. Using molasses will delay initial and final setting time
5. Bleeding and segregation in concrete is very less by using molasses as an admixture.

V. Acknowledgment

We have a great pleasure to express my deep sense of gratitude and sincere regards to our guide Pro. Gadekar P.B. for her guidance and friendly discussion which helped us immensely in selecting this topic. Her generous encouragement throughout our dissertation work helped us in completing this seminar work.

We would like to thank our Head of Civil Engineering Department Prof. Nagargoje S. M. for allowing us to do this Seminar. He has immensely helped in providing all opportunities and facilities for the seminar work.

We would also like to thank Principal Prof. Jadhavar B. R. Jaihind college of Engineering and Technology, for providing all facilities at the right period of time. We are thankful to all the faculty members of Civil Engineering and library staff for helping us in this work.

Finally, we would like to thank all those who directly or indirectly helped us during my work.

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