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Research Article

EFFECT OF MOLASSES IN CONCRETE AS A WATER REDUCING AND TIME RETARDING ADMIXTURE

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ABSTRACT

Molasses is a by-product recovered from the sugar refining process, due to molasses increases the fluidity of fresh concrete and also delays the hardening time of cement paste. In this study the molasses were determined from sugar production factories. Setting times of concrete prepared with molasses at three different dosage (0.40, 0.60, and 0.80 wt. % of cement content) were determined and it was found that molasses addition causes a considerable increase in both initial and final setting time. Also treated waste water used in concrete with different dosages of molasses (0.40, .60, and 0.80 wt. % of cement content) were determined and it was found that no harmful effect on the strength although the strength near about same slight increase. High performance concrete is prepared with molasses of different dosage (0.4, 0.6, and 0.8 wt. % of cement content) in this case also found that molasses of addition cause a considerable increase in both initial and final setting times. Workability test was carried out on fresh concrete prepared with three molasses. Compressive strength test are carried on (7, 14, and 28 days) prepared block and on hardening concrete (28 days) flexural, split test carried out. The strength of concrete with molasses showed slight increase at all ages, except early age, with respect to the control mix.

INTRODUCTION

Nowadays in civil industry concrete is widely used for construction. But in certain situation concrete can be used in all places because of its setting time. So that retarders are used in the concrete composition to improve the setting time with different type of admixtures. In this context we will try to use sugar industry by- the product of molasses in the concrete as a water reducing and time retarding admixture.

Molasses can be produced from sugar beet and sugarcane; it is the waste floating on the surface of boiling sugar juice during the processes of production of sugar is taken. When sugar is extracting from the sugar juice some amount of sugar is remain the waste liquid material which is called as molasses, and sugar includes carbohydrates and functions as a retarder. So much molasses slow down the hydration process in cement. This phenomenon increases the setting time of the concrete mix, along the quality of water added to concrete.

Therefore large-scale admixture replacement in concrete by molasses will be highly advantageous from standpoint of cost, economy, energy efficiency, durability and overall ecological and environmental benefits. Due to the existence of sugar in molasses its shows retarding setting time in fresh concrete.

Molasses consist of Dry 76-84% (including sucrose 46-51%) reducing substances 1-2.5%, raffinose 0.8-1.2%, inverted sugar 0.2-1.0%, volatile acids 1.2%, pigments 4-8%, and ash 6-10%.

Fig 1 sample of sugar and sugar cane

Objectives

1. To study the waste material (molasses) used in concrete in the concern of environment.
2. To study the effect of strength on concrete by using different percentage dosages of molasses (0.4%, 0.6% and 0.8%) with distilled water.
3. To study the effect of strength on concrete by using different percentage dosages of molasses (0.4%, 0.6% and 0.8%) with treated waste water.

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4. To study the effect of molasses on workability of concrete.
5. To study the compressive strength, splitting tensile strength, flexural strength & workability of concrete using molasses.
6. To study the comparison between the grade of concrete M30 & M60 using molasses in concrete.

MATERIALS AND METHODOLOGY

Materials

Cement

Ordinary Portland cement 53 grade was used.

The test were carried out according to the IS-456-2000 standard.

Aggregate

Fine aggregates

Those fraction from 4.75mm to 150micron are termed as fine aggregate. The river sand and crushed sand is being used as fine aggregate conforming to the requirements of IS: 383.

Coarse aggregate

The fractions from 20mm to 4.75mm are used as coarse aggregate. The coarse aggregates from 10mm & 20mm are used conforming to IS: 383 is being used.

Water

Portable water is used for mixing and curing as per IS 456:2000. From durability consideration, water cement ratio should be restricted as in case of normal concrete and it should preferably be less than 0.45.We used treated wastewater replacement by distilled water.

Description of molasses

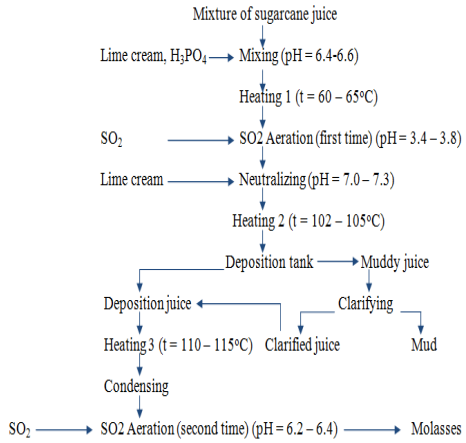
The boiling of the sugar syrup yield dark, viscous blackstrap molasses, known for its robust flavor. The majority of sucrose from the original juice has been crystallised and removed. The calorific content of blackstrap molasses is mostly due to the small remaining sugars, it contains significant amounts of vitamin B6 and minerals, including calcium, magnesium, iron, and manganese.

Table 1 shows material and nutritional value

Sr.no	Material	Nutritional value per 100g
1	Calcium	21%
2	iron	36%
3	Magnesium	68%
4	Manganese	73%
5	Phosphorus	4%
6	Potassium	31%
7	Zinc	3%

Fig 2 Image of Sample of Molasses

Molasses sample was collected from a sugar factory at shrigonda. The production process of molasses is mention below flowchart.



Flowchart of making molasses

METHODOLOGY

Conventional block

These block with specifications prepared to analyze experimentally with normal concrete of grade M30 & M60 by adopting conventional methods of the design according to IS 456:2000 & IS 10262:2009.

Concrete mixes with varying percentage of molasses in block

These block with specifications prepared to analyze experimentally with the percentage of Molasses 0.4%, 0.6%, 0.8% mix with concrete of grade M30 & M60 by adopting the design according to the design according to IS 456:2000 & IS 10262:2009.

Concrete mixes with varying percentage of molasses with treated waste water in block

These block with specifications prepared to analyze experimentally with the percentage of molasses 0.4%, 0.6%, 0.8% mix with concrete of grade M30 & M60 by adopting the design according to IS 456:2000 to IS 10262:2009.

Casted specimen

Cube moulds

The mould used is of 150mm x 150mm x 150mm size conforming to IS: 10086-1982. In assembling the mould for use, the joints between the sections of mould was thinly coated with mould oil and a similar coating of mould oil was applied to the contact surfaces of the bottom of the mould and the base plate in order to ensure that no water escapes during the filling. The interior surfaces of the assembled mould were thinly coated with mould oil to prevent adhesion of the concrete.

Cylinders

The cylindrical mould used are of size 150mm diameter and 300mm height conforming to IS: 10086-1982. The mould and base plate was coated with a thin film of mould oil before use, in order to prevent adhesion of the concrete.

Beams

The beam moulds used are of size 150mm x 150mm x 1000mm conforming to IS: 10086-1982. Used for making cement concrete prisms or bars of the square cross-section for the flexural strength test. Inside faces are machined flat to within + 0.02mm tolerance and inside dimensions are accurate to + 0.2mm made of caste iron or steel, supplied complete with the base plate.

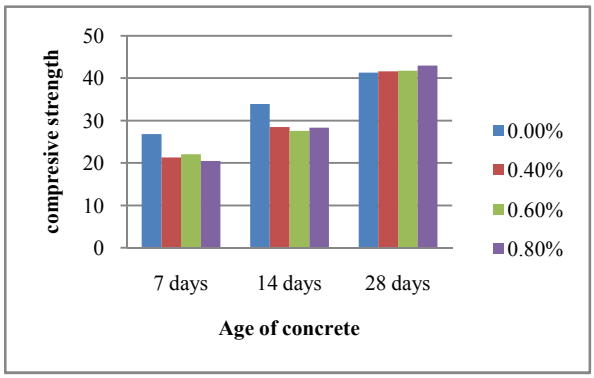
Experimental Procedure

Compressive strength test

The test was carried out as per I: 516-1959. Compressive strength tests were performed on cube samples using compression testing machine. Three samples per batch were tested with the average strength values reported in the table.

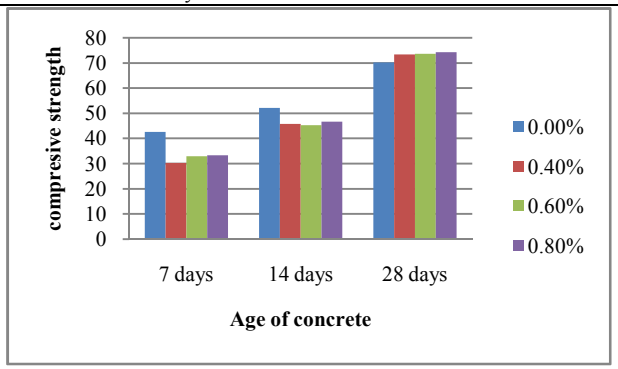
For M30 grade of concrete using molasses

Specimen	No. of days	0%	0.4%	0.6%	0.8%
Cube	7 days	26.82	21.33	22.07	20.44
	14 days	33.92	28.44	27.55	28.29
	28 days	41.33	41.63	41.77	42.96



For or M60 grade of concrete using molasses

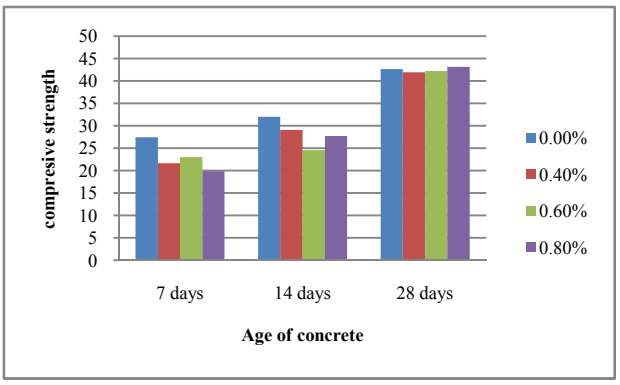
Specimen	No. of days	0%	0.4%	0.6%	0.8%
block	7 days	42.67	30.22	32.88	33.33
	14 days	52.11	45.77	45.33	46.67
	28 days	70.22	73.33	73.67	74.22



Treated waste water used in concrete with molasses

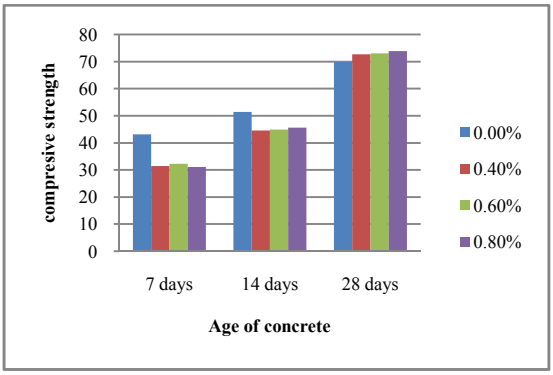
For M30 grade of concrete using molasses with treated waste water

Specimen	No. of days	0%	0.4%	0.6%	0.8%
Cube	7 days	27.41	21.63	23.03	19.85
	14 days	31.99	29.04	24.59	27.70
	28 days	42.66	41.96	42.22	43.11



For M60 grade of concrete using molasses with treated waste water

Specimen	No. day	0%	0.4%	0.6%	0.8%
Cube	7days	43.12	31.42	32.26	31.02
	14days	51.36	44.54	44.91	45.57
	28days	69.86	72.68	73.06	73.86



Splitting tensile strength

1. Splitting tensile tests were performed on the cylindrical specimen.
2. Three samples per batch were tested with the average strength values.
3. The measured splitting tensile strength fc, of the specimen, shall be calculated to the nearest 0.05 N/mm^2 using the following formula:

$$fct = \frac{2P}{\pi ld}$$

Where,
P= maximum load in Newton's applied to the specimen,
I= length of the specimen and
d= cross-sectional dimension of the specimen

For M30 grade of concrete using molasses

Specimen	No. of days	0%	0.4%	0.6%	0.8%
Cylinder	28 days	2.163	2.24	2.45	2.75

For M60 grade of concrete using molasses

Specimen	No. of days	0%	0.4%	0.6%	0.8%
Cylinder	28 days	4.90	4.97	5.03	5.24

For M30 grade of concrete using molasses with treated waste water

Specimen	No. of days	0%	0.4%	0.6%	0.8%
Cylinder	28 days	2.23	2.46	2.58	2.96

For M60 grade of concrete using molasses with treated waste water

Specimen	No. of day	0%	0.4%	0.6%	0.8%
Cylinder	28 days	4.97	3.85	4.65	5.60

Strength

1. Flexural strength tests were performed on a flexural testing machine having 100KN capacity using beam specimen.
2. Three samples per batch were tested with the average strength values reported in the table.
3. The flexural strength of the specimen shall be expressed as the modulus of rupture, which, if 'a' equals the distance between the line of fracture and the nearer support, measured on the centerline of the tensile side of the specimen, in cm, shall be calculated to the nearest 0.5kg/cm^2 as follows:

$$fb = \frac{pl}{bd^2}$$

When 'a' is greater than 20.0cm for 15.0cm specimen, or greater than 13.3cm for a 10.0cm specimen, or

$$fb = \frac{3pa}{bd^2}$$

When 'a' is less than 20.0cm but greater than 17.0cm for 15.0cm specimen or less than 13.3cm but greater than 11.0cm specimen.

Where,
B= Measured width in cm of the specimen,
D= Measured depth in cm of the specimen ay the point of failure,
L=length in cm of the span on which the specimen was supported, and
P= maximum load in kg applied to the specimen.
If 'a' is less than 17.0cm for a 15.0cm specimen, or less

Than 11.0cm for a 10.0cm specimen, the results of the test shall be discarded.

For M30 grade of concrete using molasses

Specimen	No. of days	0%	0.4%	0.6%	0.8%
Beam	28 days	12.62	12.48	13.23	13.28

For M60 grade of concrete using molasses

Specimen	No. of days	0%	0.4%	0.6%	0.8%
Beam	28 days	16.33	16.83	17.28	17.33

For M30 grade of concrete using molasses with treated waste water

Specimen	No. of days	0%	0.4%	0.6%	0.8%
Beam	28 days	12.88	13.27	13.67	13.63

For M60 grade of concrete using molasses with treated waste water

Specimen	No. of days	0%	0.4%	0.6%	0.8%
Beam	28 days	16.78	17.38	17.33	17.66

RESULT AND DISSCUSSION

Workability test

Concrete has been prepared with the addition of three different dosages with three different percentages as 0.4%, 0.6% and 0.8%. Based on the experimental results, as the percentage of admixtures increased, consequently, slump also increased. The addition of molasses to the concrete greatly influenced the setting properly and clear collapse of slum witnessed during the experimentation. The setting of cube specimens after 24hrs was difficult. During the demoulding after 24hrs, cube specimens were exhibit cracks. So, demoulding of specimens carried out after 48hrs for 0.4% and above. So, the concentration of molasses is reducing by adding 50% of water. After reduce the concentration of molasses in concrete is more feasible. The basic reason for extending the setting of time slow down the hydration process. But during the testing of slump value, it was clearly observed that collapse of slump, when molasses added at a dosage of 0.4%, 0.6% and 0.8%.

Fig 3 Slump cone and collapse of concrete after lifting

DISCUSSION

Molasses used in concrete the initial and final setting time of this concrete is an increase. subsequently, the compressive strength of the concrete also slightly increases in all ages except early days. When treated waste water is used along with the molasses in concrete then on the strength no any abrupt negative impact. This compressive strength result is same for the high-performance concrete.

In the split and flexural test also slightly increase at 28 days even after using treated waste water in the concrete also shows slightly increase in strength. so that in this experiment found that the treated waste water is using suitable for the concrete.

CONCLUSION

1. The concrete prepared with molasses show a slight increase in compressive strength at all ages.
2. Workability increased when the dosage of admixture was increased.
3. The setting time of the concrete increased as the dosage of admixture was increased.
4. Low cost and environment-friendly concrete can be produced by using molasses.
5. Concrete cost can be reduced by using molasses that also provides a green production.
6. The molasses-added cement pastes show expanded setting times even in 0.4% dosage, and the higher the molasses dosage, the longer the setting time.
7. According to this result it's clear that molasses have water reducing and retarding effect on concrete, to use molasses as water reducing and retarding mixture.

Acknowledgment

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