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RESEARCH ARTICLE

USING MOLASSES IN CONCRETE AS A 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 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 causes considerable increase in both initial and final setting times. Workability test were carried out on fresh concrete prepared with three molasses. Compressive strength test was carried on (7, 14, and 28 days) prepared block and on harden concrete (28 days) flexural, split test carried out. The strength of concrete with molasses showed slight increase at all duration of curing, except early age, with respect to the control mix.

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Introduction:-

Now a days 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- 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 include 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 existence

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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. Study of various issues in concrete technology and environment factor.
2. Study of how to use waste material in the concern of environment.
3. Chemical treatment of waste water that will be used for concrete ix easily.
4. Preparation and testing of concrete.
5. Evaluate the result and compare it.

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 use.

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 waste water 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%

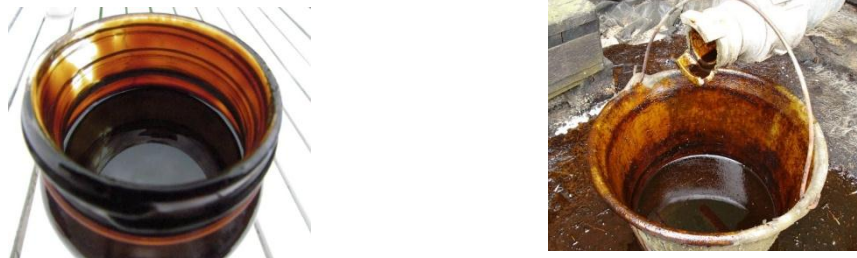
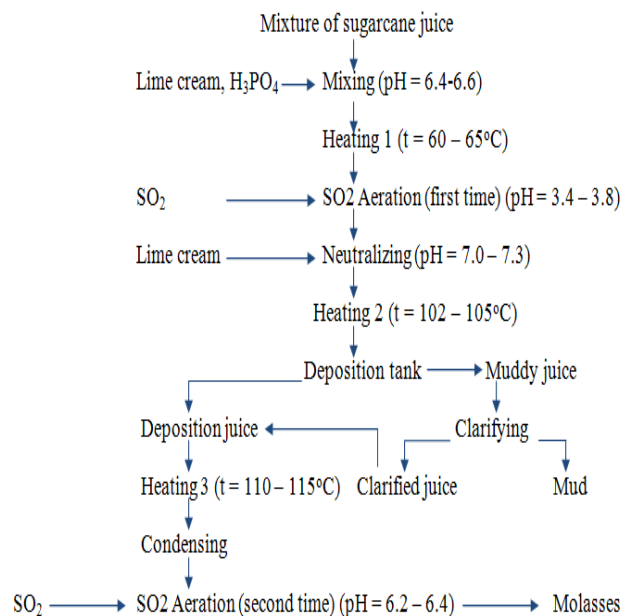


Fig 2:-Image of Sample of Molasses

Molasses sample was collected from a sugar factory at shrigonda. 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 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 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 & 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 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 are 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 between 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 assemble 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:-

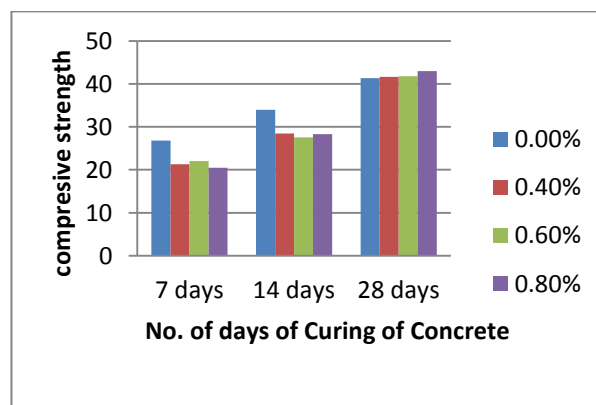
The beam moulds used are of size 150mm x 150mm x 150mm x 700mm conforming to IS: 10086-1982. Used for making cement concrete prisms or bars of square cross-section for flexural strength test. Inside faces are machined flat to within + 0.02mm tolerance and inside dimensions are accurate to + 0.2mm made of caste iron or steel, supplied complete with 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 table.

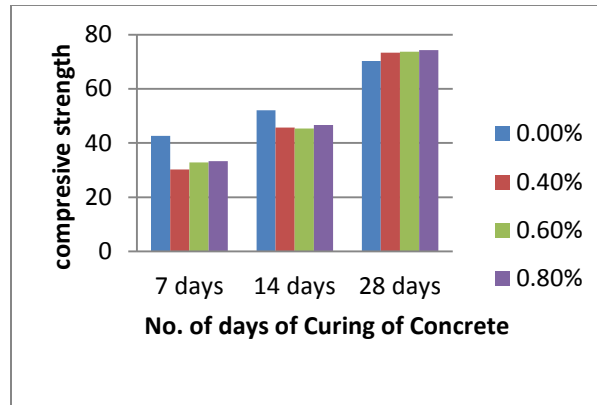
For M30 grade of concrete using molasses

Specimen	No. of days of curing	0% molasses	0.4% molasses	0.6% molasses	0.8% molasses
Block	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



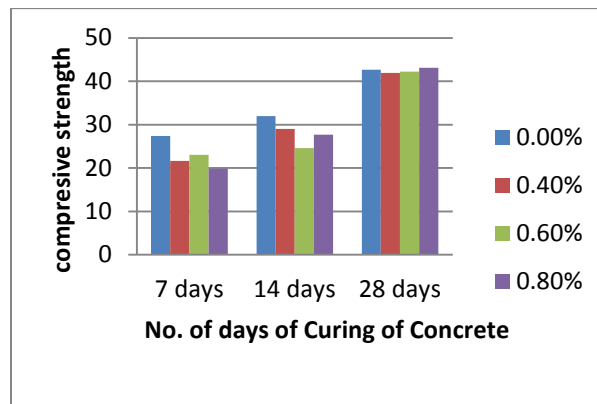
For or M60 grade of concrete using molasses

Specimen	No. of days of curing	0% molasses	0.4% molasses	0.6% molasses	0.8% molasses
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 of curing	0% molasses	0.4% molasses	0.6% molasses	0.8% molasses
Block	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



Splitting tensile strength:-

1. Splitting tensile tests were performed on cylindrical specimen.
2. Three samples per batch were tested with the average strength values.
3. The measured splitting tensile strength f_{ct} , of the specimen shall be calculated to the nearest 0.05 N/mm² using the following formula:

$$f_{ct} = \frac{2P}{\pi ld}$$

Where,

P= maximum load in Newton's applied to the specimen,

l= length of the specimen and

d= cross sectional dimension of the specimen

For M30 grade of concrete using molasses

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

For M60 grade of concrete using molasses

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

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

For M30 grade of concrete using molasses with treated waste water:-

Flexural strength:-

1. Flexural strength tests were performed on flexural testing machine having 100KN capacity using beam specimen.
2. Three samples per batch were tested with the average strength values reported in 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 center line of the tensile side of the specimen, in cm, shall be calculated to the nearest 0.5kg/cm² 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 at 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 of curing	0% molasses	0.4% molasses	0.6% molasses	0.8% molasses
Beam	28 days	3.03	3.09	3.15	3.26

For M60 grade of concrete using molasses

Specimen	No. of days of curing	0% molasses	0.4% molasses	0.6% molasses	0.8% molasses
Beam	28 days	5.41	5.52	5.66	5.80

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	3.04	3.07	3.12	3.27

Result And Discussion:-

Workability test:-

Concrete has been prepared with 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. Addition of molasses to the concrete greatly influenced the setting properly and clear collapse of slump witnessed during the experimentation. 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, 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 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 increase. subsequently the compressive strength of the concrete is also slightly increase 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. 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 has water reducing and retarding effect on concrete, to use molasses as water reducing and retarding mixture.

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