EXPERIMENTAL STUDY ON BEHAVIOUR OF BIOLOGICAL PLASTICIZER IN CONCRETE

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ABSTRACT - Small amounts of special natural or synthetic additives are used as modifiers of concrete mixtures consisting of cement, sand, gravel and water. Adding fractions of a percent of such compounds to concrete mixtures causes significant effects on chemical processes responsible for hardening, changes the structure and properties of concrete, improves the physic technological parameters of concrete mixtures and decreases its cost. Modifiers allow desired changes in the properties of concrete mixtures and concrete to be made. The additives decrease the water release from the concrete mixture, increase its fluidity and facilitate air attraction. Modifiers impart a cellular structure to concrete, increase its strength and longevity, ensure hardening at negative temperatures, improve the quality of products and facilitates building work.The most effective modifiers of concrete are substances that affect the reaction capacity of cement, rheological properties of cement gel, and physiochemical properties of cement stone. Individual ingredients of complex additives rapidly interact with one or several components of the mixture during formation of the solid phase of the bonding system and change the extent of hydration of mineral particles. These reactions result in the formation of new compounds that change the surface properties of the particles.Biological additives which displaying plasticizing affects that may regulate the properties of concrete mixtures and finished construction materials. Currently, a promising trend in the construction industry is designing high quality, long-lasting concrete materials by adding complex biological modifiers that display multi functional effects.

Introduction

Distillery spent wash is the unwanted residual liquid waste generated during alcohol production and pollution caused by it is one of the most critical environmental issue. Despite standards imposed on effluent quality, untreated or partially treated effluent very often finds access to watercourses. The distillery wastewater with its characteristic unpleasant odour posses a serious threat to the water quality in several regions around the globe. The ever-increasing generation of distillery spent wash on the one hand and stringent legislative regulations of its disposal on the other has stimulated the need for developing new technologies to process this effluent efficiently and economically. A number of clean up technologies have been put into practice and novel bioremediation approaches for treatment of distillery spent wash are being worked out. Potential microbial (anaerobic and aerobic) as well as physicochemical processes as feasible remediation technologies to combat environmental pollution are being explored. An emerging field in distillery waste management is exploiting its nutritive potential for production of various high value compounds.

There are around 400 distillery units in India, with a total production capacity of about 3800 million litres of alcohol. Average generation of spent wash is around 8-12 litres / litre of alcohol produced. The spent wash generated during the production of alcohol can be co-processed and used in cement manufacturing.

Thus the co-processing of spent wash concentrate in cement kiln has following benefits:

(a) Wastes are destroyed at a higher temperature of around 1200-1400 ^{0}C and longer residence time.

(b) Inorganic content gets fixed with the clinker apart from using the energy content of the wastes leaving no residue behind.

(c) The acidic gases, if any generated during co-processing gets neutralized, since the raw material in cement kiln is alkaline in nature, and

(d) Such phenomenon also reduces resource requirement.

While in case of incineration, residuals require to be disposed suitably. The production of cement in India is about 200 Million Tonnes per annum. The country, therefore, has potential to utilize spent wash concentrate from the distilleries for co-processing in cement industry. Based on satisfactory performance of trial run, CPCB has granted regular permission for Co-processing of few categories of wastes and 25 cement manufacturing units in various States have already started co-processing of permitted wastes. Further, trial studies are undertaken for various other wastes.

Literature review

A. V. Bolobova and V. I. Kondrashchenko (1999) who made an attempt on biological additives which displaying plasticizing affects that may regulate the properties of concrete mixtures. The composition and properties of molasses-containing yeast fermentation waste used as a plasticizer and structural biological additive to concrete mixtures are reviewed. The basic principles of the effects of organic and inorganic components of yeast fermentation waste on the properties of the bonding system are analyzed. They concentrated on structure forming processes developing in cement mixtures after adding complex biological additives are determined by the chemical nature and dosage of each component of the additive and the phase composition of the cement.

Material used

Cement

Portland Pozzolona Cement of super grades available in local market is used in the present investigation. The cement used has been tested for various proportions as per IS 4031 : 1998 and found to be confirming to various specifications are IS 12269 : 1987. The specific gravity was 3.11 and fineness of 2800 cm^2/gm was used in the present study.

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Coarse aggregate

Crushed angular aggregate of 20 mm size from a local source was used as coarse aggregate. The coarse aggregate having specific gravity of 2.67 and fineness modulus of 7.66 was used in the present study.

Fine Aggregate

Well graded river sand compromising of zone III was used as fine aggregate. The fine aggregate having specific gravity of 2.502 and fineness modulus 2.51 was used.

Super plasticizers

Here spent wash is used as a biological super plasticizers to make concrete more workable and to increase the strength of the concrete.

Mix proportion

Absolute volume method of mix design is used. The proportion of mix is given in table 2. The various percentage of addition of admixtures (Spent wash) is 0.5%, 1%, 1.5% and 2% by weight of cement respectively added to the concrete mix.

Table 1 Mix proportion

W/C ratio	Cement	Fine aggregate	Coarse aggregate	Water content
0.45	311	661.34	1311.69	140

Table 2 Different volume fractions of admixtures

% of addition of admixtures by weight of cement	Amount of admixtures added with cement
0.5	1.555
1.0	3.110
1.5	4.696
2.0	6.220

Casting, Vibrating and Curing

A tilting type rotary drum mixer machine was used for mixing of concrete ingredients. All the ingredients were placed in the mixer and the water was added during rotation. Initially 80% of the total water were added for mixing and after one minute remaining water and fibers was added and mix was continued for another two minutes. All the specimens were cast in standard moulds conforming to IS 10086 : 1982 and vibrated on a standard vibrating table. Test specimens were demoulded after 24 hours from the commencement of casting and placed into the curing tanks till the time of testing.

Test methods

Compressive strength

The compressive strength is evaluated by placing a cubical specimen between the loading surface of the compressive testing machine of capacity 2000kN, such a way that the smooth surface receives the load directly and the load is applied until failure of the cube, along the sides of cube. The compressive strength is determined by the ratio of failure load to the cross section area of the specimen.

Split tensile strength

The split tensile tests are done by placing a cylindrical specimen horizontally between surface of a compression testing machine and the load is applied until failure of the cylinder, along the vertical diameter. When the load is applied along the generatrix, an element of the vertical diameter of the cylinder is subjected to horizontal stress of $(2P / \pi \times L \times D)$. the split tensile strength is determined on the ratio of failure load to the cross sectional area of the specimen.

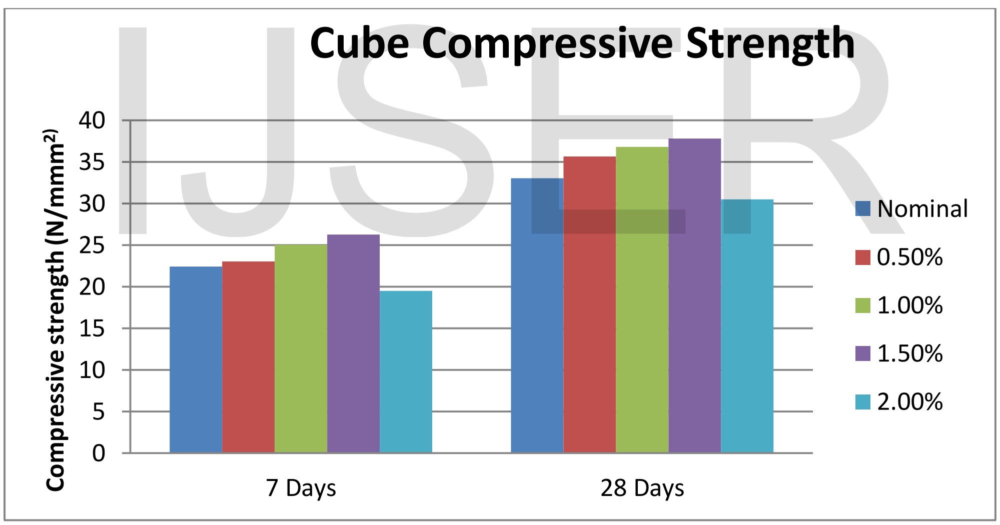
Flexural strength

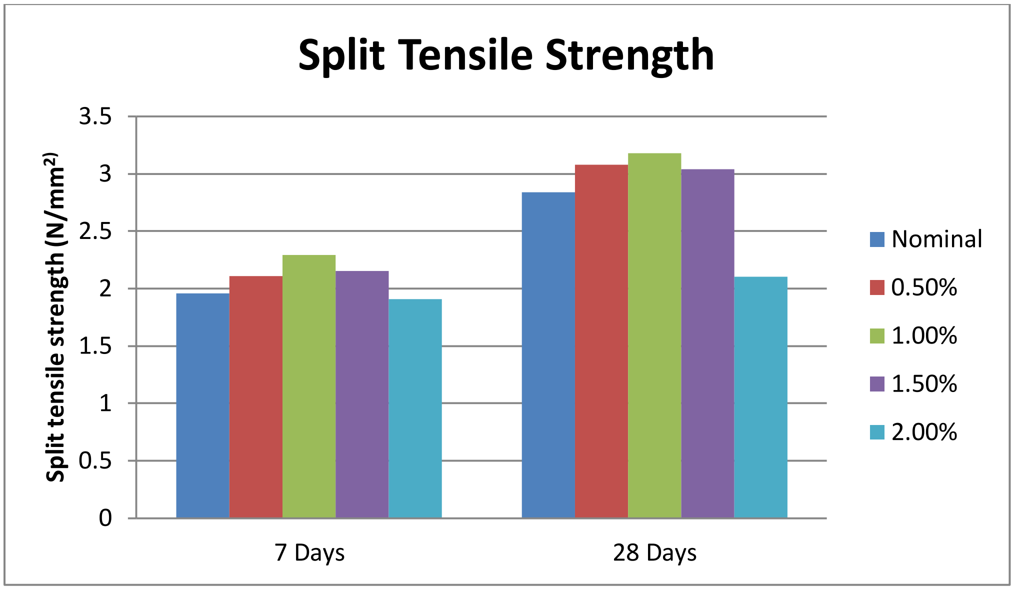
The aim of this experiment is to determine the maximum load carrying capacity of beam specimens. The flexural beams were tested under digital universal testing machine of capacity 100 tonnes. All the beams were loaded symmetrically under two points loading. The overall length of the test zone was 40 cm and the load is applied through two similar rollers mounted at the third points of the supporting span that is, spaced 13.3 cm centre to centre. The load is divided equally between the two loading rollers.

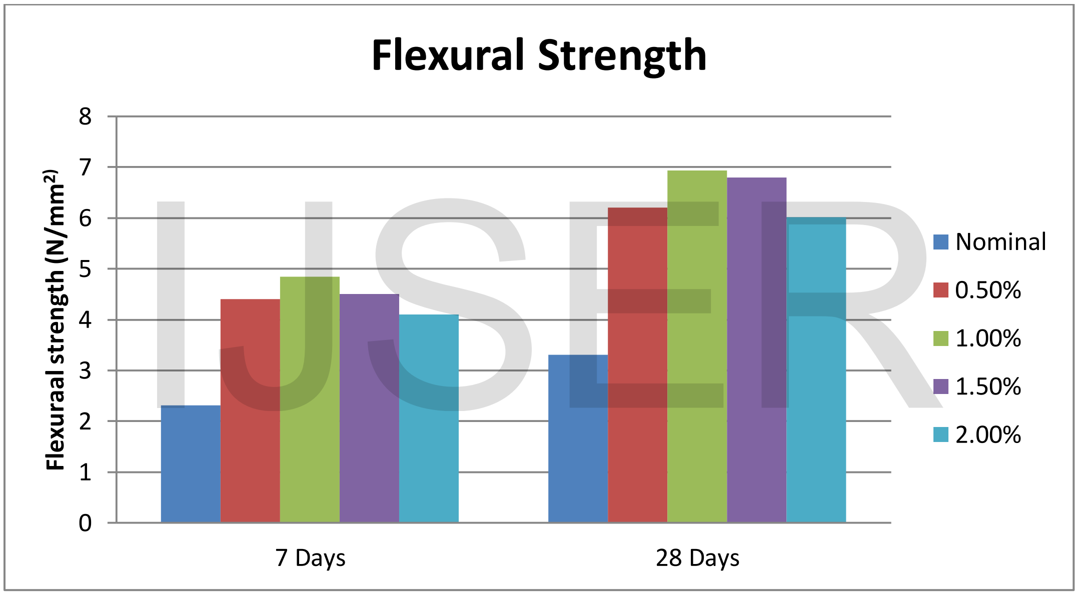
TEST RESULTS

Table 3 Test results for 7 & 28 days

% of admixtures added	Cube compressive strength (N/mm^2)		Split tensile strength (N/mm^2)		Flexural strength (N/mm^2)	
	7 Days	28 Days	7 Days	28 Days	7 Days	28 Days
0.0 (Nominal)	22.40	33.02	1.96	2.84	2.32	3.31
0.5	23.01	35.61	2.11	3.08	4.40	6.21
1.0	25.06	36.82	2.29	3.18	4.84	6.93
1.5	26.26	37.77	2.15	3.04	4.50	6.80
2.0	19.52	30.46	1.91	2.10	4.10	6.01







Discussions on test results

The test results are summarized and given in the table compressive strength: the cube compressive strength test results are tabulated in table. From figure shows the variation of 7 & 28 days compressive strength of different variations of concrete. From this graph the compressive strength of concrete is increased at 1.5% addition of admixtures when compared to other types of concrete mixes.

Split tensile strength: Split tensile strength test results are tabulated in table. From figure shows the variation of 7 & 28 days Split tensile strength of different variations of concrete. From this graph the Split tensile strength of concrete is increased at 1.0% addition of admixtures when compared to other types of concrete mixes.

Flexural strength: Flexural strength test results are tabulated in table. From figure shows the variation of 7 & 28 days flexural strength of different variations of concrete. From this graph the flexural strength of concrete is increased at 1.0% addition of admixtures when compared to other types of concrete mixes.

Conclusion

The following were made based on the experimental study.

- The addition of spent wash will improve the compressive strength marginally.

- The split tensile strength of concrete is increases 20 to 30% when compare with control concrete while the addition of 1% of spent wash.
- The flexural strength of concrete is increases 50% when compare with control concrete while the addition of 1% of spent wash.

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