# Effective Use of Vinnasse as an Admixture in Concrete (Experimental Approach)

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***Abstract-*** *Agriculture is a backbone of our country, and especially cash crops are leading for development of nation and peoples economy. In our country sugar cane are cultivated on large scale. But after the production of sugar many byproducts are produces like molasses. Further this molasses used for production of alcohol and ethanol but from this some waste product generated at huge in mass that byproduct is vinnasse. Generation of vinnasse is a big problem in front of sugar industry. Dumping and disposal of this vinnasse is very tedious work. Considering this parameter, study on utilization of vinnasse is required. CPCB (Central Pollution, Control Board) given some guidelines to cement factories regarding use of vinnasse in manufacturing of cement but it's in primary stage, on other side construction sector is rapidly develop in India, and also this sector need economical and alternative materials.*

*The effective manner is to use vinnasse in concrete by replacing cement. In this study, the replacement was done with cement by vinnasse for different proportions as 0%, 0.3%, 0.6 %, 0.9 %, 0.12 %, and 0.15 %, for a M20 grade of concrete for a water cement ratio 0.46, 0.50. Tests for compressive strength at 7 days, 14 days and 28 days are conducted on specimens. Split tensile strength and flexural strength are carried for 28 days. The optimum strength is obtained on 0.9% addition of Vinnasse.*

***Keywords***- Sugar Industry, Cement, Compressive Strength, Flexural Strength, Vinnasse, ANSYS Split Tensile Strength

## I. INTRODUCTION

Construction sector is a second largest sector in India after agriculture in terms of man power and capital invested in it. Rapid development in infrastructure and housing sector are widely spreading in our country .To fulfill this demand construction materials are massively used in all construction activity .Out of which concrete is the most important material for any type of construction work, but ingredients of concrete is produced by natural resources . In our country limited natural resources are available also during the production of ingredients environmental imbalance can happen specially during cement production industries liberates large amount of carbon dioxide which causes ozone depletion (Kanmalai, 2008). This trouble creates an issue on the sustainability of concrete. In magnitude to get realistic a sustainable significant, suitable discipline approaches can be done. To overcome this conquer vinnasse can be used as alternate construction material. In our country sugar cane are cultivated on large scale. But after the production of sugar many byproducts are produces like molasses. Further this molasses used for production of alcohol and ethanol but from this some waste product generated at huge in mass that byproduct is vinnasse. Generation of vinnasse is a big problem in front of sugar industry. Dumping and disposal of this vinnasse is very tedious work. Considering this parameter, vinnasse can use in concrete for partially replacement of cement and also its can be used as admixture for improving workability of concrete which can replace costly chemical admixtures.

For this study vinnasse is obtained from distillery of Kisan Veer Sugar Factory Bhuij District: Satara, Maharashtra, India

## II. LITERATURE REVIEW

***E.W. Gadzama, O.J.*** **2015[4],** Conclude that sugar factory waste water can be increases the strength of concrete.In this paper authors used mix ratio of 1: 2:4 :.056 containing OPC ,using ACI method of mix design .Authors replaced portable water with waste water in percentages 0%,75% 100%. With 28 days curing period. Authors found that with this percentages of waste water from sugar industry setting time and compressive strength can be increased with increase in curing duration. Authors also found that appearances of hair line cracks all over the cubes casted with an appreciable volume change in dimension of cube.

***M. S. Chennakesava Rao*** **2015[9],** focus on agro waste specially sugarcane bagasse ash .In this paper authors explain the experimental analysis of bagasse ash partially replaced in the ratio of 0% ,5%,10%,15% and 25%. by the weight cement in concrete. Authors invested that compressive strength with different proportion of bagasse can be increased by experimental analysis this paper conclude that up to 10% replacement of cement by bagasse ash gives better results. Author introduces the Green Concrete concept through this paper.

***A Pereira de Oliveira 2013*[1],** state Waste glass when ground to a very fine powder shows pozzolanic properties as it contains high sio2 and therefore to some extent can replace cement in concrete and contribute in strength development. In this paper, an attempt has been made to find out the strength of concrete containing waste glass powder as Pozzolona .Cement replacement by glass powder in the range 5% to 40% increment of 5 percentages. (0%, 5%, 10%, 15%, 20%, 25% 30%, 35%, 40%) has been studied. Replacement of 20% cement by glass powder was found to be higher strength

***Hasan Yilldirim*, 2012**[5]**.**In this paper, comparison made between molasses with 40% purity grade and Lignosulphonate with respect to improvement in properties of concrete. Paper studied 3 molasses of different sugar factories with 2 admixture doses such as .4% and .7% of cement doses in accordance with ASTM C 494 standard .Molasses are effective on retardiding of setting time .Authors conclude that molasses can be use as a water reducing and retarding admixture, some additive like triethylamine can be added to molasses.

## III. METHODOLOGY

Different basic tests are conducted on cement (ordinary Portland 53 grade), fine aggregate, coarse aggregate and Vinnasse for checking their suitability for making of concrete. Mix proportions of concrete are modified for using vinnassee with partial replacement of cement replaced with 0%, 0.3%, 0.6 %, 0.9 %, 0.12 %, and 0.15 %, of vinnasse casted in concrete elements.

**i) Tests on Ingredients**:

The materials which are used for this work are teased in lab, and following results are obtained.

Table 1: Physical Properties of Materials

| Tests | Fine Aggregate | Coarse Aggregate |
|---|---|---|
| Material Specific gravity | 2.65 | 2.7 |
| Water absorption (%) | 0.6 | 1.00 |
| Bulk density (kg/m$^3$) | 1750 | 1800 |
| Moisture content(%) | 1.5 | Nil |
| Fineness modulus | 3.18 | 4.32 |

**ii) Tests on Vinnasse:** For this study vinnasse is obtained from distillery of Kisan Veer Sugar Factory, Bhuij District: Satara, Maharashtra, India. The tests are conducted in well equipped lab at Vasantdada Sugar Institute (VSI) Pune .The tests results on vinnasse as follows

Table 2: Physical Properties of Vinnasse

| Parameter | Value |
|---|---|
| pH | 3.76 |
| Colour | Brownish |
| Specific Gravity | 1.0493 |
| COD | 1,24,000 |
| BOD | 49,500 |
| TS | 1,13,992 |
| TDS | 1,12,100 |
| TSS | 1,892 |
| Moisture | 87.14% |
| TVS | 81,150 |
| TFS | 30,950 |
| Odour | Sweet but objectionable |

**Casting of Specimens**:

Specimens are casted as per design mix and tested after appropriate curing, and tests taken are compressive strength of cubes (150mm x 150mm x 150mm), and flexural strength of beams (100mm x 100mm x 500mm) split tensile strength of cylinders (150mm x 300mm). From the studies, optimum results are found out and compared with the conventional concrete with the help of graphs.

## IV. MIX PROPORTION

Concrete mix design procedure as per IS 10262:2009, a concrete mix proportions with characteristic compressive strength (fck) of 20Mpa was designed without any admixtures with water cement ratio 0.46, 0.50.

The mix adopted for the study is given in Table 3.

Table 3: Mix Proportion Cement

| | Cement | Water (liters) | Fine Aggregate | Coarse Aggregate |
|---|---|---|---|---|
| kg/m3 | 387.5 | 186 | 680 | 1110 |
| Ratio | 1 | 0.48 | 1.75 | 2.86 |

## V. TEST RESULTS AND DISCUSSION

On the concrete specimen the compressive strength, flexural strength and split tensile strength test were conducted, results are obtained from the experimental study, given in the form of graph along with discussion.

### A. Compressive Strength

Specimens are casted and, cured then it is tested for compressive strength under compression testing machine and in concrete cubes of sizes 150 mm X 150 mm X 150 mm, (CTM). The maximum load at failure reading was taken. Figure No.1 and 2 shows the compressive strength of concrete using vinnasse at 7th, and 28th day for 0.46 and 0.50 W/C.

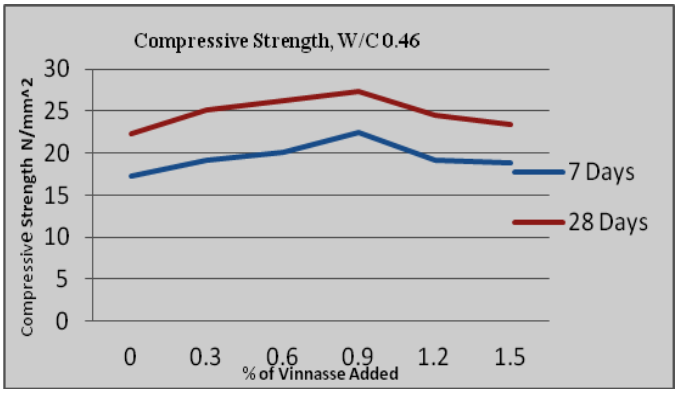


Figure 1: Compressive Strength of Concrete (W/C 0.46)

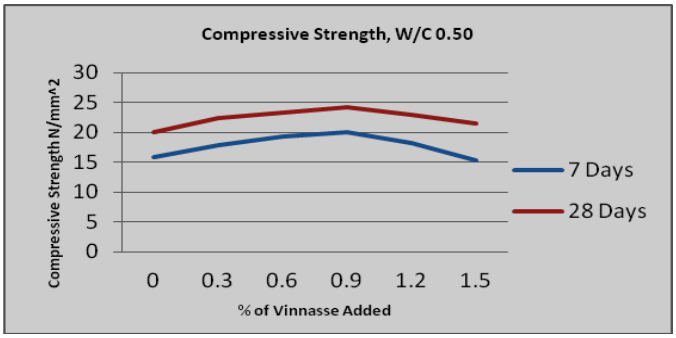


Figure 2: Compressive Strength of Concrete (W/C 0.50)

Experimentally it is found that by adding vinnasse up to 0.90 % causes to increase the Compressive strength of concrete. This is due to the quantity of macromolecular micelle-forming compounds present in vinnasse is an important factor creating good conditions for homogeneity in density of the concrete. extra increases in the dosage, cause aggregation of surfactant molecules; an mass increase in the amount of gels produced by hydration; and the formation of defects in the microstructure of concrete, resulting in a decrease in its strength.

### B. Split Tensile Strength

Concrete cylinders casted .cured and then it is tested for split tensile on 7th and 28th day, under the UTM. The specimen having diameter 150 mm and height 300 mm tested. Fig 3 and 4 shows the experimental results for 0.46 and 0.50 W/C.

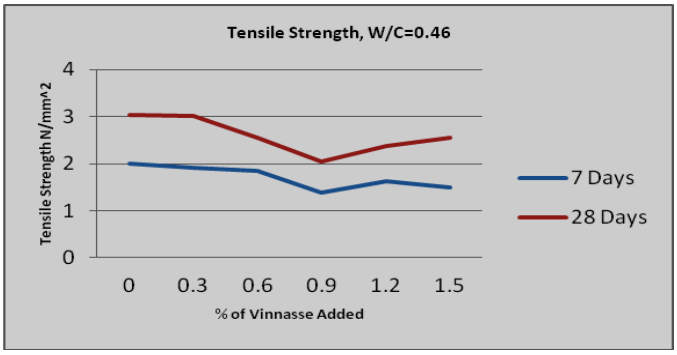


Figure 3: Split Tensile Strength of Concrete (W/C 0.46)

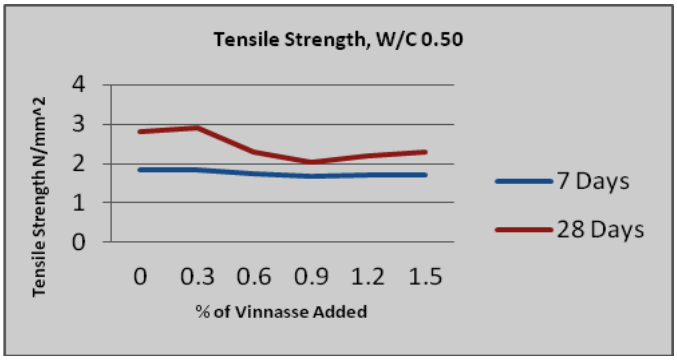


Figure 4: Split Tensile Strength of Concrete (W/C 0.50)

### C. Flexural Strength Test

The flexural strength test for beam specimen having the size of 150 mm x 150 mm x75 mm was casted and cured for 7th 28th days with W/C 0.46 and 0.50 . The specimen was kept horizontally between the supports of a Universal Testing Machine (UTM) and the load was applied until failure of the beam. The failure load was noted and shorter length from crack to support strength was measured. Figure 5 and 6 shows the flexural strength of concrete using vinnasse on 7th and 28th day. It is observed that flexural strength of concrete increases with the increase in the quantity of vinnasse as replacement of

cement. Up to 0.90% of addition of vinnasse, the flexural strength of concrete increases, then further addition it will decrease. Maximum increase in the flexural strength obtained on 0.90% addition of vinnasse This is due to addition of vinnasse improves the structure of concrete and its homogeneity.

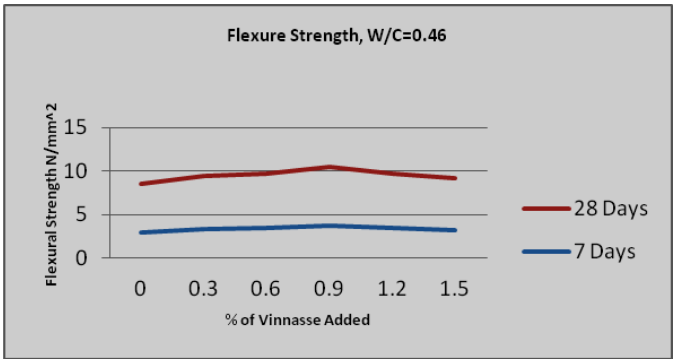


Figure 5: Flexural strength of concrete using vinnasse (W/C 0.46)

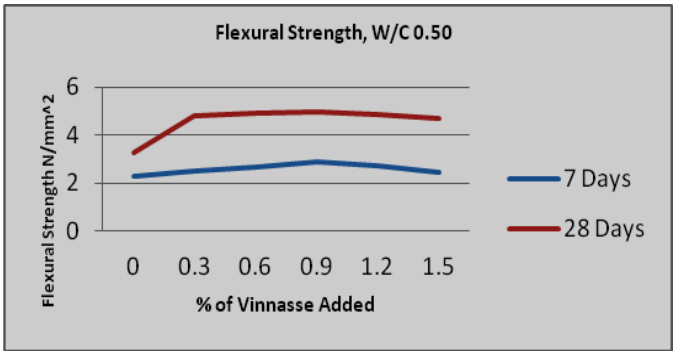


Figure 6: Flexural strength of concrete using vinnasse (W/C 0.50)

## VI. CONCLUSION

After this experimental study, it has proved to be better way for disposal Vinnasse. The replacement of cement by vinnasse has increased the compressive strength, flexural strength and split tensile strength of concrete. The optimum percentage of cement replacement with vinnasse was found to be 0.9%. As we increase the percentage of vinnasse in concrete it shows decrease in strength. When we used this optimized value, it will give additional durable concrete and excellent strength as compared to conventional concrete. It is prove that the waste material of distillery units of sugar factories are excellent modifiers of the properties of concrete. Large use of distillery vinnasse in the construction industry saves cement also improves the quality of concrete mixtures; and minimize the environmental problems, because the wastes from distillery units is directly dump in water bodies and open land, which causes pollution of water and soil.

## ACKNOWLEDGMENT

The authors are grateful to the Civil Engineering Dept, ICOER, Wagholi, Pune, for their support. I am indebted to guide Prof. Vijaykumar Bhusari and H.O.D Dr.A.W. Dhawale and Principal Dr Sachin V Admane for their valuable guidance and inspiration which constantly provided till the end.

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