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A Brief Study on the Influence of Ductile Fluids on the Quality of Concrete in Terms of its Compressive Strength

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Abstract—*Concrete is finding is utilization in various construction works all over the world. But the difficulty arises in the fact that the engineering fraternity is not fully satisfied with the properties of concrete. That is why research has been done to introduce various elements into the concrete along with the usual constituents which are cement, fine aggregates, coarse aggregates and water. Understanding Concrete is still really not fully known till today. Concrete has a lot of flexibility to add and whatever we want to add into concrete we can do it. Researchers have implemented various solid fibres in concrete and have tested the properties thereafter. These fibres include coconut fibres, steel fibres, geopolymer fibres, etc. But research has not been done basically by adding a ductile liquid component into the concrete along with cement, sand and coarse aggregates. So in order to evaluate whether the implementation of a ductile element will enhance or reduce the quality of concrete this study has been performed.*

1. INTRODUCTION

This project describes the procedure for designing a concrete mix with hot mix and cold mix bitumen as binder materials. The purpose of the experiment is to enhance the utility of concrete and enhance all the other important properties that are required for better quality construction works and better quality of the structure altogether. A good design of bituminous mix is expected to result in a mix which is adequately strong, durable, and resistive to fatigue and permanent deformation, environment friendly, economical and so on. In this study concrete properties have been investigated by implementing a liquid element which is bitumen and cold mix bitumen. The effect of the binder material may be either deterioration of the quality of concrete or enhancement of the quality of concrete. To check the effect the study was taken up.

2. MATERIALS USED

The materials that were used for the study include Coarse aggregates, Fine aggregates, Cement (ppc fly ash), Water, Bitumen (HOT MIX) and Cold mix. COLD MIX was provided to us for this study by BITCHEM Asphalt Technologies which is a leading manufacturer and distributor of cold mix bitumen in the north eastern region of INDIA.

Fig. 1: Cold mix sample (Ezee 2 in 1).

Fig. 2. Concrete and bitumen sample.

Fig. 3. Mixing bitumen in the mould.

It is made up of custom designed cationic bitumen Emulsions and aggregates. Cold mixes can be produced with a wide variety of equipment either on site or at central plants. Quality control tests were conducted on the materials before using them for the detailed study.

3. QUALITY CONTROL TESTS DONE ON THE MATERIALS

The Quality Control tests were done in the laboratory of the Department of Civil Engineering at Assam Don Bosco University. The quality control testes that were done on the materials include Impact Value Test, Abrasion Value Test, Flakiness Index and Elngation Index text for Coarse Aggregates, Softening Point test on bitumen, Ductility Test, Penetration Test of Bitumen. Corresponding relevant IS Codes were referred to for doing the tests. The observations are cited below.

1. Impact Value = 33.6% [IS 5640 (1970)]
2. Los Angeles Abrasion Value = 38.61% [IS 2386-4(1963)]
3. Flakiness Index = 15.6 [IS 2386-1 (1963)]
4. Elongation Index = 22.37 [IS 2386-1 (1963)]
5. Softening point of bitumen=42°C [IS 1205:1978]
6. Ductility Value = 15.75 [IS 1208:1978]
7. Average Penetration Value in $1/10^{th}$ of mm= 3.67 [IS 1208:1978]

4. METHODOLOGY

A sample was prepared taking a nominal mix of M20 concrete. Hot mix and cold mix as binder was used along with other concrete elements. Three samples were prepared and casted 3 cubes of 150mm*150mm of each sample

1. Plain concrete

2. Concrete + cold mix

3. Cconcrete + hot mix

w/c ratio was taken as 0.6

Cement, fine aggregate & coarse aggregate ratio was taken as 1:1.5:3

For the first three cubes

water =900ml

Cement=1.5kg

Fine aggregate=2.25kg

Coarse aggregate=4.5kg

Curing has been done for 7, 14, 28 days for the 3 cubes respectively

For the next three cubes (concrete + cold mix)

Cold mix=200ml (obtained from Bitchem)

Water =700ml

Cement=1.5kg

Fine aggregate=2.25kg

Coarse aggregate=4.5kg

Curing has been done for 7,14, 28 days for the three cubes respectively

For the last three cubes (concrete + hot mix)

Hot mix=200ml (prepared by heating bitumen)

Water =700ml

Cement=1.5kg

Fine aggregate=2.25kg

Coarse aggregate=4.5kg

Curing has been done for 7,14, 28 days for the three cubes respectively

5. RESULTS AND CONCLUSIONS

The compression test results of the cube samples after 7,14 and 28 days of curing are hereby shown in the following table. The strength is calculated in the units of N/mm^2.

Table 1: Compression test results.

	Compressive Strength		
Days	**Plain concrete (mpa)**	**Concrete+cold mix (mpa)**	**Concrete + hot mix (mpa)**
7	5.77	4.88	3.55
14	7.77	6.66	4.66
28	9.77	7.55	5.33

The compressive test result shows the decrease in compressive strength due to the mixing of hot mix and cold mix emulsion with concrete. Compressive Stress is plotted along Y axis and No of days is plotted along X axis.

Thus it can be concluded that Bitumen does not effect the quality of concrete in a good way. There are some drawbacks for which there might be the decrease in compressive strength which are discussed below. And further there are many scopes of study of concrete with bitumen which can enhance the utility of concrete and its properties in future.

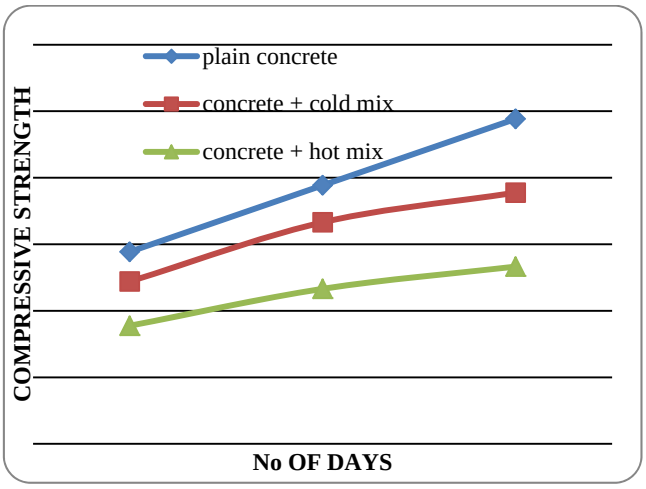

Fig. 4: Graph showing the variance of compressive strength with the number of days for the test samples.

6. DRAWBACKS

Due to time constraints and some unavoidable problems faced during the research work some works were left undone and left incomplete.

1. Error in calibration of the instrument. While using the instruments certain number of errors occurred.
2. The environment in which the work was performed was not a controlled environment was not a controlled environment. The environment in which the experiments were performed was not appropriate.
3. Lack of adequate facilities while mixing bitumen with the components of concrete. It was quite difficult to mix the bitumen with concrete due to lack of proper facilities.
4. Temperature difference between aggregate and bitumen. The temperature of the aggregate and the temperature of the bitumen were quite varying from one another.
5. Proper quality of aggregate (fine and coarse) was not available during the period of ongoing research. The quality of aggregates that were used during the experiments was not up to the mark.
6. Lack of availability of various chemicals like paraffin wax. Paraffin wax was unavailable even in the chemistry labs.

7. SCOPE FOR FUTURE WORKS

Due to time constraints many things that were to be considered, which could affect the results of the study, couldn't be covered. Therefore, such factors if taken into account can lead to some scope for future works in the field relevant to this study.

Following are some of the suggested works that can be carried out in the future:

1. Miscibility of bitumen with concrete can be observed while increasing the temperature of the components used for preparation of concrete.
2. Future research can be done on the cost factor and the economic viability can be analyzed.
3. Research work can be also carried out by using various chemicals like paraffin wax.
4. Performing the same experiment using instruments with good calibrations will give better output.
5. Studies can be done to observe the difference in miscibility of bitumen with coarse aggregate, fine aggregate and cement separately.
6. Future research can be performed using different grades of cold mix.
7. Research can be done by further reducing the viscosity of bitumen to get a better mix with concrete.

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