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An Experimental Investigation of Various Industrial Effluents on Concrete

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ABSTRACT

Water resources are the greatest boon given to mankind by nature. This non renewable resource is getting depleted day by day and the predictions say that the third world war may arise for water. Construction is one industry that uses plenty of water for all its construction purposes. Hence an effort has been made to use industrial effluents to cure concrete and thereby save water resources. In this experiment the three effluents are used, coolant oil from automobile industry, the effluent from powder coating industry and the effluent from chocolate factory. The M30 grade of concrete is cured in these effluents. Cubes, cylinders and prisms of M30 grade are casted and cured in effluents and are tested for their compressive strength. Split tensile strength and flexural strength for 7, 14 and 28 days and are compared with that of the conventional M30 grade concrete cured in water.

Key words— **Concrete, Compressive strength, Curing, Effluent, Flexural strength.**

I. INTRODUCTION

Many research works have been done to increase the strength of concrete. Usually the strength of the concrete is increased by the addition of admixtures or by reinforcement. In this present study, the effluents are used for curing purposes and thereby increase the strength of concrete. Usage of treated effluents for mixing of concrete increased the compressive strength and setting time of concrete (Ooi Soon Lee et al, 2001) [1]. The presence of poly acids in the effluents degrades the cementitious material (Alexandra Bertron et al, 2009) [2]. The use of acid resistant supplementary cementitious material (flyash or silica fumes) and quartz aggregate increases the denseness of microstructure (Robin E. Beddo and Karl Schmidt, 2004) [3]. Addition of concare and calcium nitrate to textile effluents considerably reduces the corrosion effects of concrete (K.Nirmalkumar&V.Shivakumar, 2008) [4]. The use of tertiary treated wastewater in concrete mixing shows similar properties to that of potable water (Jasem M. Alhumoud et al, 2010)[5].

II. EXPERIMENTAL INVESTIGATION

2.1 Materials

Cement: In this experimental investigation 43 grade ordinary Portland cement was used.

Fine aggregate: River sand free from impurities was used as fine aggregate. The size of it is less than 4.75mm. The percentage of passing is within the limits as per IS383-1970 [8].

Coarse aggregate: The coarse aggregate used is 20mm in size, crushed, angular in shape and free from dust. The percentage of passing is within the limits as per IS383-1970[8].

Effluents: The effluents used are coolant oil from automobile industry, effluent from powder coating and chocolate factory. The properties of these effluents were studied and are given tables 1, 2 and 3 respectively.

Table 2Properties of coolant oil

S.NO	Parameter	Quantity
1	Physical state and color	Viscous Liquid
2	Appearance	Dark Brown Color Liquid
3	Specific gravity	0.868
4	Solubility in water	Good soluble.
5	Flash point (COC),°C	150° C.
6	Kinematic Viscosity cSt	20, min @ 40° C
7	Percent Volatiles	2 % min.
8	Emulsion Test (20 : 1 ratio)	0.1 ml and 0.2ml cream permitted

Table 2.Properties of powder coating effluent

S.No	Parameter	Quantity
1	Total suspended solids	560 mg/L
2	Chloride content	800 mg/L
3	Oil and grease	20 mg/L
4	COD	400 mg/L
5	pH	4
6	Total settleable solids	560 mg/L

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7	Nitrogen content	45 mg/L
8	BOD	20 mg/L

TABLE 3.Properties of chocolate effluent

S.No	Parameter	Quantity
1	Total suspended solids	56 mg/L
2	Chloride content	704 mg/L
3	Oil and grease	<1 mg/L
4	COD	192 mg/L
5	pH	7.53
6	Total dissolved solids	1300 mg/L
7	Sulphate content	74 mg/L
8	BOD	29 mg/L

2.2 Grade of concrete
The grade of concrete used is M30 and concrete mix is designed as per IS 456-2000[6] and IS 10262 – 1982[7]. The water cement ratio adopted is 0.45.

2.3 Preparation of specimens
Cubes, cylinders and prisms of M30 grade are casted and their strength parameters are studied. The ingredients were collected and mixed to appropriate proportion by adding water. On the other hand the moulds were prepared by applying oil. The concrete was poured in to the mould layer by layer and vibrated thoroughly. The specimens were removed from the moulds after 24 hours and then the specimens were cured in potable water and effluents 1, 2, and 3 for 7, 14 and 28 days. The details of the specimens are given in table 4.

Table4.Number of specimens

Specimen	Potable water	E1	E2	E3
Cubes	3	3	3	3
Cylinders	3	3	3	3
Prisms	3	3	3	3

Fig.1 Coolant oil (E1)

Fig.2 Powder coating effluent (E2)

Fig.3Chocolate effluent (E3)

Fig.4 Curing of specimens in E1

Fig.5 Curing of specimens in E2

Fig.6 Curing of specimens in E3

3. TESTING

The concrete specimens were taken out of curing after 28days. The cubes of size 150X150X150 mm were tested for compressive strength, cylinders of size 150 mm diameter X300 mm height were tested for their split tensile strength and prisms of size 500X100X100 mm were tested for their flexural strength.

4. RESULTS AND DISCUSSIONS

From the tests conducted it is found that the compressive strength, split tensile strength and flexural strength has increased for the specimens cured in effluents when compared to the specimens cured in potable water. The test results obtained are given in table 5,where C stands for conventional and E1,E2,E3 stands for effluents.

Table 5 Experimental test results

Strength	M30 (N/mm^2)			
	C	E1	E2	E3
Compressive strength	31.35	31.92	31.87	32.42
Split tensile strength	3.10	3.15	3.14	3.18
Flexural strength	3.89	3.95	3.94	3.99

4.1 Effect on compressive strength of concrete

From figure 3 it is seen that the compressive strength of cubes cured in effluent 1 increased by 1.8% and for effluent 2 it increased by 1.7% and for effluent 3 it increased by 3.5%. Thus all the three effluents tend to increase the compressive strength of concrete and the maximum compressive strength is attained for the specimens cured in effluent 3.

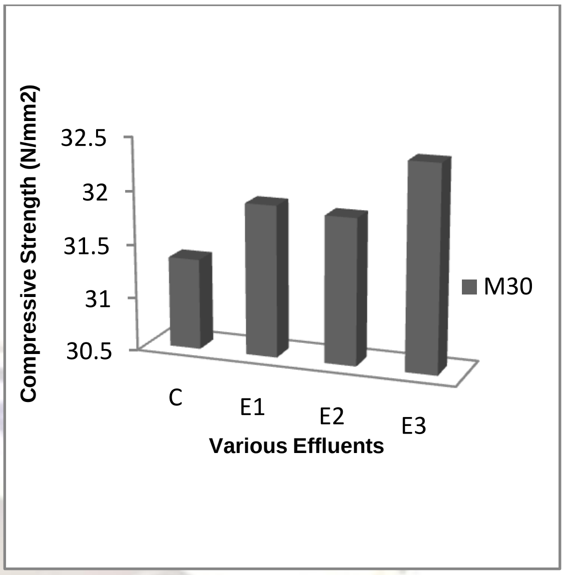

Fig.7 Compressive strength after 28 days of curing

4.2 Effect on tensile strength of concrete

It can be seen from figure 4 that the split tensile strength of cylinders cured in effluent 1 increased by 1.7% and for effluent 2 it increased by 1.5% and for effluent 3 it increased by 2.5%. Thus the split tensile strength gets increased in all the three effluents.

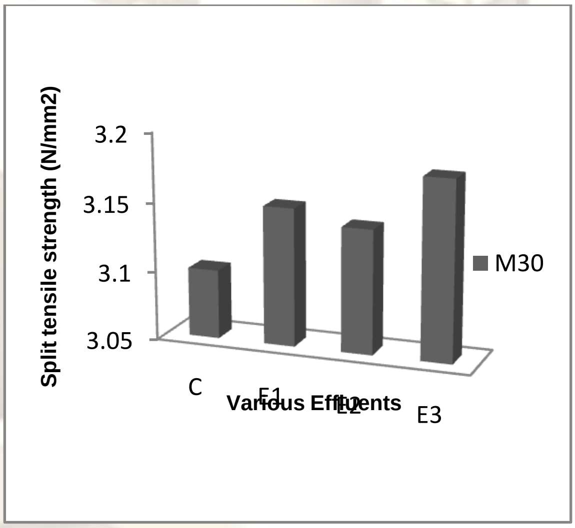

Fig.8 Split tensile strength after 28 days of curing

4.3 Effect on flexural strength of concrete

From figure 5 it is seen that the flexural strength of prisms cured in effluent 1 increased by 1.6% and for effluent 2 it increased by 1.45% and for effluent 3 it increased by 2.3%. Thus all the three effluents tend to increase the flexural strength of concrete.

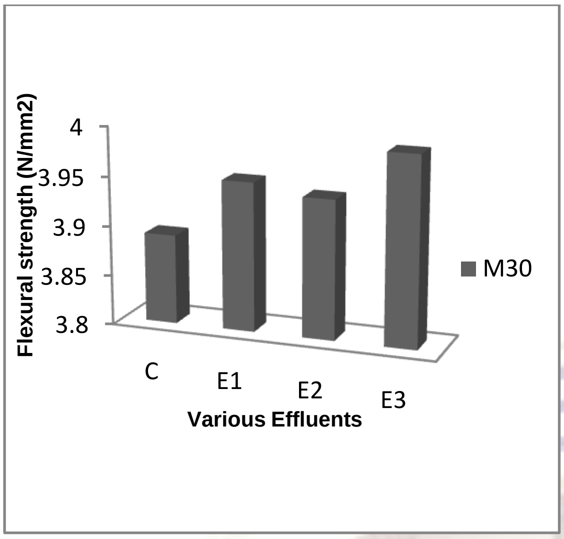

Fig.9 Flexural strength of concrete after 28 days of curing

Fig.10 Tensile failure

Fig.11 Flexural failure

6. CONCLUSION

Industrial effluent E3 can very well be used for curing concrete structures instead of water, as it has shown considerable increase in compressive, tensile and flexural strengths of 3.5, 2.5 and 2.6 percentages respectively, compared to conventional water curing. The other effluents E1 and E2 also increased the strength of concrete compared to water.

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