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ASSESSMENT OF STRENGTH PROPERTIES OF THE CONCRETE BY REPLACING POTABLE WATER WITH TANNERY AND TEXTILE EFFLUENTS

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ABSTRACT

The wastewater from tannery and textile industry can be used for construction purpose, so as to reduce shortage of water and to safeguard the environment. The basic properties of the treated and untreated wastes from both the tannery and textile industry were tested and the results were satisfactory for their use in construction. By using these wastewaters, cubes and cylinders were casted and tested for compressive strength and split tensile strength. The results were compared with the specimens casted with potable water and were found to be satisfactory.

INTRODUCTION

The water sources are fast depleting in quality and quantity, so the wastes of industries can be used for industrial activities like construction purposes, if they are found suitable. The disposal of tannery and textile wastewaters is posing a great problem to the environment (Anbalagan et al. 1997). The wastewaters available from tannery and textile industries in and around Erode can be used for the construction purpose after suitable treatment. So, an attempt has been made to utilize the polluted tannery and textile wastes for construction purposes by making some primary treatments.

The wastewater from the industry is tested for its basic properties and compared with the BIS recommendations for water to be used for construction purposes (Tables 1 and 2) .

MATERIALS AND METHODS

For preparing test specimens, 43 grade ordinary portland cement conforming to IS: 269-1976 was used, which should undergone field tests before casting (Rangwala 1997), and natural river sand and stone aggregate satisfying the required tests (Shetty 2001) were used. The maximum size of the coarse aggregate was limited to 20 mm to get the maximum increase in compressive strength. A sieve analysis conforming to IS: 2386 (Part I)-1963 was carried out for both fine and coarse aggregates. The concrete mix proportion M_{20} adopted was 1 : 1.38 : 3.09 (cement: sand: coarse aggregate) with water cement ratio of 0.5, M_{25} adopted was 1 : 1.31 : 2.94 with a water cement ratio of 0.45 and M_{30} adopted was 1 : 1.06 : 2.51 with a water cement ratio of 0.39 with respect to the mix design (Shetty 2001). The concrete mix was designed so as to achieve cube strength of 20MPa, 25MPa and 30MPa. Cubes were casted of size 150 × 150 × 150 mm. Cylinders were casted of size 150 mm diameter and 300 mm height. The specimens were cured for 7 days, 14 days and 28 days in water after 24 hours of their casting by immersion method .

Table 1: BIS recommendations for concrete water (IS: 2490-1974):

S.No	Parameters	Permissible Limit
1	pH	5.5-9.0
2	Chlorides (mg/l)	250
3	Total dissolved solids	500
4	Acidity	100
5	Sulphates	250

Table 2: Test results of the treated and untreated tannery and textile wastes.

Sample	Parameters					
	pH	Chloride Content (mg/L)	Total Dissolved Solids (mg/L)	Acidity (mg/L)	Sulphate (mg/L)	COD (mg/L)
UTT	12.2	6750	8000	3800	5400	13860
TT	7.2	298.58	5950	24	918.18	679
UTD	8.5	5760	8576	2143	4478	9678
TD	7.1	406	3300	10.3	1636.74	560

UTT - Untreated Tannery Water; TT - Treated Tannery Water; UTD - Untreated Textile Water
TD - Treated Textile Water

Table 3: Compressive strength of concrete using potable water.

Grade of Concrete	Compression strength of concrete (N/mm^2)		
	7 Days	14 Days	28 Days
M_{20}	17.77	20.63	25.97
M_{25}	22.33	25.63	30.36
M_{30}	27.66	30.63	35.30

Table 4: Split tensile strength of concrete using potable water.

Grade of Concrete	Split tensile strength of concrete (N/mm^2)
M_{20}	2.57
M_{25}	2.73
M_{30}	2.77

Table 5: Compressive strength of concrete using untreated tannery water.

Grade of Concrete	Compression strength of concrete (N/mm^2)		
	7 Days	14 Days	28 Days
M_{20}	18.03	24.37	25.63
M_{25}	23.06	29.36	30.63
M_{30}	28.06	34.36	35.63

Table 6: Split tensile strength concrete using untreated tannery water.

Grade of Concrete	Split tensile strength of concrete (N/ mm^2)
M_{20}	2.78
M_{25}	2.98
M_{30}	3.10

The specimens were removed from the curing tank before two days of testing. They were dried for one day and the cubes and cylinders were tested by using compression testing machine as per the procedure (Shetty 2001). The specimens were tested after 7 days, 14 days and 28 days of curing. The specimen was placed in a position and load was applied. From the dial gauge reading compression load can be calculated. The size of the cube was 150 mm × 150 mm and the compressive strength was given in terms of load/area in N/mm^2. The volume of cylinder was taken as $(\pi d^2/4) \times L$ and split tensile strength as $2p/(\pi \times L \times d)$ N/mm^2, where p= load applied in KN, L is length of the specimen in mm (300mm) and d is diameter of cylinder in mm (150mm). The split tensile strength was determined for 28 days of curing only.

TEST RESULTS, EVALUATION AND CONCLUSION

The results of the compressive strength and tensile strength of M_{20}, M_{25} and M_{30} concrete using potable water, and untreated and treated tannery and textile wastes are given in Tables 3 to 16 and

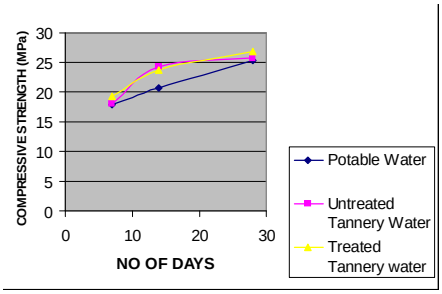

Fig. 1: Comparative study on potable water, and untreated and treated tannery wastes.

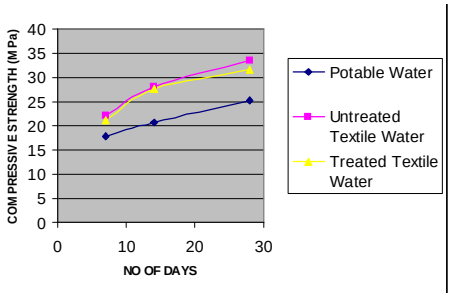

Fig. 2: Comparative study on potable water, and untreated and treated textile wastes.

Table 7: Compressive strength of concrete using treated tannery water.

Grade of Concrete	Compression strength of concrete (N/mm^2)		
	7 Days	14 Days	28 Days
M_{20}	19.2	23.8	26.8
M_{25}	24.16	28.76	31.80
M_{30}	29.20	33.80	36.80

Table 8: Split tensile strength of concrete using treated tannery water.

Grade of Concrete	Split tensile strength of concrete (N/mm^2)
M_{20}	2.80
M_{25}	2.97
M_{30}	3.12

Table 9: Comparative study of potable water, untreated tannery water, treated tannery water on its mechanical properties (28 days compressive strength in N/mm^2).

Grade of Concrete	Potable Water	Untreated Tannery Water	Treated Tannery Water
M_{20}	25.97	25.63	26.8
M_{25}	30.36	30.63	31.80
M_{30}	35.30	35.63	36.80

Table 10: Comparative study on potable water, untreated tannery water, treated tannery water on its mechanical properties (28 days split tensile strength in N/mm^2)

Grade of Concrete	Potable Water	Untreated Tannery Water	Treated Tannery Water
M_{20}	2.57	2.78	2.80
M_{25}	2.73	2.98	2.97
M_{30}	2.77	3.10	3.12

Table 11: Compressive strength of concrete using untreated textile water.

Grade of Concrete	Compression strength of concrete (N/mm^2)		
	7 Days	14 Days	28 Days
M_{20}	22.06	28.73	33.6
M_{25}	27.06	33.73	38.6
M_{30}	32.06	38.73	43.6

Table 12: Split tensile strength of concrete using untreated textile water.

Grade of Concrete	Split tensile strength of concrete (N/mm^2)
M_{20}	2.88
M_{25}	2.98
M_{30}	3.14

Table 13: Compressive strength of concrete using treated textile water.

Grade of Concrete	Compression strength of concrete (N/mm^2)		
	7 Days	14 Days	28 Days
M_{20}	21.23	27.53	31.73
M_{25}	26.23	32.53	36.73
M_{30}	31.23	37.53	41.73

Table 14: Split tensile strength of concrete using treated textile water.

Grade of Concrete	Split tensile strength of concrete (N/mm^2)
M_{20}	2.78
M_{25}	2.98
M_{30}	3.16

Table 15: Comparative study on potable water, untreated textile water and treated textile water on its mechanical properties (28 days compressive strength in N/mm^2).

Grade of Concrete	Potable Water	Untreated Tannery Water	Treated Tannery Water
M_{20}	25.97	33.6	31.73
M_{25}	30.36	38.6	36.73
M_{30}	35.30	43.6	41.73

Table 16: Comparative study on potable water, untreated textile water and treated textile water on its mechanical properties (28 days split tensile strength in N/mm^2).

Grade of Concrete	Potable Water	Untreated Tannery Water	Treated Tannery Water
M_{20}	2.57	2.88	2.78
M_{25}	2.73	2.98	2.98
M_{30}	2.77	3.14	3.16

Figs. 1 and 2 and compared. Based upon the results obtained during this study, the following conclusions have been drawn.

1. Chemical analysis of the wastes shows that there is a deviation in acidity, chloride content, sulphates and total dissolved solids from the conventional water to polluted water.
2. While considering the mechanical properties of the concrete there is a considerable increase in the compressive strength and split tensile strength for the polluted water and this is due to the salts and chemicals present in the effluent water.
3. Even though the results of specimens with polluted concrete are better than the conventional concrete, its chemical properties do not satisfy the BIS recommendations. Hence, further study may be carried out on corrosion and durability of the wastewater made concrete for its complete recommendation for use in construction purposes.

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