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Strength of Concrete in Treated Waste Water

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Abstract: **This feasibility study of using reclaimed wastewater for concrete mixing was carried out in the laboratory. The compressive strength of concrete cubes cast with reclaimed wastewater in the total mixing water was studied. In general, slight increases in strength at early ages were observed from cubes cast with reclaimed wastewater compared with those, cast with potable water. At 7 days and 28 days compressive strengths were determined. No adverse effect on compressive strength was observed when concrete was cured in reclaimed wastewater. In fact, concrete cubes asted in reclaimed wastewater showed increases in strength at earlier ages compared to those casted in potable water. The long-term compressive strengths are similar.**

Keywords: **feasibility; concrete; compressive strength; portable water.**

1. INTRODUCTION

Concrete is considered to be very durable material that requires little or no maintenance. Concrete is a mixture of cement, fine aggregate, coarse aggregate and water. Concrete plays a vital role in the development of infrastructure viz., buildings, industrial structures, bridges and highways etc., The ratio of the amount of water, minus the amount of water absorbed by the aggregates, to the amount of cementitious materials by weight in concrete is called the water-cementitious ratio and commonly referred to as the w/cm ratio. The w/cm ratio is a modification of the historical water-cement ratio (w/c ratio) that was used to describe the amount of water, excluding what was absorbed by the aggregates, to the amount of the portland cement by weight in concrete.

The ease of mixing, placing, consolidating and finishing concrete is called workability. The water content of the mixture is the single most important factor that affects workability. Other important factors that affect workability include: mix proportions, characteristics of the coarse and fine aggregates, quantity and characteristics of the cementitious materials, entrained air, admixtures, slump (consistency), time, air and concrete temperatures.

2. OBJECTIVES OF THE RESEARCH

The main objective of this investigation is

1. To study the behavior as well as properties of concrete in fresh and hardened state.
2. To study the effect of Waste water on the workability of concrete.
3. To study the compressive strength of concrete casted with potable water and also with reclaimed waste water.

3. STATEMENT OF THE PROBLEM

Wastewater produced at ready-mixed concrete plants from the cleaning of the concrete truck's drum has recently been banned from direct disposal to ground or surface waters. Recent environmental regulations require ready-mixed concrete plants to manage and contain wastewater by the use of a reclamation system until it is environmentally acceptable for discharge.. The objective of this study was to investigate water quality standards and the possibility of reusing concrete wastewater as aggregate irrigation and/or batch mixing water in the production of fresh concrete. The project included the following: (1) Surveys of state highway agencies and Florida ready-mixed concrete producers to determine national and state regulations and practices concerning wastewater reuse; (2) A water analysis of Type I and Type II wastewater produced at ready-mixed concrete plants in Florida to determine chemical and physical properties considered to be problematic; and (3) A two phase fresh and hardened concrete test program to determine the effects of Type II wastewater on concrete properties when used as 1) aggregate irrigation water and 2) aggregate irrigation water and batch water. The results indicate that Type II wastewaters used in this study, which did not meet FDOT water quality specifications (Section 923 - Water for Concrete), but did comply with the water quality standards of AASHTO M 157 (Standard Specification for Ready-Mixed Concrete), has no detrimental effects on concrete properties.

4. LIMITATIONS OF THE STUDY

Based on the data produced during this project, it is recommended that the FDOT water quality specification be supplemented to address the use of Type II wastewater as aggregate irrigation and/or batch mixing water in the production of fresh concrete. Type II wastewater shall be tested for compliance with the requirements established by AASHTO M 157 which sets limits on the amount of sulfate, chloride ion, total solids, and total alkalies, as Na2O equivalent, for water used in concrete.

5. RESEARCH METHODOLOGY

IS 3025[5] recommended that, testing of water play an important role in controlling the quality of cement concrete work. Systematic testing of the water helps to achieve higher efficiency of cement concrete and greater assurance of the performance in regard to both strength and durability. Wateris susceptible to being changed due to physical, chemical or biological reactions which may take place between at the time of sampling and analyzing. Hence it is necessary to test water before used for cement concrete production. Samples should be collected, as far as possible, from midstream at mid depth, Sites should be selected such That marginal changes inwater observed with naked eyes, where there are major river discharges or obstructions occurred, sample from 100maway of the discharge point in downstream side is taken for small streams.In case of long length river there should be at least three fixed sampling locations along the cross-section.Sampling locations can be fixed with reference to significant features In case of waste water form sewersand narrow effluent channels, samples should be drawn from one third water depths from the top without skimming the top or scrapping the bottom. Velocity of flow at the sampling point should be sufficient to prevent the deposition of solids. Sample should be drawn gently without causing aeration or liberation of dissolved gases. In most cases, sewage flows are intermittent and hence collection of sample at every hour is necessary. Waste waters usually decompose rapidly at room temperature, therefore, certain test setups, such as dissolved oxygen, sulfides, residual chlorine, nitrite and pH should be fixed atsite. For certain other tests, preservatives should be added immediately to individual sample.

6. CONCEPTUAL RESEARCH MODEL

SLUMP TEST:

Slump test is the most commonly used method of measuring consistency of concrete which can be employed either in the laboratory or at site of work. It is not a suitable method for very wet concrete or very dry concrete. It does not measure all factors contributing to workability nor is it always representative of the placability of the concrete. However it is used conventionally as a control test and gives an indication of uniformity of concrete from batch to batch.

Bottom diameter : 20cm

Top diameter : 10cm

Height : 30cm

COMPACTION FACTOR TEST:

It is sensitive than the slump test and is particularly useful for concrete mixes of very low workability as are normally used when concrete is to be compacted by vibration. . The trap-door is opened so that the concrete falls into the lower hopper. Then the trap-door of the lower hopper is opened and the concrete is allowed to fall into the cylinder. The excess concrete remaining above the top level of the cylinder is then cut off with the help of plane blades supplied with the apparatus. The outside of the cylinder is wiped clean. The concrete is filled up exactly upto the top level of the cylinder. The weight is known as weight partially compacted concrete.

$$\text{The Compaction Factor} = \frac{\text{Weight of partially compacted concrete}}{\text{Weight of fully compacted concrete}}$$

FLOW TABLE TEST:

Equipment & apparatus:

▪ Flow table

▪ Frustum

Procedure:

1. Before commencing test, the table top and inside of the mould is to be wetted and cleaned of all gritty material and the excess water is to be removed with a rubber squeezer.

2. The mould is to be firmly held on the centre of the table and filled with concrete in two layers, each approximately one-half the volume of the mould and rodded with 25 strokes with a tamping rod, in a uniform manner over the cross section of the mould.

3. After the top layer has been rodded, the surface of the concrete is to be struck off with a trowel so that the mould is exactly filled.

4. The mould is then removed from the concrete by a steady upward pull.

5. The table is then raised and dropped from a height of 12.5 mm, 15 times in about 15 seconds.

6. The diameter of the spread concrete is the average of six symmetrically distributed caliper measurements read to the nearest 5 mm.

7. RESULTS AND DISCUSSION

Grade of concrete	Type of water	Flow value
M20	Normal water	358
	Waste water	206
M25	Normal water	85
	Waste water	636

The flow of the concrete is the percentage increase in diameter of spread concrete over the base diameter of the moulded concrete, calculated from the following formula.

$$\text{Flow}(\%) = \frac{\text{Spread dia.(cm)} - 25}{25} \times 100$$

8. MAJOR FINDINGS

pH VALUE: pH measurements are important in agronomy, medicine, biology, chemistry, agriculture, forestry, food science, environmental science, oceanography, civil engineering, chemical engineering, nutrition, water treatment and water purification, as well as many other applications. pH Value of Normal water - 6.67, pH Value of Waste water - 7.23

ELECTRICAL CONDUCTIVITY:

Conductivity is a measurement of the ability of an aqueous solution to carry an electrical current. An ion is an atom of an element that has gained or lost an electron which will create a negative or positive state. For example, sodium chloride (table salt) consists of sodium ions (Na+) and chloride ions (Cl-) held together in a crystal. In water it breaks apart into an aqueous solution of sodium and chloride ions. This solution will conduct an electrical current.

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Electrical conductivity of normal water- 830 ms

Electrical conductivity of waste water- 1447 ms

9. CONCLUSION

This research was carried out to investigate the effect of different type of normal water and treated waste water on properties of concrete especially compressive strength. The study analyzed the quality of some water samples. Then tests were conducted on concrete made with the water samples. particular attention was focused on treated waste water for concrete mix. On replacement of fresh water with treated waste water. We found that on increasing the composition of treated waste water strength compressive goes on increasing with further increase in treated waste water composition. The compressive strength M20 mix for 7 days increases from 23.34 N/mm2 to 27N/mm2 and for M20mix for 28 days increases from 16.84N/mm2 to 29.54N/mm2. The compression strength for M25 mix for 7 days increases from 17N/mm2 to 25N/mm2 and for 28 days it increases from 28.03N/mm2 to 37.88N/mm2. It is found that although the strength increases but the obtained strength is within the acceptable limits. And also the cost of construction also increases as we are using treated waste water.

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