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Features

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Waste Water Recycling Study

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A study was conducted into the quality of recycled water at a ready-mix concrete plant to determine its suitability as mixing water for concrete. Concrete mixes made with different mix designs Recycled water was used to replace municipal water at various proportions of 0, 50 and 100%, then used as mix water. Tests were done on fresh and hardened concretes The chemical impurities present in the recycled water satisfied the limits given in ASTM C1602 for mix water. The use of recycled water as mix water led to a slight reduction in slump of Concrete, affected, and compressive strengths increased with a rise in the proportional amount of recycled water used in the mix.

It was found that recycled water from ready-mix concrete plants can be suitable for use as mix water in concrete-making.

Technical:

Water of questionable suitability can be used for making concrete if the concrete performance and the water characteristics meet the limits.

The acceptance criteria of using waste water in concrete mix according to ASTM C1602/C1602:

	Limits
Compressive strength, min % control at 7 days[A,B]	90
Time of set, deviation from control, h: min[A]	From 1:00 early to 1:30 later

Maximum Concentration in Combined Mixing Water, ppm[B]	Limits
A.Chloride as Cl^-, ppm	
1- In prestressed concrete, bridge decks, or otherwise designated	500[C]
2- Other reinforced concrete in moist environments or containin aluminum embedments or dissimilar metals or with stay-in-place galvanized metal forms	1000[C]
B. Sulfate as SO_4, ppm	3000
C. Alkalies as (Na_2O + 0.658 K_2O), ppm	600
D. Total solids by mass, ppm	50,000

Experimental:

Trial mixes has been conducted to show how the concrete properties are affected when waste water mix is used. With three different mix designs each one has three trial mixes 100% sweet water, 100% waste water and mix of 50% sweet water and 50% waste water.

Effect of Recycled Water on Properties of Fresh Concrete:

• **Slump:** The slump results are low but this is understandable since the waste water would have more fine particles that will reduce the slump results. As shown in Figure (1).

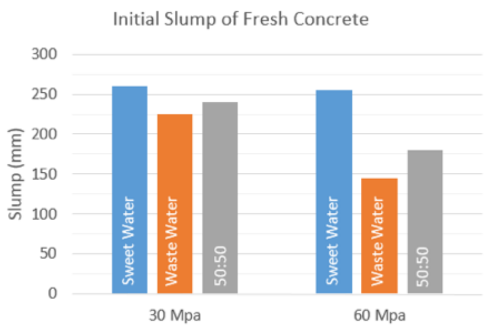


Figure 1: Initial slump results.

• **Temperature:** There is no significance change on the temperature when waste water is used or mixed with sweet water.

Effect of Recycled Water on Hardened Concrete Properties:

• **Compressive strength:** The compressive strength results were equal or greater than 90% of the strength of control specimens made using pure water. As shown in Figure (2).

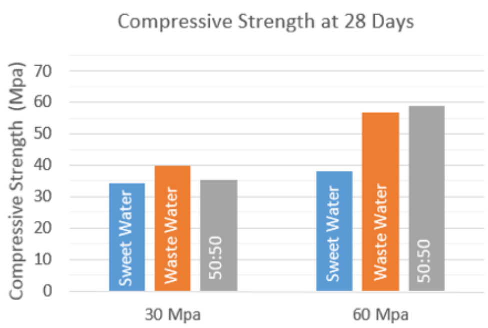


Figure 2: Compressive strength results.

• **Durability:** The surface resistivity results show that there is no effect on the concrete durability.

Chemical analyses of recycled water:

The analyses of recycled water and municipal water are reported in Table 1. The values obtained for recycled water satisfy the maximum limits set out in ASTM C1602 except for alkalis.

	100% Sweet water	100% Wastewater	50:50	70:30
(TDS)	150	7,280	3,715	2,289
Chloride	50	779	414.5	268.7
Sulphate	4.59	250	127.3	78.2
Alkalis	190	990	590	430

Conclusion:

Based on the results of this investigation, the following conclusions on the use of recycled water from ready-mix concrete plants can be made:

- All the concrete mixes achieved at least 90% of the strength of the control, with some results equaling or exceeding the strength of the control mix.
- A trend showing some visible loss in workability and an increase in unit weight was observed when recycled water was used.
- The setting times of concretes were prominently reduced by the use of recycled water.

Tests Method for Indication of Concrete Ability to Resist Chloride Ion Penetration

Ahmad Nagro

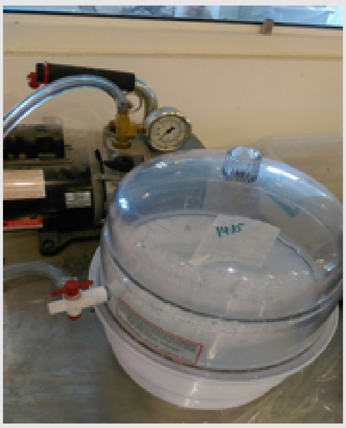
The construction industry accepts Rapid Chloride Permeability Test (RCP) (AASHTO T 277 and ASTM C1202) as measurement for determining chloride permeability. In practice RCP has evolved to applications such as quality control and acceptance testing. Rapid Chloride Permeability Test (RCP) can give great values for the producer and associated acceptance criteria for the delivered product. Moreover, there are alternative tests to the RCP test which is resistivity testing to measure electrical resistivity of concrete such as surface resistivity (SR) (AASHTO TP 95) and Bulk Resistivity.

Scope:

The RCP test is determination of the electrical conductance of concrete to provide a rapid induction of resistance to the penetration of chloride ions. The electrical current is applied to the concrete specimen to increased and accelerated the rate of chlorides to get into concrete.

(RCP) apparatus:

RCP Test device with 4 Port



Vacuum pump, Moisture trap

Plexiglass chambers - 4 pairs

Temperature probe

(RCP) Test procedure:

The test method must have a 100-mm diameter cylinder sample from the concrete being tested. Cut a 50-mm specimen from the sample. Then, the side of the cylindrical specimen is covered with epoxy and put in a vacuum chamber for 3 hours. It is then place the cylindrical specimen in the plexiglass chambers and fill left-hand side (–) of the test cell with a 3% NaCl solution and fill the right-hand side (+) of the test cell with 0.3N NaOH solution. The system is then connected and a 60-volt potential is applied for 6 hours. Readings are taken every 30 minutes. At the end of 6 hours the sample is removed from the cell and the number of coulombs passed through the specimen is calculated.

Chloride Penetration	Rcp Test Result of Charge Passed (Coulombs)	Typical of
High	>4000	High W/C ratio (>0.60) conventional PCC
Moderate	2000 – 4000	Moderate W/C ratio (0.40–0.50) conventional PCC
Low	1000 - 2000	Low W/C ratio (<0.40) conventional PCC
Very Low	100-1000	Latex-modified concrete or internally-sealed concrete
Negligible	<100	Polymer-impregnated concrete, Polymer concrete

On the other hand, there is alternative to the RCP test which is Surface Resistivity Test (SR) (AASHTO TP 95). Surface resistivity test is easier, doesn't need any specimen preparation, better precision, and faster to run than the RCP. With these advantages (SR) is significant cost savings. You can classify mixtures with chloride penetrability either on resistivity or charged passed by AASHTO TP 95 or ASTM C1202 on the following table:

Chloride Penetration	SR Test Result, AASHTO TP 95 (Kohm- cm)	RCP Test Result, ASTM C1202 (Coulombs)
High	>12	>4000
Moderate	12– 21	2000 - 4000
Low	21 - 37	1000 - 2000
Very Low	37-254	100 - 1000
Negligible	>254	<100

Bulk resistivity (BR) (ASTM C1760) is for Bulk Electrical Conductivity of Hardened Concrete. The (BR) test uses the RCP test setup and sample preparation but uses a single measurement after voltage is applied for only one minute. For best results, bulk resistivity test should be conducted before conducting RCP test.

Chloride Penetration	BR Test Result, ASTM C1760 (Kohm- cm)	RCP Test Result, ASTM C1202 (Coulombs)
High	<5	>4000
Moderate	5 - 10	2000 - 4000
Low	10 - 20	1000 - 2000
Very Low	20 - 200	100 - 1000
Negligible	>200	<100

Electrical resistance and conductivity are both characteristic properties of materials that can be assessed for the durability of concrete. There is a solid connection between electrical resistivity and permeability of concrete, which is the main factor in the long term durability of concrete.