The Importance of Water Quality in the Concrete Mix

Above
Poor quality water could affect the quality of concrete.

John Roxburgh, a senior lecturer at the School of Concrete Technology of Cement and Concrete SA (CCSA), says this could mean that concrete producers will come under increased pressure to use water from sources other than municipal tap water in the future.

The quality of concrete may be affected by using poor quality water. Roxburgh here discusses some of the effects of using water containing sufficient quantities of impurities.

He says likely consequences could include:

·Alteration of the setting times
·Increase in water demand
·Entraining of excessive air
·Change in the strength gain characteristics
·Degradation of the hardened concrete
·Corrosion of the reinforcement within the concrete
·Staining, and
·Production of efflorescence.

Mixing water makes up about 8% of the total mass of concrete. So, the proportion of impurities in the water compared to the cement mass is typically very low.

For example, 2 000 mg/ℓ of total dissolved solids (TDS) in water equates to about 400g of material per cubic meter of concrete, compared with 300 to 400kg of cement. So often, these impurities have very little to no effect on the hardened concrete.

However, non-potable water should continuously be assessed for suitability for use as mixing water in concrete. The limits to the quantities of impurities in the water should always be checked against the South African National Standards (SANS 51008), which contains specifications for sampling, testing, and assessing the suitability of water for concrete production.

> In early 2018, Cape Town came dangerously close to ‘day zero’ - a term for the day that the taps would run dry in residential areas of the city. This threat now hangs over parts of the Eastern Cape. It could become a more common occurrence nationally in the future due to South Africa’s limited resources of good quality water.

Roxburgh says that when assessing the suitability of water of unknown quality, both the composition of the water and proposed application of the concrete should be considered. In general, the suitability of water for concrete depends on its origin. following types could be encountered:

Potable water is suitable for use in concrete and needs no testing.

Water recovered from processes in the concrete industry will generally be suitable but must conform to SANS 51008.

Water from underground sources may be suitable but must also be tested and assessed following the requirements of SANS 51008.

Natural surface water and industrial wastewater may be suitable for use in concrete, but here also needs testing in terms of SANS 51008.

Below:
Seawater may be used for concrete – but only when it will not contain steel reinforcement or other embedded metal.

Seawater or brackish water may be used for concrete that will not contain steel reinforcement or other embedded metal. For concrete with steel reinforcement, or embedded metal, the permissible total chloride content in the concrete is the determining factor.

Sewage water is not suitable for use in concrete.

Some common substances deleterious to concrete and found in water are chlorides, sulphates, alkalis, humic matter, oil, algae, sugar, and detergents. There are many more, and SANS51008 should be consulted.

"Water for use in concrete must conform to the requirements for preliminary assessment and also chloride, sulphate, and alkali contents. The water must also conform to either the chemical requirements for harmful contamination or the requirements for setting time and compressive strength," Roxburgh adds.

The water must be examined and, if not conforming to one or more of the requirements mentioned, may be used only if it meets the requirements for setting time and strength.

Requirements for a preliminary inspection of mixing water concerning the item listed below:

1.Oils/fats - No more than visible traces.
2. Detergents - Any foam should disappear within two minutes.
3. Colour - Water not recovered from processes in the concrete industry. The color must be assessed qualitatively as pale yellow or paler.
. Suspended matter - Water from processes in the concrete industry (see SANS 51008). Water from other sources: Maximum 4 mℓ sediment.
5. Odour - Water from processes in the concrete industry: There must be no smell, except the odor allowed for potable water and a slight smell of cement. Where blast furnace slag is present in the water, a slight smell of hydrogen sulphide is acceptable.
Water from other sources: There must also be no smell, except the odor allowed for potable water. No smell of hydrogen sulphide after the addition of hydrochloric acid is acceptable.
. Acids - The pH level must be greater than or equal to 4.
7. Humic matter - The color must be assessed qualitatively as yellowish-brown or paler after the addition of NaOH.

The maximum chloride content of mixing water allowed:
Pre-stressed concrete or grout - 500
Concrete with reinforcement or embedded metal - 1 000
Concrete without reinforcement or embedded metal - 4 500.

The sulphate content of the water must not exceed 2 000 mg/ℓ. This limit should continuously be assessed with regards to sulphate content within the aggregate and cement.

Above
John Roxburgh, senior lecturer at the School of Concrete Technology.

"Concrete producers will come under increased pressure to use water from sources other than municipal tap water in future," John Roxburgh warned.

"If alkali-reactive aggregates are expected to be used in the concrete, the water must be tested for its alkali content. If high, the water may be used only if it can be shown that actions have been taken to prevent deleterious alkali-silica reactions," Roxburgh explains.

Regarding harmful contamination, firstly qualitative tests for sugars, phosphates, nitrates, lead and zinc must be carried out. If the qualitative tests are not performed or show a positive result, either the quantity of the substance concerned must be determined or tests for setting time and compressive strength must be performed.

The initial setting time obtained on specimens made with the unknown water must not be under an hour and not differ by more than 25% from the initial setting time of specimens made with distilled or de-ionized water.

The final setting time must not exceed 12 hours and not differ by more than 25% from the last setting time obtained on specimens made with distilled or de-ionized water.

The mean compressive strength at seven days of the concrete, or mortar specimens prepared with the water, must be at least 90% of the mean compressive strength of corresponding specimens prepared with distilled or de-ionized water.

When sampling water, volumes of at least five liters must be used, taking the possible effects of seasonal fluctuations into consideration. The water must be tested within two weeks of sampling.

SANS 51008 also provides test methods for the tests required, applicable frequencies for testing, and detailed requirements for the use of water recovered from processes in the concrete industry.