1.8 QUALITY OF WATER FOR USE IN CONCRETE

Water used for mixing and curing should be free from oil, acid and alkali, salts and organic material. It should be potable and concreting generally requires a value purer than that of drinking. Whenever there is uncertainty in quality, water should be tested before use. Even chlorine added for city water supply will affect concrete if used carelessly without proper testing and treatment. If well water is used for construction, it must be tested for impurities.

A popular yard-stick to the suitability of water for mixing concrete is that, if water is fit for drinking it is fit for making concrete. This does not appear to be a true statement for all conditions. Some waters containing a small amount of sugar would be suitable for drinking but not for mixing concrete and conversely water suitable for making concrete may not necessarily be fit for drinking.

Some specifications require that if the water is not obtained from source that has proved satisfactory, the strength of concrete or mortar made with questionable water should be compared with similar concrete or mortar made with pure water. Some specification also accept water for making concrete if the pH value of water lies between 6 and 8 and the water is free from organic matter.

Instead of depending upon pH value and other chemical composition, the best course to find out whether a particular source of water is suitable for concrete making or not, is to make concrete with this water and compare its 7 days ‘and 28 days ‘strength with companion cubes made with distilled water.

If the compressive strength is upto 90 per cent, the source of water may be accepted. This criteria may be safely adopted in places like coastal area of marshy area or in other places where the available water is brackish in nature and of doubtful quality. However, it is logical to know what harm the impurities in water do to the concrete and what degree of impurity is permissible is mixing concrete and curing concrete.

Carbonates and bi-carbonates of sodium and potassium effect the setting time of cement. While sodium carbonate may cause quick setting, the bicarbonates may either accelerate or retard the setting. The other higher concentrations of these salts will materially reduce the concrete strength. If some of these salts exceeds 1,000 ppm, tests for setting time and 28 days strength should be carried out. In lower concentrations they may be accepted.

Brackish water contains chlorides and sulphates. When chloride does not exceed 10,000 ppm and sulphate does not exceed 3,000 ppm the water is harmless, but water with even higher salt content has been used satisfactorily. Salts of Manganese, Tin, Zinc, Copper and Lead cause a marked reduction in strength of concrete. Sodium iodate, sodium phosphate, and sodium borate reduce the initial strength of concrete to an extra-ordinarily high degree. Another salt that is detrimental to concrete is sodium sulphide and even a sulphide content of 100 ppm warrants testing.

Silts and suspended particles are undesirable as they interfere with setting, hardening and bond characteristics. A turbidity limit of 2,000 ppm has been suggested. The initial setting time of the test block made with a cement and the water proposed to be used shall not differ by ±30 minutes from the initial setting time of the test block made with same cement and distilled water.

- **Chlorides:** They can cause corrosion of steel reinforcement, can accelerate setting. The water used may be contaminated with chlorides because of seawater, some admixtures, salts or deliberate chlorination for disinfections.
- **Sulphates:** They reduce long-term strength levels.

Impurity		Tolerable Concentration
Sodium and potassium carbonates and bi-carbonates	:	1,000 ppm (total). If this is exceeded, it is advisable to make tests both for setting time and 28 days strength
Chlorides	:	10,000 ppm.
Sulphuric anhydride	:	3,000 ppm
Calcium chloride	:	2 per cent by weight of cement in non-pre-stressed concrete
Sodium iodate, sodium sulphate, sodium arsenate, sodium borate	:	very low
Sodium sulphide	:	Even 100 ppm warrants testing
Sodium hydroxide	:	0.5 per cent by weight of cement, provided quick set is not induced.
Salt and suspended particles	:	2,000 ppm. Mixing water with a high content of suspended solids should be allowed to stand in a s ettling basin before use.
Total dissolved salts	:	15,000 ppm.
Organic material	:	3,000 ppm. Water containing humic acid or such organic acids may adversely affect the hardening of concrete; 780 ppm. of humic acid are reported to have seriously impaired the strength of concrete. In the case of such waters there- fore, further testing is necessary.
pH	:	shall not be less than 6

Tolerable Concentrations of Some Impurities in Mixing Water

The following guidelines should also be taken into consideration regarding the quality of water.

- To neutralize 100 ml sample of water using phenopthaline as an indicator, it should not require more than 5 ml of 0.02 normal NaOH.
- To neutralise 100 ml of sample of water, using mixed indicator, it should not require more than 25 ml of 0.02 normal H_2SO_4

Permissible limit for solids as per IS 456 of 2000

Material	Tested as per	Permissible limit Max.
Organic	IS 3025 (pt 18)	200 mg/l
Inorganic	IS 3025 (pt 18)	3000 mg/l
Sulphates (as So_3)	IS 3025 (pt 24)	400 mg/l
Chlorides (as Cl)	IS 3025 (pt 32)	2000 mg/l for concrete work not containing embedded steel and 500 mg/l for reinforced concrete work
Suspended	IS 3025 (pt 17)	2000 mg/l

Algae in mixing water may cause a marked reduction in strength of concrete either by combining with cement to reduce the bond or by causing large amount of air entrainment in concrete. Algae which are present on the surface of the aggregate have the same effect as in that of mixing water.