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Codal Provisions for Quality of Water for Construction

Mandar M. Joshi[1], Dr. S. K. Deshmukh[2]
[1] *Asst.Professor, Civil Engg Dept, PLIT, Buldana, MH, India*
[2] *Principal, COETA, Akola, MH, India*

ABSTRACT

Concrete is a chemically combined mass which is manufactured from binding materials and inert materials with water. It is most popular construction material due to its unique durability and reasonable strength; more interestingly can be modified and designed for wide range of strength requirements and set under variable environmental conditions. Cement is the most important material of concrete which is produced at the cost of environmental emission of CO_2. So such an energy intensive materials constitutes concrete which may be seriously affected by (both strength and durability point of view) by relatively available and cheap but essential element water; more precisely impurities in water. Quality of mixing water is mainly considered for performance of concrete in both fresh and hardens state. Impurities in mixing water intervene the setting time of the paste and may produce detrimental effect on strength and durability of concrete also. When impurities are chemically active, they may take part in the chemical reaction contributing significant change in setting, hardening and development of strength of concrete. More over health hazard during handling this water should carefully considered. In this regard past performance of a particular source of water can be used to evaluate suitability of water; if not available, some testing inevitable to evaluate water for setting time, compressive strength and durability. This paper reveals different countries codal provisions for requirement for water for construction.

***Keyword** - Concrete, water quality, sustainability, mixing water, impurities*

1. INTRODUCTION

The common specifications regarding quality of mixing water is water should be fit for drinking. Such water should have inorganic solid less than 1000 ppm. This content lead to a solid quantity 0.05% of mass of cement when w/c ratio is provided 0.5 resulting small effect on strength. But some water which are not potable may be used in making concrete with any significant effect. Dark color or bad smell water may be used if they do not posses deleterious substances. P^H of water to even 9 is allowed if it not tastes brackish. In coastal areas where local water is saline and have no alternate sources, the chloride concentration up to 1000 ppm is even allowed for drinking. But this excessive amount of alkali carbonates and bicarbonates, in some natural mineral water, may cause alkali-silica reaction. Besides potable water, various new and existing sources are available for mixing water which can be used for complete and partial replacement of valuable potable water.

This includes

- Ground water
- Reclaimed water
- Treated water from municipal sewer
- Waste water of ready-mix concrete plant etc.

In many regions of the world there have scarcity of water and the local authorities are looking for new sources and reused water. There treated water are used for agricultural requirements and daily needs for construction industry. like washing aggregates, as concrete mixing water and curing of the same. Water from river and sometimes even sea are considered suitable if it is free from brackish matter. In arid regions, brackish groundwater is mixed with desalinated water and considered suitable for concrete production and for concrete slurry too.

In addition to testing on constituent of concrete like aggregate cementitious materials and admixtures etc., testing of water is an important part of quality control of concrete. A systematic testing schedule for water testing yields higher efficiency of concrete and assure good performance in regard of strength and durability.

Important thing to remember is that water can be changed by chemical, physical or biological reactions; such modification may occur during sampling and at the time of analyzing. So it should be tested before using in concrete.

A simple way of determining the suitability of such water is to compare the setting time of cement and the strength of mortar cubes using the water in question with the corresponding results obtained using known suitable or distilled

water. About 10% tolerance is generally allowed. Such tests are recommended when water for which no service record is available containing dissolved solids in excess of 2000 ppm or, in excess of 1000 ppm. When unusual solids are present a test is also advisable.

1.1 General considerations

Suspended Solids

Mixing water with high content of suspended solids should be allowed to stand in a setting basing before use as it is undesirable to introduce large quantities of clay and slit into the concrete.

Acidity and Alkalinity

Natural water that are slightly acidic are harmless, but presence of humic or other organic acids may result adverse affect over the hardening of concrete. Water which are highly alkaline should also be tested.

Algae

The presence of algae in mixing water causes air entrainments with a consequent loss of strength. The green or brown slime forming algae should be regarded with suspicion and such water should be tested carefully.

Sea Water

Sea water contains a total salinity of about 3.5% (78% of the dissolved solids being NaCl and 15% $MgCl_2$ and $MgSO_4$), which produces a slightly higher early strength but a lower long-term strength. The loss of strength is usually limited to 15% and can therefore be tolerated. Sea water reduces the initial setting time of cement but do not effect final setting time.

Chloride

Water containing large amount of chlorides tends to cause persistent dampness and surface efflorescence. The presence of chlorides in concrete containing embedded steel can lead to its corrosion.

Moisture Content of Aggregate

Aggregate usually contains some surface moisture. Coarse aggregate rarely contains more than 1% of surface moisture but fine aggregate can contain in excess of 10%. This water can represent a substantial proportion of the total mixing water indicating a significant importance in the quality of the water that contributes surface moisture in aggregate.

Lead

Samples having high concentration of lead lost significant strength with a significant increase in setting time of cement in mortar. However, a marginal increase in setting time and compressive strength was found at a concentration of 2000 mg/liter.

1.2 Different Codal Provisions

IS 3025 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. Water is 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 in water 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

AS 1379 recommended that, mixing water shall be drawn from a source of acceptable quality. Acceptable quality of water is, water from ready mix concrete plant in washout operations, may be used as mixing water if it is stored such as to prevent contamination by deleterious matters to concrete and the water drawn from the storage outlet

ASTM C94 recommended that, mixing water comprises, water and ice added to the batch, water occurring as surface moisture on the aggregates and, in the case of truck mixers, any wash water retained in the drum for use in the next batch of concrete. Water shall conform to ASTM C1602, which defines sources of water and provides requirements and testing frequencies for qualifying individual or combined water sources. In any case where the requirements of the owner differ from the specifications, the owner‘s specification shall be provided. ASTM C94 permits the use of non-potable water or water from concrete production operation in ready mix concrete plant, the limits qualified to meet the requirements and optional limits summarized in code

EN 1008 recommended the requirements for water, suitable for making concrete conforming to EN 206-1 and describes methods for assessing its suitability. This standard considers, the use of potable water, water recovered from processes in the concrete industry, water from underground sources, natural surface and industrial waste water for reinforced concrete, and seawater or brackish water for production of concrete without reinforcement or with

other embedded metal. Sewage water is not suitable for production of concrete. The requirements for water are summarized in standard comprising preliminary assessment, chemical properties, setting time and strength development. Standard provides specific requirements for the use of water recovered from processes in the concrete industry.

1.3 Comparison of values from different standards.

Table -1 Comparison of values from different standards

Parameter	Standards				
	IS456-2000	IS 3025 - Part17,24	AS 1379	ASTM C94, C1602M	EN 1008
pH value	≥6.0		>5.0		≥4.0
Suspended solid matter		≤2000 mg/L	-	≤50,000 mg/L	≤1% of total aggregate
SO_4		400 mg/L	≤500 mg/L of cement	≤3000 mg/L	≤2000 mg/L
Cl– content		≤2000mg/L	≤800 mg/L	≤1000 mg/L	≤ 1000 mg/L

2. CONCLUSIONS

Different countries have their own design standards, limits for various paprameters.The ranges of values is sometimes very large. Income standards limiting values for some of the parameters are not defined. The variations in values may be due to various reasons like environmental conditions, atmosphere, cement and other concrete ingredients properties, water quality etc. The water used for concrete making should be well tested before use. The values of different parameters should be within limits. If the water available is not found suitable then suitable admixtures should be used to maintain the limiting values.

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