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## 4 WATER

### 4.1 GENERAL

#### 4.1.1 Scope

1 This Part includes water used for concrete mixtures, washing of aggregates and equipment, wetting of surfaces or ponding during curing or for wetting formwork and washing reinforcement.

2 Related Sections and Parts are as follows:

This Section

Part 2,..... Aggregates

Part 6,..... Property Requirements

Part 9,..... Formwork

Part 10,..... Curing

Part 11,..... Reinforcement

#### 4.1.2 References

1 The following standards are referred to in this Part:

ASTM C109.....test Method for Compressive Strength of Hydraulic Cement Mortars  
(using 2-in or 50 mm Cube Specimens)

BS 1377.....Methods of test for soils for civil engineering purposes.

BS 2690.....Methods of testing water used in industry

BS 6068.....Water quality

EN 196-1 .....Determination of strength

EN 196-2 .....Methods of testing cement - Part 2: Chemical analysis of cement

EN 196-3 .....Determination of setting time and soundness

EN 1008 .....Mixing water for concrete, Specification for sampling, testing and assessing the suitability of water, including water recovered from processes in the concrete industry, as mixing water for concrete

ISO 7890 .....Water quality -- Determination of nitrate -- Part 1: 2,6-Dimethylphenol spectrometric method

ISO 9297 .....Water quality — Determination of chloride — Silver nitrate titration with chromate indicator (Mohr's method)

ISO 9963-1 .....Determination of total and composite alkalinity

ISO 9963-2 .....Determination of carbonate alkalinity

SM 5220 B .....Chemical Oxygen Demand (COD)

SM 4500 .....Standard Methods for the Examination of Water and Wastewater

SM 3125B (ICP/MS)....Metals by Inductively Coupled Plasma/Mass Spectrometry

## 4.2 QUALITY OF WATER

### 4.2.1 General

- 1 Potable water is suitable for use in concrete, while water of other origin such as underground water, natural surface water, recovered water, as well as municipal treated water or mixed water shall be tested to prove that its quality shall conform to water quality requirements as given below in 4.3.
- 2 On site, where a permit is issued for Municipal Treated Effluent use for concrete, the effluent shall be treated by tertiary treatment stage: Reverse Osmosis (R.O.), and disinfection (Ultraviolet Radiation, or ozonation).
- 3 The water shall be examined in accordance with the test procedures stated in Table 1, EN 1008. Water not conforming to one or more of the requirements in Table 1, EN 1008 may be used only, if it can be shown to be suitable for use in concrete, in accordance with the physical tests of Table 1 below.
- 4 The site health and safety services and Treated Effluent Quality shall fulfil the requirements of 5

### 4.2.2 pH of Water

- 1 The pH of water used in concrete works shall be as shown in Table 4.2.

### 4.2.3 Permissible Temperatures

- 1 Temperature of water for concrete shall not be less than 5 °C and not more than 40 °C
- 2 Water may be cooled to not less than 5 °C by the gradual addition of chilled water or ice as follows:
  - (a) no ice particles shall be present in the mix
  - (b) alternatively, flaked ice may be used
  - (c) ice to be used shall be crushed and shall be a product of frozen water which complies with the acceptance criteria of Tables 4.1 and 4.2 and 4.3.
- 3 Every effort should be made to protect water pipes and tanks from the sun; e.g., burying, shading, insulation or painting white.

### 4.2.4 Supply and Storage

- 1 The Contractor shall make his own arrangements and obtain the approval of the Engineer for the supply of water.
- 2 Storage of water should be such that contamination is prevented from occurring. Any measures taken to avoid contamination of the water shall be to the approval of the Engineer.

## 4.3 TESTING AND SAMPLING

- 1 Whenever required to do so by the Engineer, the Contractor shall take samples of the water being used, or which it is proposed to use, for mixing concrete and test them for quality.
- 2 Samples of water of not less than 5 l shall be taken, sealed and sent for testing at an approved independent laboratory, prior to the approval of any water source, and whenever the sources of water is changed periodically during the continuance of its use.
- 3 Water of questionable quality should comply with the physical tests of Table 4.1 and chemical limitations listed in Table 4.2 & Table 4.3.
- 4 No source of water shall be used until the required tests have demonstrated its suitability for concreting.

- 5 The use of water from a municipal or government supply does not preclude the requirement for testing.

Table 4.1  
Acceptance Criteria and Physical Tests for Mixing Water

	Test Method	Limits
Compressive strength at 7 d, min % of control	EN 196-1	90 %
Setting time, max. deviation from control, (h:min)	EN 196-3	from 1:00 early to 1:30 later

Table 4.2  
Chemical Limitations for Mixing Water

Parameter	Test Method	Maximum Limit, mg/l
(a) Chloride (as Cl) (a-1) for Prestressed concrete. (a-2) for reinforced concrete. (a-3) for concrete without reinforcement.	BS 6068-1.37 (ISO 9297)	500 1000 4500
(b) Sulphates (as $\text{SO}_4^{2-}$ )	EN 196-2	2000
(c) Alkali (c-1) Alkali carbonates and bicarbonates (c-2) Alkali equivalent sodium oxides	BS 6068-2.51 ISO 9963-1 ISO 9963-2 EN 196-2	500 1500
(d) Total dissolved ions, including a, b and c above (d-1) for prestressed concrete (d-2) reinforced concrete. (d-3) for concrete without reinforcement.	BS 1377 : Part 3	1000 2000 5000
(e) pH	BS 6068-2.50	6.5 - 9.0

Table 4.3  
Maximum limit of Harmful Contaminants

Parameter	Test Method	Maximum Limit, mg/l
COD	SM 5220 B	50
Phosphate; expressed as $\text{PO}_4 - \text{P}$	SM 4500 P B, C, SM 4500 PD by subtraction	30
Nitrate; expressed as $\text{NO}_3^- - \text{N}$	ISO 7890-1	100
Lead; expressed as $\text{Pb}^{2+}$	SM 3125B (ICP/MS)	100
Zinc; expressed as $\text{Zn}^{2+}$	SM 3125B (ICP/MS)	100

SM: Standards Methods for the Examination of Water and Wastewater.

#### 4.3.2 Health and Safety

- 1 On site, where a permit is issued for Municipal Treated Water use in construction works, the effluent should be treated by tertiary treatment stage including filtration and disinfectant (Chlorine alone, or Ultraviolet Radiation, or ozonation). Furthermore, the following site health and safety services and the Treated Effluent Quality shall be fulfilled:
  - (a) Residual chlorine level shall be within the range of 0.5 – 1.0 mg/l. For water to be used for concrete, the disinfectant shall be Ultraviolet Radiation, or ozonation.
  - (b) Coliform level shall fulfil one of the following:
    - (i) Fecal Coliform < 200 CFU/100 ml, in case there is no direct exposure on site labour.
    - (ii) Total Coliform < 23 CFU/100 ml, in case there is direct exposure on site labour.
  - (c) The site shall be facilitated by health and safety guidelines signs, where it is indicated by Arabic, English, and any other languages where there are 5 workers or more on the site, that “Water not for Human Consumption”
  - (d) The site shall be facilitated by health and safety equipment, as well as personal health and safety protection equipment.
  - (e) Labour shall follow health and safety guidelines and instructions and use their health and safety personal protection equipment.

END OF PART