

*Indian Standard*METHODS OF SAMPLING AND TEST
(PHYSICAL AND CHEMICAL) FOR WATER
AND WASTEWATER

PART 25 CHLORINE DEMAND

(First Revision)

1. Scope — Prescribes the method of determination of chlorine demand. Two methods are prescribed in this standard. Method A is laboratory method and Method B is field method.

2. Terminology — The chlorine demand of water is the difference between the amount of chlorine applied and the amount of free, combined or total available chlorine remaining at the contact period. The chlorine demand of any water varies with the amount of chlorine applied, time of contact, pH and temperature. As 0.2 mg/l of residual chlorine is desirable at the consumers end, this quantity plus the actual demand will give the chlorine demand figures (for drinking water analysis).

3. Laboratory Method

3.1 Theory and Application — This method is designed to determine the so-called immediate demand as well as other demands at longer contact period. Chlorine demand is measured to determine the amount of chlorine that must be applied to a water to produce a specific free, combined or total chlorine residual after a selected period of contact. If the amount of chlorine applied to waters containing ammonium or organic nitrogen compounds is not sufficient to reach what is termed the 'break point', chloramines and certain other chloroderivatives are produced. When sufficient chlorine has been added to reach the breakpoint, which depends on pH, ratio of chlorine to nitrogenous compound present and other factors, subsequent additions of chlorine remain in the free available state.

3.2 Apparatus

3.2.1 Colorimetric Equipment — One of the following is required.

3.2.1.1 Spectrophotometer — For use in the wavelength range of 420 to 490 nm suitable for the method selected for determination of residual chlorine.

3.2.1.2 Comparator — Colour and turbidity compensating.

3.2.1.3 French Square Bottle — Capacity 30 to 60 ml.

3.3 Reagents

3.3.1 Standard Chlorine Solution — See 4.4.8 of IS : 3025 (Part 26) - 1986 'Methods of sampling and test (physical and chemical) for water and waste water : Part 26 Determination of chlorine, residual (first revision)'.

3.3.2 Acetic Acid (glacial)

3.3.3 Potassium Iodide Crystal

3.3.4 Standard Sodium Thiosulphate — 0.025 N.

3.3.5 Starch Indicator — See IS : 2263-1979 'Methods of preparation of indicator solutions for volumetric analysis (first revision)'.

3.3.6 Appropriate reagents for estimating residual chlorine.

3.4 Procedure

3.4.1 Volume of Sample — Measure at least 10 equal portions of the sample, preferably into brown glass stoppered bottles or long necked flasks of ample capacity to permit mixing. If the object of the test is to determine chlorine demand, measure 200 ml portions; if it is to relate chlorine demand to bacterial removal, the effect on taste and odour, or the chemical constituents of the water, use portions of 500 ml or more. Properly sterilize all glassware as for bacteriological use.

3.4.2 Addition of Chlorine Water — Add an amount of chlorine to the first portion that leaves no residual chlorine at the end of the contact period. Add increasing amount of chlorine to the successive portions in the series. Increase the dosage between portions in increments of 0.1 mg/l for determining low demands and up to 1.0 mg/l or more for higher demands. Mix while adding. Dose the portions of the sample according to a staggered schedule that will permit the determination of chlorine residuals at the predetermined contact time. An approximation to the ultimate chlorine demand can be made by dosing (minimum 1 mg available chlorine per litre) so that the residual is one half the dosage. Confirm this demand by doubling the dosage; the second demand should be within 10 percent of the first.

3.4.3 Contact Time — The usual purpose of a chlorine demand test is to determine the amount of chlorine required to produce a specific free, combined or total available chlorine residual after a definite time interval that may vary from a few minutes to many hours. Carry out the test over the desired contact period. If the objective of the test is to duplicate in the laboratory the temperature and the plant contact time, make several preliminary chlorine determination during different reaction periods, such as 15, 30 and 60 min in order to determine the chlorine consumption with respect to time information that can be valuable in treatment plant control. Record the contact time. Protect the chlorinated samples from the strong day light throughout the test.

3.4.4 Examination of Samples — At the end of the contact period, determine the free and/or combined available residual chlorine by one of the standard methods given in IS : 3025 (Part 26)-1986. Plot the residual chlorine or the amount consumed *versus* the dosage to aid in studying the results. If necessary, remove samples for bacteriological examination at desired intervals.

3.4.5 Taste and Odour — Observe the taste and odour of the treated samples at ordinary temperatures with or without dechlorination. For odour observation at elevated temperatures, dechlorinate the samples before heating. Choose the dechlorinating agent with due regard to its effect on the odour in the water under examination. Generally, sodium sulphite is satisfactory if only a slight stoichiometric excess is used.

4. Field Method

4.1 Theory and Application — This method is designed for the measurement of chlorine demand in the plant or field when facilities or personnel are not adequate to use the more exact method. Results obtained in this test are approximate only.

4.2 Apparatus

4.2.1 Chlorine Comparator — Colour and turbidity compensating.

4.2.2 Dropper — That will deliver 20 drops per ml. The end of the dropper should be well cleared so that water adheres all around the periphery, and that the dropper be held in a strictly vertical position, with the drops being formed slowly.

4.2.3 Flasks of 1 litre capacity, marked at the 500 ml level—10 numbers.

4.2.4 60 ml bottle marked at 20 ml level—10 numbers.

4.2.5 Glass Stirring Rod

4.2.6 Glass Stemmed thermometer

4.3 Reagents

4.3.1 Standard Chlorine Solution — Dilute a 5 percent household bleaching solution 1+4. Standardize as directed in 4 of IS : 3025 (Part 26)-1986 but take 20 drops of the diluted hypochlorite solution as the sample to be titrated. Use the same dropper that will be used in the procedure.

$$\text{available Cl, mg, for each drop} = \frac{A \times N \times 35}{20}$$

where

A = ml titration for sample, and

N = normality of standard thiosulphate solution.

Adjust this solution to 10 mg/ml (0.5 mg chlorine/drop) so that 1 drop added to a 500 ml water sample will represent a dosage of 1 mg/l.

4.3.2 Test Reagent — Use the appropriate reagents for estimating residual chlorine by one of the method given in IS : 3025 (Part 26) - 1986.

4.4 Procedure

4.4.1 Measurement of Samples — Fill each container to the 500 ml mark with sample. Record the temperature.

4.4.2 Addition of Chlorine — While stirring constantly, add 1 drop of chlorine solution to the water in the first flask, 2 drops in the second flask, 3 in the third flask, etc.

4.4.3 Contact Time — Follow direction as given in 3.4.3 of Method A.

4.4.4 Examination of Samples — At the end of the contact period, remove a portion from each sample and determine the residual chlorine by one of the methods described IS : 3025 (Part 26) - 1986.

4.5 Calculation

4.5.1 Chlorine demand, mg/l = mg/l of chlorine added - mg/l of residual chlorine.

EXPLANATORY NOTE

The methods of sampling and test for water and wastewater were originally covered in various Indian Standards like IS : 2488 (in parts) 'Methods of sampling and test for industrial effluents', IS : 3025-1964 'Methods of sampling and test (physical and chemical) for water used in industry', IS : 3550-1965 'Methods of test for routine control of water used in industry', and IS : 4733-1972 'Methods of sampling and test for sewage effluent (*first revision*)'. The Committee responsible for the preparation of these standards decided to revise these standards by amalgamating into one comprehensive standard on methods of sampling and test (physical and chemical) for water and wastewater. The amalgamated revision will be published in many parts each part dealing with a particular test method.