



# **Observations and Suggestions on WTP labs**

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**Indian Standard**  
**DRINKING WATER — SPECIFICATION**  
**( Second Revision ) BIS: 10500-2012**

Parameter	Units of Measurement	BIS: 10500-2012 Acceptable limits	BIS: 10500-2012 Permissible limits in the Absence of Alternate source	Beyond this range the water effects
<b>Turbidity</b>	NTU	< 1	(1 -5.0)	Acceptance decreases
<b>pH</b>	No units	(6.5 - 8.5)	(6.5 - 8.5)	effect the mucous membrane; bitter taste; affects aquatic life
<b>EC</b>	$\mu\text{S/cm}$	---	—	salty or bitter taste, Undesirable taste; gastro intestinal irritations
<b>Total Dissolved Solids</b>	mg/lit	500	(500-2000)	
<b>Total Alkalinity as CaCO<sub>3</sub></b>	mg/lit	200	(200-600)	Low Alkalinity (i.e. high acidity) gastro intestinal irritations
<b>Total Hardness as CaCO<sub>3</sub></b>	mg/lit	200	(200-600)	Scale in utensils and hot water system, soap scum
<b>Calcium as Ca</b>	mg/lit	75	(75-200)	
<b>Magnesium as Mg</b>	mg/lit	30	(30-100)	
<b>Iron as Fe</b>	mg/lit	1.00	NO relaxation	Beyond this limit taste affected, has adverse effect, promotes iron bacteria and staining of clothes s
<b>Chloride as Cl</b>	mg/lit	250	(250-1000)	Beyond this Cause high blood pressure, effects the taste.
<b>Fluoride as F</b>	mg/lit	1.00	(1.0-1.5)	Cause fluorosis (brownish discoloration of teeth, Bone damage).
<b>Nitrate as NO<sub>3</sub></b>	mg/lit	45	NO relaxation	Infants below the age of six months who drink water containing nitrate in excess could become seriously ill and, if untreated, may die. Symptoms include shortness of breath (methaemoglobinemia) and blue-baby syndrome.
<b>Sulphate as SO<sub>4</sub></b>	mg/lit	200	(200-400)	Beyond this causes gastro intentional irritation ( laxative effects) , formation of "rotten-egg" odor from hydrogen sulfide gas
<b>Free residual chlorine,</b>	mg/lit	0.2	1	Beyond this Cause gastro intestinal irritation
<b>Sodium as Na</b>	mg/lit	—	—	
<b>Potassium as K</b>	mg/lit	—	—	
<b>MPN of Coliform Bacteria</b>	—	<b>Shall not be detectable in any 100 ml sample</b>		Beyond this causes Gastrointestinal illness
<b>MPN of E. coli Bacteria</b>	—	<b>Shall not be detectable in any 100 ml sample</b>		Beyond this causes Gastrointestinal illness

**FREQUENCY OF WATER SAMPLING AND TESTING FOR SURFACE WATER AS PER (O&M OF WATER SUPPLY SYSTEM-CPHEEO  
MANUAL IN ANNEXURE 9.6c(1) & (2)**

	<b>MONITORING</b>	<b>Parameters</b>
<b>a) Raw water, Source and intake well:</b>		
Physical / Chemical -	Daily	Colour, Odour, Turbidity, pH, EC, TDS, Total Alkalinity & RC
Bacteriological –	weekly	MPN & E. coli
Biological-	Occasionally	Total count of Planktone
Heavy metals , Pesticides and other parameters	Annually	As per IS 10500 : 2012
Problem Parameters -	Annually	As, Cr, Fe, Mn & F -
<b>b) Sedimentation Tank after clarifier:</b>		
Turbidity -	Daily	Turbidity
Bacteriological –	weekly	MPN & E. coli
<b>c) Filter Water:</b>		
Turbidity -	Daily	Turbidity
Bacteriological –	weekly	MPN & E. coli
<b>d) Clear Water Storage Reservoir:</b>		
Residual Chlorine-	Daily	Residual Chlorine-
Physical / Chemical -	Daily	Colour, Odour, Turbidity, pH, EC, TDS, Total Alkalinity & RC
Bacteriological	weekly	MPN & E. coli
<b>e) Distribution System:</b>		
Residual Chlorine-	Daily	Residual Chlorine
Bacteriological	weekly	MPN & E. coli
Physical / Chemical -	Monthly	Colour, Odour, Turbidity, pH, EC, TDS, Total Alkalinity & RC

## 1.a) Daily Test Parameters at WTPs

S. N O	Raw Water						Clear water					
	1	Colour	Odour	pH	Turbidity	Total Alkalinity	RC	Colour	Odour	pH	Turbidity	Total Alkalinity

## b) Jar Test for Alum optimum dosage fixation:

Jar No	Alum dosage in mg/L	Floc Settling Rate	Supernatant Clarity	Initial Turbidity in NTU	After Jar test Turbidity in NTU	pH	Alkalinity in Mg/L	Remarks
Jar - 1								
Jar - 2								
Jar - 3								
Jar - 4								
Jar - 5								
Jar - 6								

Floc Settling Rate =  $\frac{\text{Turbidity reading before jar test} - \text{Turbidity reading after jar test}}{\text{Turbidity reading after jar test}}$

### c) Weekly Bacteriological test:

S. NO	Raw Water		Clear water	
1	MPM Coliform bacteria	MPM of E . coli	MPM Coliform bacteria	MPM of E . coli

### d) Monthly test parameters:

S. No	Clear Water													
	ELECTRICAL CONDUCTIVITY	TOTAL DISSOLVED SOLIDS (TDS)	TOTAL ALKALINITY AS CaCO3	TOTAL HARDNESS AS CaCO3	Calcium as Ca.	MEGNESIUM as Mg	CHLORIDES as cl	RESIDUAL CHLORINE	FLOURIDE	SULPHATE	NITRATE as NO3	IRON as Fe	SODIUM	POTASSIUM

### e) Annually test parameters:

- Heavy Metals, Pesticides, Problem parameters ( Trace elements) Fe, Mn & F

### **WTP in-charge responsibility:**

- To visit the lab daily, and verify the register of testing parameters results and sign on the register.

### **Competency of WTP lab staff:**

- The WTP lab in-charge to verify the certificates of chemist and microbiologist who are engaged by the agency and confirm whether they are able to understand the SOP manual and conduct the water quality parameters which are to be tested as per SOP and also able to calibrate the concerned instruments as per SOP.
- It is mandatory for the concerned area **WQM lab Chemist/ Microbiologist**, should visit every fortnight to the nearby WTP lab, check the register and verify the results, tested by the WTP chemists, compare with them, by testing of samples of raw water, after CFL water, after filter bed and clear water samples for PH, Turbidity, RC and write & sign in the register whenever they visit.

### III) Details of the test parameter- Chemicals-Equipment Required.

Name of the test Parameter	CHEMICALS & REAGENTS REQD	Equipment /APPARATUS
1. COLOUR	1. Potassium chloro platinate(AR)	1. pH meter
	2. Crystallised cobaltous chloride (AR)	2. centrifuge
	3. conc.Hcl	
	4. NaoH (AR)	
2. ODOUR	Not reqd.	Not reqd.
3. TURBIDITY	1. Hydrazine sulphate	1. Nephelometric turbidity
	2. Hexamethylene tetramine (Hexamine)	2. Digital Balance
4. pH VALUE	1. pH buffer solutions 4.00,7.00 & 9.18	1. Digital pH with potentiometer
	or 4.00, 7.00 & 9.20 pH capsules	2. Temperature compensating device.
	2. KCl (4M KCl to store electrode)	3. Glass electrode of platinum series
		4. pH electrode

Name of the test Parameter	CHEMICALS & REAGENTS REQD	Equipment /APPARATUS
5. ELECTRICAL CONDUCTIVITY	1. Potassium chloride (KCl) solution	1. Digital conductivity meter 2. Digital Balance 3. Thermometers
6. TOTAL DISSOLVED SOLIDS (TDS)	Not reqd.	1. Whatmann filter paper no. 542 (pore size 2.0- 2.5µm) 2. Drying Oven (Thermostatic, temperature up to 180±2°C) 3. Analytical Balance.
7. TOTAL ALKALINITY AS CaCO <sub>3</sub>	1. Conc Sulphuric acid or (N/50 Sulphuric acid ) 2. phenolphthalein indicator 3. Mixed indicator or methyl orange indicator 4. sodium carbonate (Na <sub>2</sub> CO <sub>3</sub> ) 5. Ethyl alcohol or methyl alcohol 6. Bromo cresol Green	Analytical Balance.
8. TOTAL HARDNESS AS CaCO <sub>3</sub>	1. Ammonia buffer solution or 1 A). Ammonium Chloride, Ammonium hydroxide Magnesium Salt of EDTA or Magnesium Sulphate 2. calcium Chloride or Calcium Carbonate 3. Erichrome black T- indicator 4. EDTA salt or Standard EDTA (N/50) solution 5. Hydroxylamine Hydrochloride	Analytical Balance.
9. CHLORIDES as Cl <sup>-</sup>	1. Potassium chromate 2. Standard silver nitrate 3. Sodium Chloride	Analytical Balance.

<b>Name of the test Parameter</b>	<b>CHEMICALS &amp; REAGENTS REQD</b>	<b>Equipment /APPARATUS</b>
10. CHLORINE DEMAND	1. Bleaching powder	1. Chloroscope
	2. Orthotolidine reagent	2. Analytical Balance.
11. AMMONICAL NITROGEN as NH <sub>3</sub> N	1. Zinc sulphate (ZnSo <sub>4</sub> .7H <sub>2</sub> O) .	1. Spectrophotometer.
	2. Sodium hydroxide (NaOH).	2. Nessler's tubes 100 ml.
	3. EDTA reagent.	3. pH meter.
	4. Rochelle salt solution. Or	
	4 A) potassium sodium tartrate tetrahydrate	
	5. Nessler's reagent or	
	5A) Potassium iodide	
	5B) Mercuric iodide	
	6. Conc Sulphuric acid	
	9. Ammonium Chloride.	
12. RESIDUAL CHLORINE	1. Orthotolidine reagent. Or	1. Rc Kit/ Colorimeter.
	2A) Orthotolidine dihydrochloride	2. Analytical Balance.
	2 B). Conc .HCl	
13. FLOURIDE	1. Sodium flouride	1. Millivolt meter.
	2 A). Sodium hydroxide (NaOH).	2. Flouride ion selective electrode.
	2 B). Ammonium acetate.	3. Reference electrode.
	2 C). CDTA	4. Magnetic stirrer (stir bead)
	2 D). Conc. Hcl. or TISAB Buffer	5. Analytical Balance.

<b>Name of the test Parameter</b>	<b>CHEMICALS &amp; REAGENTS REQD</b>	<b>Equipment /APPARATUS</b>
14. NITRITE as NO <sub>2</sub>	1. Sulphanilamide.	1. 50 ml Nessler's tubes.
	2. NED ( 1- Naphthyl -ethylene diamine dihydrochloride)	2. Spectrophotometer.
	3. sodium oxalate	3. Analytical Balance.
	4. sodium nitrite	
	5. Conc. HCl	
15. SULPHATE	1. Standard Sulphate 1000ppm solution or	1. Spectrophotometer.
	1 A). sodium sulphate .	2. Magnetic Stirrer
	2A). magnesium chloride (MgCl <sub>2</sub> . 6H <sub>2</sub> O).	3. Analytical Balance.
	2B). Sodium acetate .	
	2C). Barium chloride crystals.	
	2D). potassium nitrate (KNO <sub>3</sub> )	
	2E) . Acetic acid	
16. NITRATE as NO <sub>3</sub>	1. Standard nitrate (KNO <sub>3</sub> ) solution.	1. UV Spectrophotometer.
	2. IN HCl.	2. Analytical Balance.
17. IRON as Fe	1. Ferrous aluminium sulphate.	1. Spectrophotometer.
	2. Hydroxylamine hydrochloride.	2. Hot plate equipment
	3. Ammonium acetate.	3. Analytical Balance.
	4. 1,10-phenanthroline.	
	5. Glacial acetic acid.	
	6. IN HCl.	

Name of the test Parameter	CHEMICALS & REAGENTS REQD	Equipment /APPARATUS
18. MANGANESE	1. Ammonium persulfate ((NH <sub>4</sub> ) <sub>2</sub> S <sub>2</sub> O <sub>8</sub> )	1. Spectrophotometer.
	2. Potassium permanganate (K <sub>2</sub> MnO <sub>4</sub> )	2. Analytical Balance.
	3. Sodium oxalate.	
	4. Silver nitrate	
	5. mercuric sulphate (HgSO <sub>4</sub> )	
	6. Phosphoric acid	
	7. Nitric acid	
	8. Hydrogen peroxide	
19. DETERMINATION OF DISSOLVED O <sub>2</sub> by Wrinkler's method	1. Manganese sulphate.	1. DO sampler
	2. Alkali iodide-azide reagent.	2. Analytical Balance.
	3. Sulphuric acid (H <sub>2</sub> SO <sub>4</sub> ).	
	4. Starch indicator.	
	5. sodium thiosulphate 0.1 N	
	6. Sodium hydroxide.	
20. Percentage of alumina content	1. NaOH solution of N/2 strength	1. Hot plate equipment
	2. Phenolphthalein indicator	
	3. Alum	2. Analytical Balance.
21. Jar test for fixing optimum dose of alum	1. Alum	1. Bench flocculator/stirring equipment
		2. Turbidity meter.
		3. Analytical Balance.

Name of the test Parameter	CHEMICALS & REAGENTS REQD	Equipment /APPARATUS
22. Test for coliform bacteria.	1. Mac conkey's broth  2. Ethylalchol	1. Autoclave. 2. Incubator. 3. Laminar air flow (LAF) 4. Weighing balance. 5. Bunsen burner.
23. E. coli (18216224981) (reaffirmed 2003) part 3.3.4	1. Brilliant green bile broth 2. Alkaline peptone water. 3. Kovac's reagent.	1. Laminar air flow (LAF) 2. Weighing balance. 3. pH meter. 4. Incubator. 5. Water bath. 5. Colony Counter . 6. Bunsen burner
24. SILICATE (sio2)	1. Sulphuric acid (H2So4). 2. Ammonium molybdate 3. Oxalic acid . 4. sodium hexa fluoro silicate or sodium metasilicate nonhydrate .  5. 1-amino-2-naphthol-4-sulphonic acid . 6. Sodium Sulphate 7. Sodium-bi- Sulphate	1. Spectrophotometer. 2. Analytical Balance.

Name of the test Parameter	CHEMICALS & REAGENTS REQD	Equipment /APPARATUS
25. Calcium as Ca.	1. NaoH buffer solution	1.Analytical Balance.
	2. Hcl 1:1	
	3. Ammonium purpurate (Mureoxide ) indicator solution.	
	4. EDTA salt or Standard EDTA solution	
	5. Calcium carbonate or Calcium chloride	
26. Insoluble matter (IS-260-1969)	1. IN H2So4	1. Muffle furnace with temp. 105°C to 110°C
	2. Alum	
27. % of available chlorine in bleaching powder & Sodium hypochloride.	1. Bleaching powder	1.Analytical Balance.
	2. Conc. Acetic acid (CH3CooH)	
	3. Potassium iodide crystals (KI)	
	4 Sodium thiosulphate	
	5. Starch indicator.	

# Calibrations:

Internal and external calibrations for the instruments are mandatory for the WTP labs.

S. No	Internal ( by lab)	External ( third party)
1	pH Meter ( Daily)	Yearly
2	EC meter ( Daily)	Yearly
3	Turbidity meter ( Daily)	Yearly
4	UV spectrophotometer (once in 3 months)	Yearly
5	Balance (when ever operated for chemical weighing )	Yearly
6	Ion Meter (when ever operates)	NA
7	Flame photometer (when ever operates)	NA

# Observations At new WTPs

- The new WTP agencies are not supplied (some are missing) the instruments/ chemicals/ glassware as per the agreement.
- The most of the WTPs lab personnel are not engaged as per requirement, ie. at least 1 no Chemist, 1 no Microbiologist and 1 no helper .
- Most of the lab staff seems to be not competent.
- The testing results of parameters are not convincing and reliable.
- It was observed at one of the WTP lab, tested and recorded the fluoride concentration in raw water as more than the permissible limits, clear water as low concentration.
- It was observed that some the parameters are recorded abnormally as per BIS standards which are questionable.
- It was observed that Only one person is conducting the testing parameters , same person is being utilized for other purposes like addition of Alum, amd addition of chlorine etc... the same person is maintaining the records and registers (as per check list). And also Working in two shifts.

- Only for pH, Turbidity, Rc tests are being conducted.
- The lab persons unable to answer/ reply for the details about testing / maintenance of records, which are questioned by the advisory team.
- Some of the parameters like Nitrates, Sulphates, iron and fluoride are being tested with available UV spectrophotometer with ready to use chemicals in some of the WTP labs.
- Most of the labs are not conducting Jar test daily for fixation for optimum dosage of Alum.
- All the WTP labs are not conducting microbiological tests/ even not started. In some of the WTPs, though the material available, which were procured by the agency.
- H<sub>2</sub>s vials are being utilized as microbiological tests in some of the WTP labs
- Most of the labs are not able to perform calibrations to the instruments as when required.
- The chemicals/ reagents are also not available for calibrations.

# Observations At Old WTPs (Integrated)

- Most of the WTPs are not having separate laboratory .
- It was observed that Only one person is available for the testing parameters ie, for only Turbidity and Rc . Same person is being utilized for other purposes like addition of Alum and addition of chlorine.
- No Jar test is being conducting for alum optimum dosage fixation.
- No microbiological tests are being conducted.

## VI) Recommendations/ suggestions:

- At all the WTPs in-charges and agencies were informed and suggested to arrange / supply the instruments/ chemicals , glassware and others ,as per the agreement concluded.
- The lab personnel suggested and explained about the BIS standards and the test parameters to be conducted as per the CPHEEO manual ie. For no. of parameters for chemical / bacteriological , on daily basis/ weekly basis / monthly / Annually.
- The lab personnel were suggested to conduct calibrations regularly and explained the procedure of the calibration and testing of some of the important standard parameters to be carried out.
- Explained and trained on jar test (fixation of alum dosage) calculation of alum dosage and chlorine dosage. Conversion in to ppm or mg/lit
- Hence it is suggested that, the detailed training is required for the WTPs staff on chemical / bacteriological / Jar testing/ calibration and calculations

➤ Explained how to write / maintain the registers/ records in the WTP labs.

➤ It is suggested that the old WTPs (integrated labs) should be upgraded as like new WTPs by providing financial assistance/ for procurement of instruments, chemicals, glassware and others, so as to conduct minimum parameters (pH, turbidity, jar test, Rc, percentage of liquid chlorine, (where ever only liquid chlorine is being utilized for disinfection).

# Observations at WTP labs by the Advisory Team













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**THANK YOU**