

WATER QUALITY STANDARDS

The basic purpose of making guidelines or standards is to provide safe drinking water to all the citizens. The World Health Organization (WHO) has provided guidelines for drinking water, which are advisory in nature, and are based on scientific research and epidemiological findings. The values of various water quality parameters recommended by WHO are the general guidelines. That is why, different countries have established their own water quality standards to meet their national priorities taking in to account their economic, technical, social, cultural, and political requirements. The PCRWR and Pakistan Standard Institution (PSI) have already drafted drinking water quality standards, however, the enforcement of these standards is still pending. This matter needs to be addressed on top priority basis. The WHO guidelines and standards proposed by national agencies like PCRWR, Pakistan Standard Institution (PSI), International Bottled Water Association (IBWA), Food Development Authority (FDA), Environmental Protection Agency (EPA) and other countries are given in this chapter.

3.1 WHO Guidelines

A. Bacteriological Qualities

Source/Organisms	Guideline Value
a. All water intended for drinking (E. Coli or thermo tolerant Coliform bacteria)	Must not be detectable in any 100 ml sample
b. Treated water entering the distribution system (E. Coli or thermo tolerant coliform and total coliform bacteria)	Must not be detectable in any 100 ml sample
c. Treated water in the distribution system (E. Coli or thermo tolerant coliform and total coliform bacteria)	Must not be detectable in any 100 ml sample In the case of large supplies, where sufficient samples are examined, must not be present in 95% of samples taken throughout any 12-month period.

B. Chemicals of Health Significance

Inorganic	mg/l	Inorganic	mg/l	Inorganic	mg/l
Antimony	0.005	Copper	2.000	Molybdenum	0.070
Arsenic	0.010	Cyanide	0.070	Nickel	0.020
Barium	0.700	Fluoride	1.500	Nitrate(NO ₃)	50.00
Boron	0.300	Lead	0.010	Nitrite(NO ₂)	03.00
Cadmium	0.003	Manganese	0.500	Selenium	0.010
Chromium	0.050	Mercury	0.001		

C. Other Parameters

Inorganic	mg/l	Inorganic	mg/l	Inorganic	mg/l
Colour	15 TCU	1,2 dichlorobenzene	1-10	Hardness,pH, DO	-
Taste, Odour.	-	1,4-dichlorobenzene	0.3-30	Hydrogen sulfide	0.05
Turbidity	5 NTU	Dichlorobenzene	5-50	Iron	0.3
Toluene	24-170	Synthetic detergents	-	Manganese	0.1
Xylenes	20-1800	Aluminum	0.2	Sodium	200
Ethyl-benzene	2.4-200	Ammonia	1.5	Sulfate	250
Styrene	4-2600	Chloride	250	TDS	1000
Monochlorobenzene	10-120	Copper	1	Zinc	3

D. Disinfectants and Disinfectant by-Products

Name	Value	Name	Value
Chlorine chlorophenol	600-1000	2,4,6-trichlorophenol	2-300
2,4-dichlorophenol	0.3-40	2-chlorophenol	0.1-10

3.2 Standards Drafted by PCRWR*A. Bacteriological Standards (Urban and Rural water supplies)*

Categories	Standards
<i>A. Piped Water Supplies</i>	
A-1 Treated water entering the distribution system	
• Faecal Coliform	0/100 ml
• Coliform organisms	0/100 ml
A-2 Un-treated water entering the distribution system	
• Faecal Coliform	0/100 ml
• Coliform organisms	0/100 ml
• Coliform organisms	3/100 ml
A-3 Water in the distribution system	
• Faecal Coliform	0/100 ml
• Coliform organisms	0/100 ml
• Coliform organisms	3/100 ml
<i>B. Un-piped Water Supplies</i>	
• Faecal Coliform	0/100 ml
• Coliform Organisms	10/100 ml

B. Standards for Inorganic Health Related Constituents

Constituent	Unit	HDL*	MPL**	Toxic Effects
Fluoride	mg/l	1.000	1.500	Dental fluorosis in children, excessive concentrative may cause crippling skeletal fluorosis.
Nitrate (NO ₃)	mg/l	45.000	45.000	Infantile methaemoglobinaemia.
Lead	mg/l	0.050	0.050	Children particularly susceptible to effects of lead on central nervous system
Mercury	mg/l	0.001	0.001	Neurological effects

* Highest Desirable Level.

** Maximum Permissible Level.

C. Other Parameters

Constituent	Unit	HDL*	MPL**	Undesirable Effects
Turbidity	NTU	2.5	5	Un-aesthetic, decrease in efficiency of disinfections
Colour	PCU	5	15	Un-aesthetic
Taste & Odour	-	Unobjectionable		Taste & Odour
TDS	mg/l	500	1500	Fault or salty taste, corrosion or instruction
Iron	mg/l	0.1	1.0	Taste, discoloration
Manganese	mg/l	0.05	0.5	Taste, discoloration
Magnesium	mg/l	30	150	Stomach disturbances
Copper	mg/l	0.05	1.5	Taste, corrosion of pipes and utensils taste
Zinc	mg/l	5	15.0	Taste

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Sulfate	mg/l	200	400	Corrosion, Laxative effect
Chloride	mg/l	200	600	Taste, Corrosion
pH	-	7.0-8.5	6.5-9.2	Taste, Corrosion
Hardness	mg/l	200	500	Corrosion or scale formation
Phenolic substances	mg/l	0.001	0.002	Taste

* Highest Desirable Level.

** Maximum Permissible Level.

3.3 Pakistan Standard Institution

Drinking Water Quality Standards

A. Physical Requirements

S. #	Characteristics	Unit	MAC*	MAC**
1.	Turbidity	NTU	5	25
2.	Colour	TCU	5	50
3.	Taste & Odour	-	Unobjectionable	
4.	pH	-	7.0-8.5	≥ 6.5- ≤ 9.2

B. Chemical Requirements

1.	Total Dissolved Solids	mg/l	1000	1500
2.	Chloride (Cl)	mg/l	200	600
3.	Sulfate (SO ₄)	mg/l	200	400
4.	Nitrate (NO ₃)	mg/l	-	45
5.	Total Hardness (CaCO ₃)	mg/l	20	500
6.	Nitrite (NO ₂)	mg/l	Nil	Nil
7.	Magnesium (Mg)	mg/l	500	1000
8.	Total Ammonia	mg/l	0.1	0.5
9.	Hydrogen Sulfide	mg/l	Undetectable odour	
10.	Fluoride (F)	mg/l	-	1.5
11.	Iron (Fe)	mg/l	0.3	1.0
12.	Zinc (Zn)	mg/l	5.0	15.0
13.	Manganese (Mn)	mg/l	0.1	0.5
14.	Copper (Cu)	mg/l	1.0	1.5
15.	Calcium (Ca)	mg/l	75	200
16.	Magnesium (Mg)	mg/l	50	150
17.	Phenolic Substances	mg/l	0.001	0.002
18.	Alkyl Benzyl Sulfates	mg/l	0.5	1.0
19.	Carbon Chloroform Extract	mg/l	0.2	0.5

C. Limits of Toxic Substances

1.	Arsenic (As)	mg/l	0.05	-
2.	Cadmium (Cd)	mg/l	0.01	-
3.	Chromium (Cr)	mg/l	0.05	-
4.	Cyanide (Cn)	mg/l	0.20	-
5.	Lead (Pb)	mg/l	0.05	-
6.	Selenium (Se)	mg/l	0.20	-
7.	Radionuclides	Uo/l	1000	-

D. Biological Requirements (Chemical Indicators of Pollution)

1.	Chemical Oxygen Demand (COD)	mg/l	10	-
2.	Biochemical Oxygen Demand (BOD)	mg/l	6	-
3.	Ammonia (NH ₃)	mg/l	0.5	-
4.	Grease	mg/l	1	-

E. Limits for Bacteriological Contaminants

Acceptable bacterial standards for potable water supplies:		
i)	Standard plate count (SPC)/mls	No more than 100
ii)	Presumptive test for Coliform	Negative
iii)	Most probable number (MPN)	< 101 subject to the frequency of opportunity for water analysis.

* Maximum Acceptable Concentration. ** Maximum Allowable Concentration.

3.4 International Bottled Water Association (IBWA) Standards

A. Chemical Quality

Characteristics	Unit	Standard	Characteristics	Unit	Standard
Arsenic (As)	mg/l	0.05	Mercury (Hg)	mg/l	0.001
Barium (Ba)	mg/l	1	Nitrate (NO ₃)	mg/l	10
Cadmium (Cd)	mg/l	0.005	Nitrite (NO ₂)	mg/l	1
Chromium (Cr)	mg/l	0.05	Selenium (Se)	mg/l	0.01
Chloride (Cl)	mg/l	250	Silver (Ag)	mg/l	0.025
Copper (Cu)	mg/l	1	Sulfate (SO ₄)	mg/l	250
Cyanide (Cn)	mg/l	0.1	Phenolic	mg/l	0.001
Fluoride (F)	mg/l	4	PCB	mg/l	0.0005
Iron (Fe)	mg/l	0.3	TDS	mg/l	500
Lead (Pb)	mg/l	0.005	Zinc (Zn)	mg/l	5
Manganese (Mn)	mg/l	0.05	-	-	-

B. Microbiological Quality

Total Plate Count/ml	CFU/ml	<200	Escherichia coli	MPN/100 ml	
Coliform (MPN/100 ml)	MPN/100 ml	<220	Salmonella	CFU/100ml	

3.5 Food Development Authority (FDA) Water Standards

Characteristics	Unit	Standard	Characteristics	Unit	Standard
Arsenic (As)	mg/l	0.05	Nitrate (NO ₃)	mg/l	10
Barium (Ba)	mg/l	1	Selenium (Se)	mg/l	0.01
Cadmium (Cd)	mg/l	0.01	Silver (Ag)	mg/l	0.05
Chromium (Cr)	mg/l	0.05	Sulfate (SO ₄)	mg/l	250
Chloride (Cl)	mg/l	250	Phenolic	mg/l	0.001
Copper (Cu)	mg/l	1	Ra 226 activity (pCi/l)	-	5
Iron (Fe)	mg/l	0.3	Total Beta activity (pCi/l)	-	8
Lead (Pb)	mg/l	0.05	TDS	mg/l	500
Manganese (Mn)	mg/l	0.05	Zinc (Zn)	mg/l	5
Mercury (Hg)	mg/l	0.002	Coliform (MPN/100 ml)		<2,20

3.6 National Environmental Quality Standards by EPA (Liquid Industrial Effluents)

Sr.#	Parameter	Standards
1.	Temperature	40 C
2.	pH Value (acidity/basicity)	6-10 pH
3.	5-day Biochemical Oxygen Demand (BOD) at 20 ⁰ C	80 mg/l
4.	Chemical Oxygen Demand (COD)	150 mg/l
5.	Total Suspended Solids	150 mg/l
6.	Total Dissolved Solids	3500 mg/l
7.	Grease and Oil	10 mg/l
8.	Phenolic Compounds (as phenol)	0.1 mg/l
9.	Chloride (as Cl)	1000 mg/l
10.	Fluoride (as F)	20 mg/l
11.	Cyanide (as Cn)	2 mg/l
12.	An-ionic detergents (as MBAS) ³	20 mg/l
13.	Sulfate (SO ₄)	600 mg/l
14.	Sulfide (S)	1.0 mg/l
15.	Ammonia (NH ₃)	40 mg/l
16.	Pesticides, herbicides, fungicides and insecticides	6.15 mg/l
17.	Cadmium	0.1 mg/l
18.	Chromium (trivalent and hexavalent)	1.0 mg/l
19.	Copper	1.0 mg/l
20.	Lead	0.5 mg/l
21.	Mercury	0.01 mg/l
22.	Selenium	0.5 mg/l
23.	Nickel	1.0 mg/l
24.	Silver	1.0 mg/l
25.	Total Toxic Metals	2.0 mg/l
26.	Zinc	5.0 mg/l
27.	Arsenic	1.0 mg/l
28.	Barium	1.5 mg/l
29.	Iron	2.0 mg/l
30.	Manganese	1.5 mg/l
31.	Boron	6.0 mg/l
32.	Chlorine	1.0 mg/l

3.7 Indian Water Quality Standards

A. Physical and Chemical Standards

Sr. #.	Characteristics (mg/l)	Acceptable	Marginal	Sr. #.	Characteristics (mg/l)	Acceptable	Marginal
1	Turbidity (NTU)	2.5	10	7	Fluoride	1.0	1.5
2	Colour (TCU)	5	25	8	Nitrate (N)	45	45
3	Taste & Odour	Unobjectionable		9	Calcium	75	200
4	pH	7-8.5	6.5-9.2	10	Magnesium	30	150
5	TDS	500	1500	11	Iron	0.1	1.0

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6	Hardness	200	600	12	Manganese	0.05	0.5
13	Chloride	200	1000	21	Copper	0.05	1.5
14	Sulfate	200	400	22	Zinc	5.0	15
15	Phenolic Compounds	0.001	0.002	23	Lead	0.1	0.1
16	Anionic Detergents	0.2	1.0	24	Selenium	0.01	0.001
17	Arsenic	0.05	0.05	25	Mercury	0.001	0.2
18	Cadmium	0.01	0.01	26	Polynuclear aromatic hydrocarbons (g/l)	0.2	3
19	Chromium	0.05	0.05	27	Gross Alpha Activity	3 (pCi/l)	30
20	Cyanide	0.05	0.05	28	Gross Beta Activity pico curie/l	30 (pCi/l)	-

- The figures indicated under the column “*Acceptable*” are the limits up to which the water is generally acceptable to the consumers.
- Figures in excess of those mentioned under “*acceptable*” render water not acceptable, but still may be tolerated in absence of alternative and better source but up to the limits indicated under column “*Marginal*” above which the supply will have to be rejected.

B. Bacteriological Standards

- i) Water entering the distribution system coliform count in any sample of 100 ml should be zero.
- ii) Water in the distribution system shall satisfy all the three criteria indicated below:
 - E.Coli count in 100 ml of any sample should be zero;
 - Coliform organisms no more than 10 per 100 ml shall be present in any sample; and
 - Coliform organisms should not be detectable in 100 ml of any two consecutive samples or more than 50% of the samples collected for the year.
- iii) Individual or small community supplies.
 - E.Coli count should be zero in any sample of 100 ml and coliform organisms should not be more than 3 per 100 ml.

C. Virological Aspects

- i) A level of 0.5 mg/l of free chlorine residual for one hour is sufficient to inactivate virus, even in water that was originally polluted. This free chlorine residual is to be insisted in all disinfected supplies in areas suspected of endemicity of infectious hepatitis to take care of the safety of the supply from virus point of view, which incidentally takes care of the safety from the bacteriological point of view as well. For other areas 0.2 mg/l of free chlorine residual for half an hour should be insisted.

The water quality standards developed and enforced by various countries are given below:

3.8 Water Quality Standards of Indonesia, Singapore, Malaysia, Thailand, Philippines and Brunei.

A. Chemical Quality

S. #	Substances	Unit	Indonesia	Singapore	Malaysia	Thailand	Philippines	Brunei
1	Arsenic (As)	mg/l	0.05	0.05	0.05	0.05	0.05	<0.003
2	Barium (Ba)	mg/l	-	1	-	1	-	<0.02
3	Borate (BO ₃)	mg/l	-	0.03	30	-	-	0.2
4	Cadmium (Cd)	mg/l	0.1	0.01	0.01	0.005	0.01	<0.002
5	Chromium (Cr)	mg/l	-	0.05	0.05	0.05	0.05	<0.01
6	Chloride (Cl)	mg/l	250	0.05	-	250	-	-
7	Chlorine (Cl ₂)	mg/l	-	-	1	1	-	-
8	Copper (Cu)	mg/l	0.5	-	-	0.1	1	<0.01
9	COD	mg/l	-	-	0.01	1	-	-
10	Cyanide (CN)	mg/l	0.05	0.01	2	-	0.01	-
11	Fluoride (F)	mg/l	1	2	-	-	2	0.09
12	Hardness (CaCO ₃)	mg/l	170	-	-	100	-	-
13	Iodine (I)	mg/l	-	1	-	0.3	-	-
14	Iron (Fe)	mg/l	0.1	-	-	0.05	1	-
15	Lead (Pb)	mg/l	0.05	0.05	0.05	0.05	0.05	<0.01
16	Manganese (Mn)	mg/l	0.05	2	2	0.002	0.1	0.01
17	Mercury (Hg)	mg/l	0.001	1	0.001	-	0.001	<0.005
18	Mineral Oil	mg/l	-	ND	ND	-	-	-
19	Nitrate (NO ₃)	mg/l	ND	45	45	4	45	<0.01
20	Nitrite (NO ₂)	mg/l	ND	0.005	0.005	-	0.01	-
21	Organic Matter	mg/l	1	0.003	3	-	5	-
22	Selenium (Se)	mg/l	-	0.01	0.01	0.01	0.01	-
23	Silver (Ag)	mg/l	-	-	-	0.05	-	-
24	Surfactant	mg/l	-	ND	ND	-	2	-
25	Sulfide (S)	mg/l	ND	0.05	0.05	-	-	-
26	Sulphate (SO ₄)	mg/l	200	-	-	250	-	-
27	Phenolic	mg/l	-	ND	ND	0.001	0.001	-
28	Ra 226 activity	pCi/l	-	30	-	-	-	-
29	Total Beta activity	pCi/l	-	1	-	-	-	-
30	TDS	mg/l	500	-	-	500	-	-
31	Zinc (Zn)	mg/l	-	-	5	5	5	-

B. Microbiological Quality

1	Total Plate Count/ml	CFU/ml	Max 1x10 ⁴	Max. 1x10 ⁵	-	-	-	-
2	Coliform (MPN/100 ml)	MPN/100ml	<2.20	0/250 ml	Max.10	<2,20	<2.20	Nil
3	Escherichia coli	MPN/100ml	0	0	0	Negative	-	Nil
4	Salmonella/100 ml	CFU/100ml	-	0	-	-	-	-
5	Staphylococcus Aureus/250 ml	CFU/250ml	-	0	-	-	-	-
6	Pseudomonas Aeruginosa/250 ml	CFU/250ml	0	0	-	-	-	-
7	Faecal Streptococci/20 ml	MPN/20ml	-	-	-	-	1/100 ml	-

3.9 Water Quality Standards of Vietnam, Japan, China, Hong Kong, Korea and Taiwan.

A. Chemical Quality

Sr.#	Substances	Unit	Vietnam	Japan	China	H. Kong	Korea	Taiwan
1	Arsenic (As)	mg/l	0.05	<0.2	0.05	0.01	0.05	0.05
2	Ammonium (NH ₄)	mg/l	-	<0.5	-	1.5	0.5	-
3	Barium (Ba)	mg/l	-	-	-	0.7	-	-
4	Borate (BO ₃)	mg/l	10	-	-	0.3	-	-
5	Cadmium (Cd)	mg/l	0.01	<0.05	0.01	0.003	0.01	0.01
6	Chromium (Cr)	mg/l	-	<0.05	0.05	0.05	0.05	0.05
7	Chloride (Cl)	mg/l	-	<350	250	250	150	250
8	Chlorine (Cl ₂)	mg/l	-	-	-	-	-	1
9	Copper (Cu)	mg/l	1	<0.05	1	2	1	0.01
10	COD	mg/l	-	-	-	-	-	0.8
11	Cyanide (Cn)	mg/l	0.01	<0.01	0.01	0.07	ND	-
12	Fluoride (F)	mg/l	2	<1.5	0.8	1.5	1	-
13	Hardness (CaCO ₃)	mg/l	-	100-500	250	-	300	250
14	Iodine (I)	mg/l	-	-	-	-	-	0.3
15	Iron (Fe)	mg/l	-	<0.1	0.3	0.3	0.3	0.05
16	Lead (Pb)	mg/l	0.05	<0.1	0.05	0.01	0.1	0.05
17	Manganese (Mn)	mg/l	2	<0.1	0.05	0.5	0.3	0.001
18	Mercury (Hg)	mg/l	-	-	0.001	0.001	ND	-
19	Nitrate (NO ₃)	mg/l	45	<5.0	10	50	10	10
20	Nitrite (NO ₂)	mg/l	-	-	ND	3	-	ND
21	Organic Matter	mg/l	3	-	0.1	-	-	0.1
22	Selenium (Se)	mg/l	-	<0.05	0.01	0.01	0.01	0.01
23	Silver (Ag)	mg/l	0.01	-	0.05	-	-	0.05
24	Sulphate (SO ₄)	mg/l	-	<250	250	250	200	250
25	Phenolic	mg/l	-	<0.001	-	-	0.005	-
26	Total Beta activity	pCi/l	-	-	-	1.0 Bq/l	-	-
27	TDS	mg/l	-	<1000	500	1000	-	500
28	Zinc (Zn)	mg/l	5	<5	5	3	1	5

B. Microbiological Quality

1	Total Plate Count/ml	CFU/ml	<10	-	100	-	<100	-
2	Coliform (MPN/100 ml)	MPN/100ml	-	<15.100	3	<2.2	0	-
3	Escherichia coli	MPN/100ml	2.2	-	-	-	-	0/100 ml

3.10 Water Quality Standards of Saudi Arabia, Guam, Australia, Argentina, Mexico and Canada.

A. Chemical Quality

Sr.#	Substances	Unit	S. Arabia	Guam	Australia	Argentina	Mexico	Canada
1	Arsenic (As)	mg/l	0.05	0.05	0.05	0.05	0.05	0.025
2	Ammonium (NH ₄)	mg/l	-	-	-	0.2	0.5	-
3	Barium (Ba)	mg/l	1	1	1	-	0.7	1
4	Borate (BO ₃)	mg/l	-	-	30	-	-	5
5	Cadmium (Cd)	mg/l	0.01	0.01	0.005	0.01	0.005	0.005
6	Chromium (Cr)	mg/l	0.05	0.05	0.05	0.05	-	0.05
7	Chloride (Cl)	mg/l	250	250	-	350	250	-
8	Chlorine (Cl ₂)	mg/l	-	-	0.01	0.5	0.1	-
9	Copper (Cu)	pCi/l	1	1	1	2	1	-
10	COD	mg/l	-	-	3	-	-	-
11	Cyanide (Cn)	mg/l	0.05	-	0.1	0.10	-	0.2
12	Fluoride (F)	mg/l	-	-	1.5	2	2	-
13	Iron (Fe)	mg/l	0.3	0.3	-	2	0.3	-
14	Lead (Pb)	mg/l	0.05	0.05	-	0.05	0.02	0.01
15	Manganese (Mn)	mg/l	0.05	0.05	2	0.1	0.05	-
16	Mercury (Hg)	mg/l	-	0.002	0.001	0.001	0.001	0.001
17	Nitrate (NO ₃)	mg/l	-	10	45	45	10	45
18	Nitrite (NO ₂)	mg/l	-	-	0.01	0.1	-	3.2
19	Selenium (Se)	mg/l	-	0.01	0.01	-	0.05	0.01
20	Silver (Ag)	pCi/l	0.05	0.05	-	0.05	-	-
21	Surfactant	mg/l	-	-	-	-	0.5	-
22	Sulfide (S)	mg/l	-	-	0.05	-	-	-
23	Sulphate (SO ₄)	mg/l	250	250	-	500	250	-
24	Phenolic	mg/l	0.001	0.001	-	-	0.001	-
25	Ra 226 activity	pCi/l	3	5	1	-	-	-
26	Total Beta activity	pCi/l	-	8	-	-	-	-
27	TDS	mg/l	-	500	-	1500	500	-
28	Zinc (Zn)	mg/l	5	5	5	5	3	-

B. Microbiological Quality

1	Total Plate Count/ml	CFU/ml	-	-	<1	500	100	100
2	Coliform (MPN/100 ml)	MPN/100ml	-	<2.20	Max.10	3	<2	-
3	Escherichia coli	MPN/100ml	-	-	-	Negative	-	0
4	Pseudomonas Aeruginosa/250 ml	CFU/250ml	-	-	-	Negative	-	0