

Ground Water Quality Standards

Water is used by man for domestic including drinking purposes, in agriculture for irrigation of crops and in industries for manufacture of various food products and in the processing of ores. Quality of water is the reflection of wide variety of chemical and biological constituents present in it. The quality is beneficial when these constituents are present within desirable levels. Bureau of Indian Standards (BIS) and US Federal Water Pollution Control Administration, 1968 have specified concentration limits of various constituents for waters for different uses, such as domestic, agriculture and Industrial.

Domestic

Medical researchers have established that presence of some constituents in drinking waters, in small amount, are essential whereas in large concentrations they are injurious to human health. Based on these considerations, Bureau of Indian Standards (BIS) has prescribed limits for various physical, chemical biological and radio nuclides for waters used for drinking purposes. Limits for some constituents have been extended to maximum permissible levels; uses of these waters are permitted only in the absence of an alternative source with desirable concentrations.

DRINKING WATER STANDARDS AND PROBABLE EFFECTS OF HUMAN HEALTH (BIS: IS: 10500, 1991)

S. No.	Parameters	Prescribed limits		Probable effects
		Desirable	Permissible	
1	COLOUR (HAZEN UNIT)	5	25	Aesthetically undesirable.
2	ODOUR	Essentially free		Aesthetically undesirable.
3	TASTE	Agreeable		Aesthetically undesirable.
4	TURBIDITY (NTU)	5	10	Indicates pollution/contamination.
5	pH	6.5	8.5	Affects taste, corrosivity& supply system.
6	HARDNESS, as CaCO ₃ , mg/l	300	600	Causes scaling, excessive soap consumption, calcification of arteries.
7	IRON, as Fe , mg/l	0.30	1.00	Causes staining of laundry and porcelain. In traces it is essential for nutrition.
8	CHLORIDE, as Cl , mg/l	250	1000	May be injurious to heart or kidney

				patients. Taste, indigestion, corrosion & palatability are affected.
9	RESIDUAL CHLORINE, only when Water is chlorinated	0.20	-	Excessive chlorination causes asthma, colitis & eczema
10	TOTAL DISSOLVED SOLIDS, mg/l	500	2000	May cause gastro-intestinal irritation, corrosion and laxative effect to new users.
11	CALCIUM, as Ca, mg/l	75	200	Excessive Cause incrustation, deficiency causes rickets, essential for nervous, muscular, cardiac functions and in coagulation of blood.
12	MAGNESIUM, as Mg, mg/l	30	100	Its salts are cathartics and diuretic. Excessive may cause laxative effect; deficiency causes structural and functional changes. It is activator of many enzyme systems.
13	COPPER, as Cu, mg/l	0.05	1.50	Beneficial in human metabolism, deficiency results in nutritional anaemia in infants. Large amounts may result in liver damage, causes central nervous system irritation & depression. Enhances corrosion of Al in water supply systems.
14	SULPHATE, as SO ₄ , mg/l	200	400	Causes gastro-intestinal irritation. Along with Mg or Na can have a cathartic effect. Concentration more than 750 mg/l may have laxative effect.
15	NITRATE, as N, mg/l	45	100	Causes infant methaemoglobinaemia, at very high

				concentration causes gastric cancer and effects central nervous & cardiovascular system.
16	FLUORIDE, as F, mg/l	1.00	1.50	Reduces dental carries, very high concentration may cause crippling skeletal fluorosis.
17	CADMIUM, as Cd, mg/l	0.01	No relaxation	Acute toxicity may be associated with renal, arterial hypertension, itai-itai (bone disease). Cd salts cause cramps, nausea, vomiting & diarrhea.
18	LEAD, as Pb, mg/l	0.05	No relaxation	Burning in mouth, severe inflammation of gastro-intestinal tract with vomiting and diarrhea. Chronic toxicity produces nausea, severe abdominal pain, paralysis, mental confusion, visual disturbances, and anaemia etc.
19	ZINC, as Zn , mg/l	5	15	Essential & beneficial in human metabolism. Imparts astringent taste to water.
20	CHROMIUM, as Cr, mg/l	0.05	No relaxation	Cr ⁶⁺ produces lung tumors, cutaneous and nasal mucous membrane ulcers and dermatitis.
21	ARSENIC, as As, mg/l	0.05	No relaxation	Causes skin damage, circulatory problems, increased risk of skin cancer.
22	ANTIMONY, as Sb, mg/l	0.006	No relaxation	Raises blood cholesterol, lowers blood sugar.
23	ALUMINIUM, as Al, mg/l	0.030	0.200	Leads to neurological disorders.
24	BARIUM, as Ba, mg/l	2	No relaxation	Increases blood pressure.
25	BERYLLIUM, as Be, mg/l	nil	0.0002	Is carcinogenic

26	CYANIDE, as CN, mg/l	0.05	No relaxation	Causes nerve damage, thyroid problem.
27	MERCURY, as Hg, mg/l	0.001	No relaxation	Neurological and renal disturbances. Excess causes gonadotoxic and mutagenic effects and disturbs the cholesterol metabolism.
28	MANGANESE, as Mn, mg/l	0.10	0.30	Essential as a cofactor in enzyme systems and metabolism processes. Excessive causes change in appetite and reduction in metabolism of iron to form haemoglobin. Imparts undesirable taste and stains plumbing fixtures and laundry.
29	SELENIUM, as Se, mg/l	0.01	No relaxation	Leads to hair, finger loss, and numbness in fingers or toes, circulatory problems.
30	BORON, as B, mg/l	1.00	5.00	Affects central nervous system, salts may cause nausea, cramps, convulsions, coma, etc.
31	ALKALINITY, as CaCO ₃ , mg/l	200	600	Imparts unpleasant taste, deleterious to humans in presence of high pH, hardness and TDS.
32	PESTICIDES, ug/l	nil	0.001	Imparts toxicity, accumulates in different organs of body, affects immune and nervous systems. Carcinogenic.
33	PHOSPHATE, as PO ₄ , mg/l	No guideline		High concentration causes vomiting & diarrhoea stimulates secondary hyperthyroidism and bone loss.
34	SODIUM, as Na, mg/l	No guideline		Harmful to persons suffering from cardiac, renal & circulatory diseases.

35	POTASSIUM, as K, mg/l	No guideline		Essential nutrition element but excessive amounts is cathartic.
36	NICKEL, as Ni , mg/l	No guideline		Non-toxic element but may be carcinogenic in animals, can react with DNA resulting in DNA damage in animals.
37	PATHOGENS a)TOTAL COLIFORM No/dl b)FAECAL COLIFORM No/dl	1	10	Causes water borne diseases like coliform jaundice; Typhoid, Cholera etc. produces infections involving skin mucous membrane of eyes, ears and throat.
38	RADIOACTIVITY: -BETA PARTICLES -ALPHA PARTICLES -RADIUM	0-4 millirem/year 0-15 picocuries/year 0-05 picocuries/year		Increases risk of cancer.

Agriculture

Generally, salinity, sodicity and toxicity of specific ions are considered for assessing suitability of waters used for irrigation purposes. Use of waters exceeding the maximum permissible limits of these parameters will affect the soil structure and decrease the yield of the crops grown. Recent studies have shown that some heavy metal in low concentrations in irrigation waters also affect the crop yields. Based on above considerations, Bureau of Indian Standards (BIS) has prescribed the following concentration ranges for irrigation waters.

EFFECTS OF WATER QUALITY PARAMETERS ON IRRIGATION WATER (AFTER AYERS R.S. AND WESTCOTT.D.W.1985)

S. No.	Parameters	Prescribed limits		Probable effects
		Desirable	Permissible	
1	Salinity/EC in Mmhos/cm at 25 ⁰ c	Sensitive crops <1500 Semi-tolerant 1500-3000 Tolerant >3000		Plant growth is retarded with stunted fruits, leaves and stem in high salinity
2	SODICITY/SAR	SAR<10 10-18 18-26 >26	Excellent Good Medium Bad	Causes deflocculation of soil, restricting free movement of water

3	R.S.C meq/l	<1.25 1.25-2.5 >2.5	Excellent Good Bad	Result in increase of Sodium causing adverse effects.
4	SODIUM (NA) %	No Guideline		Increase total salinity, has adverse effect on sodium sensitive species such as stone fruit trees and avocados
5	CHLORIDE, (cl) mg/l	No Guideline		May have direct toxic effect with sodium.
6	NITRATE, (NO ₃) mg/l	No Guideline		An essential plant nutrient but its excess may delay maturity and seed growth in some plants
7	BORON, (B) mg/l	Sensitive crops <1.0 Semi-tolerant 1.0-2.0 Tolerant 2.0-4.0 Unsatisfactory for most crops>4.0		An essential plant nutrient at low concentration but high conc. are toxic to plant
8	COPPER, (Cu) mg/l	0.20 ^a	5.00 ^b	Essential for plant as micronutrient. Deficiency may cause crop damages, chlorosis also leading to dieback of plant.
9	LEAD, (Pb) mg/l	5.20 ^a	10.00 ^b	Some plants accumulate it that may have harmful effect on human health. Very high concentration may reduce root growth.
10	ZINC, (Zn) mg/l	2.00 ^a	10.00 ^b	An essential plant nutrient as activator of enzymes. Deficiency leads to several diseases such as by ionizing rosette or little leaf, high conc., produces toxic effects
11	CHROMIUM, (Cr) mg/l	0.10 ^a	1.00 ^b	Toxic to plants, very high conc. may reduce growth, produce iron deficiency in plants and reduce yield
12	CADMIUM, (Cd) mg/l	0.01 ^a	0.50 ^b	Reduces plant growth, bio-

					accumulates in plants, causes adverse effects on human consumption, reduces yield.
13	Iron, (Fe) mg/l	5.0 ^a	20.00 ^b		An important and essential element, deficiency caused by excess of lime in soil, results in chlorosis. Excess iron contributes to soil acidification.
14	Nickel, (Ni) mg/l	0.20 ^a	2.00 ^b		Causes stunted growth of plant in the concentration 0.5 mg/l. Toxic to barley, beans, oats, when more than 2.0 mg/l

A-continuous use

B-short term use on fine texture soil