

2. Using Rice-Husk Carbon (RHC)

The Cr and Zn metal ions are absorbed from water by using rice husk carbon method. Rice husk are widely available and low cost absorbant used for water treatment process.

3. Using Fly ash

The fly ash from the pulverised fuel combustion system is used to remove heavy metals such as copper and chromium from waste water by using the blend of fly ash and coal fly ash. The powdered coal ash obtained from the combustion of powdered coal is a very good absorbent used in the water treatment process.

4. Using Clay and Coal based absorbents

Clay is good absorbent of moisture in which china clay is used to remove As (III) and Zn (II) from the distilled water.

Faller earth [i.e, it can be any clay material capable of decolonize oil (or) liquids without chemical] and Kadine [it is a clay material] are used to remove Pb and Cd from water.

Table 2.1 Toxic effects of heavy metals on human health

Metal	Effects of human health
Mercury	Minamata epidemic, the first major disaster of mercury poisoning occurred in 1953 at Minamata in Japan; the victims developed of the limbs, lips and tongue and lost muscle control. Also caused deafness
Lead	Lead pollution causes liver and kidney damage, reduction in hemoglobin formation, metal retardation, and abnormalities of fertility and pregnancy children may suffer from macrocephaly or convulsions or both.

Arsenic	Cause mental disturbance, liver cirrhosis, hyperkeratosis, lung cancer, ulcers in gastrointestinal tract, kidney damage
Cadmium	Bone deformation, kidney damage, testicular atrophy, anaemia, injury of central nervous system and liver, hypertension; the It-ital first reported from Japan was shown to be due to cadmium toxicity.
Copper	Hypertension, uremia, coma, sporadic fever
Zinc	Vomiting, renal damage, cramps
Chromium (hexavalent)	Nephritis, gastro-intestinal ulceration, cancer

2.14 WATER QUALITY STANDARDS

Table 2.2 Indian Standard Specifications for Drinking Water

S. No.	Parameter	Requirement desirable Limit	Remarks
1.	Colour	5	May be extended upto 50 if toxic substances are suspected.
2.	Turbidity	10	May be relaxed upto 25 in the absence of alternate.
3.	pH	6.5 to 8.5	May be relaxed upto 9.2.
4.	Total Hardness	300	May be extended upto 600
5.	Calcium - Ca	75	May be extended upto 200
6.	Magnesium-Mg	30	May be extended upto 100

S. No.	Parameter	Requirement desirable Limit	Remarks
7.	Copper - Cu	0.05	May be extended upto 1.5
8.	Iron	0.3	May be extended upto 1
9.	Manganese	0.1	May be extended upto 0.5
10.	Chlorides	250	May be extended upto 1000
11.	Sulphates	150	May be extended upto 400
12.	Nitrates	45	No relaxation
13.	Fluoride	0.6 to 1.2	If the limit is below 0.6 water should be rejected, Max. Limit is extended to 1.5
14.	Phenols	0.001	May be extended upto 0.002
15.	Mercury	0.001	No relaxation
16.	Cadmium	0.01	No relaxation
17.	Selenium	0.01	No relaxation
18.	Arsenic	0.05	No relaxation
19.	Cyanide	0.05	No relaxation
20.	Lead	0.1	No relaxation
21.	Zinc	5.0	May be extended upto 10.0
22.	Anionic detergents (MBAS)	0.2	May be extended upto 1
23.	Chromium-Cr ⁺⁶	0.05	No relaxation

S. No.	Parameter	Requirement desirable Limit	Remarks
24.	Poly aromatic hydrocarbons	-	-
25.	Mineral Oil	0.01	May be extended upto 0.03
26.	Residual Chlorine	0.2	Applicable only when water is chlorinated
27.	Pesticides	Absent	-
28.	Radio active	-	-

Table 2.3: Drinking Water Specification:
IS:10500, 1992 (Reaffirmed 1993)
Tolerance Limits

S. No.	Parameter	IS:10500 Requirement (Desirable limit)	Undesirable effect outside the desirable limit	IS: 10500 Permissible limit in the absence of alternate source
Essential Characteristics				
1.	pH	6.5-8.5	Beyond this range the water will effect the mucous membrane and / or water supply system	No relaxation

S. No.	Parameter	IS:10500 Requirement (Desirable limit)	Undesirable effect outside the desirable limit	IS: 10500 Permissible limit in the absence of alternate source
2.	Colour (Hazen Units), Maximum	5	Above 5, consumer acceptance decreases	25
3.	Odour	Unobjectionable	—	—
4.	Taste	Agreeable	—	—
5.	Turbidity, NTU, Max	5	Above 5, consumer acceptance decreases	10
Following Results are expressed in mg/l:				
6.	Total hardness as CaCO_3 , Max	300	Encrustation in water supply structure and adverse effects on domestic use	600

S. No.	Parameter	IS:10500 Requirement (Desirable limit)	Undesirable effect outside the desirable limit	IS: 10500 Permissible limit in the absence of alternate source
7.	Iron as Fe, Max	0.30	Beyond this limit taste/appearance are affected, has adverse effect on domestic uses and water supply structures, and promotes iron bacteria.	1.0
8.	Chlorides as Cl, Max	250	Beyond this limit taste, corrosion and palatability are effected	1000
9.	Residual, Free Chlorine, Min	0.20	—	—

S. No.	Parameter	IS:10500 Requirement (Desirable limit)	Undesirable effect outside the desirable limit	IS: 10500 Permissible limit in the absence of alternate source
Desirable Characteristics				
10.	Dissolved solids, Max	500	Beyond this palatability decreases and may cause gastro international irritation	2000
11.	Calcium as Ca, Max	75	Encrustation in water supply structure and adverse effects on domestic use	200
12.	Magnesium as Mg, Max	30	-	100

S. No.	Parameter	IS:10500 Requirement (Desirable limit)	Undesirable effect outside the desirable limit	IS: 10500 Permissible limit in the absence of alternate source
13.	Copper as Cu, Max	0.05	Astringent taste, discoloration and corrosion of pipes, fitting and utensils will be caused beyond this	1.5
14.	Manganese as Mn, Max	0.1	Beyond this limit taste/appearance are affected, has adverse effect on domestic uses and water supply structures	

S. No.	Parameter	IS:10500 Requirement (Desirable limit)	Undesirable effect outside the desirable limit	IS: 10500 Permissible limit in the absence of alternate source
15.	Sulphate as SO_4 Max	200	Beyond this causes gastro intestinal irritation when magnesium or sodium are present	400
16.	Nitrates as NO_3	45	Beyond this methanemoglobinemia takes place	100
17.	Fluoride, Max	1.0	Fluoride may be kept as low as possible. High fluoride may cause fluorosis	1.5
18.	Phenolic compounds as $\text{C}_6\text{H}_5\text{OH}$, Max	0.001	Beyond this, it may cause objectionable taste and odour	0.002

S. No.	Parameter	IS:10500 Requirement (Desirable limit)	Undesirable effect outside the desirable limit	IS: 10500 Permissible limit in the absence of alternate source
19.	Mercury as Hg, Max	0.001	Beyond this, the water becomes toxic	No relaxation
20.	Cadmium as Cd, Max	0.01	Beyond this, the water becomes toxic	No relaxation
21.	Selenium as Se, Max	0.01	Beyond this, the water becomes toxic	No relaxation
22.	Arsenic As, Max	0.05	Beyond this, the water becomes toxic	No relaxation
23.	Cyanide as CN, Max	0.05	Beyond this, the water becomes toxic	No relaxation
24.	Lead as Pb, Max	0.05	Beyond this, the water becomes toxic	No relaxation

S. No.	Parameter	IS:10500 Requirement (Desirable limit)	Undesirable effect outside the desirable limit	IS: 10500 Permissible limit in the absence of alternate source
25.	Zinc as Zn, Max	5	Beyond this limit it can cause astringen taste and an opalescence in water	15
26.	Anionic detergents as MBAS, Max	0.2	Beyond this limit it can cause a light froth in water	1.0
27.	Chromium as Cr^{6+} , Max	0.05	May be carcinogenic above this limit	No relaxation
28.	Polynuclear aromatic hydrocarbons as PAH, Max	-	May be carcinogenic	-

2.15 WATER TREATMENT PROCESS

Water treatment is the industrial-scale process to make water potable and more acceptable for an end-use, which may be drinking, industry, or medicine purpose. Water treatment will remove existing water contaminants or reduce their concentration so that the water becomes fit for its desired end-use.

The processes involved in water treatment for drinking purpose are

- (a) Solids separation using physical processes such as settling and filtration, and
- (b) Chemical processes such as disinfection and coagulation.
- (c) Biological processes using aerated lagoons, activated sludge or slow sand filters.

2.15.1 Terrestrial water treatment

Normally, groundwater located underground requires less treatment than water from lakes, rivers, and streams. The Fig. 4.16 shows the schematic diagram of different water treatment processes namely

- (a) Coagulation
- (b) Sedimentation
- (c) Filtration
- (d) Disinfection and
- (e) Storage

(a) Coagulation

Coagulation removes dirt and other particles suspended in water. Alum with other chemicals are added to water to form tiny sticky particles called "floc" which attract the dirt particles.