

Water – The Elixir of Life

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Image by Freepik

THE recent water scarcity in the Silicon Valley of India, Bengaluru, has drawn much attention to conserving this natural resource. The groundwater is rapidly diminishing, and climate change has affected the monsoon cycle of India to an immense extent. Cherrapunji no longer holds the distinction of being the place with the heaviest rainfall in India. Although 75% of the world is water, most is in the oceans. Thus, techniques are being developed to desalinate this water to make it safe to drink. Also, all the available fresh water in the world is being polluted daily due to urbanisation and industrialisation. Thus, there is a need to purify this water before it can be consumed.

Standard Parameters of Pure Water

There are certain parameters, listed below, which determine the quality of water. It is crucial that these parameters lie within the optimal ranges for the water to be safe for humans and aquatic organisms.

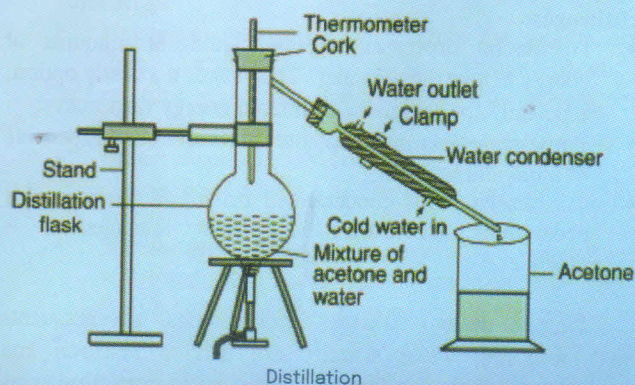
- **pH** – It differentiates acidic and basic solutions. If the solution has a pH less than 7, it is classified as acidic, whereas a pH value more than 7 classifies the solution as basic or alkaline. The ideal pH value of water is in the range 6 to 8.5.
- **Dissolved Oxygen (DO)** – This is one of the most significant constraints of water quality, which indicates the amount of oxygen dissolved directly into water. DO is elemental for the survival of aquatic organisms. The oxygen solubility in water has an optimal pressure of 1 atm (atmospheric pressure) that ranges from ~ 15 mg/L at 0°C to 8 mg/L at 30°C. It can also affect the solubility and availability of nutrients in the water.
- **Total Dissolved Solids (TDS)** – Solutes like sodium, calcium, magnesium, chloride, and bicarbonate remain as a solid residue after water evaporation in a solution.

The concentration of these solutes is known as TDS. Its presence in water is due to dynamics like industrial waste, sewage, agriculture, etc. The higher the levels of TDS, the worse the water quality. A desirable freshwater TDS level is between 0 and 1,000 mg/L.

In addition to the above parameters, water should be free from pollutants like metals, hydrocarbons and industrial chemicals.

Methods of Water Purification

Boiling water is the oldest and cheapest way to remove microorganisms from water. Most microbes cannot survive at temperatures above 60°C. Thus, increasing the water temperature to 100°C for 10 minutes kills all harmful bacteria, viruses and serves to remove some impurities too. The major downside of this method is that the dead microbes settle at the bottom and must be removed by straining through appropriate microporous filters. Also, boiling does not remove solutes having a higher boiling point than water. Another limitation of boiling water is that if it is not immediately consumed but stored for later use, new microorganisms might develop in it, which renders the boiling process ineffective.



Distillation, an age-old technique for purifying liquids, has found a crucial application in water scarcity. This process involves converting seawater or brackish water into potable water. While it is an energy-intensive method, technological advancements have made it a viable option for many regions facing water crises. Distillation is a thermal process that exploits the difference in boiling points of water and its impurities. The saline water is heated until it evaporates, leaving the salts and other contaminants behind. The resulting water vapour is then condensed into liquid form, yielding pure water.

Several distillation techniques have been developed for desalination, each with its advantages and drawbacks:

- **Multi-Stage Flash (MSF) Distillation:** most widely used method. Seawater is heated under pressure, and