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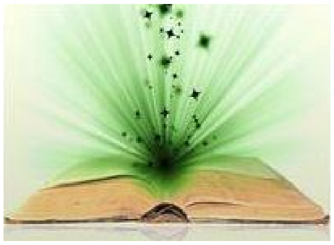

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Water Quality Management- An Overview

Prof. Kaza Somasekhara rao

Editor-In-chief, Journal Of Applicable Chemistry
Dept. of Chemistry, Nagaland University, LUMAMI-798627

E-mail: sr_kaza1947@yahoo.com

ABSTRACT

Water is one of the abundantly available substances in nature. It is an essential constituent of all animal and vegetable matter and forms about 75% of the matter of earth's crust. The per-capita water-demand for drinking and other domestic needs in a modern town varies from 100 to 500 liters a day. Whether we are poor or rich will be indicated by water sources. Main problem throughout the World is the water management. There is need to bring awareness in people in utilization of water, saving of water in industrial and agriculture. Quality of water and how to manage the water quality is important to protect the Environment and to save water . Waste water can be utilized by proper management through appropriate treatment for removal of pollutants.

Keywords: Water

WATER:

Water is one of the abundantly available substances in nature. It is an essential constituent of all animal and vegetable matter and forms about 75% of the matter of earth's crust. It is also an essential ingredient of animal and plant life. Water is distributed in nature in different forms such as rainwater, river water, spring water and mineral water. The reserves of water on the earth are immense, but they mostly contain salt water (i.e. sea water) which is unfit for drinking or irrigation purposes. However, fresh water is also available in considerable quantities. But its distribution over the Globe is uneven. The per-capita water-demand for drinking and other domestic needs in a modern town varies from 100 to 500 liters a day. Besides, water is also consumed in industry and agriculture (irrigation, cattle breeding), and when the total water-demand is considered, it increases by 10 – 12 times to per-capita need. No other compound can be compared to water as solvent. Water is to be regarded as universal solvent, because more things can be dissolved in water than in any other liquid. The Physical properties of water are peculiar and can be seen from Table 1.

Table 1: Physical properties of water

S.No.	Property	Unit	Value
1.	Boiling point	^{O}C	100.00
2.	Critical Temperature	^{O}C	374.20
3.	Electrical conductivity at 18 ^{O}C	$Ohm^{-1}\ cm^{-1}$	4.3×10^{-8}
4.	Freezing point at 760 mm Hg	^{O}C	0.00
5.	Molar heat of vaporization	K J K Cal	40.67 9.720
6.	Molar heat of fusion	K J K Cal	6.020 1.440
7.	Molar entropy of vaporization	$J\ deg^{-1}$ $Cal\ deg^{-1}$	109.00 26.10
8.	Viscosity at 20^{O}C	Centipoises	1.005
9.	Surface tension at 20^{O}C	$Dynes\ cm^{-1}$	73.00
10.	Dielectric constant at 18^{O}C	----------	81.0
11.	Dipole moment	Debye	1.84
12.	Specific heat	$Cal\ g^{-1}\ C^{-1}$	1.00
13.	Heat of vaporization	$Cal\ g^{-1}$	540.00
14.	Thermal conductivity	$Cal\ cm^{-1}\ Sec^{-1}\ deg^{-1}$	0.00143

99.7% of the Earth's water supply is not usable by humans. Only freshwater, which is contained in rivers, lakes, and underground sources, can be used for human consumption. The water is contaminated with ions (*e.g.*, Na^{+}, Ca^{2+}, F^{-}, and HSO_4^{-}) ,dissolved gases (*e.g.*, O_2 and CO_2) and other natural dissolved molecules (*e.g.*, organic by-products of decaying leaves) ,dissolved molecules from human activity (*e.g.*, industrial and agricultural wastes) .

Drinking Water Quality

A safe and potable drinking water should conform to the following water quality characteristics -

- Free from pathogenic organisms.
- Low in concentration of compounds that are acutely toxic or that have serious long – term effect, such as lead and arsenic
- Clear.
- Not saline (salty).
- Free of compounds that cause an offensive taste, odor and color.
- Non-corrosive, nor should it cause encrustation of piping or staining of clothes.

- Reasonably soft
- Should not be highly alkaline (pH should be about 8)
- Turbidity should be less
- Free from objectionable gases like SO_2, NO2 etc.

Water Pollutants – limits, sources of them and management/treatment
The water quality standards vary from one Nation to other depending on the climate , since many Nations have fixed their own Standards . Here it was given the WHO (World Health Organization) Standards.

Color : WHO:5.0-15.0 TCU
Source - Color is common in surface water supplies, while it is virtually non-existent in spring water and deep wells. Color in water may also be the result of natural metallic ions (iron and manganese). A yellow tint to the water indicates that humic acids are present, referred to as "tannins ". A reddish color would indicate the presence of precipitated iron. Stains on bathroom fixtures and on laundry are often associated with color also. Reddish-brown is ferric hydroxide (iron) will precipitate when the water is exposed to air. Dark brown to black stains are created by manganese. Excess copper can create blue stains.
Treatment - Color is removed by chemical feed, retention and filtration. Activated carbon filtration will work most effectively to remove color in general. Anion scavenger resin will remove tannins, but must be preceded by a softener or mixed with fine mesh softener resin.

Odor : WHO : 3 (TON) (Thresh Odor Number)
Source -Troublesome compounds may result from biological growth or industrial activities. The "rotten egg" odor is caused by hydrogen sulfide. Odor in the drinking water is usually caused by blue-green algae. Moderate concentrations of algae in the water can cause it to have a "grassy", or "spicy" odor. Decaying vegetation is probably the most common cause for taste and odor in surface water supplies. In treated water supplies chlorine can react with organics and cause odor problems.
Treatment - Odor can be removed by oxidation-reduction or by activated carbon adsorption. Aeration can be utilized if the contaminant is in the form of a gas, such as H_2S . Chlorine is the most common oxidant used in water treatment, but is only partially effective on taste and odor. The most effective oxidizers for treating taste and odor are chlorine dioxide and ozone. Activated carbon has an excellent history of success in treating taste and odor problems.

Taste : WHO : No
Source - Taste problems in water come from total dissolved solids (TDS) and the presence of such metals as iron, copper, manganese, or zinc. Magnesium chloride and magnesium bicarbonate are significant in terms of taste. Fluoride may also cause a distinct taste. The "salty" taste of water due to presence of chlorides are 500 mg/l or above. Decaying vegetation is probably the most common cause for taste and odor in surface water supplies. In treated water supplies chlorine can react with organics and cause taste and odor problems.
Treatment - Taste and odor can be removed by oxidation-reduction or by activated carbon adsorption. Activated carbon has an excellent history of success in treating taste and odor problems.

Turbidity : WHO:5.0 NTU (Nephelometric Turbidity Units).
Source – Turbidity gives the water a cloudy appearance or shows up as dirty sediment. Undeserved materials such as sand, clay, silt or suspended iron contribute to turbidity. Turbidity can cause the staining of sinks and fixtures as well as the discoloring of fabrics. Turbidity may be due to particles in the water consisting of finely divided solids, larger than molecules, but not visible by the naked eye; ranging in size from 1 to 150 microns.
Treatment - Typically turbidity can be reduced to 75 microns with a cyclone separator and then reduced down to 20 micron with standard back washable filter. Turbidity can be reduced to 10 micron with a multimedia filter. Ultra filtration also reduces the turbidity levels of process water.

pH : WHO : 5-8
Source - pH is a measure of the relationship of the acid to the alkali. The pH value of water will decrease as the content of CO_2 increases, and will increase as the content of bicarbonate alkalinity increases. The ratio of carbon dioxide and bicarbonate alkalinity (within the range of 3.6 to 8.4) is an indication of the pH value of the water.
Treatment - The pH can be raised by feeding sodium hydroxide (caustic soda), sodium carbonate (soda ash), sodium bicarbonate, potassium hydroxide, etc. into the water stream. A neutralizing filter containing Calcite (calcium carbonate) and/or Corosex (magnesium oxide) will combat low pH problems, if within the range of 5 to 6.

Total Dissolved Solids : WHO : 200-500 mg L^{-1}
Source - Total Dissolved Solids (TDS) consist mainly of carbonates, bicarbonates, chlorides, sulfates, phosphates, nitrates, calcium, magnesium, sodium, potassium, iron, manganese, and a few others. The TDS can be estimated by measuring the specific conductance of the water. TDS is the sum of all materials dissolved in the water; it has many different mineral sources.

The chart below indicates the TDS from various sources.

Distilled Water	0
Two-column Deionizer Water	8
Rain and Snow	10
Oceans	35,000
Brine Well	125,000
Dead Sea	250,000

High levels of TDS can adversely affect the industrial applications those requiring the use of water such as cooling tower operations, boiler feed water, food and beverage industries and electronics manufacturers. High levels of chloride and sulfate will accelerate corrosion of metals.
Treatment - TDS reduction is accomplished by reducing the total amount in the water. This is done during the process of deionization or with reverse osmosis. Electro dialysis will also reduce the TDS.

Total Hardness : WHO: 100-500 mg L^{-1} as $CaCO_3$
Source –
Temporary Hardness Salts : Calcium carbonate rare in water supplies and it causes alkalinity in water. Calcium bicarbonate forms when water containing CO_2 comes in contact with limestone and it also causes alkalinity in water. When heated CO_2 is released and the calcium bicarbonate reverts back to calcium carbonate thus forming scale. Magnesium carbonate and Magnesium bicarbonate are other salts

Permanent Hardness Salts : Calcium sulfate will precipitate and form scale in boilers when concentrated. Magnesium sulfate have laxative effect if great enough quantity is in the water. Magnesium chloride and calcium chloride salts are also causes hardness. Sodium salts are also found in household water supplies, but they are considered harmless as long as they do not exist in large quantities.

Treatment - Softeners can remove compensated hardness up to a practical limit of 100 grain per gallon. If the hardness is above 30 grain per gallon or the sodium to hardness ratio is greater than 33%, then economy salt settings cannot be used. If the hardness is high, then the sodium will be high after softening and may require that reverse osmosis be used for producing drinking water.

Sulfate : WHO : 250 mg L^{-1}

Source - Most sulfate compounds originate from the oxidation of sulfite ores, shale and the industrial wastes. Sulfate is one of the major dissolved constituent in rain. High concentrations of sulfate in drinking water causes a laxative effect when combined with calcium and magnesium,

Treatment - Reverse osmosis (97 - 98%). Sulfates can also be reduced with a strong base anion exchanger.

Chlorine

Source - Chlorine is the most commonly used agent for the disinfection of water supplies. Chlorine is a strong oxidizing agent capable of reacting with many impurities in water including ammonia, proteins, amino acids, iron and manganese. The amount of chlorine required to react with these substances is called the chlorine demand. Chlorine also reacts with residual organic material to produce potentially carcinogenic compounds, the trihalomethanes (THM's).

Treatment - Chlorinated water can be dosed with sulfite-bi sulfite-sulfur dioxide or passed through a activated carbon filter. Activated carbon will remove 880,000 ppm of free chlorine per cubic foot of media.

Chloride

Source - Chloride is one of the major anions found in water and generally combined with calcium, magnesium or sodium. Since almost all chloride salts are highly soluble in water. Sea water contains over 30,000 mg L^{-1} as NaCl. Corrosion rate and the iron dissolved into the water from piping increases as the sodium chloride content of the water is increased. Salty taste produced in drinking water.

Treatment - Reverse Osmosis will remove 90 - 95% .Electro dialysis and distillation are two more processes that can be used to reduce the chloride content of water .Strong base anion exchanger which is the later portion of a two-column deionizer does an excellent job at removing chlorides for industrial applications.

Fluoride: WHO : 0.5-1.5 mg L^{-1}

Source - Fluoride is a common constituent of many minerals. Municipal water treatment plants commonly add fluoride to the water for prevention of tooth decay. Concentrations above 5 mg L^{-1} are detrimental to tooth structure. High concentrations are contained in waste water from the manufacture of glass and steel, as well as from foundry operations. Organic fluorine is present in vegetables, fruits and nuts. Inorganic fluoride, under the name of sodium fluoride, is a waste product of aluminium and used in some rat poisons.

Treatment - Anion exchange. Adsorption by calcium phosphate, magnesium hydroxide, activated carbon will also reduce the fluoride content of drinking water. Reverse osmosis method

Cyanide: WHO : 0.01mg L^{-1}

Source - Cyanide is extremely toxic and is not commonly found at significant levels in drinking water. Cyanide is normally found in waste water from metal finishing operations.

Treatment - Chlorine feed, retention and filtration will break down the cyanide. Reverse osmosis or electro dialysis will also remove 90 - 95 % of it.

Nitrate and Nitrite : WHO :45 mg L^{-1} (NO_3^-) &1mg L^{-1}(NO_2^-)

Source - Nitrate comes into water supplies through the nitrogen cycle rather than via dissolved minerals. Most of the nitrate that occurs in drinking water is the result of contamination of ground water supplies by septic systems, feed lots and agricultural fertilizers. Nitrate is reduced to nitrite in the body. Nitrites are not usually found in drinking water supplies. Nitrates are reduced to nitrites in the saliva of the mouth and upper Gastro Intestinal tract. This occurs to a much greater degree in infants than in adults, because of the higher alkaline conditions in their GI tract. The nitrite then oxidizes hemoglobin in the blood stream to met hemoglobin, thus limiting the ability of the blood to carry oxygen throughout the body. Anoxia (an insufficiency of oxygen) and death can occur.

Treatment - Reverse osmosis will remove 92 - 95%.Anion exchange resin method or distillation method will remove both ions.

Ammonia

Source - Ammonia gas, usually expressed as nitrogen, is extremely soluble in water. It is the natural product of decay of organic nitrogen compounds. Ammonia finds its way to surface supplies from the runoff in agricultural areas where it is applied as fertilizer. Ammonia is oxidized to nitrate by bacterial action. A concentration of 0.1 to 1.0 ppm is typically found in most surface water supplies. Ammonia is not usually found in well water supplies because the bacteria in the soil converts it nitrates. The concentration of ammonia is not restricted by drinking water standards. Since ammonia is corrosive to copper alloys it is a concern in cooling systems and in boiler feed.

Treatment - Ammonia can be destroyed chemically by chlorination. Ammonia can also be removed by cation exchange resin in the hydrogen form. Degasification will also remove Ammonia.

Sodium : WHO : 200 mg L^{-1}

Source - Sodium (Na) is a major component in drinking water. The higher the sodium content of water, the more corrosive the water becomes. A major source of sodium in natural water is from the weathering of feldspars and clay. Intake from food is generally the major source of sodium, ranging from 1100 to 3300 mg day^{-1}. Persons requiring restrictions on salt intake, usually have a sodium limitation down to 500 mg day^{-1}. The amount of sodium obtained from drinking softened water is insignificant compared to the sodium ingested in the normal human diet. The amount of sodium contained in a quart of softened, 18 grain per gallon water is equivalent to a normal slice of white bread. Sodium in the body regulates the osmotic pressure of the blood plasma to assure the proper blood volume. Sodium chloride is essential in the formation of the stomach acids which are necessary for the digestive processes.

Treatment - Sodium can be removed with the hydrogen form cation exchanger portion of a deionizer. Reverse osmosis will reduce sodium by 94 - 98%. Distillation will also remove sodium.

Potassium

Source - Potassium is an alkaline metal closely related to sodium. It is seldom that one sees it analyzed separately on a water analysis. Potassium is not a major component in public or industrial water supplies. Potassium is, however, essential in a well balanced diet and can be found in fruits such as bananas.

Treatment - A cation exchange resin, usually in the form of a softener, can remove Potassium.
It can also be reduced by 94 - 97% utilizing electro dialysis or reverse osmosis.

Calcium : WHO :75 -200 mg L^{-1}

Source - Calcium is the major component of hardness in water. Calcium is derived from nearly all rocks, but the greatest concentrations come from limestone and gypsum. Calcium ions are the principal cations in most natural water. Calcium reduction is required in treating cooling tower makeup. Complete removal is required in metal finishing, textile operations and boiler feed applications.

Treatment - Calcium, as with all hardness, can be removed with a simple sodium form cation exchanger (softener). Reverse Osmosis will remove 95% - 98% . Electro dialysis and Ultra filtration. Calcium can also be removed with the hydrogen form cation exchanger portion of a deionizer system.

Magnesium : WHO : 50-150 mg L^{-1}

Source - Magnesium hardness is usually approximately 33% of the total hardness of a particular water supply. Magnesium is found in many minerals, including dolomite, magnesite, and many types of clay. It is abundant in sea water where its concentration is five times the amount of calcium. Magnesium carbonate is seldom a major component of scale.

Treatment - Magnesium may be reduced to less than 1mg L^{-1} with the use of a softener or purification exchanger in hydrogen form.

Chromium : WHO : 0.05mg L^{-1}

Source - Chromium is found in drinking water as a result of industrial waste contamination. The occurrence of excess chromium is relatively infrequent. Cr^{3+} ion is slightly soluble in water and is considered essential in man and animals for efficient lipid, glucose, and protein metabolism. Cr^{6+} ion on the other hand is considered toxic.

Treatment – Cr^{3+}, can be removed with strong acid cation resin regenerated with hydrochloric acid. Cr^{6+}, on the other hand requires the utilization of a strong base anion exchanger that must be regenerated with caustic soda (sodium hydroxide) NaOH. Reverse Osmosis can effectively reduce both forms of chromium by 90 to 97%. Distillation will also reduce chromium.

Copper : WHO :1.0 -1.5 mg L^{-1}

Source – Copper in drinking water can be derived from rock weathering. The principal sources are the corrosion of brass, copper piping and the addition of copper salts when treating water supplies for algae control. The body for proper nutrition requires copper but high doses of copper can cause liver damage or anemia.

Treatment - Copper can be reduced or removed with sodium form strong acid cation resin (softener) depending on the concentration. Reverse osmosis or electro dialysis will remove 97 - 98 % of the copper in the water supply. Activated carbon filtration will also remove copper by adsorption.

Lead : WHO : 0.05 mg L^{-1}

Source - Lead found in fresh water usually indicates contamination from metallurgical wastes or from lead-containing industrial poisons. Lead in the body can cause serious damage to the brain, kidneys, nervous system and red blood cells.

Treatment - Lead can be reduced considerably with a water softener. Activated carbon filtration. Reverse osmosis can remove 94 to 98 %. Distillation will also remove the lead from drinking water.

Arsenic : WHO : 0.05 mg L^{-1}

Source - Arsenic is not easily dissolved in water. It is usually comes from mining or metallurgical operations or from runoff from agricultural areas where materials containing arsenic were used as industrial poisons.

Treatment - If arsenic is in inorganic form, it can be removed or reduced by conventional water treatment processes.

Iron : WHO : 0.3-1.0mg L^{-1}

Source - Iron occurs naturally in ground waters in three forms - ferrous iron (clear waste iron), ferric iron (red water iron) and heme iron (organic iron). Each can exist alone or in combination with the others. Heme iron is organically bound iron complexed with decomposed vegetation. The organic materials complexed with the iron are called tannins or lignins.

Treatment - Ferrous iron can be removed with a softener provided it is less than 0.5 ppm for each grain of hardness and the pH of the water is greater than 6.8. If the ferrous iron is more than 5.0 ppm, it must be converted to ferric iron by contact with a oxidizing agent such as chlorine. Ferric iron can simply be removed by mechanical filtration. Heme iron can be removed by an organic scavenger anion resin or by oxidation with chlorine followed by mechanical filtration

Manganese : WHO : 0.05-0.5 mg L^{-1}

Source - The chemistry of manganese in water is similar to that of iron. A high level of manganese in the water produces an unpleasant odor and taste.

Treatment - Removal of manganese can be done by ion exchange (sodium form cation - softener) or chemical oxidation - retention - filtration Greensand filter with potassium will remove up to 10 ppm if pH is above 8.0. Brim filter with air injection will reduce manganese if pH is 8.0 to 8.5.

Mercury : WHO:0.001mg L^{-1}

Source - Mercury is one of the least abundant elements in the earth's crust. It exists in two forms, an inorganic salt or an organic compound (methyl mercury). Mercury detected in drinking water is of the inorganic type. Organic mercury enters the food chain through fish and comes primarily from industrial chemical manufacturing waste or from the leaching of coal ash. If inorganic mercury enters the body, it usually settles in the kidneys, where as organic mercury attacks the central nervous system.

Treatment - Activated carbon filtration is very effective for the removal of mercury. Reverse osmosis will remove 95 – 97.00 %.

Nickel :WHO: 0mg L^{-1}-limit
Source - Nickel is common and exists approximately 85% of the water supplies. The US EPA has classified nickel as a possible human carcinogen on inhalation exposure but non carcinogenic via oral exposure.
Treatment - Nickel can be removed by a strong acid cation exchanger. Activated carbon filtration can be used to reduce the amount of nickel in drinking water. Reverse osmosis will remove 97 - 98 % of the nickel from drinking water.

Selenium : WHO : 0.01 mg/L
Source - Selenium is essential for human nutrition. The concentration found in drinking water is usually low and comes from natural minerals. Selenium is also a by-product of copper mining / smelting. It is used in photoelectric devises because it's electrical conductivity varies with light Naturally occurring selenium compounds have not been shown to be carcinogenic in animals. However, acute toxicity caused by high selenium intake has been observed in laboratory animals and in animals grazing in areas where high selenium levels exist in the soil.
Treatment - Anion exchange can reduce the amount of selenium in drinking water by 60 - 95%. Reverse osmosis is excellent at reduction of selenium.

Barium : WHO:1.0-2.0 mg L^{-1}
Source - Barium is a naturally occurring alkaline earth metal found primarily in the Midwest. Traces of the element are found in surface and ground waters. It can also be found in oil and gas drilling muds, waste from coal fired power plants, jet fuels and automotive paints .Barium is highly toxic when its soluble salts are ingested.
Treatment – Sodium form cation exchange units (softeners) are very effective at removing Barium .Reverse Osmosis and Electro dialysis are extremely effective in its removal.

Cadmium : WHO: 0.005-0.001mg L^{-1}
Source - Cadmium enters the environment through a variety of industrial operations, it is an impurity found in zinc. By-products from mining, smelting, electroplating, pigment, and plasticizer production can contain cadmium. Cadmium emissions come from fossil fuel use. Cadmium makes its way into the water supplies as a result of deterioration of galvanized plumbing, industrial waste or fertilizer contamination.
Treatment - - Cadmium can be removed from drinking water with a sodium form cation exchanger (softener). Reverse Osmosis will remove 95 - 98% of the cadmium in the water. Electro dialysis will also remove the majority of the cadmium.

Viruses
Source - Viruses are infectious organisms that range in size from 10 to 25 nanometers. They are particles composed of an acidic nucleus surrounded by a protein shell. There are over 100 types of enteric viruses. Enteric viruses are the viruses that infect humans. Enteric viruses, which are of particular interest in drinking water, are

Virus	Disease
Enteroviruses	Polio, Aseptic meningitis, and Encephalitis

Reoviruses	Upper respiratory and gastrointestinal illness
Rotaviruses	Gastroenteritis
Adenoviruses	Upper respiratory and gastrointestinal illness
Hepatitis A	Infectious
Norwalk-type	Gastroenteritis

Treatment - Chemical oxidation / disinfection is the preferred treatment. Chlorine feed with 30 minute contact time for retention, followed by activated carbon filtration is the most widely used treatment. Ozone or iodine may also be utilized as oxidizing agents. Ultraviolet sterilization or distillation may also be used for the treatment of viruses.

Bacteria

Source - Bacteria are tiny organisms occurring naturally in water. Not all types of bacteria are harmful. Biological contamination may be separated into two groups: (1) pathogenic (disease causing) and (2) non-pathogenic (not disease causing).

Pathogenic bacteria cause illnesses such as typhoid fever, dysentery, gastroenteritis, infectious hepatitis and cholera.

All water supplies should be tested for biological content prior to use and consumption. E.Coli (Escherichia Coli) is the coliform bacterial organism that is looked for when testing the water. If E.Coli is found in a water supply along with high nitrate and chloride levels, it usually indicates that waste has contaminated the supply from a septic system or sewage dumping and has entered by way of runoff, a fractured well casing or broken lines. If coliform bacteria are present, it is an indication that disease-causing bacteria may also be present.

The most common non-pathogenic bacteria found in water is iron bacteria. Iron bacteria can be readily identified by the red, feathery flock that forms overnight at the bottom of a sample bottle containing iron and iron bacteria.

Treatment- Bacteria can be treated by micro filtration, reverse osmosis, ultra filtration, or chemical oxidation and disinfection. Ultraviolet sterilization will also kill bacteria. Ultraviolet treatment also does not provide residual bactericidal action; therefore, periodic flushing and disinfection must be done. The most common and undisputed method of bacteria destruction is chemical oxidation and disinfection. Ozone injection into a water supply is one form of chemical oxidation and disinfection. Chlorine injection is the most widely recognized method of chemical oxidation and disinfection. Chlorine must be fed at 3 to 5 ppm to treat bacteria and a residual 0.4 ppm of free chlorine must be maintained for 30 minutes in order to meet standards. Reverse Osmosis will remove 99+ % of the bacteria in a drinking water system.

Protozoan

i). Cryptosporidium

Source - Cryptosporidium is a protozoan parasite that exists as a round Oocyst about 4 to 6 microns in diameter. Oocyst pass through the stomach into the small intestine where it's sporozoites invade the cell lining of the gastrointestinal tract.

Symptoms of infection include diarrhea, cramps, nausea, and low-grade fever. **Treatment -** Filtration is the most effective treatment for protozoan cysts.

ii). Giardia Lamblia

Source - Giardia is a protozoan which can exist as a trophozoite, usually 9 to 21 tm long or as an ovoid cyst approximately 10 tm long and 6 tm wide.

Symptoms include diarrhea, fatigue, and cramps.

Treatment - Slow sand filtration or a diatomaceous earth filter can remove up to 99 % of the cysts when proper pretreatment is utilized. Chemical, ultra filtration and reverse osmosis all effectively remove Giardia cysts. Ozone appears to be very effective against the cysts when utilized in the chemical oxidation - disinfection process instead of chlorine. The most economical and widely used method of removing Giardia is mechanical filtration.

Organics

Sources - Organics come from three major sources: (1) the breakdown of naturally occurring organic materials, (2) domestic and commercial chemical wastes and (3) chemical reactions that occur during water treatment processes. Petroleum-based aliphatic and aromatic hydrocarbons. Organics derived from domestic and commercial chemical wastes include wastewater discharges, agricultural runoff, urban runoff and leaching from contaminated soils. Organic contaminants formed during water treatment include disinfection by-products such as THM's (trihalomethanes) or undesirable components of piping assembly such as joint adhesives.
Treatment - Activated carbon is generally used to remove organics, color, taste and odor causing compounds. Reverse osmosis will remove 98 to 99% of the organics in the water. Ultra filtration (TJF) and nanofiltration (NF) have both been proven to remove organics. Anion exchange resin also retains organics, but periodically needs cleaning.

Pesticides

Source - Pesticides are common synthetic organic chemicals (SOCs). Pesticides reach surface and well water supplies from the runoff in agricultural areas where they are used. Pesticides usually decompose and break down as they perform their intended function. Low levels of pesticides are found where complete breakdown does not occur.
Treatment - Activated carbon filtration is the most effective way to remove synthetic pesticides. Ultra filtration and Reverse osmosis will remove 97 - 99% of the pesticides.

Synthetic Organic Chemicals

Source - Over 1000 SOC's (Synthetic Organic Chemicals) have been detected in drinking water at one time or another. Most are of no concern, but some are potentially a health risk to consumers. Below is a list of synthetic organic chemicals along with the proposed MCL (maximum contamination level) in mg L^{-1} as determined by the US EPA Primary Drinking water Regulations.

Synthetic Organic Chemicals	Proposed MCL, mg L^{-1}
Acryl amide	0.0005
Atrazine	0.002
Carbofuran	0.04
Chlordane	0.02
1,2-Dichioropropane	0.005
Monochlorobenzene	0.1
Polychlorinated biphenyls	0.0005
Pentachlorophenol	0.2
Styrene	0.005
Tetrachloroethylene	0.005

Toluene	2.0
Xylene	10.0

Treatment - Activated carbon is generally used to remove organics. Reverse osmosis will remove 98 to 99% of the organics in the water. Ultra filtration and nanofiltration, both will remove organics. Anion exchange resin also retains organics, but periodically needs cleaning.
Almost all water quality parameters can be removed by Reverse osmosis and Electro dialysis methods. But these methods are costly and recurring. Water purified by these methods contain no minerals which is also not good for drinking purpose. Other treatment methods are also to be used.

CONCLUSION

Man uses water and pollutes it inevitably. When such water is returned to the open bodies, it contaminates natural water. Management of the quality of water is now the concern of experts in all countries of the World. The decision of WHO's 29th session emphasizes that water delivered to the consumer should meet the high requirements of modern hygiene and should at least be free from pathogenic organisms and toxic substances. The quality of water depends on the location of the source and the state of environmental protection in a given area. The increasing demand placed on it has stimulated investigations oriented towards quantification of the resource which is basic to the formulation of plans for its exploitation, management and conservation.
There arises a Struggle for Water and also predicting the Water War near future between various Countries on the Globe. Experts and Public think over on this problem and take a Challenge to prevent this situation and protect the Good Environment. First step in this is SAVE WATER AND MANAGE THE AVAILABLE WATER BY PROPER TREATMENT METHODS OF COTAMINATED WATER.

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