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Treatment of Water and Waste Water, using Adsorption

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ABSTRACT

Water is an essential compound for the survival of any living creatures. Water consists of two hydrogen atoms as well as one oxygen atom, and is considered to be universal solvent for its unique properties. The universe is composed of 65% water and 35% of terrain. All living creatures enjoy water through the natural process of Hydrological cycle, where water evaporates from the sea surface, forms clouds and then condenses to form water on the terrain. In the process of use of water and discharging improperly, by human being, the water bodies are being polluted day by day.

The objective of current paper is to review about water, waste water and the probable treatment methods for best use of current and future generation. The paper discusses about the chemical requirements like total dissolved solids, calcium, potassium, sodium, manganese, magnesium, chloride, fluoride etc., of potable water, and its impact on deviation, like damage to human beings, animal beings, plants beings, and to the eco system. According to World Health Organization, water supplied by most of the Government's is not meeting the standards. The paper also discusses about the results of simple methods of water treatment using adsorption technologies.

Keywords

Water, water pollution, waste water, treatment water and waste water

1. Introduction

Water posses with the chemical formula H_2O, with transparent in nature and forms streams, ponds, rivers, and canals. Almost all the living organisms contains major portion of water as a constituent. Water is embedded with covalent bonds, and is a liquid at room temperature, it also appears in the form of solid as ice, snow, fog and dew at lower temperatures. Water also appears as vapor in higher temperatures. Water occupies 65-71 % of earths surface (1), as seas and oceans and is an important parameter for ecosystem.96.5% of water is found in earths surface the form of seas and oceans, 1.7% of ground water, 1.7% of glaciers in Antarctica dn Greenland, and 0.001% in the form of vapour(2,3). Large portion of water is found in the earth's interior portion(4). Water has the tendency of fluidization and keeps moving, as the cycle of evaporation, transpiration, condensation, precipitation and runoff, and yields by merging in the seas. Pure drinking water is very much essential for the survival of human being. Approximately one billion people are not getting safe drinking water and about 2.5 billion has inadequate sanitation(5). Coorelated access to safe drinking water and gross domestic product per person(6), is not matching, nevertheless estimates reports that by 2025, half of the world population will be facing water issues(7), According to some reports water demand will increase by 50% in 2030(8). Increase of population, and rapid growth of industrialization, requires more and more volumes of water and unfortunately industrialists are not bothered in treating waste water, in-turn, most of the water is being polluted. Out of the water being used by human being, 70% goes to agriculture (9).

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1.1 Water quality requirements as per Indian Standards:

S.No	Parameter	Permissible Limit
1	Copper as Cu (mg/l)	0.05
2	Iron as Ce (mg/l)	0.3
3	Manganese as Mn (mg/l)	0.1
4	Nitrate as NO3 (mg/l)	45
5	Fluoride as F (mg/l)	1
6	Zink as Zn (mg/l)	5
7	Aluminum as Al (mg/l)	0.03
8	Chlorides as Cl (mg/l)	250
9	Selenium as Se (mg/l)	0.01
10	Sulfate as SO4	200
11	Alkalinity as CaCO3	200
12	Calcium as Ca	75
13	Magnesium as Mg30	30
14	Residual, free chlorine	0.2
15	Phenolic compounds as C6H5OH	0.001
16	Mineral Oil	0.01
17	Anionic Detergents as MBAS	0.2
18	Boron as B	0.3
19	Barium as Ba	0.7
20	Molybdenum as Mo	0.07
21	Sulphide as H2S	0.05

1.2 Waste Water: Water when used for man made activities, entrainment of substances into it, terming waste water, which is originated from domestic, agricultural as well as commercial agencies (10). The sewage water, which is also called municipal waste water is transported in a conduit or sever and sent to treatment plant, where unit operations like sedimentation, floatation and filtration is done. The treated sewage is sent into ambient water bodies.

Origin and occurrence of waste water:

- Human Waste (from toilets, feces, urine and bodily fluids)
- Human Waste (from toilets, feces, urine and bodily fluids)
- Leakage of cesspit Discharge of septic tank
- Discharge from sewage treatment plants
- Domestic used water
- Rainfall run off water
- Infiltrated ground water
- Extra product, or batch failure of industrial proceses
- Sea water entrainment
- Industrial wastes

1.3 Constituents of waste water:

- Flush water from lavoratories contain 95 % of water

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- Waste water constitutes pathogens like bacteria, viruses etc
- Non pathogenic bacteria
- Organic compounds like feces, food, hair, vomit, plant material, fibers, humes etc.,
- Organic material soluble in nature like urea, proteins, drugs, fruits etc.,
- Inorganic compounds like sand, metal particles, ceramics, grit etc.,
- Animals like protozoa, arthoporods, small fish, insects
- Macro solid compounds lie napkins, diapers dead animal matters etc.,
- Gases like carbon dioxide, hydrogen sulphide, methane etc.,
- Emulsions like adhesives, paints, warnishes etc.,
- Toxins like pesticides, herbicides etc.,

1.4 Microfiltration:

Microfiltration is abbreviated as MF, which is a special of physical filtration, where polluted water is passed through a particular pore membrane, at appropriate pressure. Microorganisms and suspended particles of liquid gets separated. It is used in different proceses to separate contaminants from mother liquor, solvent, water etc.

Microfiltration uses in pre treatment of separation processes before ultra filtration. The particle size of microfiltration ranges between 0.1 to 10 micrometers(11). The micro filtration membranes can separate particles of molecular weights less than 100000 g/gmol(12).The filters used in micro filtration process is are designed particularly to remove particles like algae, sediment, protozoa and large bacteria. More quantities of microscopic, atomic or ionic compounds like water, a monovalent, species like Sodium or Chloride ions, or dissolved organic matter and collides and viruses will still permeate through the membrane (13). Suspended solids present is passed through a high velocity of 1-3 m/s and at a pressure of 100-400 KPa, parallelly of tangentially to the semi-permeable membrane in a curved sheet or tubular form. A pump of vacuum is used to maintain pressure of negative pressure in the other side. A pressure guage is fitted to monitor the pressure. Massive use of microfiltration membranes are in bevarages, water treatment and bio processing of industries. The percentage of volume of output varies from 90-96% (14)

Microfiltration is also a best means to treat drinking water. The membranes serves as a primary disinfecting mechanism, of the water stream. The raw stream poseses pathogens like protozoa, cryptosporidium and giardialamblia, which causes multiple diseasses. The species exhibit gradual resistance to conventional disinfectants like chlorine (15).

Likewise Micro filtration membranes are used in secondary waste water treatments to separate turbidity, and also serves treatment for disinfection.

1.5 Nano Filtraiton:

Nano filtration is a membrane filtration, used for low concentration dissolved solids like surface water, and ground water, to soften and disinfection of microbial matter and other ortanic matter (16).Nano filtration has become videly adopted technology in processing foods like dairy for simultation concentration and part removal of minerals. The pore size of nano filtration 1-10 nano meters, and the liquid to be purified is passed through the membrane at 90oC. Membranes are prepared by using polyethylene terephthalate or with metals like aluminium (17), such membranes are called ‘Track-etch” membranes.Nano foiltration is being used ffectively in water treatmen, retaining Ca2+and Mg2+ ions(18)

1.6 Ultra filtration:

Ultra Filtration is commonly known as UF, where a different membrane is used with certain pressure. A semi permeable membrane is used to separate suspended solids. The process is very much adopted in industry to lessen the initial concentration. UF can be used to separate impurities from raw water and can be used for drinking. Ultra filtration is compact in size, no chemicals is used, and has the potential of meeting standard quality norms. It is also to be learnt that much water will not be wasted. Membrane fouling and replacement costs are little higher in ultra filtration.

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1.7 Reverse Osmosis:

Reverse osmosis is also calledas RO, where dissolved solids and microbial matter is treated to reduce to zero levels. It uses a pressure gradient of 6 Kg/cm2 and is found to be very effective in producing drinking water. The membrane rejects approximately 45% of waste water, which has high TDS with a value of 1600 ppm, which is considered to be toxic for plants and animals. A study has been done to re utilize the waste water of reverse osmosis, where three different rejects were collected.

1. Materials and Methods:

Adsorption coloumn: Four adsorption columns are prepared, from locally available low cost adsorbants like, fine sand, coarse sand, pebbles, and saw dust. Four adsorption coloumns were kept inseeries, in which first one consists of saw dust, second consists of fine sand, third consists of coarse sand and the last one consists of pebbles of 5 mm size. Waste carboy's of 30 liter volume are used as adsorption coloumns, in which 65% of it was used filled with adsorbate. are used Bore water is passed through these beds.

The treated water is analyzed for before and after effect.

2. Results & Discussions:

The samples collected from different sources were tested, and the results were dipicted as below:

S.No	Sample Details	Sample TDS in ppm	Major Pollutant and its TDS Pre treatment	Major Pollutant TDS post treatment	Sample TDS after adsorption in ppm	Remarks
1	Bore water collected in Kazipalli Area	1150	Nitrate as No3, 65ppm	Nitrate as No3, 43ppm	982	Within WHO range
			Sulphate as So4, 290 ppm	Sulphate as So4, 190 ppm		
			Alkanity as CaCo3, 335	Alkanity as CaCo3, 196 ppm		
			Zink as Zn 12 ppm	Zink as Zn, 4.5 ppm		
2	Bore water collected in Narsapur Area	970	Nitrate as No3, 55ppm	Nitrate as No3, 33 ppm	801	Within WHO range
			Sulphate as So4, 270 ppm	Sulphate as So4, 178 ppm		
			Alkanity as CaCo3, 305 ppm	Alkanity as CaCo3, 177 ppm		
			Zink as Zn 9 ppm	Zink as Zn, 3.5 ppm		
3	Bore water collected in Gagilapur Area	1080	Nitrate as No3, 57ppm	Nitrate as No3, 39 ppm	903	Within WHO range
			Sulphate as So4, 240 ppm	Sulphate as So4, 205 ppm		
			Alkanity as CaCo3, 280 ppm	Alkanity as CaCo3, 199 ppm		
			Zink as Zn 8.5 ppm	Zink as Zn, 4.8 ppm		

All the three zones of water had been tested in laboratory, and deviation was found in four parameters in three zones of water viz. nitrates, sulphates, alkanity and zink. It had been observed that, in all places, adsorption rate was phenomenal, and the results were very much encouraging. The water samples were found to be

beyond the scope of World Health Organization (WHO) standards, and after the treatment, everything was falling in the range, which depicts, adsorbents used are effectively functioning to treat pollutants.

3. Conclusions:

It can be concluded that, water which consists of impurities such as sulphates, alkanity and zink can be easily removed by simple adsorbants like saw dust, fine sand, coarse sand and pebbles, and can be made potable for human consumption.

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