Discipline Specific Elective Course

Industrial and Environmental Microbiology
## Course Code: BOTDSC03T

Unit: 6   <u>Microbial Flora of Water</u>   (Part-1)

- Microbes are the living organisms which are non visible in naked eyes, it includes microscopic organisms like bacteria, virus, protozoa, fungi, algae and so on. Microbes present everywhere in the environment. So, water bodies also contain the microbes. The residential microbes of the water bodies which does not affect the properties any features of the water body as well as have no adverse effect on water living plants and animals are known as microbial flora of water.

- ❖ Water Pollution:
    - ▪ Water pollution is the contamination of water bodies, usually as a result of human activities (Natural phenomena such as volcanoes, algae blooms and growth of microorganisms, storms, and earthquakes also cause major changes in water quality and the ecological status of water). Water bodies include for example lakes, rivers, oceans and groundwater. Water pollution results when contaminants are introduced into the natural environment. For example, releasing inadequately treated wastewater into natural water bodies can lead to degradation of aquatic ecosystems. Apart from that polluted water may use for drinking or bathing or irrigation. As a result of it water pollution is the leading worldwide cause of death and disease, e.g. due to water-borne diseases. Water pollution accounted for the deaths of 1.8 million people in 2015. The organization Global Oceanic Environmental Survey (GOES) consider water pollution as one of the main environmental problems that can present a danger for the existence of life on earth in the next decades. One of the main concerns is that water pollution, heart phytoplanktons that produce 70% of oxygen and remove a large part of carbon dioxide on earth.

Table 1. Examples of waterborne pathogens	
Viruses	**Health effect**
adenovirus	conjunctivitis, diarrhea, encephalitis, respiratory and heart disease
astrovirus	diarrhea
norovirus	diarrhea, 'stomach flu'
coronavirus	diarrhea
hepatitis A virus	hepatitis
rotavirus	diarrhea
enterovirus	paralysis, meningitis, rash, fever, myocarditis, respiratory disease, diarrhea
reovirus	respiratory disease
Bacteria	**Health effect**
Aeromonas hydrophila	sepsis, gastrointestinal illness
Yersinia enterocolitica	gastroenteritis
Salmonella (non)/typhi	paratyphoid fever, gastroenteritis, typhoid fever
E. coli O157:H7	gastroenteritis, vomiting, hemolytic uremic syndrome, hemorrhagic colitis
Shigella spp.	dysentery
Campylobacter sp.	gastroenteritis, nervous system disorders
Helicobacter pylori	ulcers
Legionella pnemophila	Legionnaires Disease, Pontiac fever, pneumonia
Vibrio cholerae	diarrhea
Protozoa	**Health effect**
Cryptosporidium parvum	cryptosporidiosis
Microspora	gastroenteritis
Giardia lamblia	giardiasis
Entamoeba histolytica	dysentery
Cyclospora cayetanensis	gastroenteritis
Acanthamoeba	eye infections
Toxoplasma gondii	similar to mononucleosis
Naegleria fowleri	amoebic meningoencephalitis

- The components which are responsible for changing the properties of water and make it no usable known as water pollutants. Men made pollutants are classified under several categories.
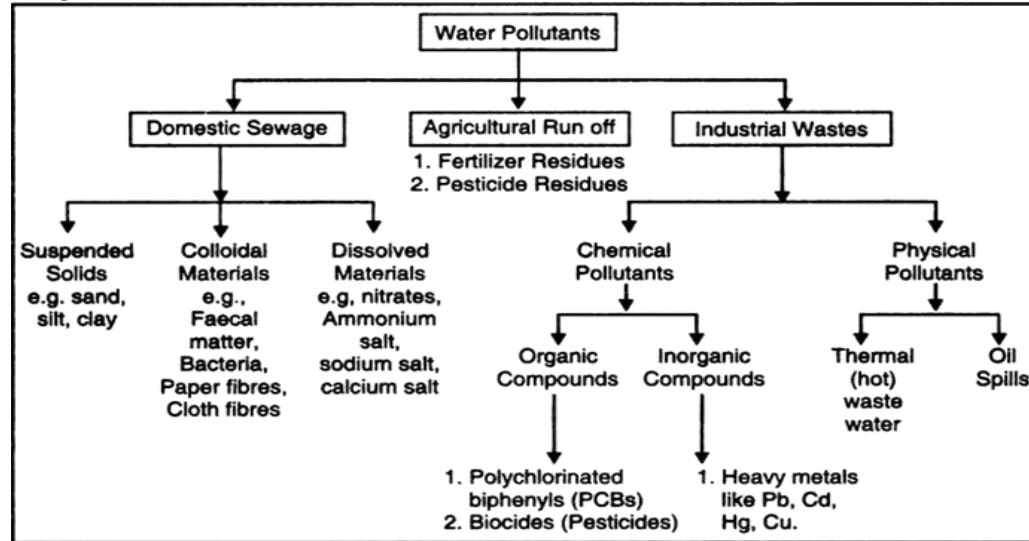
- After pollution, polluted water can be classified on the basis of its nature of pollutant. Different pollutant results different kinds of symptoms and effects, some major types are listed below-

Type of Water Pollution	Cause of Pollution	Symptoms of Pollution	Effect of Pollution	Source of Pollution
Biodegradable waste	Humans and animals	Decreasing numbers of fish and other aquatic life, increasing number of bacteria	Increased number of bacteria, decreased oxygen levels, death of aquatic life	Run-off, improperly treated effluent,
Nutrients	Nitrates and phosphates	Green, cloudy, slimy, stinky water	Algae blooms, eutrophication of water source	Over use of fertilizers, run-off from fields, improper disposal of containers, wastewater treatment
Heat	Increased water temperature	Warmer water, less oxygen, fewer aquatic organisms	Decrease in oxygen levels, death of fish and plants	Industrial run-off, wastewater treatment
Sedimentation	Suspended particles settling out of water	Cloudy water, increased amount of bottom	Warms up water, decreases depth of water source, deposits toxins	Construction sites, farming and livestock operations, logging, flooding, city run-off, dams
Chemicals	Toxic and hazardous chemicals	Water colour changes, develops an odour, aquatic life die out	Kills aquatic life, can enter human food chain, leads to birth defects, infertility, cancer and other diseases in humans and animals	Human-made, improper disposal, run-off, dams, landfill leachate, industrial discharge, acid rain
Radioactive pollutants	Radioactive isotopes	Increased rates of birth defects and cancer in human and animal populations.	Kills aquatic species and leads to cancer and death in humans and other animals	Waste water discharges from factories, hospitals and uranium mines
Medical	Medicines, antibiotics	Infertility in aquatic organisms, and other unknown symptoms	Unknown	Humans dumping medicines into water systems, wastewater treatment
Microbiological	Bacteria, viruses, protozoa	People and animals become ill with gastrointestinal disorders	Undrinkable water	Improper treatment of water/effluent, can occur naturally

- On the basis of type of water body, water pollution is of two types – Surface water pollution (it includes pollution of rivers, lakes and oceans) and Ground water pollution (it indicates the water content below the earth crust.)

  Surface water actually prone to pollution but ground water pollution depends on the soil quality. In case of porous soil contaminated water of surface gradually enters inside of earth crust and results the pollution of ground water.

Surface Water	Ground Water
Water content found on the surface of the earth crust. E.g. Stream, River, Lake water etc.	Water content below the earth crust. E.g. Water at porous rock etc.
Directly used for irrigation.	At first these water need to pump out then used for irrigation purpose.

- On the basis of source, water pollution can be categories into two types again-

Point Source	Non Point Source
Having definite area from where pollutants are released. E.g. Factories, Domestic swage, Oil plants etc.	Have no definite area of release of pollutants. E.g. Industrial belts, Croplands, Urban areas etc.
Easy to detect and clean up.	Difficult to detect and regulate.

- Water pollution can be measured by different practices , which in turn classified under three categories-

Physical Methods	Chemical Methods	Biological Methods
Water Temperature.	pH	Biologically water pollution is monitored by the ability of growth of some aquatic organisms known as bio indicators.
Chemical Conductance.	Biological Oxygen Demand (BOD).	
Total suspended solids.	Chemical Oxygen Demand (COD).	
Total dissolved solids.	Dissolved Oxygen.	
Turbidity.	Heavy Metals.	
Odor.	Nitrates.	
Colour.	Pesticides.	
Taste.	Surfactants.	

- In recent days water pollution is a serious issue because of its limitless adverse effects on environment. There are many guidelines from respective government of each country to control the water pollution. India also has some guidelines of it under "Sustainable Sanitation and Water Management" (2018). Guide lines are listed below-

Ends

Objectives

Means

Catch and income of fishing families is stabilised or increased

Threat to the riverine ecosystem is reduced, and fish stocks are increased

Incidence of water borne diseases and illnesses is reduced, particularly among poor families and under 5s

River water quality is improved

The quantity of solid waste dumped into the river is reduced

No. of households and factories discharging wastewater directly into the river is reduced

Wastewater treatment meets environmental standards

Polluters are effectively controlled

Population more aware of the danger of waste dumping

New legal regulations are established which are effective in preventing direct discharge of wastewater

Increased % of households and businesses are connected to sewerage network

Environment Protection Agency is effective and more responsive to a broad range of stakeholder interests

Public information/education programs established

Pollution management is given a higher political priority

Increased capital investment

Improved business planning within Local Government is established, including cost recovery mechanisms