OLYMPIAD Champs

SCIENCE

Wastewater Story

Learning Objective

- **1**. Types of waste
- **2.** Water Treatment plants
- **3.** Waste Management
- **4.** Sewerage system
- **5.** Eutrophication



INTRODUCTION

Wastewater needs to be treated before it can be reused, or released into a water body. Wastewater has many impurities and these impurities should be removed by water treatment. Wastewater from households is treated at a treatment plant to remove the physical, biological and chemical matter. In the physical process, wastewater is filtered to remove large impurities. For example: Take a funnel. Place a filter paper in the funnel and wet it with water. Then add some sand, fine gravel and medium gravel into the funnel. These are layers for the filtration of water. Now pour wastewater into the funnel and collect clean water. Repeat the same process several times till the collected water looks clean.

Do you know?

• Over 1.5 billion people do not have access to clean safe water.

• On an average women in Africa and Asia have to walk 3.7 miles to collect water.

• 80% of an illness in the developing world comes from water borne diseases.

WATERTREATMENT PLANTS

In water treatment plants, the layers are substituted by:

Bar Screens

Bar screens are screens that prevent the flow of large objects in wastewater. These screens help

to remove large objects like rags, plastic bags, cans, napkins and sticks from sewage. These bar screens are cleaned regularly either manually or with the help of the machines.

Grit and Sand Removal Tank

The grit and sand removal tank may not remove some impurities, such as faeces.

Clarifier

A clarifier is a tank with its central part inclined downwards so as to allow faeces to settle down. The inclined waste is then removed using a scraper. This waste is termed as sludge. Sludge is transferred to a separate tank where it is decomposed using bacteria. The gas produced is burned in an apparatus such as micro-turbine to generate electricity. Finally, a skimmer is used to remove the oils and grease. Thus, if all the physical contaminates are separated from the sewage, then the sewage is termed to be clarified water. Biological contaminates such as bacteria and microbes consume humar waste, food waste, soaps and other wastes, and still remain in the clarified water. Now this clarified water is passed into an aerator in waste water treatment. An aerator pumps air into the water. After many hours, the bacteria settle at the bottom of the tank as activated sludge. The water present in the top is 95% clean and is let out into a water source, while the activated sludge is dried in a sand bed and is used as manure, hi the chemical process, take a chlorine tablet and put it in a beaker full of water. Observe that water is clean when the tablet dissolves. That is why chlorine tablets or ozone is used to disinfect water in treatment plants. Different mechanisms were used to treat water, even in the olden days. The ancient Greek and Indian writings dating back to as early as 2000 BC recommended water treatment methods. People knew about water treatment procedures back in 2000 BC. The Egyptians discovered the process of coagulation for water treatment. Eucalyptus trees are planted along the sewage ponds in which water is released after water treatment processes. Eucalyptus trees absorb waste water from the pond and release pure water vapour into the atmosphere. Oils and fats can harden and block water pipes. Fats clog the soil pores in an open drain, reducing the effectiveness of filtration of water. So avoid throwing tea leaves, solid food remains and napkins into the drain. These block the flow of oxygen to the microbes that help in water treatment. Chemicals like paints, medicines, motor oil and solvents loll the microbes that help in water treatment. People need to be made aware of the ill effects of throwing pollutants into the drain.

WASTEWATER TREATMENT PLANT OR SEWAGE TREATMENT PLANT

These are large plants where wastewater is cleaned before being sent to the nearest water bodies or being reused. The sewage treatment involves physical, chemical and biological processes to remove impurities from the wastewater.



Physical Process

Filtration: The wastewater is passed through bar screen. Large objects; like rags, sticks, plastic bags, cans, etc. are removed in this process.

Grit and Sand Removal: The wastewater is slowly passed through the sedimentation tank. Grit, sand and pebbles settle down at the bottom.

Sedimentation: Water is then sent to the sedimentation tank. Solids; like faeces settle at the bottom. Floatable impurities; like oil and grease float on the surface. A scraper removes the faeces from the water. The impurity thus collected is called sludge; which is sent to the sludge tank. The sludge can be used to produce biogas or to produce manure. A skimmer removes the floatable impurities. Now, the water is called clarified water.

Do you know?

Simply washing hands can decrease the chance of diarrhea by around 35%

Biological Process

Aeration: Air is pumped into clarified water so that bacteria can proliferate. Bacteria consume the human waste. It leaves food waste, soap and other unwanted materials in the water. The microbes settle down at the bottom after several hours. Water is then removed from the top. This water is fit for irrigation and can be used for that purpose.

Chemical Process

Chlorination: Water purified through aeration is not fit for human consumption. It needs to be treated with chlorine. For this, bleaching powder is added to the water. The chlorine kills whatever germs maybe left in the water. After chlorination, the water is fit for drinking.

EFFECTS OF POOR SANITATION

Everyone must know about the adverse effects of poor sanitation. The problem is at its worst in villages, where proper sanitation is not available. Villagers defecate in the open, on dry river beds, railway tracks, fields and even directly in water. This causes water and soil pollution. Moreover, it contaminates and affects ground water as well as surface water, resulting in diseases such as cholera, typhoid, polio, meningitis, hepatitis and dysentery.

Do you know?

• Over 2.6 billion people lack access to adequate sanitation

• 90% of wastewater in developing countries is discharged into rivers or streams without any treatment.

Sanitation is a major problem in developing countries such as India and China. The government is unable to provide proper sanitation through underground drainages. Also, lack of knowledge and of money, illiteracy, large population and lack of social awareness results in improper sanitation. To avoid these problems, low-cost onsite sewage disposal systems should be used. These systems collect human excreta and store it in a hole or a pipe, and later direct it to a sewage treatment plant, m the absence of a proper sanitation network, people can use some other mechanism for sewage disposal. The other mechanisms are septic tanks, chemical toilets, composting pits and vermi-processing toilets.

Septic Tanks

Septic tanks are suitable for places such as hospitals, isolated buildings and clusters of houses where there is no sewage. Local governments or private corporations usually provide septic tanks in areas that have no direct connection to main sewage pipes. The septic tank system consists of a small sewage treatment system.

Chemical Toilets

Aeroplanes and trains usually have chemical toilets. A chemical toilet uses chemicals to disinfect human waste and remove its bad odour. That is why trains and aeroplanes do not have elaborate plumbs and sewage.

Composting Toilets

Another method of clearing human waste is by the process of composting pits. A composting toilet is a system that converts human waste into organic compost and usable soil. This happens when micro-organisms, such as bacteria and fungi, and macro-organisms, such as earthworms, oxidize organic waste to break it down into essential minerals.

Vermi-Composting Toilets

A vermi-composting toilet is a process that involves earthworms, which treat human excreta. This process is low cost. Moreover, the entire human

Sulabh Toilets

Organisations such as Sulabh International have developed a twin-pit pour flush toilet system that is being used by ten million people every day. The waste from these toilets flows through covered drains into a biogas plant for the generation of biogas and bio-fertilizers.

Biogas plants offer safe and hygienic disposal of wastes. Biogas has great advantage, i.e. it is used as a source of low-cost fuel. It can be used for heating, cooking running heat engines, generating mechanical or electrical power.

Litter and Waste

Litter and waste cause sanitation havoc at public places. This becomes common when exhibitions and fares are conducted. Public places such as railway stations, bus depots, airports and hospitals generate a lot of waste, which leads to diseases. To prevent disease, certain measures should be taken and awareness among people should be created.

Manhole: These are the holes made in sewers at frequent intervals, so that timely inspections and cleaning of sewers can be done through them. The manhole is covered with a hard lid so that people and traffic can easily move over it.

Do you know?

• It takes up to 5000 liters of water to produce 1 kg of rice.

• The average toilet uses 8 liters of clean water in a single flush.

SANITATION

Better Housekeeping Practices to Maintain Sanitation

1. Do not throw cooking oil and fat in the drain. This can block the drain. The fat and oil clogs the pores in the soil; in open drains. This reduces the filtering capacity of soil.

2. Do not throw chemicals; like paint, insecticides, medicines, etc. into the drain. They

kill the bacteria which otherwise help in cleaning the water.

3. Do not throw used tea leaves, solid food, soft toys or napkins in the drain. They can clog the drain and do not allow oxygen to enter the sewage water. Oxygen is important for the natural process of decomposition.

Sanitation and Disease

Maintaining overall cleanliness in the home and in surroundings is called. Sanitation is important for the health of a person and that of the community. Many people have the habit of defecating in the open. Uncovered human excreta attract flies and other insects. These insects carry the germs of many dangerous diseases; like cholera, typhoid, and jaundice. With constant public awareness campaign, the practice of open defecation can be stopped. Poor sanitary condition also contaminated the groundwater because contaminants percolate down the ground. Stagnant water is a perfect breeding ground for mosquitoes. Mosquitoes Are the carriers of several diseases; like malaria, dengue, chikungunya and filarial.

Alternative Arrangements for Sewage Disposal

In the absence of a sewerage system, arrangements for onsite sewage disposal can be made. For example; septic tanks are built in which human excreta are collected. In due course of time, the human excreta get decomposed into compost. Composting pits can be made to dump waste and to make manure from them. Sewage can be collected into biogas plants to produce useful biogas. Chemical toilets are new discoveries. They do not require much water for the disposal of human excreta and are environment friendly. Such toilets are ideal for the trains.

Sanitation at Public Places

Maintaining sanitation at public places is also important. In a heavily populated country; like India; any public place is always teeming with people. More footfall at public places results in more filth. Sanitation workers often work continuously to maintain cleanliness at public places. But it is our responsibility also to maintain sanitation at public places. We should follow some simple rules to help the sanitation workers. For example; always throw the trash in a dustbin and avoid littering. Don't spit at public places and use the dustbin or special bins marked for the purpose.

Do you know?

A child dies of water borne diseases about every 15 seconds. That is about 12 children just since you started reading this page.

Eutrophication

Eutrophication is the enrichment of an ecosystem with chemical nutrients, typically compounds containing nitrogen, phosphorus, or both. Eutrophication can be a natural process in lakes, occurring as they age through geological time. Eutrophication was recognized as a pollution problem in India and other developed countries. Human activities can accelerate the rate at which nutrients enter ecosystems. Run of from agriculture and development, pollution from septic systems and sewers, and other human-related activities increase the flux of both inorganic nutrients and organic substances into aquatic, and coastal terrestrial, marine ecosystems (including coral reefs).

SOME IMFORTANTTERMS

Wastewater: The water which gets contaminated after various works; like washing, bathing, mopping, etc. is called wastewater.

World Water Day: 22nd March

International Decade for Action on Water for Life: 2005-2015: It was declared by the General Assembly of the United Nations. Its main goal was to reduce the number of people who do not have access to safe drinking water; by half.

Sewage Treatment: The process of removing impurities from waste water before it can be reused or sent to the water bodies is called sewage treatment or cleaning of water.

Sewage: The liquid waste which has water as its largest component; along with various types of impurities; is called sewage.

Composition of Sewage	
Type of	Examples
impurities	
Organic	Human faeces, animal
impurities	waste, oil urea (uine),
	pesticides, herbicides, fruits
	and vegetables
Inorganic	Nitrates, phosphates, metals
impurities	
Nutrients	Phosphorus, nitrogen

Bacteria	Various types; such as those causing, cholera, typhoid, etc.
Other microbes	Various types; such as those causing diarrhea, jaundice, etc.

Sewers: The pipes which carry wastewater. **Sewerage:** The network of sewers.

KEYWORDS

1. Sludge - solid waste that settles down are sediment.

2. Sewerage - Removal of waste water. Flow through sewer system

3. Bloom - Abundance, too many.

4. **Waste** - Any material generated from domestic, industrial, or agricultural activities that has no immediate utility and is usually discarded

