

Chapter 10 Microbes in Human Welfare

BIOCHEMICAL OXYGEN DEMAND (BOD)

the amount of oxygen that would be consumed if all the organic matter in 1 liter of water was oxidized by the bacteria.

BIOCONTROL

the use of biological methods for controlling plant disease and pests.

BIOFERTILISERS

the organisms that enrich the nutrient quality of the soil.

BIOGAS

the mixture of gases (mainly CH₄, CO₂) produced by the microbial activity and which can be used as fuel.

BT COTTON

a variety of cotton which is incorporated with BT gene and it is resistant for insects pests.

CLOT BUSTER

the microbial product for removing clots from the blood vessels of the patients who have undergone myocardial infarction leading to heart attack.

FERMENTATION

the process of anaerobic respiration in which the complex molecules are broken into simple ones by the microbial action.

FERMENTERS

the containers made up of large amount of CH₄, CO₂ and H₂ as they grow on cellulosic material.

MYCORRHIZA

A symbiotic relation between fungal hyphae and roots of the tree (Higher plant)

PEST

organism that destroys crop or its products is known as pest.

SEWAGE

the waste-water containing large amount of organic matter and microbes.

Microbes are present everywhere.

- **E.g. Thermal vents of geyser (Temp. above 1000°C)**
- **Deep in soil.**
- **Under snow.**
- **Diverse.** Protozoa, Bacteria, Fungi, Virus, Viroids, Prions (Proteinaceous infectious agents)
- **Useful :** Antibiotics.
- **Harmful :** cause diseases.

In Household Products :-

- **Everyday :** Lactobacillus (LAB) Lactic acid Bacteria – form curd from milk.
- Increase Vit . B12
- Check disease causing microbes in our stomach.
- Fermentation of dough for dosa, idli (CO₂ produced)
- Making bread – Baker's yeast. *Saccharomyces cerevisiae*.
- Toddy made from sap of palm.
- Cheese making (eg. Swiss cheese by *Propionibacterium sharmanii*, Roquefort cheese by fungi.)

In Industrial Products :-

Beverages and antibiotics.

- **Fermentors :** Large vessels for growing microbes.

Fermented Beverages :-

- Beverages like wine, beer, whisky, Brandy, Rum (*Saccharomyces cerevisiae*) Malted cereals and fruit juices used to produce ethanol, wine and beer produced without distillation. Whisky, brandy, rum produced after distillation.

♦Antibiotics :- (Against life)

- Penicillin produced by Alexander Fleming from *Penicillium notatum* while working with Staphylococci Earnest Chain and Howard Florey awarded Nobel Prize in 1945 for establishing Penicillin as an effective antibiotic.
- **Uses :** Treat diseases like plague, whooping cough, diphtheria, leprosy.
- **Chemicals :** Enzymes and other Bioactivities Molecules:
- **Uses:**
- **Aspergillus niger** for production of Citric Acid.
- **Aspergillus niger** for production of Citric Acid.
- **Acetobacter aceti** for production of Acetic Acid.
- **Clostridium butylicum** for production of Butyric Acid.
- **Lactobacillus** for production of Lactic acid.
- **Lipases used** in detergents to remove oil stains from Laundry.
- **Pectinases** and **Proteases** to clarify bottled juices.
- **Streptokinase** (from *Streptococcus*) as clot buster in patients with myocardial infraction (heartattack).
- **Cyclosporin A-** an immuno-suppressant used in organ transplant patients (produced by *Trichoderma polysporum*)
- **Statins** produced by yeast **Monascus purpureus** used as blood, cholesterol lowering agent.

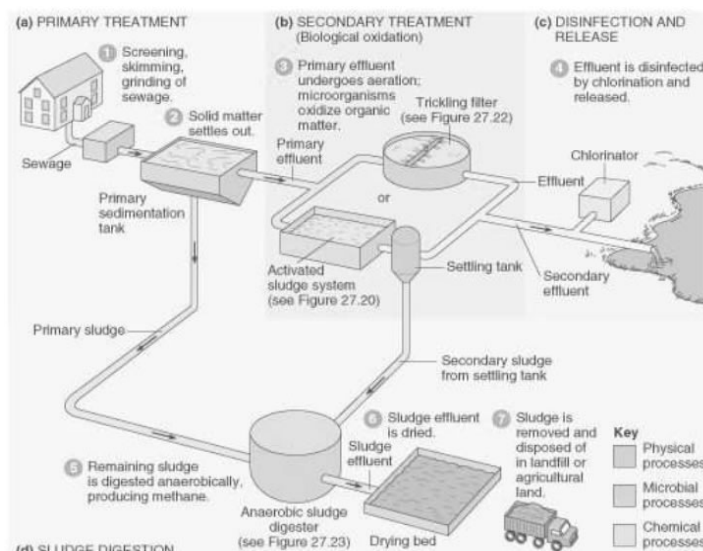
Microbes in sewage Treatment :-

Why treatment necessary ?

- Major component of waste water, human excreta.
- Waste water sewage.
- Cannot be disposed directly into rivers and streams.

Where & how ?

- Before disposal sewage treated in sewage treatment plants (STPs)
- Treatment done in two stages.
- **Primary :** Physical removal of particles large and small by filtration and sedimentation.
- Solids – primary sludge.
- Supernatant – effluent.
- **Secondary :** Primary effluent taken to large aeration tanks.
- Agitated mechanically and air pumped into it.
- Aerobic microbes form masses with fungal filaments flocs.
- Microbes consume organic matter in effluent for growth.
- BOD (Biological oxygen demand) reduced.
- Passed into settling tank.
- Bacterial flocs sedimented (activated sludge)
- Small part of activated sludge used as inoculums in aeration tank.
- Major part pumped into large anaerobic sludge digesters.
- Anaerobic bacteria digest bacteria and fungi.
- Bacteria produce gases such as methane, hydrogen sulphide and CO₂ – Biogas.
- Secondary effluent released into rivers and streams.
- No man made technology available till date.
- Untreated sewage if released into rivers causes pollution.
- Ministry of environment and Forests initiated, Ganga Action Plan and Yamuna Action Plan.



Biogas plant :-

- Concrete tank 10- 15 meters deep, slurry or dung fed.
- Floating cover placed above rises as biogas content rises.
- Connecting pipe for supply of biogas.
- Used for cooking and lighting.
- **Development by IARI :-** Indian Agriculture Research institute & KVIC : Khadi and village Industries Commission.

Microbes as Biocontrol Agents :

- Insecticides and Pesticides toxic, harmful & are pollutants.
- Natural predation better method.
- No of pests kept in check, not totally eradicated.
- Food chains not disturbed
- Eg. Ladybird and Dragon flies useful to get rid of aphids and mosquitoes.
- **Bacillus thuringiensis (Bt)** used to control butterfly caterpillar.
- Mode of spores operation.
 - o Available is sachets, mixed with water and sprayed on plants.
 - o Eaten by insect larva
 - o Toxin released in gut kills larvae.
- Now Bt toxin genes introduced into plants – resistant to insect pests.
e.g. Bt cotton.
- **Tungus trichoderma** now being developed.
- **Nucleo polyhedrovirus** good for narrow spectrum insecticide applications.
- No negative impacts on plants, mammals, birds, fish or target insects.
- For overall IMP (Intergrated pest Management) programme.
- For ecologically sensitive areas.

As Biofertilizers : -

- Chemical fertilizers major pollutant.
- Switch to organic farming and use of biofertilizers need of the time.
- Main sources of biofertilizers. **Bacteria, Fungi & Cyanobacteria.** Eg Rhizobium present in roots of leguminous plants fix atmospheric nitrogen into usable organic form. **Azospirillum** and **Azotobacter** free living bacteria – fix atmospheric Nitrogen.
- Symbiotic Associations
 - Eg.Genus Glomus sp. form mycorrhiza
 - Fungal symbiont absorbs phosphorus from soil and passes it to plant.
 - Plants show
 - o resistance to root – borne pathogens.
 - o Tolerance to salinity and drought
 - o Increase in growth and development.
- Cyanobacteria- autotrophic – fix atmospheric nitrogen
- Imp.biofertilizer. e.g. **Anabaena, Nostoc, Oscillatoria.**
- **Blue green algae** - increase fertility by adding organic matter.
- No. of biofertilizers are commercially available.

For production of biodegradable plastics :-

- biodegradable plastic, e.g. polyhydroxybutyrate (PHB) is being produced commercially by fermentation with the bacterium *Alcaligenes eutrophus*.
- Production of PHB may be easily achieved in tree plants like populus, where PHB can be extracted from leaves.
- Other main drawback of bacterial PHB is its high production cost, making it substantially very expensive than synthetic plastics.

As edible vaccines :-

- the genes encoding the antigenic proteins of virus and bacteria can be isolated from the pathogens and expressed in plants.
- such transgenic plants or their tissues producing antigens can be eaten for vaccination/immunization (edible vaccines).
- the expression of such antigenic proteins in crops like banana and tomato are useful for immunization of humans since banana and tomato fruits can be eaten raw. Example: cholera and hepatitis B vaccine.

Process of sewage treatment in STP

- a) Primary treatment(physical)
 - b) Secondary treatment(biological)
- Effluent loaded in large aeration tank, Agitation & rapid growth of aerobic microbes (flocs)
,Consumes organic matter ,reduces BOD, Effluent passed to settling tank, Flocs sediments form – activated

sludge(A.S.) Poured into sludge digester (small amount of A.S. used as inoculum) Filtration & sedimentation.

Process of sewage treatment in STP

