

Chapter – 10: Microbes in Human Welfare

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*
Ernest 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.

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 infarction (heart attack).

Cyclosporin A – an immunosuppressant 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.

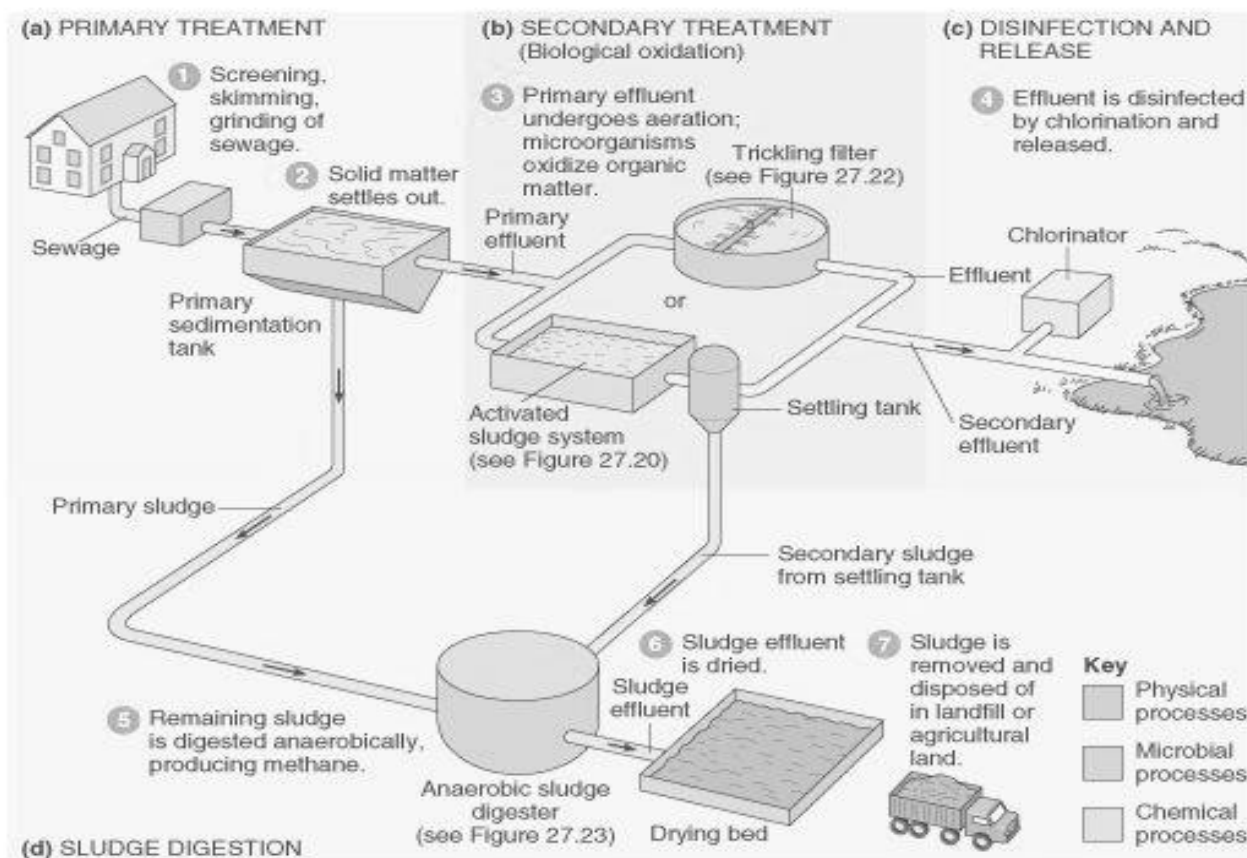
Bacteria produce gases such as methane, hydrogen sulphide and CO₂ – Biogas.

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 mts 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.

Available in sachets, mixed with water and sprayed on plants.

Eaten by insect larva

Toxin released in gut kills larvae.

Now Bt toxin genes introduced into plants – resistant to insect pests.

e.g. Bt cotton.

Fungus Trichoderma now being developed.

Nucleo polyhedrovirus– good for narrow spectrum insecticide applications.

Advantages :-

No negative impacts on plants, mammals, birds, fish or target insects.

For overall IMP (Integrated 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

- resistance to root – borne pathogens.
- Tolerance to salinity and drought
- 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.

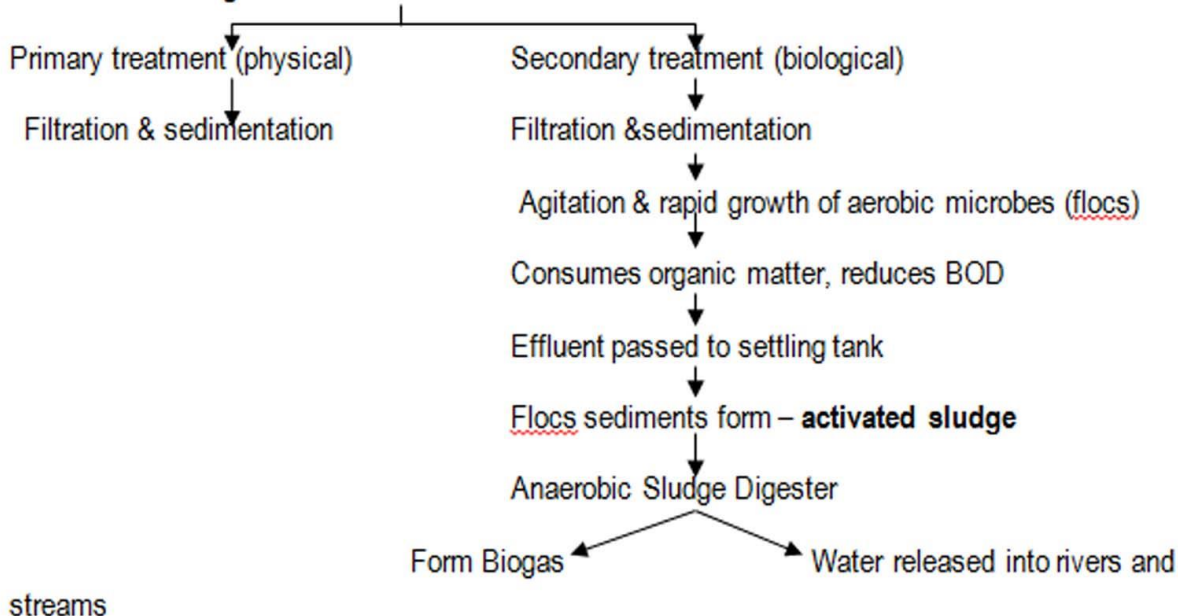
Process of sewage treatment in STP

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, Floc 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



Questions

(1 mark)

1. Name two vitamins produced by microbial fermentation.
2. What is the botanical name of baker's yeast?
3. Milk starts to coagulate when lactic acid bacteria is added to warm milk as a starter. Mention two benefits LAB provides.
4. Name any two antibiotics produced from microbial action.

Ans: Penicillin – *Penicillium notatum*

Streptomycin- *Streptomyces griseus*

5. Name any two human therapeutic proteins produced in bacteria.

Ans: *human* insulin, hepatitis B surface antigen, human growth hormone, interferons etc.

(2 marks)

1. State the use of:

Trichoderma with respect to organ transplant

1. Nucleopolyhedro virus with respect to pest management
2. Why should sewage be treated before its disposal?
3. What is primary sludge?
4. Name the pests, lady birds and dragonflies help to get the rid of respectively
5. Give the role of microbes in single cell protein.
6. What is micorrhiza? How does it help as biofertilizers?
7. What is BOD? What does it mean if a water sample has more BOD?
8. Name any two Cyanobacteria. How do they serve as main source of biofertilizer ?
9. What is the difference between Bt and Bt cotton? Explain the use of Bt as a biological control.
10. Give reason-
 - a) Bottled fruit juices brought from market are clearer as compared to those made at home,
 - b) Large holes are found in swiss-cheese,

c) The insect which are so called pest are not eradicated in organic fumes.

11. Name the gobar gas liberated from biogas plant. Which type of bacteria are responsible for its production? Give advantage.

12. What do you mean by GRAS?

Ans: GRAS means 'generally regarded as safe category' which includes microbes which are non-pathogenic, non-toxic, non-antibiotic producing etc. These are generally used as hosts for production of recombinant molecules.

14. What is 'Golden Rice'? In what way is it different from normal rice?

Ans: The staple food rice is extremely low in vitamin A and therefore the improvement of vitamin A required. Prof. Ingo Potrykus and Dr. Peter Beyer developed genetically engineered rice which is enriched in pro-vitamin A (beta-carotenoid) by introducing three genes involved in the biosynthetic pathway for carotenoid. It is called 'golden rice', the seeds are yellow in colour because of pro-vitamin A is produced in the entire grain.

15. What do you mean by 'flavr savr' tomato?

Ans: These are transgenic tomatoes commercialized in U.S with longer shelf life due to slow ripening. Gas hormone, ethylene is involved in the regulation of fruit ripening. Therefore, ripening can be slowed down by blocking or reducing ethylene production.

(3 marks)

1. Differentiate between

- a) Primary sludge and activated sludge,
- b) Biofertilizer and chemical fertilizer,
- c) Primary sewage treatment and secondary sewage treatment.

(5 marks)

1. Answer briefly:

- 1) How is sewage harmful to man?
- 2) What is organic farming?
- 3) Which group of organisms attack insect and arthropod? How are they best biocontrol biological agent,
- 4) What is the difference between flocks and primary sludge?

2. Write short notes on: a) baker's yeast, b) alcohol c) statin d) brewer's yeast e) streptokinase

Ans:

- The study of metagenomes or microbial genomes recovered directly from environmental samples like soil, water or any other niche.
- The comprehensive study of nucleotide sequence, structure, regulation, and function". Scientists can study the smallest component of an environmental system by extracting DNA
- from organisms in the system and inserting it into a model organism. The model organism then expresses this DNA where it can be studied using standard laboratory techniques.
- Employed as a means of systematically investigating, classifying, and manipulating the entire genetic material isolated from environmental samples.
- A multi-step process that relies on the efficiency of four main steps (see Figure) which are (i) the isolation of genetic material, (ii) manipulation of the genetic material, (iii) library construction, and the (iv) the analysis of genetic material in the metagenomic library.

ABBREVIATIONS AND EXPANSIONS

IARI ----Indian Agricultural Research Institute.

KVIC----- Khadi and Village Industries Commission

Bt ----- Bacillus thuringiensis

BOD ----- Biochemical Oxygen Demand

LAB ----- Lactic acid bacteria.

Name of scientist	Contribution
Alexander Fleming	Discovered Penicillin
Ernest Chain and Howard Florey	Used penicillin as an effective antibiotic to treat solidiers wounded in world war 2