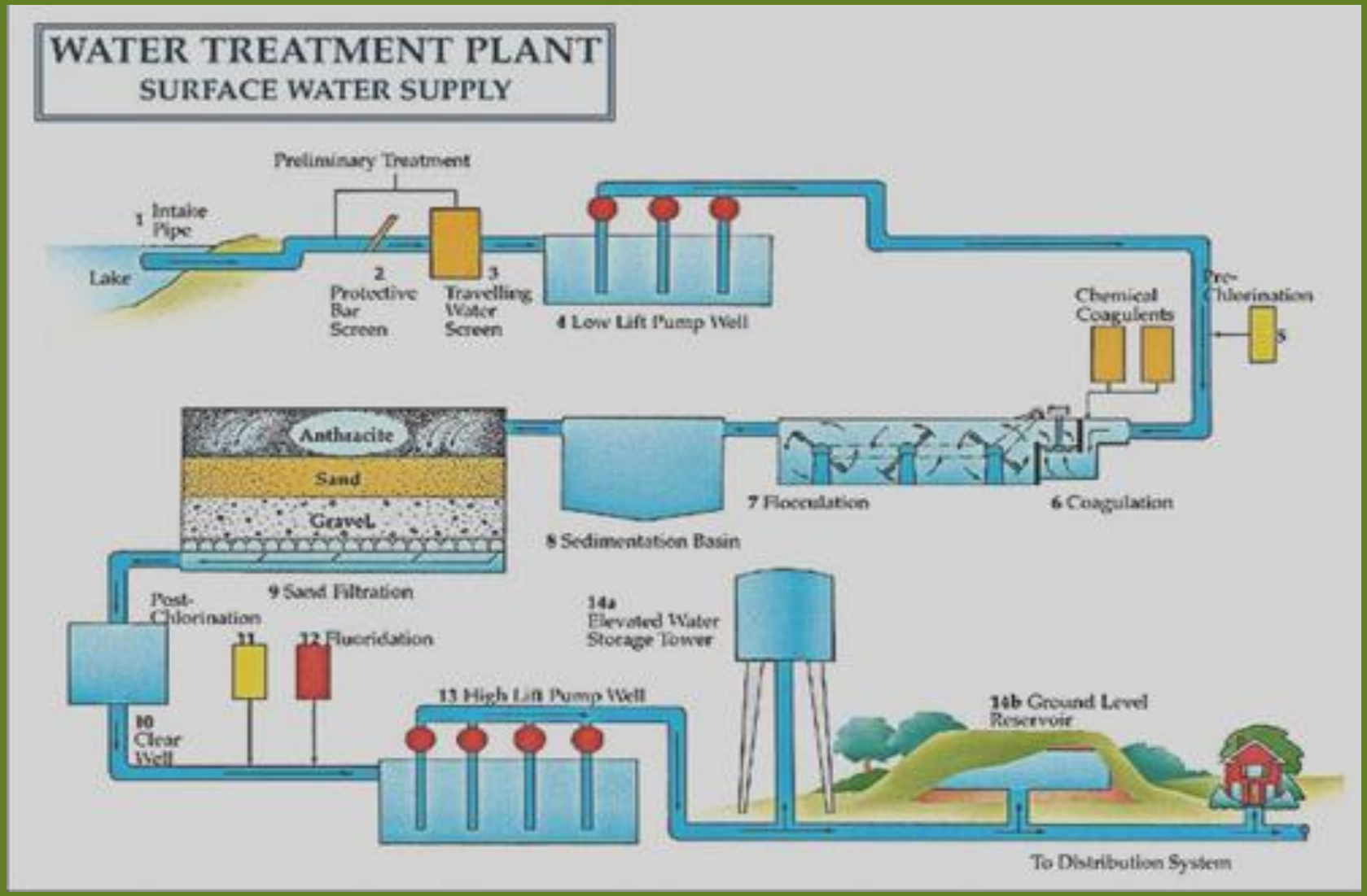
ENVIRONMENTAL ENGINEERING

Environmental Engineering is the application of science and engineering principles to improve the natural environment (air, water, and/or land resources), to provide healthy water, air, and land for human habitation (house or home) and for other organisms.

ENVIRONMENTAL ENGINEERING

It involves waste water management and air pollution control, recycling, waste disposal, radiation protection, industrial hygiene, environmental sustainability, and public health issues as well as a knowledge of environmental engineering law. It also includes studies on the environmental impact of proposed construction projects.

Water Treatment Plant



Water Treatment Plant

1. Before the water can be treated, it must first be collected from lakes, rivers and reservoirs. Most often, the water is transported from the source to the treatment plant via a complex network of pumps and pipelines, though natural means (such as rivers) may be used.

Water Treatment Plant

2. **Screening.** The first step in the treatment process is to screen the water to remove larger items of suspended materials, such as rubbish, plants, trees, animals and other debris. As the name suggests, these are captured and removed via the use of a large metal screen.

Water Treatment Plant

3. Chemical addition. At this point, chemicals are now added to encourage smaller particles of suspended matter to clump together and form “floc”. The chemicals used to achieve this purpose are called coagulants and there are many different products available.

Water Treatment Plant

4. **Coagulation.** After the coagulant has been added to the water, it must be mixed at varying speeds over a period of time to allow the flocs to form (this part of the process is known as flocculation).

The most important alums are:

Potassium Alum

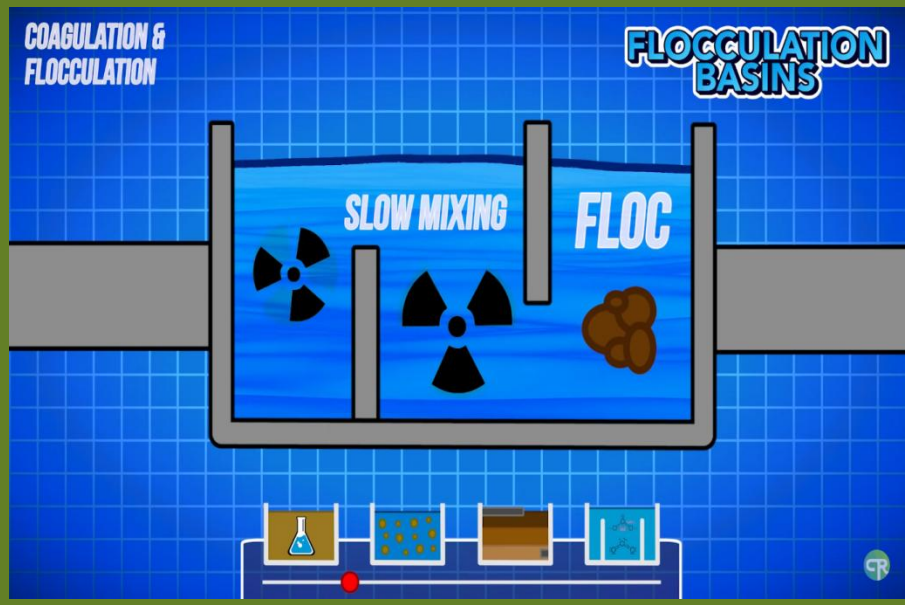
$KAl(SO_4)_2 \cdot 12\,H_2O$, also called "potash alum" or simply "alum".

Sodium alum

$NaAl(SO_4)_2 \cdot 12\,H_2O$, also called "soda alum".

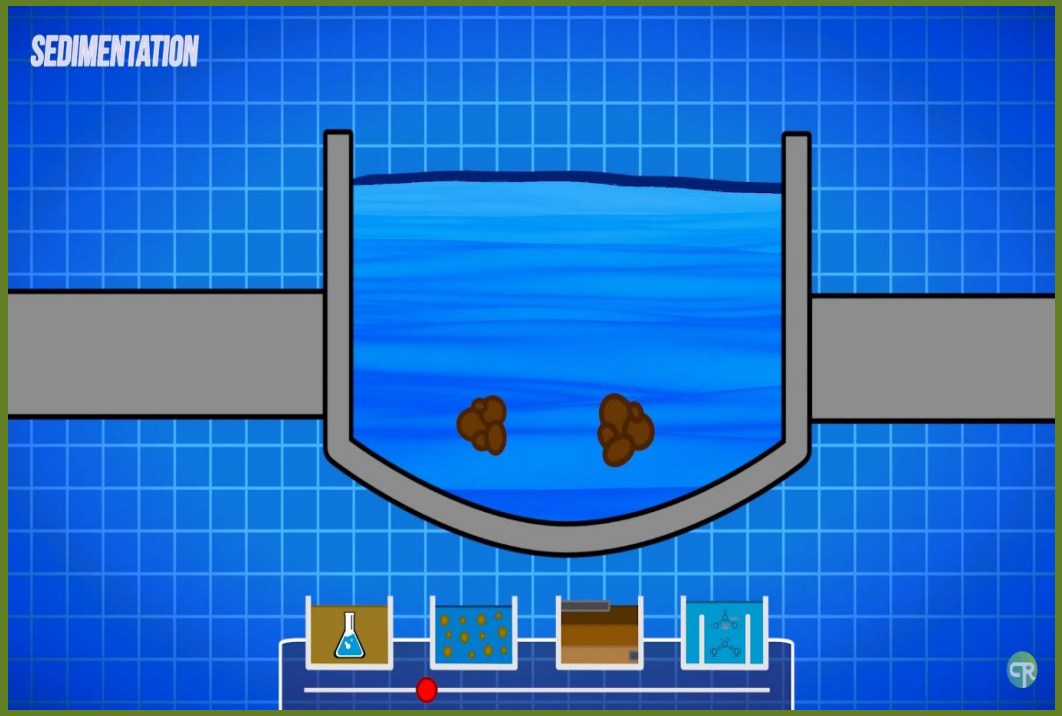
Ammonium alum

$NH_4Al(SO_4)_2 \cdot 12\,H_2O$



Water Treatment Plant

5. **Sedimentation and clarification.** Once the flocs have formed, the water is passed over a sedimentation basin. Here, the clumps of floc particles can settle at the bottom of the basin, where they are removed to a disposal pond.



RECTANGULAR SEDIMENTATION TANK

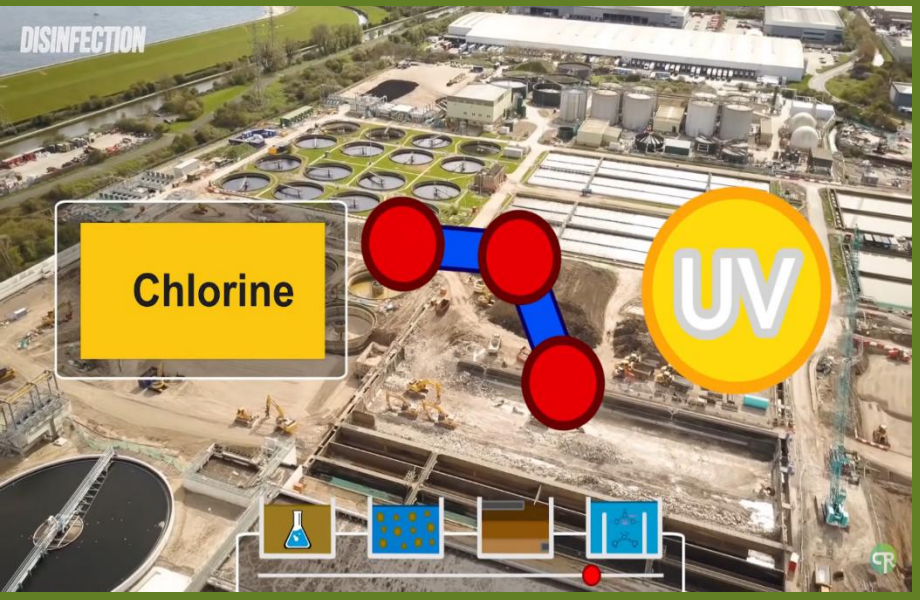
CIRCULAR SEDIMENTATION TANK

Water Treatment Plant

6. Filtration. With the larger particles taken out of the water, it must now be filtered through a variety of media such as sand, gravel or granular activated carbon to remove the smaller unwanted particles which still persist.

Water Treatment Plant

7. **Disinfection.** The remaining water has now had the vast majority of its impurities removed, but it may still contain bacteria, viruses and other microorganisms. In order to kill these elements, it must be treated with enough chlorine to be effective but not too much to affect taste or odour.



Disinfection

Destroys the pathogens (disease causing microorganisms)

Methods of disinfection

Chlorination - bleaching powder, chloramines or liquid chlorine

$$Cl_2 + H_2O \rightarrow HOCl + HCl$$

$$ClNH_2 + H_2O \rightarrow HOCl + NH_3$$

Ozone treatment - $O_3 \rightarrow O_2 + [O]$

Ultraviolet (UV) light - 254 nm UV light damages the RNA and DNA of the microorganisms. Destroys chemical contaminants also.

Water Treatment Plant

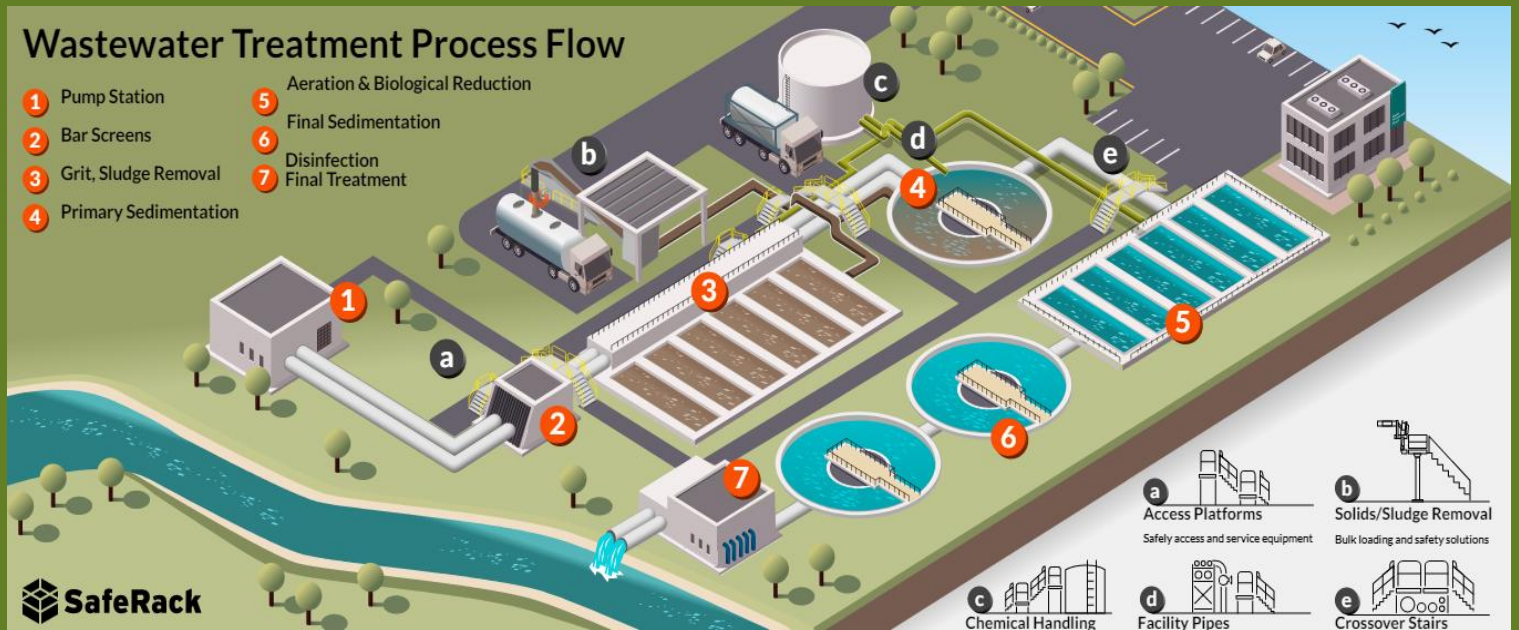
8. **Storage.** The water is now essentially ready for public consumption, but must be stored until demand for it surfaces. It is most commonly stored in underground or overground tanks. As well as drinking water, there must also be a stored supply of water for emergencies such as fires.

9. **Distribution.** The water is finally sent to homes and businesses around the country via a sophisticated system of pumps, tanks, pipelines, hydrants, valves and meters.

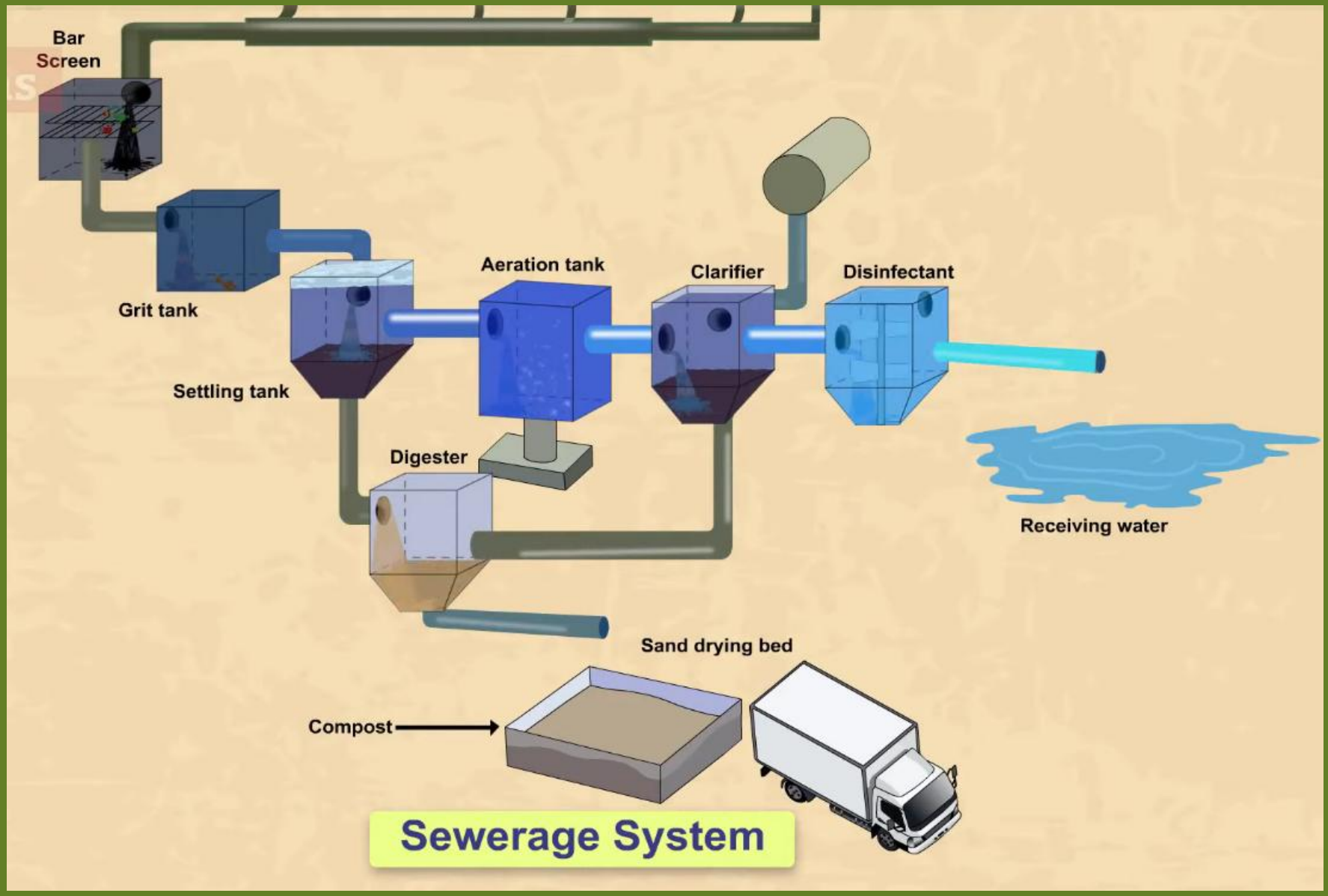
WATER QUALITY PARAMETERS

Parameter	BIS Guideline value (Desirable)	General & Health effect
Total dissolved Solids(TDS)	500mg/lit	Undesirable taste; gastro intestinal irritations; corrosion
pH	6.5–8.5	Affects mucous membrane; bitter taste; corrosion; affects aquatic life
Alkalinity	200 mg/lit	Boiled rice turns yellowish
Hardness	300 mg/lit	Poor lathering with soap; deterioration of the quality of clothes; skin irritation; boiled meat and food become poor in quality
Calcium	70 mg/lit	Poor lathering and deterioration of the quality of clothes
Magnesium	35 mg/lit	Poor lathering and deterioration of clothes
Nitrate	45	Blue baby disease) algal growth
Sulphate	200	Taste affected; gastro intestinal irritation
Chloride	250	Taste affected; corrosive

Wastewater Treatment Plant



Wastewater Treatment Plant



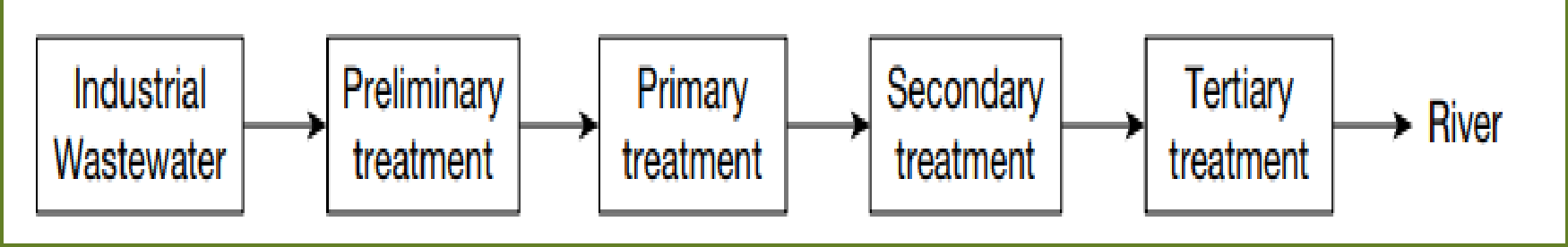
Wastewater Treatment

- The need to treat the wastewaters is felt more, at present, due to shortage or scarcity of freshwaters.
- The untreated wastewaters would add pollutants into water bodies-freshwater and saline.
- These receiving bodies include rivers, lakes, ponds, oceans, and estuaries and reservoirs.
- It needs to be noted that the pollutants discharged into the river ultimately end up in the oceans. An example of this pollution is the rivers like Sabarmati and Ganga, flowing through urban and industrial areas such as Ahmedabad and Kanpur respectively. As these rivers flow through, they pick up the pollutants, such as heavy metals, organics, pesticides etc.
- These pollutants ultimately reach the sea and therein threaten the aquatic.

Wastewater Treatment Plant

- The major aim of wastewater treatment is to remove as much of the suspended solids (Organic and inorganic) as possible before the remaining water, called effluent, is discharged back to the environment.
- Also as organic material decays, it uses up oxygen, this oxygen is required by the micro organisms to decompose the organic material.
- As the pollutant is released in the water body oxygen demand of the micro organisms is fulfilled by the dissolved oxygen present in the water body which is also needed by the plants and animals living in the water.
- As a result scarcity of oxygen prevails and after some time these living organisms looses their lives.
- Therefore, before releasing this sewage into the water body it must be neutralized.

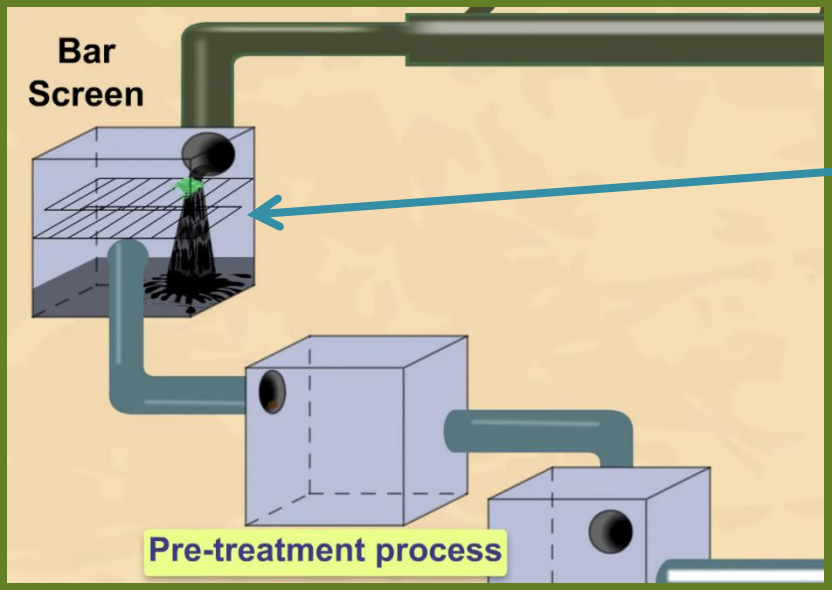
Wastewater Treatment Plant

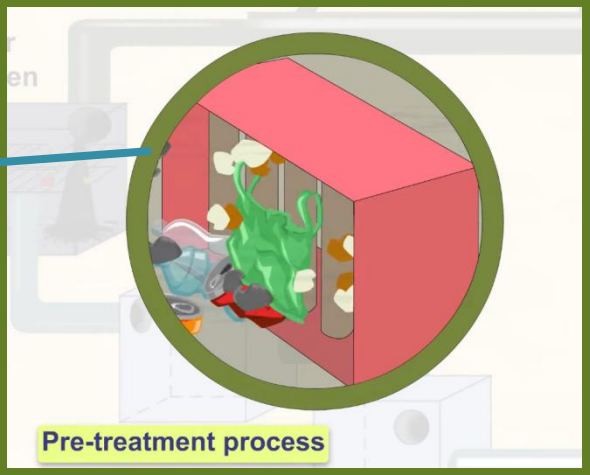


Steps in wastewater treatment:

1. Preliminary treatment:

   Usually, the first treatment of the raw effluent is the screening to remove coarse floating material. Up to 30-40% of gross suspended solids in the raw waste stream can be removed by properly designed screens. The skimming of fats, grease and oils is also accomplished under this stage of treatment.


Bar
Screen
Pre-treatment process


Pre-treatment process

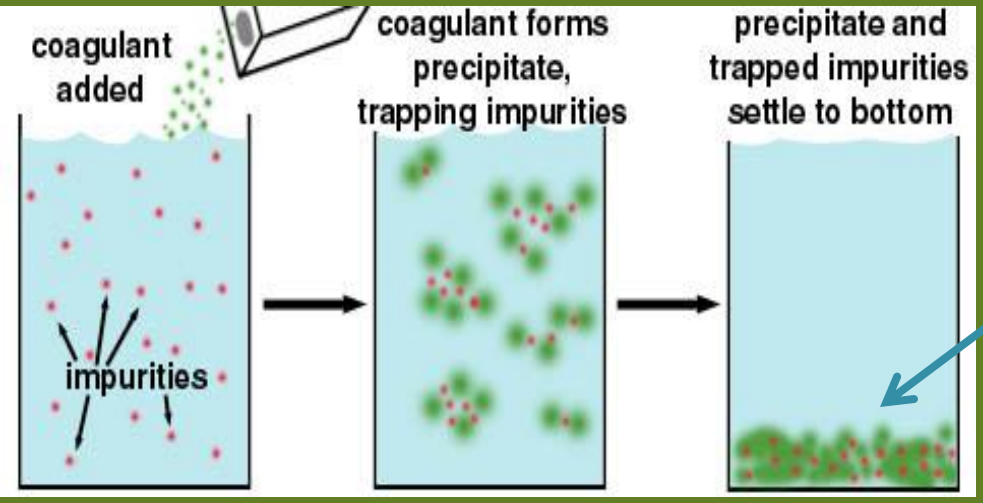
Wastewater Treatment Plant

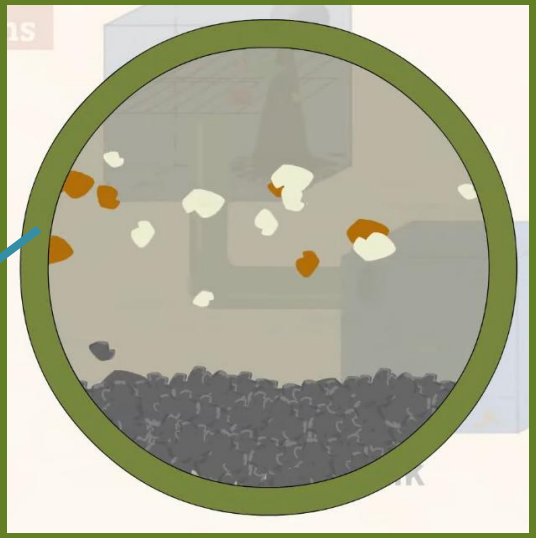
1. **Primary (Physio-Chemical) Treatment:**

   It involves coagulation, flocculation and gravity settling to remove a substantial percentage of the Suspended solid.

   The objective here is the removal of settable and colloidal solids—organic and inorganic—by sedimentation. Approximately 25–50% of incoming biochemical oxygen demand, 50–70% of total suspended solids (TSS) and 65% of the oil and grease are removed during primary treatment

Flocculator and slow agitator

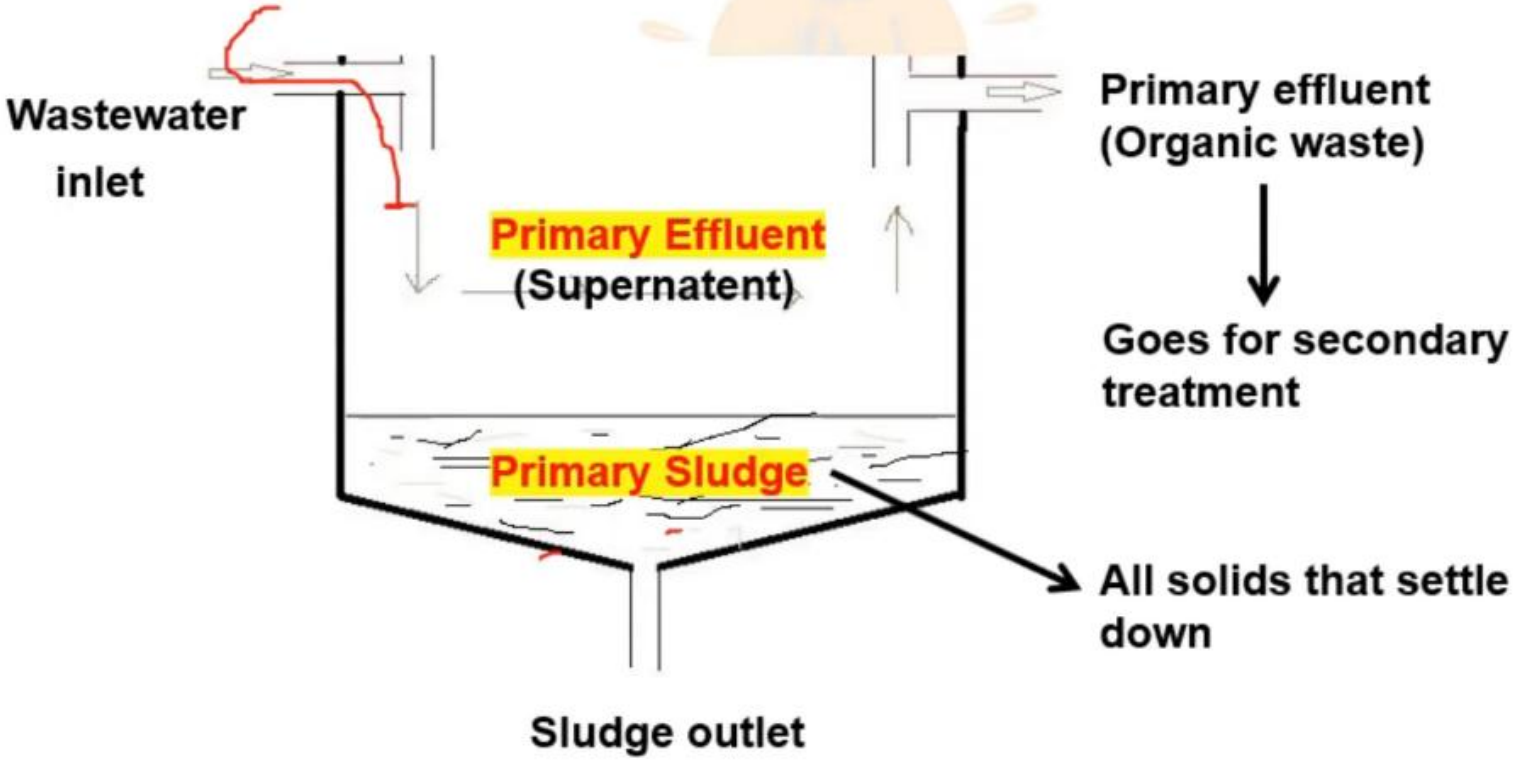




Primary Treatment

1. Sequential filteration → Remove all floating debris

2. Sedimentation → Removal of grit (Soil & pebbles)

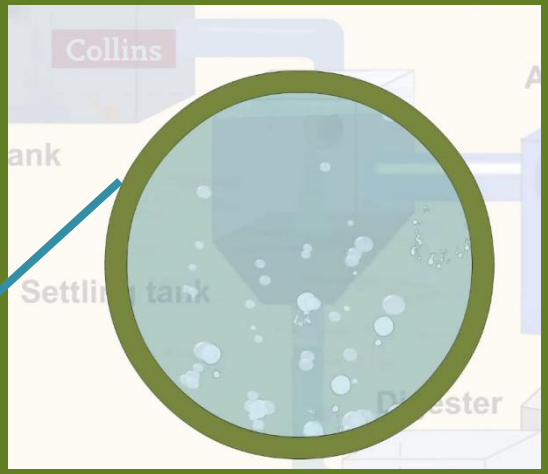



SEDIMENTATION TANK


AERATION BASINS

Wastewater Treatment Plant

- **Secondary (Biological Oxidation) Treatment**: It follows the primary treatment. It's goal is the removal of biodegradable dissolved and colloidal organic matter using aerobic biological treatment processes.
- The effluent after primary treatment is generally easily biodegradable in standard aerobic biological treatment units such as activated sludge, trickling filters, rotating biological disc etc.
- Several biological processes are used for secondary treatment—the difference being the manner in which oxygen is supplied to the microorganisms and at the rate at which the microorganisms metabolise the organic matter.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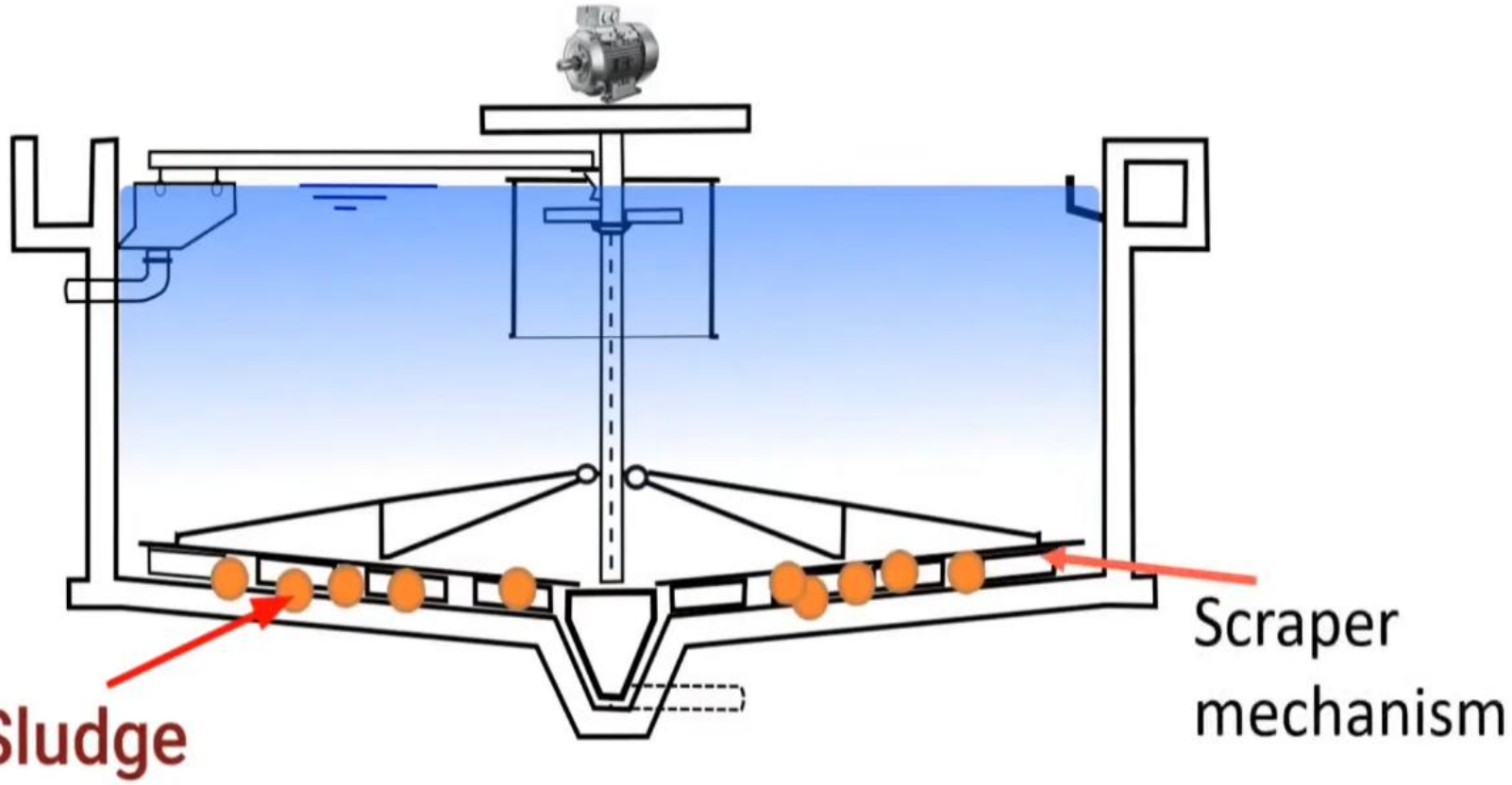
WASTEWATER
AERATION BASINS

AERATION BASIN

SEDIMENTATION IN CLARIFIERS



AEROBIC DIGESTION

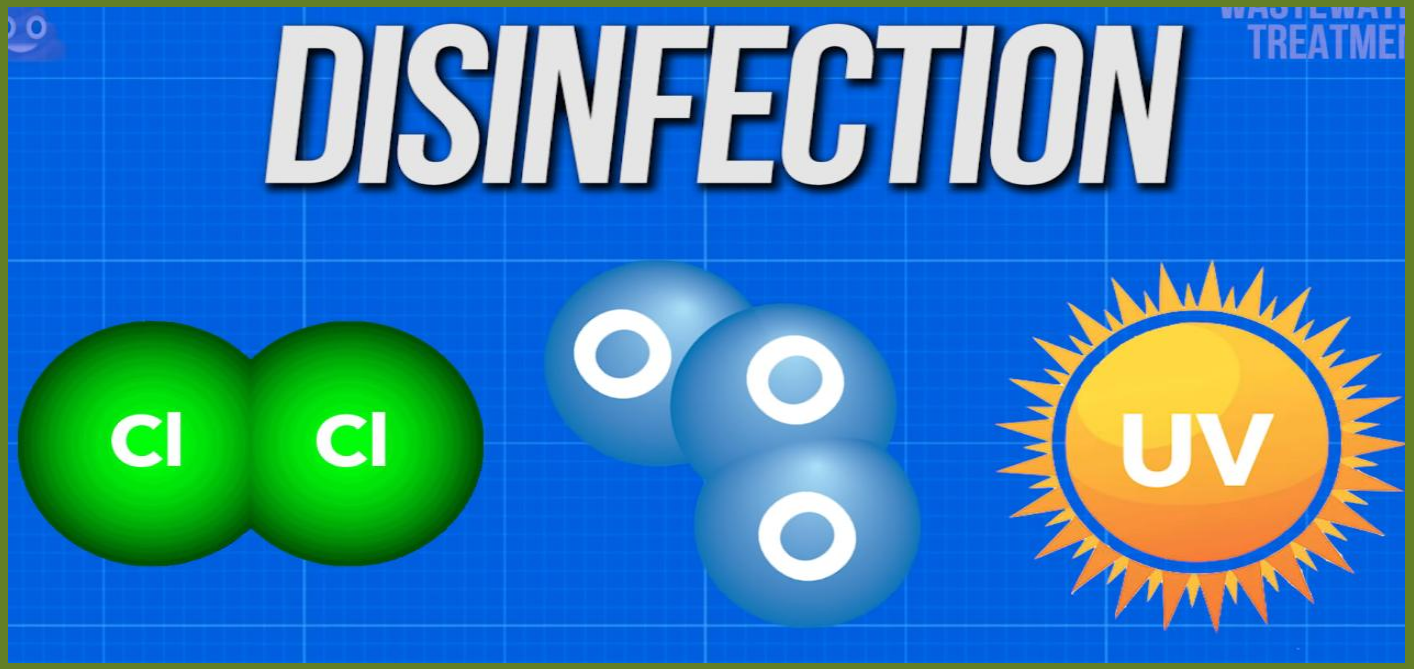
WASTEWATER TREATMENT

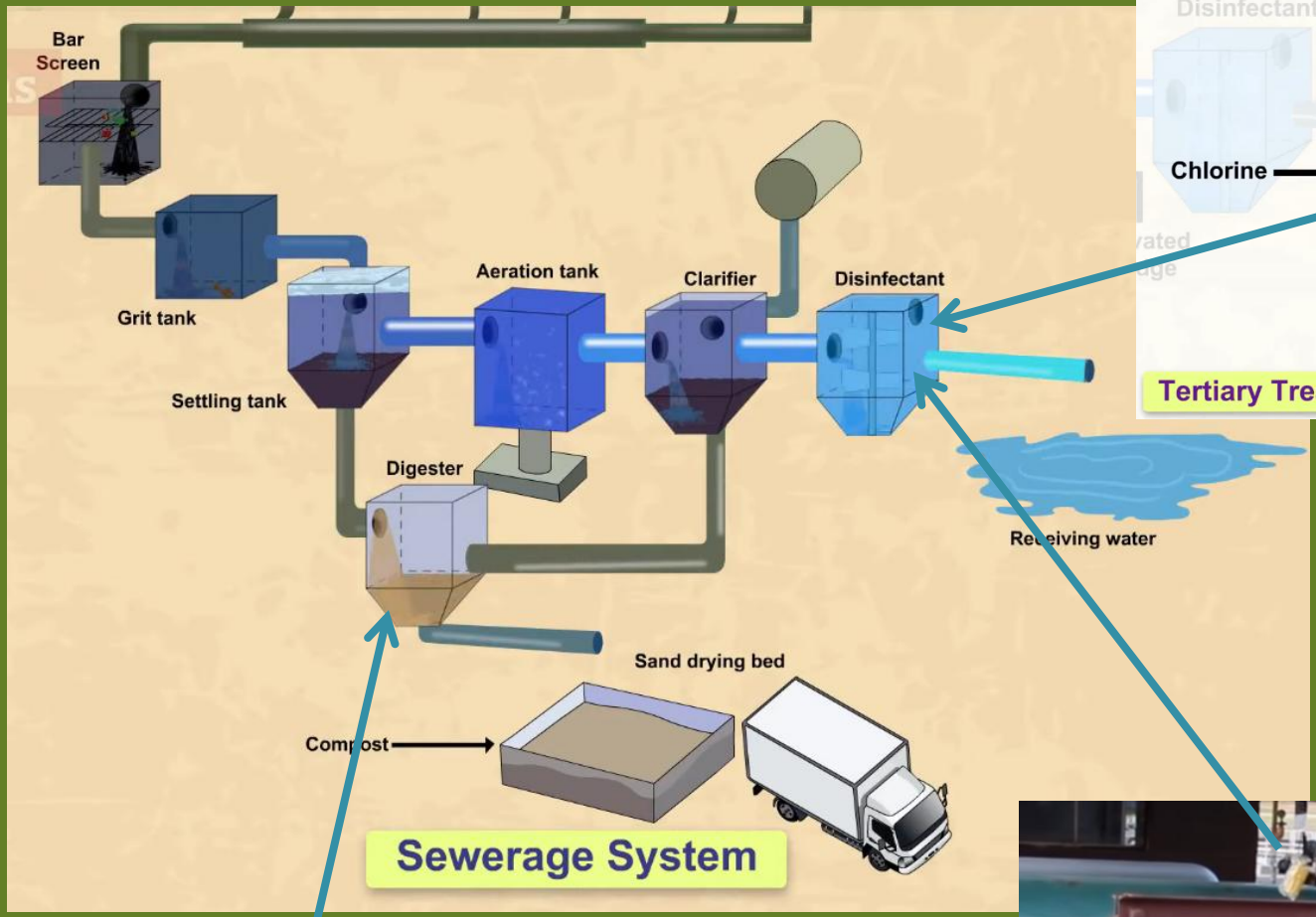
BREAKDOWN OF ORGANIC MATTER USING EXCESS OXYGEN

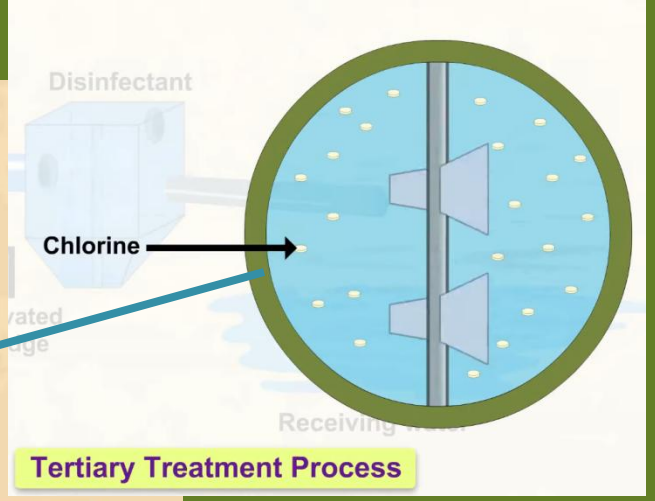
TRICKLING FILTERS

Wastewater Treatment Plant

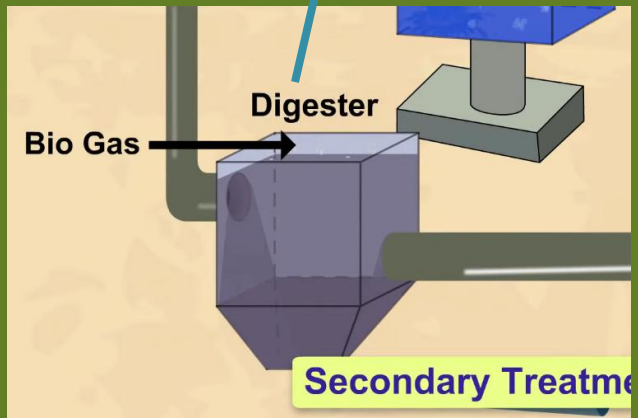
3. Tertiary treatment: physical, biological, and chemical processes to remove nutrients like phosphorus and inorganic pollutants, to deodorize and decolorize effluent water, and to carry out further oxidation.




Bar Screen
Grit tank
Settling tank
Aeration tank
Clarifier
Disinfectant
Digester
Receiving water
Sand drying bed
Compost
Sewerage System


Disinfectant
Chlorine
Tertiary Treatment Process

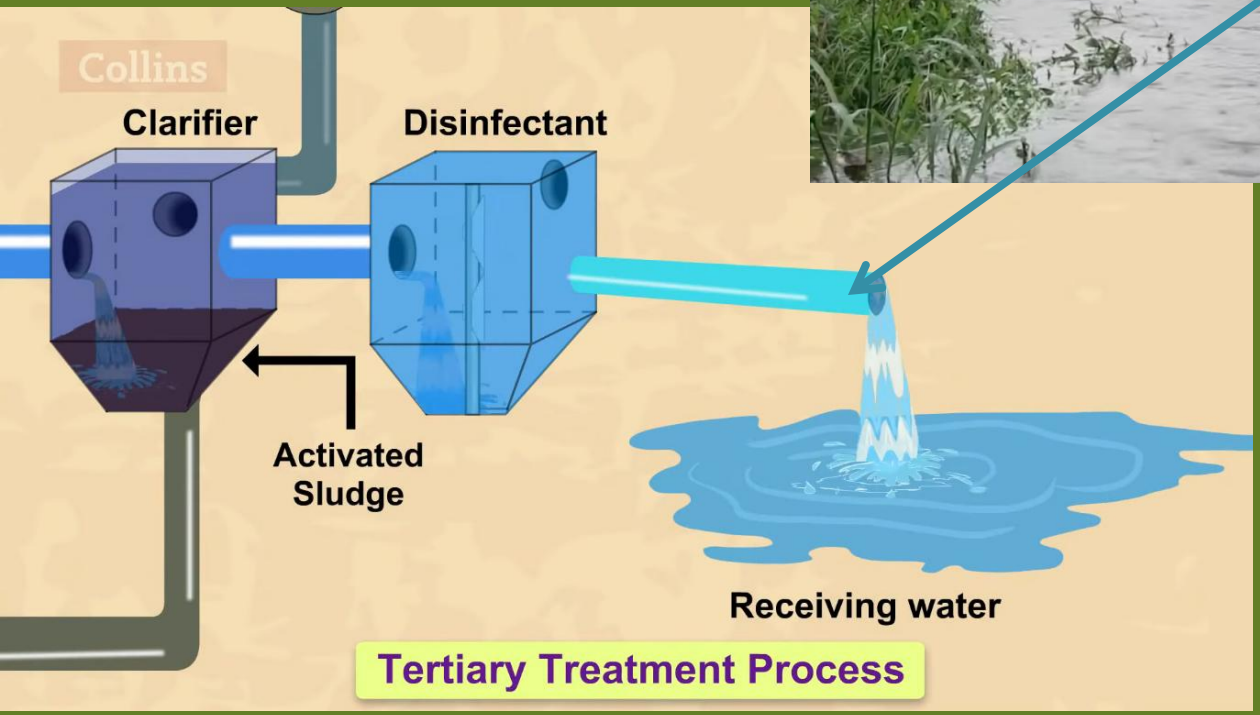

SULFUR DIOXIDE
UN1079
INHALATION HAZARD


Digester
Bio Gas
Secondary Treatme

Wastewater Treatment Plant

- **Disinfection – Killing bacteria**
- Finally, the wastewater flows into a ‘chlorine contact’ tank, where the chemical chlorine is added to kill bacteria, which could pose a health risk, just as is done in swimming pools. The chlorine is mostly eliminated as the bacteria are destroyed, but sometimes it must be neutralized by adding other chemicals. This protects fish and other marine organisms, which can be harmed by the smallest amounts of chlorine.
- The treated water (called effluent) is then discharged to a local river or the ocean.

Wastewater Treatment Plant



Assignment Questions

1. Write a short note on rain water harvesting.

2. How a branch of civil engineering can help in curtailing down the air pollution and noise pollution.

Hint: Nature of pollutant, source of pollutant, dispersion of pollutant (Horizontal as well as vertical dispersion), Designing and implementing quality improvement solutions, enforce compliance with regulations.

3.

TRANSPORTATION ENGINEERING

- Transportation engineering is a branch of civil engineering that involves the planning, design, operation, and maintenance of transportation systems to help build smart, safe, and livable communities.
- Any system that moves people and goods from one place to another falls under the scope of transportation engineering, which includes:

1. Highways and roadways
2. Railways
3. Airways
4. Waterways
5. Traffic control systems

The roles and responsibilities

1. To develop the various Transportation strategies for the efficient movement of Traffic.
2. To plan, design, and develop the transportation systems, which include traffic signal systems.
3. To prepare the administrative-technical and statistical reports on the traffic operations.
4. To prepare to estimate the various construction of the transportation projects.
5. To implement cost-efficient technologies in the Transportation system.
6. To evaluate the traffic control devices and determine the need of its modification and expansion.
7. To provide required width of roads, highways.
8. To provide necessary degree of curves and superelevation.
9. To design airways and waterway navigational systems.
10. To design and provide suitable thickness of roads.
11. To suggest suitable type of road and material to be used.
12. To provide necessary road signs

TRAFFIC SIGNS

List of Indian traffic signs with their meanings

1. Regulatory signs

Traffic Signs	Names	Meanings
	Stop	"Stop" sign requires the drivers to stop
	Give Way	"Give Way" sign reminds drivers to give way to right side drivers.
	No Entry	"No Entry" sign indicates that there is a restricted area ahead
	One Way	"One Way" suggests that the vehicles must go in a single direction
	Vehicles Prohibited in Both Directions	"Vehicles Prohibited in Both Directions" sign suggests the area ahead is blocked from both the sides
	Right Turn Prohibited	The sign directs the driver to not take the right turn

	Left Turn Prohibited	The sign directs the driver to not take the left turn.
	U-Turn Prohibited	The sign directs the driver to not take the right turn.
	Overtaking Prohibited	This sign indicates that overtaking is not allowed
	Horn Prohibited	This sign shows that driver should not horn and keep silent when driving through a particular area
	No Parking	Parking in a designated area is not allowed.
	Speed Limit	The driver should not surpass the speed mentioned on the Speed Limit sign
	Compulsory Turn Left	The sign indicates that one should turn left
	Compulsory Ahead	The sign indicates that one should go in a straight direction
	Compulsory Right Turn	The sign indicates that one should turn right

2. Cautionary signs

Traffic Signs	Name	Meanings
	Right-hand Curve	It notifies about a right-hand curve on the way ahead.
	Left-hand Curve	It notifies about a left-hand curve on the way ahead.
	Right Hairpin Band	The sign is usually seen on hilly roads with sharp turns. It indicates there's a sharp right turn ahead.
	Left Hairpin Band	This sign will warn you about a sharp left turn ahead.
	Right Reverse Band	This sign indicates the same Z-shaped formation of the road ahead towards the right. When seeing this sign, the driver should reduce speed.
	Left Reverse Band	This Z-shaped sign gives road users a warning about the same Z-shaped formation of the road ahead towards the left.
	Steep Ascent	This sign gives you a warning about the steep upward slope

	Slippery Road	The sign gives road users a warning about the slippery road ahead
	Loose Gravel	This sign is usually seen on the hilly area where there's a possibility of loose earth or gravel keeps on falling.
	Cycle Crossing	There is a cycle path crossing the major road, the sign will warn the driver about that.
	Pedestrian Crossing	The sign indicates that there's a crossing for pedestrians. When seeing this sign, the driver should either slow down or stop the vehicle and let the pedestrian cross the road first.
	School Ahead	This sign indicates a school ahead.
	Men at Work	This indicates that there are people working or repairing ahead the road.
	Cattle	This sign indicates that there might be cattle straying on the road.
	Falling Rocks	The sign gives a warning about the falling of rocks ahead
	Cross Road	This sign suggests that there is a crossing of two roads ahead

3. Informatory signs

Traffic Signs	Name	Their Meanings
	Public Telephone	The sign indicates that there is a telephone service ahead.
	Petrol Pump	This sign suggests there is a petrol pump in the way ahead.
	Hospital	This sign suggests there is a hospital ahead
	First Aid Post	This sign indicates the first aid facility ahead
	Eating Place	This sign indicates a food facility ahead
	Light Refreshment	This sign suggests there is a light refreshment ahead
	No Thorough Road	This sign suggests there is no exit ahead
	No Thorough Side Road	This sign is placed when there is a no-through side road on the main road.