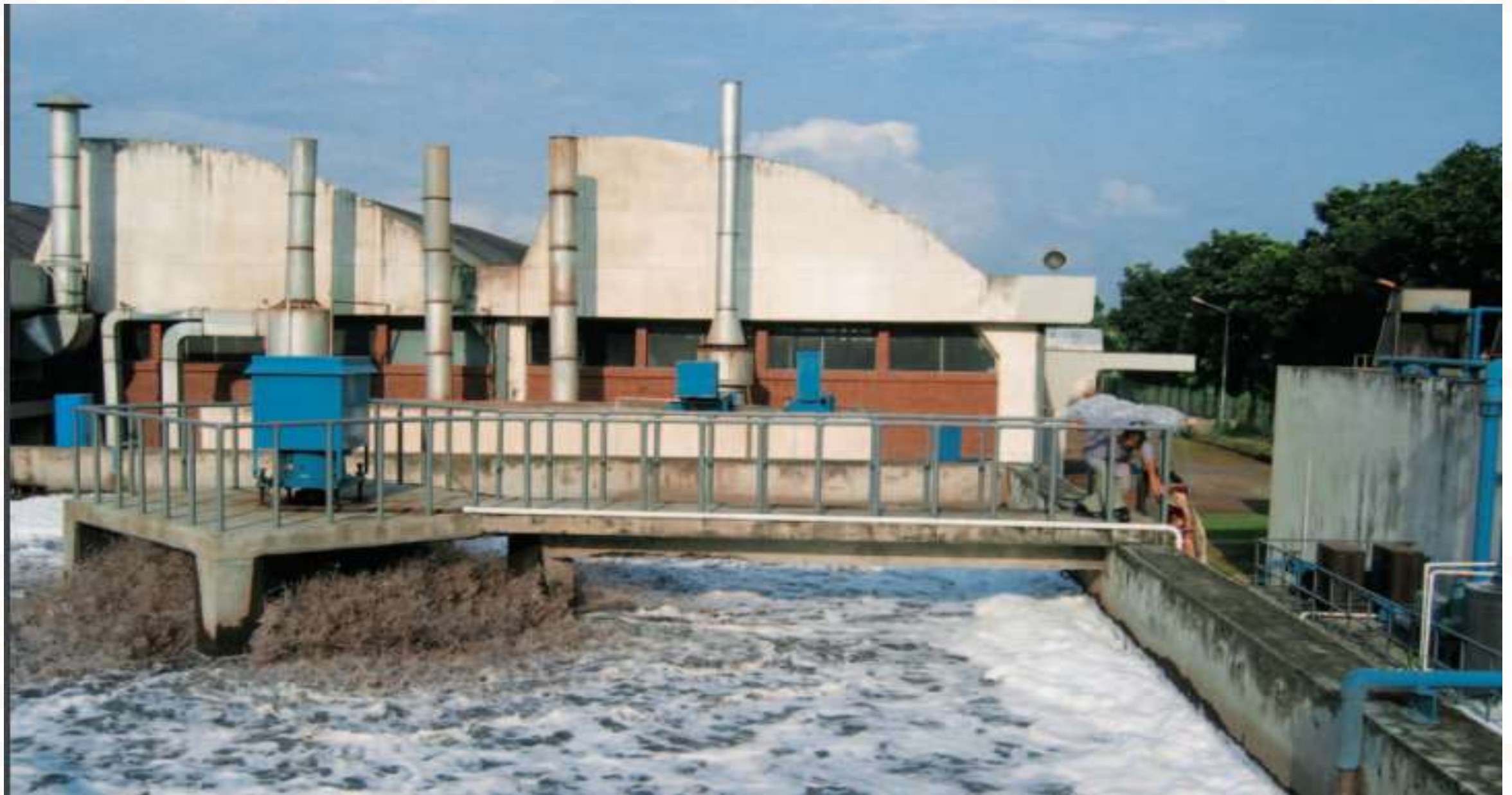


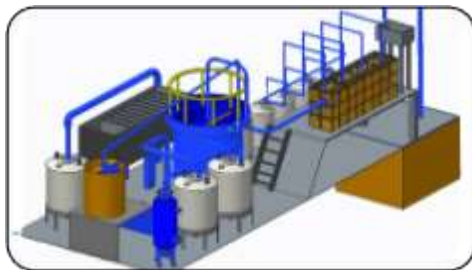
Effluent Treatment Plant in Dairy Industry



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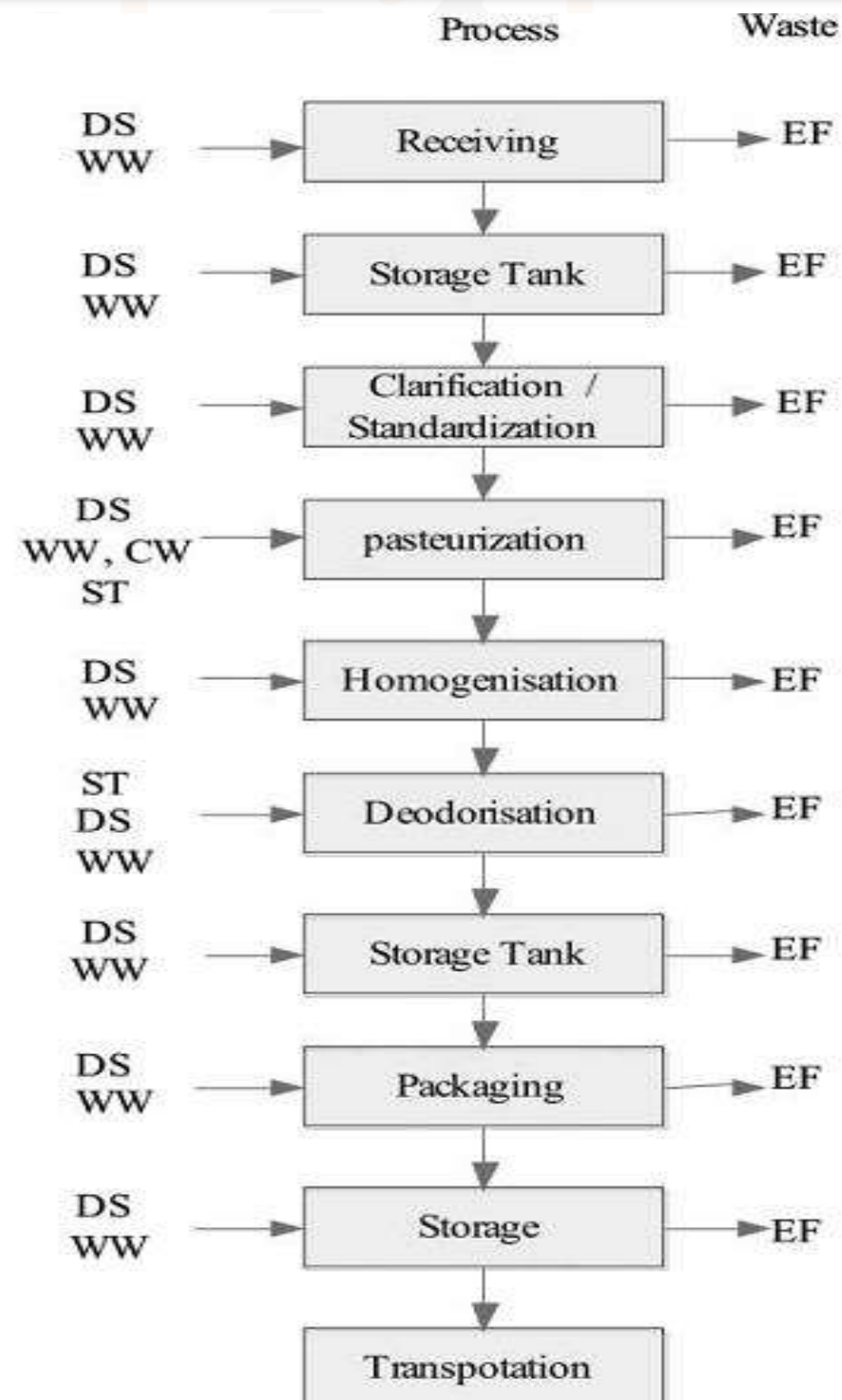


4. Reference

1. INTRODUCTION

1. Dairy industry is among one of the most polluting, in the food industries due to its large water consumption.
2. Effluent generated in a dairy contains highly putrescible organic constituents, which can be removed with help of an Effluent treatment plant(ETP).
3. ETP is a process designed for treating industrial wastewater for its reuse or safe disposal in the environment.
4. In order to have proper processes in the ETP, characterization of wastewater, treatability studies, and planning of proper units and processes for effluent treatment is very much necessary.

Effluent generation from various unit in dairy



DS-Detergents and Sanitizing Agents

WW-Wash Water,
ST-Steam

CW-Cooling Water.

Typical characteristic of different dairy plant Effluent

Sr. No	Product	BOD (mg/L)	COD (mg/L)	ph	TS (mg/L)	TSS (mg/L)
1.	Milk and dairy products factory	5123	10250	8.34	-	5802
2.	Dairy effluent	1200-1800	1900-3000	7.2-8-8	900-1200	500-740
3.	Whey	71,526	20000	4.1	56,782	22,050
4.	Cheese whey pressed	80000-90000	120,000-135,000	6	-	8000-11000

Minimal standards for discharge of effluents from the dairy plant

Parameter	CPCB INDIA max value (except for PH)
PH	6.5-8.5
BOD ₅	100
TSS	150
OIL & Grease	10
Total nitrogen	10

2. Consideration when planning an ETP

What national or international standards must you comply with?



what volume of effluent do you have?



What chemicals does it contain?



Do you plan to increase production?



How much can you afford to spend on constructing and running an ETP?

How much land do you have available, or can you buy, on which to build the ETP?



Which ETP expert or designer should be used?



What type of plant will best suit your requirements?

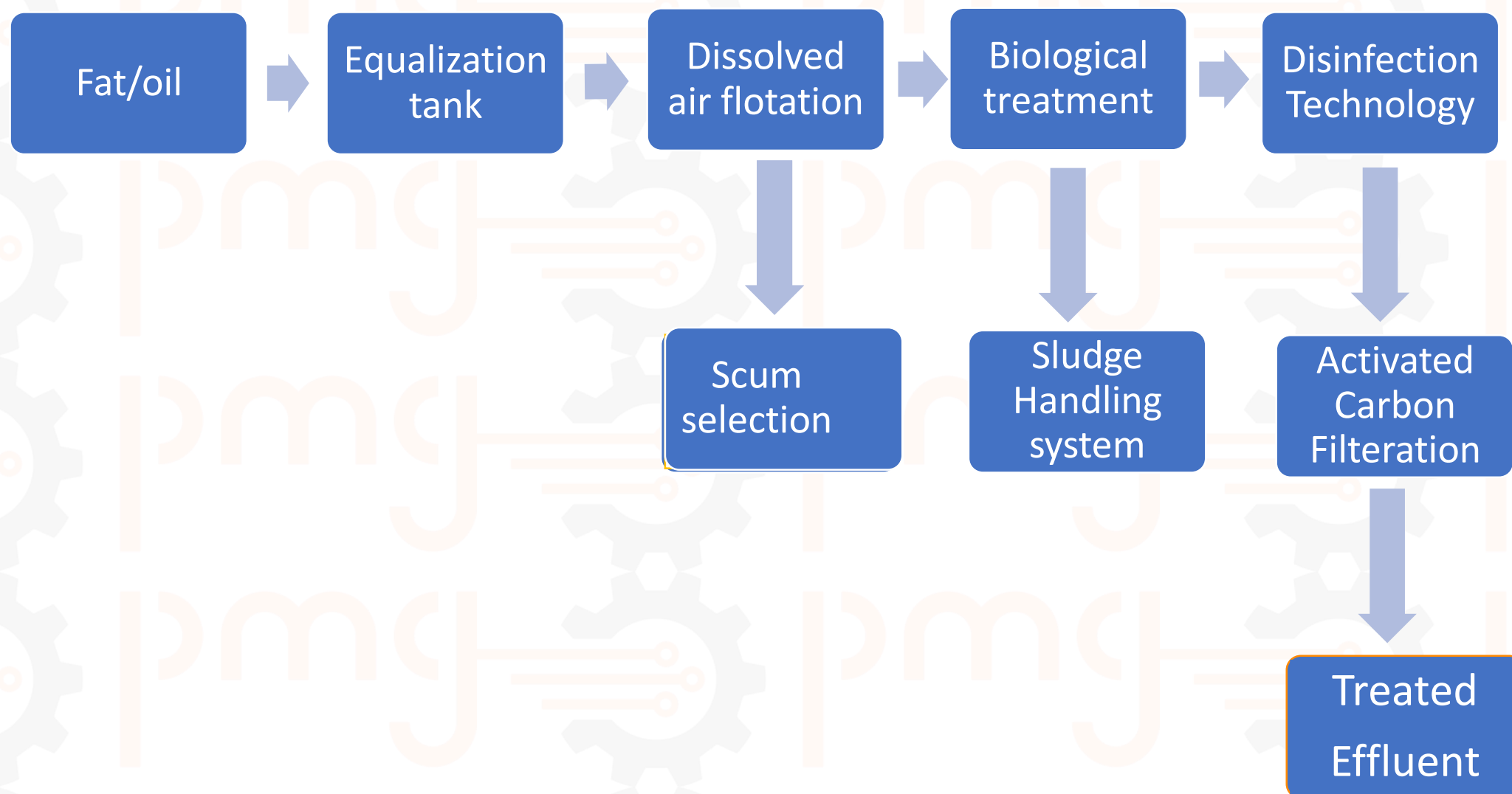


What capacity do you have in your factory to manage the ETP? Do you need to hire more staff or train existing staff?

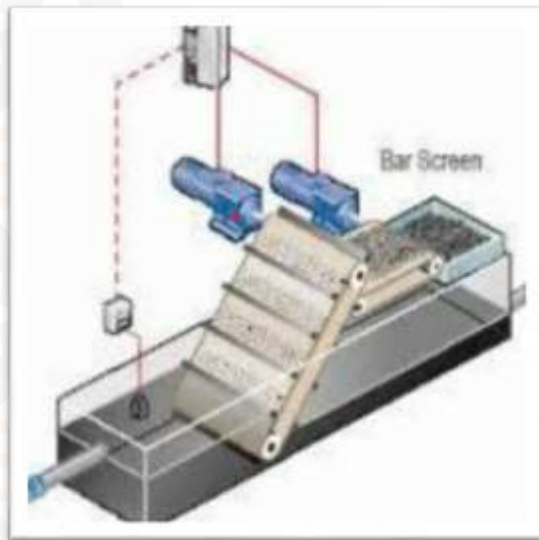
3. Treatment method and mechanics of ETP

Treatment Method	Description	Mechanism
Preliminary	Removal of large solids such as rags, sticks, grit and grease that may damage equipment or result in operational problems	Physical
Primary	Removal of floating and settleable materials such as suspended solids and organic matter	Physical And chemical
Secondary	Removal of biodegradable organic matter and suspended solids	Biological and chemical
Tertiary/advanced	Removal of residual suspended solids / dissolved solids	Physical, chemical and Biological

Typical effluent treatment scheme for dairy Industry



Physical treatment used in ETP

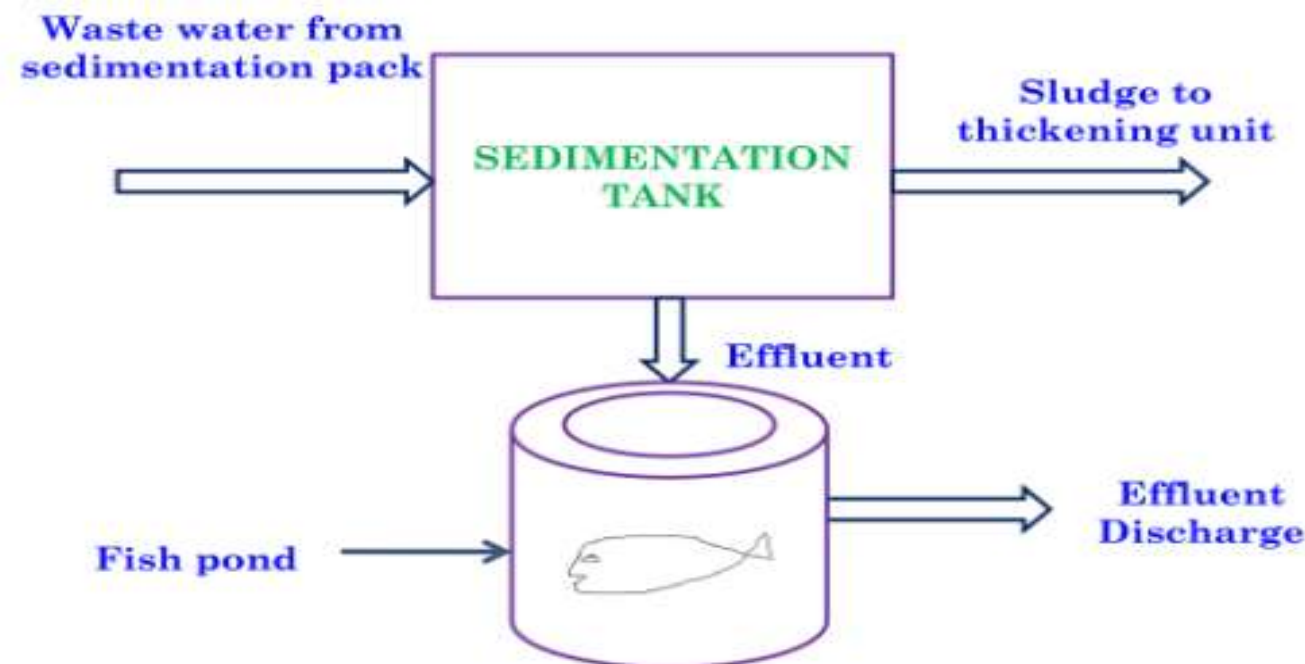


❑ **Screening**- Screening is a wastewater pre-treatment, which aims to prevent coarse solids, such as plastics, rags and other trash, from entering a sewage system or treatment plant. Solids get trapped by inclined screens or bar racks. The spacing between the bars usually is 15 to 40 mm, depending on cleaning patterns.

❑ **Flow equalization**- A centrifugal pump is a mechanical device designed to move fluid by means of the transfer of rotational energy from one or more driven rotors, called impellers.

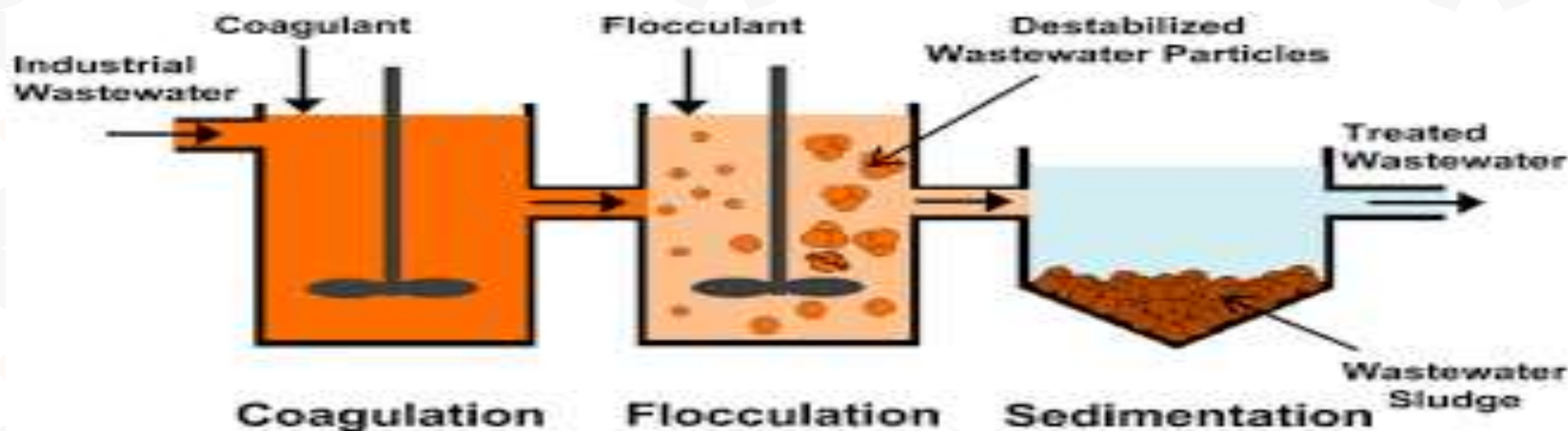


- ❑ **Sedimentation and filtration-** The flocs formed in flocculation are large enough to be removed by gravitational settling, also known as sedimentation. This is achieved in a tank referred to as the sedimentation tank, settling tank or clarifier.
- ❑ Sedimentation is also used to remove grit and suspended solids, to produce clarified effluent, and to thicken the sludge produced in biological treatment.
- ❑ Flocculation and sedimentation should remove most of the suspended solids and a portion of the BOD.



Chemical treatment used in ETP

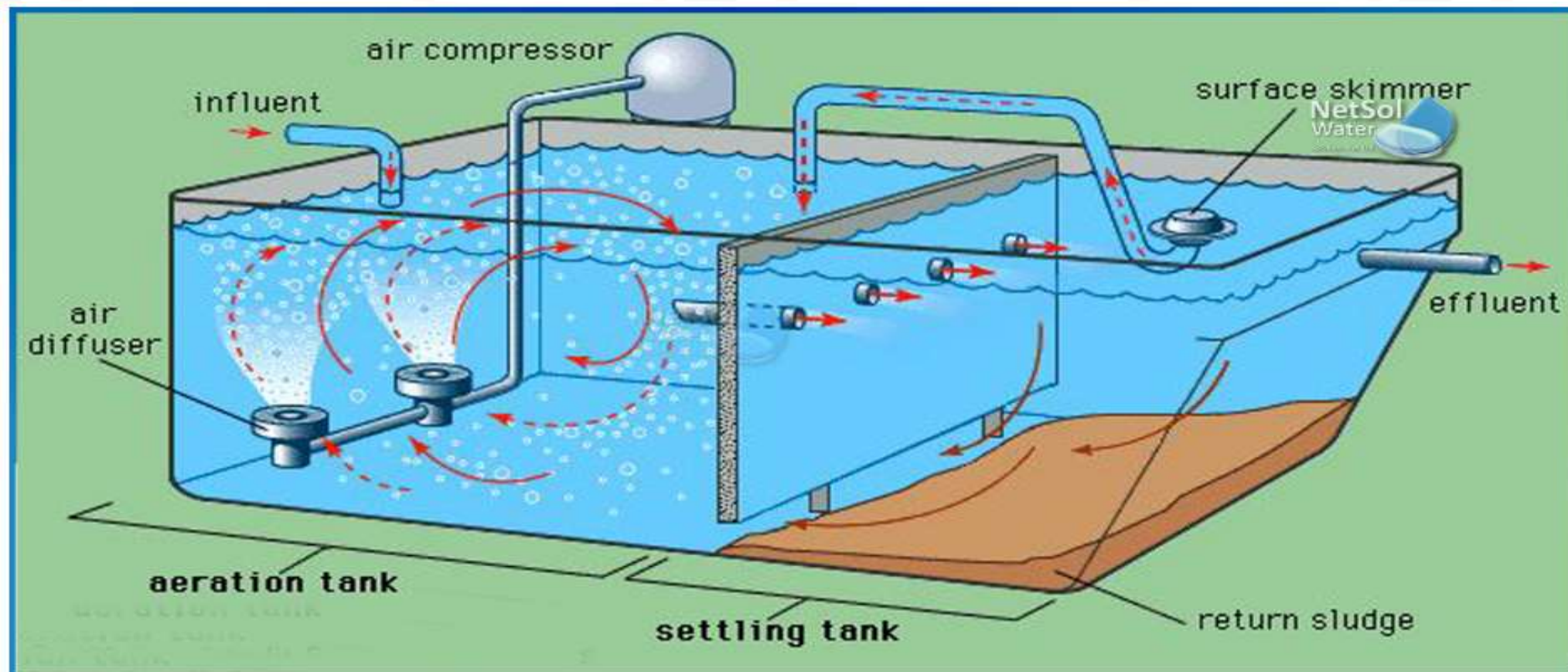
- ❑ **pH control**- Chemical processes use the addition of chemicals to the wastewater to bring about changes in its quality. Various chemicals are used for pH control. For acidic wastes (low pH) sodium hydroxide, sodium carbonate. For alkali wastes (high pH) sulphuric acid or hydrochloric acid is added.
- ❑ **Chemical coagulation**- it is the process of collecting into a larger mass the minute solid particles are dispersed in a liquid. Chemical coagulants such as aluminum sulfate (alum) are added to wastewater to improve the attraction of fine particles so that they come together and form larger particles called flocs.



❑ Aeration- Aeration

is required in biological treatment processes to provide oxygen to the micro-organisms that break down the organic waste.

❑ Aeration is the process of adding air into wastewater to allow aerobic biodegradation of the organic materials. The principal secondary treatment techniques used are the trickling filter and the activated sludge process and are often classified as fixed-film or suspended-growth systems respectively.



Biological treatment operation used in ETP

Treatment Process	Definition
Suspended-growth processes e.g., activated sludge	The micro-organisms are maintained in suspension in the liquid
Attached-growth processes or fixed-film processes	The micro-organisms are attached to some inert medium such as rock or inert plastics
Combined processes	A combination of suspended-growth and fixed-film

3. Choosing an Effluent Treatment plant

Every factory that is having an ETP designed and constructed must decide on followings:

1- Type of treatment they are going to follow :

- Biological Treatment
- Physico -Chemical Treatment
- Physico -chemical and Biological

2- Area Requirement Comparison- which mostly depends on

- quality of wastewater to be treated flow rate
- the type of biological treatment to be used
- the orientation of different treatment units

3- Cost Comparison

The installation costs of ETPs can vary greatly depending on such factors

- The materials used, including the quality and source of the equipment(e.g. pumps and air blowers)
- Land area
- Dimensions for construction,
- Quality and quantity of wastewater to be treated,
- Quality of the required output

3. CASE STUDY

Working of Effluent Treatment Plant with Double Pass Biological Treatment with SBR and MBR Technology

1 -Effluent from the dairy industry contains high COD, BOD which is required to be treated by double pass Biological Treatment to produce perfect quality Ultra filtered Treated water for recycling/usage.

2-The dairy effluent treatment plant follows a set of steps:

- a. The pH is first adjusted to 8.5 using pH controllers such as caustic or acid. Any emulsions are then broken down and solids precipitate with the help of a de-emulsifier.

- b. Other important steps in the treatment of dairy effluent include flocculation and dissolved air flotation. The effluent is flocculated by passing it through a slow mix zone, where the particles are gathered to form larger ones, which are then treated further using the air flotation technique.
- c. The dissolved air flotation technique works as follows: air flotation system bubbles are propelled by a Recycle Air Dissolving system, which blows the treated effluent, pressurizes it, and dissolves it with air.
- d. Finally, the sludge batch is pumped through the filter press and disposed of in accordance with environmental regulations.
- e. Finally, the Effluent Treatment System designed specifically for the dairy industry results in efficient resource use, lower operating costs, smooth dairy functions, compliance with environmental regulations, and peace of mind.

Automatic Brush screening and collection

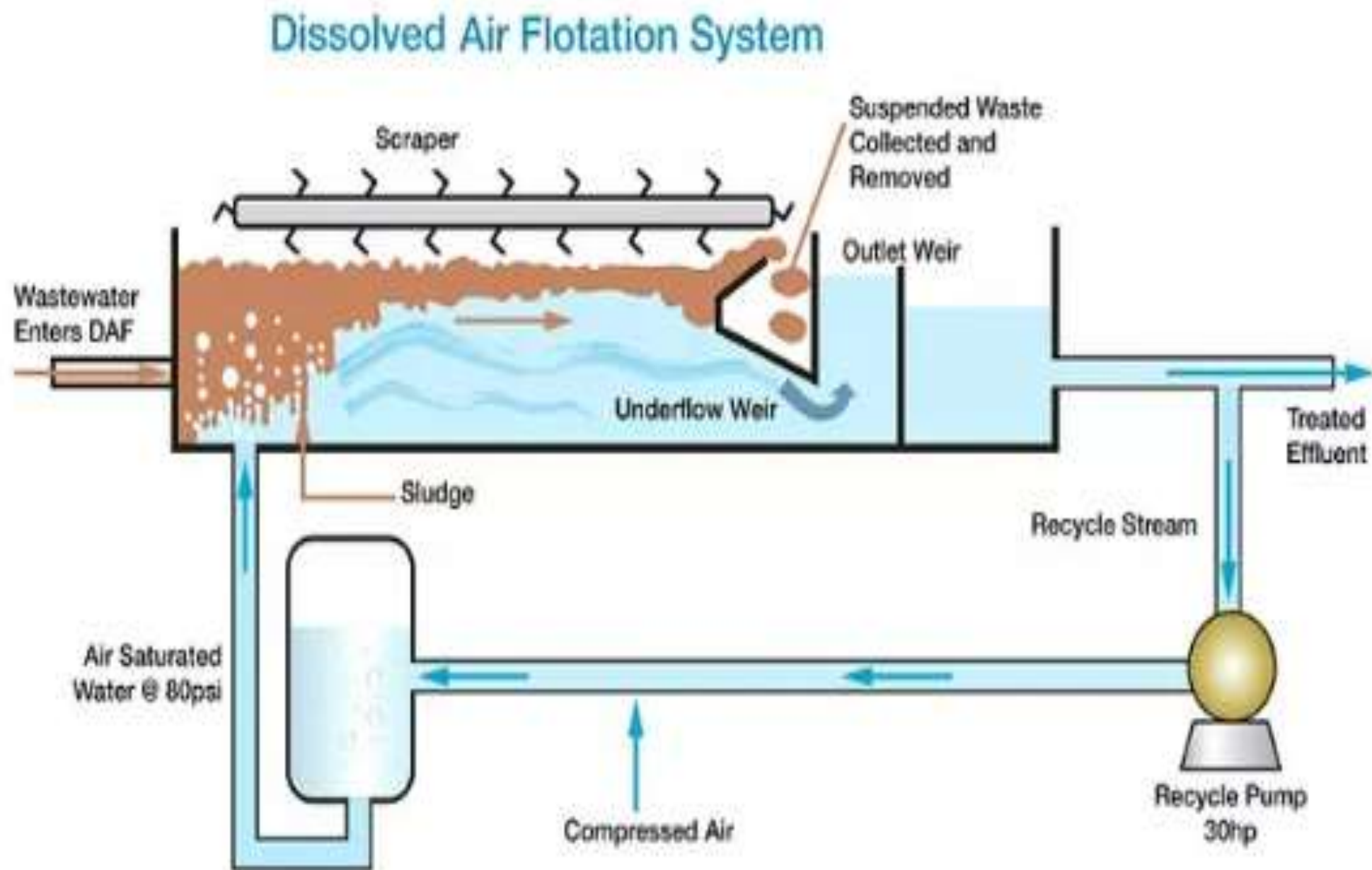
- In this unit Effluent is screened through an automatic Motorized Brush screen for removal of fluff and coarse impurities before feeding to DAF unit.
- Screened effluent after Oil and Grease Trap shall be collected in RCC collection tank.



Dissolved air flotation (DAF)

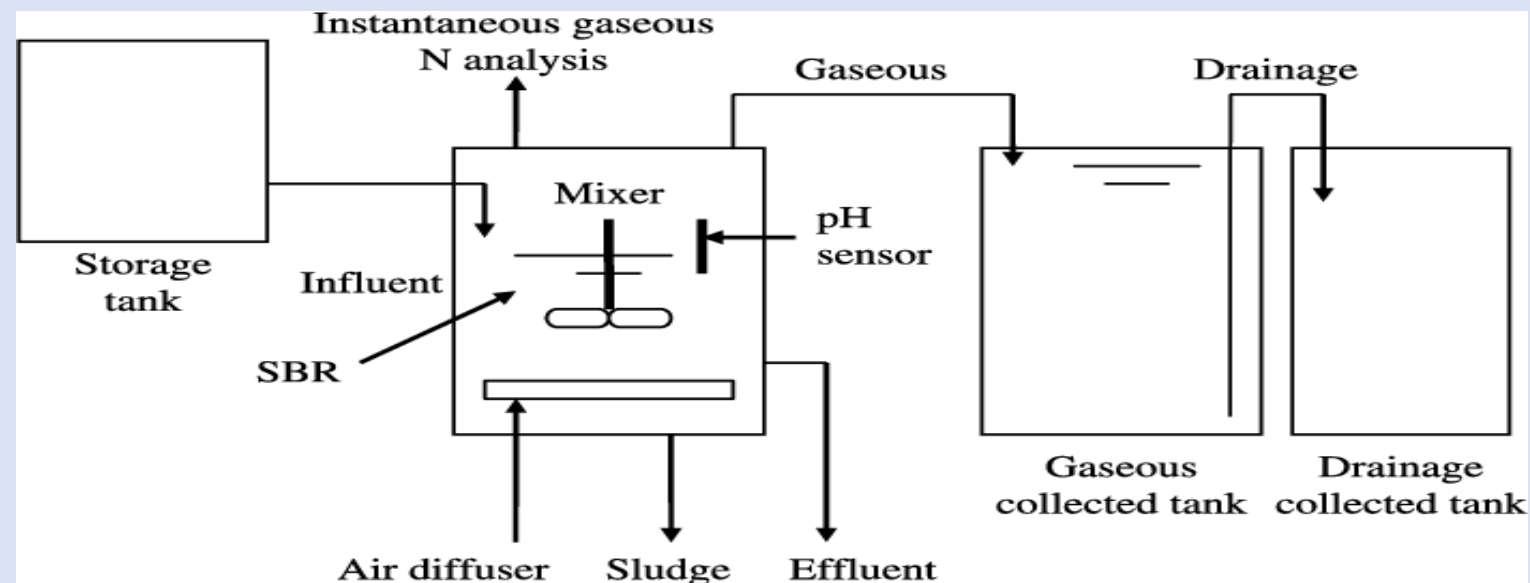
- DAF systems are designed to remove total suspended solids (TSS), biochemical oxygen demand (BOD), and oils and greases (O&G) from a wastewater stream.
- Contaminants are removed using a dissolved air-in-water solution produced by injecting air under pressure into a recycle stream of clarified DAF effluent.
- The recycle stream is then combined and mixed with incoming effluent in an internal contact chamber where the dissolved air comes out of the solution in the form of micron-sized bubbles that attach to the contaminants.
- The bubbles and contaminants rise to the surface and form a floating bed of material that is removed by a surface skimmer into an internal hopper for further handling.

Dissolved Air flotation system

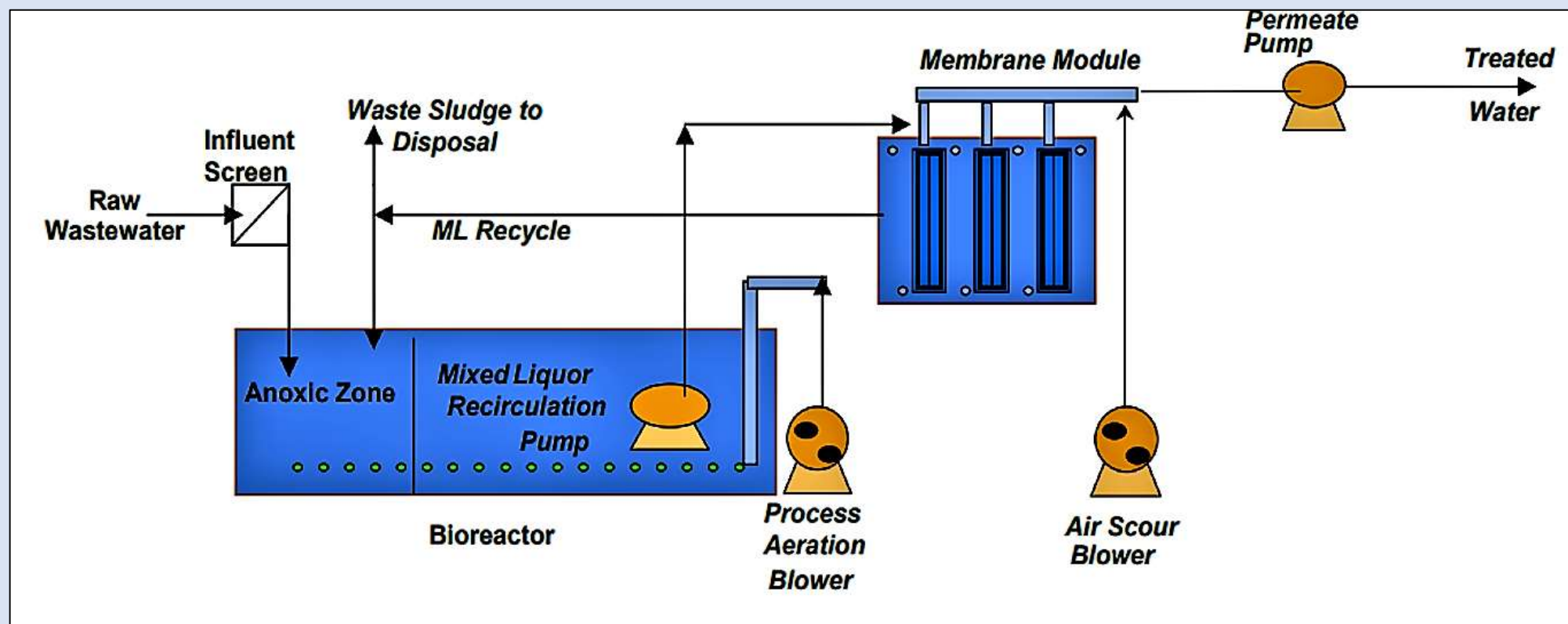


Double Pass Biological Treatment

- Double Pass Biological treatment is used to get the high-quality filtered water at the final outlet. This treatment is divided into two biological treatment stages
 - SBR technology
 - MBBR technology
- **Sequencing Batch Reactor (SBR)**—is the process of wastewater treatment that uses the activated sludge by the sequencing batch reactor plant. This technology separates the water and activated sludge through the oxygen bubbles..



- **Membrane bioreactor-** MBR combines conventional biological treatment (e.g. activated sludge) processes with membrane filtration to provide an advanced level of organic and suspended solids removal.
- There are two different MBR configurations: (1) submerged membrane bioreactor (SMBR) and (2) side stream membrane bioreactor
- In SMBR the membrane is located inside the biological reactor, submerged in the wastewater. In latter configuration, the membrane is located outside the reactor, as an additional step after biological treatment.



Double Pass Biological Treatment

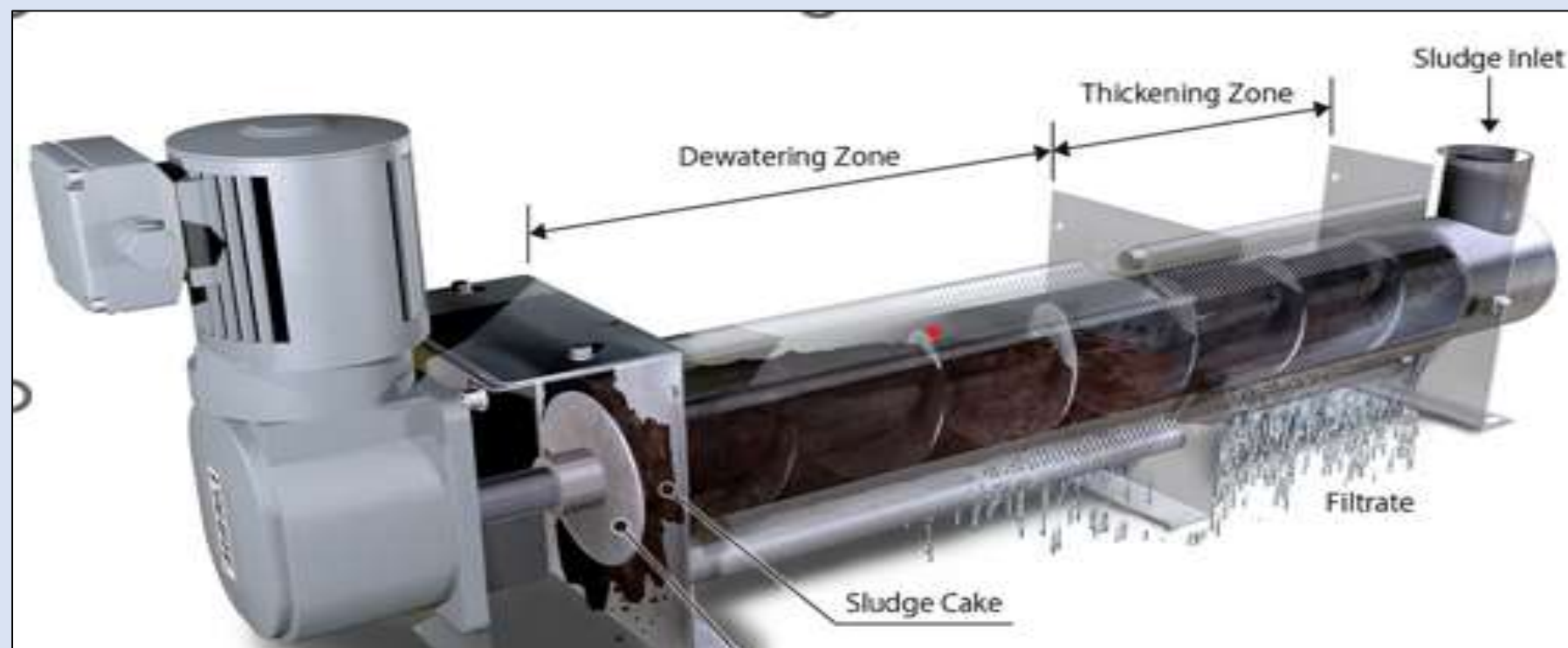
1. Outlet of the DAF unit is directly transferred to the Equalization tank having diffused aeration system with fine bubble diffusers, to be operated as Biological Treatment STAGE-1. This stage reduces the COD by 50%.
2. Auto pH correction dosing unit at the inlet of biological stage-1 is there to maintain the desired pH the at Biological inlet.
3. Outlet of Biological stage -1 is pumped to Biological Stage -2, to produce ultra-filtered water.
4. MBR technology with strong heavy-duty PVDF hollow fiber membranes which are submerged in a tank connected to a biological chamber.

6. The ultra filtered clear ultra-filtered with the help of suction of permeate pumps. Thus, biological outlet passing through the membranes becomes perfect quality free from suspended impurities (TSS < 5 mg/l).

5. Moreover, since the membranes don't allow any bacteria to pass through its fine pore, it is used to maintain high MLSS in the biological tank for perfect degradation of organic matters

Sludge dewatering system

- Screw Press technology is used for dewatering of DAF and biological sludge with minimum moisture content.
- For the MBR technology in Biological, the generation of sludge is very less and whatever generation of sludge, will be used as manure.



Sludge dewatering system

- Sludge from DAF, Biological stage 1 and 2 is collected in a Sludge pit and pumped to an Automatic screw press unit.
- Small dose of fine flocculant is added to flocculate the suspended sludge for better efficiency of the screw press.

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