

# Leachate Treatment

AT HYDERABAD INTEGRATED MUNICIPAL SOLID WASTE: HiMSW Ltd.

A PROJECT REPORT  
ANSHUL MODI

# What is Leachate ?

Leachate refers to the liquid that drains or leaches from waste heaps, comprising excess water along with various dissolved organic and inorganic solid compounds.



Landfill leachate entering retention ponds for treatment.

# Where it comes ?

Municipal Solid Waste (MSW) processing involves multiple stages, including the composting of its organic fraction through the windrow turning method. This aerobic technique facilitates the breakdown of complex organic compounds into simpler substances, releasing carbon dioxide and water as by-products

# Factors affecting Leachate Quality and Quantity

- Particle size
- Compaction of waste
- Waste composition
- Site hydrology
- Cover design
- Waste age
- Landfill design/Operation
- Interaction of leachate with environment

# Impacts of Leachate on Environment

## **Impact on Soil**

Leachate may contaminate soil by adding toxic chemicals like Pb, Hg, etc. or altering the pH, EC, fertility of soil etc.

## **Impact on Air**

Unpleasant odor from leachate is due to volatile compounds like sulfides, mercaptans, putrefied compounds etc. cause headache and irritation

## **Impact on Ground Water**

Leachate may contaminate groundwater and can disrupt the ecosystem by poisoning people, plants, and other wildlife

## **Impact on Aesthetics**

Fresh leachate is light yellow in color which becomes darker with age, finally showing up as black liquid, very unpleasant to look at as flows through

# Physico-chemical Characteristics of Leachate

**TEST RESULTS FOR LEACHATE SAMPLES**

Sl.No.	Parameters	Units	Method	RESULTS		
				170929/1	170929/2	170929/3
1	pH	—	APHA 4500 H+ B	7.4	7.6	6.2
2	Electrical Conductivity	µMhos/cm	APHA 2510 B	50328	52866	49116
3	Non Volatile Organic Compounds	mg/L	APHA 2540 E	NA	NA	NA
4	Total Dissolved Solids at 180°C	mg/L	APHA 2540 C	30196	31716	29468
5	Chlorides as Cl <sup>-</sup>	mg/L	APHA 4500 Cl-C	6652	6642	6214
6	Sulphates as SO <sub>4</sub> <sup>2-</sup>	mg/L	APHA 4500 SO <sub>4</sub> <sup>2-</sup> D	562	974	878
7	Kjehldal Nitrogen	mg/L	APHA 4500 N (org) B	686	522	628
8	Ammonical Nitrogen	mg/L	APHA 4500 NH <sub>3</sub> B, C	1464	1022	1164
9	Nitrates as NO <sub>3</sub> -N	mg/L	APHA 4500 NO <sub>3</sub> -B	32	36	22
10	Nitrite as NO <sub>2</sub> -N	mg/L	APHA 4500 NO <sub>2</sub> - B	<1	<1	<1
11	Alkalinity as CaCO <sub>3</sub>	mg/L	APHA 2320 B	8542	9206	7842
12	Calcium as Ca	mg/L	APHA 3500 Ca B	1742	1802	1642
13	Magnesium as Mg	mg/L	APHA 3500 Mg B	1096	1162	1462
14	Sodium as Na	mg/L	APHA 3500 Na B	4578	4794	5028
15	Potassium as K	mg/L	APHA 3500 K B	1464	1245	1594
16	Fluoride as F <sup>-</sup>	mg/L	APHA 4500 F D	2.4	2.6	3.2
17	Chemical oxygen Demand	mg/L	APHA 5220 B	40032	45214	45102
18	Biological Oxygen Demand (3 day at 27°C)	mg/L	IS 3025(P-44)	11792	12452	13302
19	Oil & Grease	mg/L	APHA 5520 B	10	8	4
20	Lead as Pb	mg/L	APHA 3120 B	<0.1	<0.1	<0.1
21	Cadmium as Cd	mg/L	APHA 3120 B	<0.1	<0.1	<0.1
22	Total Chromium as Cr	mg/L	APHA 3120 B	<0.5	<0.5	<0.5
23	Chromium as Cr <sup>+6</sup>	mg/L	APHA 3500 Cr B	<0.1	<0.1	<0.1
24	Nickel as Ni	mg/L	APHA 3120 B	<0.5	<0.5	<0.5
25	Zinc as Zn	mg/L	APHA 3120 B	<0.1	<0.1	<0.1
26	Manganese as Mn	mg/L	APHA 3120 B	<0.2	<0.2	<0.2
27	Copper as Cu	mg/L	APHA 3120 B	<0.5	<0.5	<0.5
28	Mercury as Hg	µg/L	APHA 3120 B	<0.01	<0.01	<0.01
29	Arsenic as As	mg/L	APHA 3120 B	0.25	0.31	<0.1
30	Cyanide as CN <sup>-</sup>	mg/L	APHA 4500 CN-E	<0.1	<0.1	<0.1
31	Phenolic compounds	mg/L	APHA 5530 D	<1	<1	<1
32	Absorbable organically bound Halogen(AOX)	mg/L	-	NA	NA	NA
33	Dry matter at 105°C	mg/L	In-house	34688	34842	34564
34	Iron as Fe	mg/L	APHA 3500 Fe B	3.2	4.4	3.6
35	Iron as Fe <sup>+3</sup>	mg/L	APHA 3500 Fe B	<0.2	<0.2	<0.2
36	Sulphide as S <sup>2-</sup>	mg/L	APHA 4500 S <sup>2</sup> F	24	34	16

NA: Not Analyzed,

- Opinion and interpretation: Nil
- Reports pertained only to the collected samples when monitoring
- Test reports shall not be reproduced except in full, without written approval of the Laboratory

TDS: 25,000 to 40,000 mg/L;

COD: 20,000 to 35,000mg/L;

BOD: 11,000 to 13,000 mg/L;

Chlorides: 5000 to 8500 mg/L



Above are the major parameters of concern in the leachate treatment

# Leachate Treatment systems

- Recirculation
- Evaporation (Open & Closed)
- Biological treatment
- Chemical treatments (Precipitation, Coagulation, flocculation)
- Physical treatments (Filtration and Adsorption)
- Combination of Physical-chemical and biological treatments

# Major Factors effecting on Leachate Treatment

## BOD/COD Ratio

- Relative biodegradability of leachate
- Methane formation

## PH

- Influence chemical and biological process of precipitation
- Controlling metal solubility

## Cost

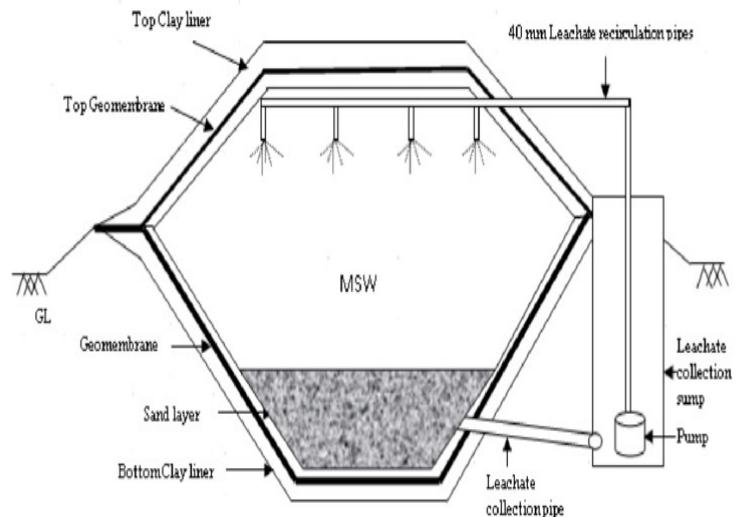
- High in cost

## Limitations for disposal

- Public Sewage disposal
- Inland disposal

# Recirculation of Leachate

- Leachate recirculation on Landfill is good for methane production
- Leachate recirculation on composting process to maintain moisture and

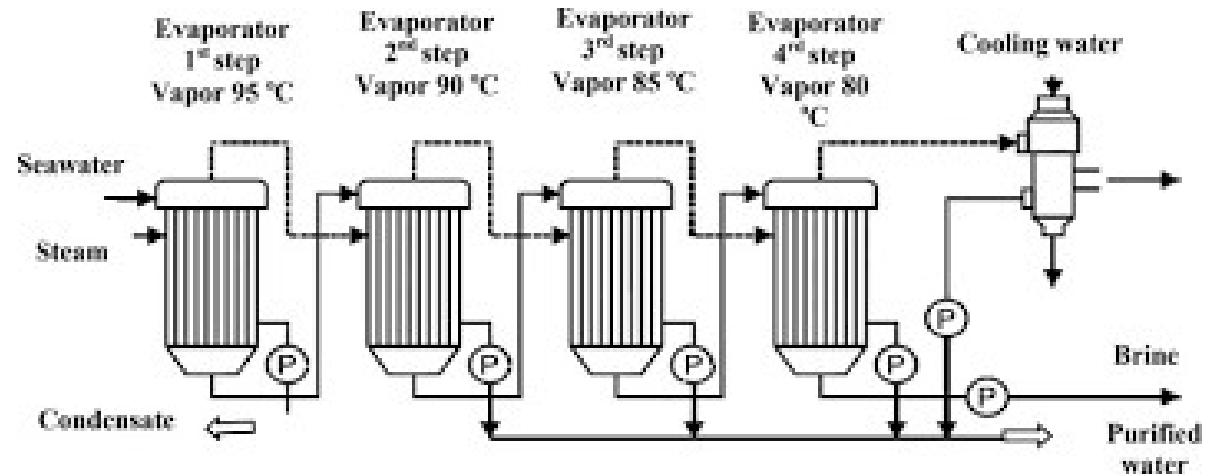


# Evaporation of Leachate



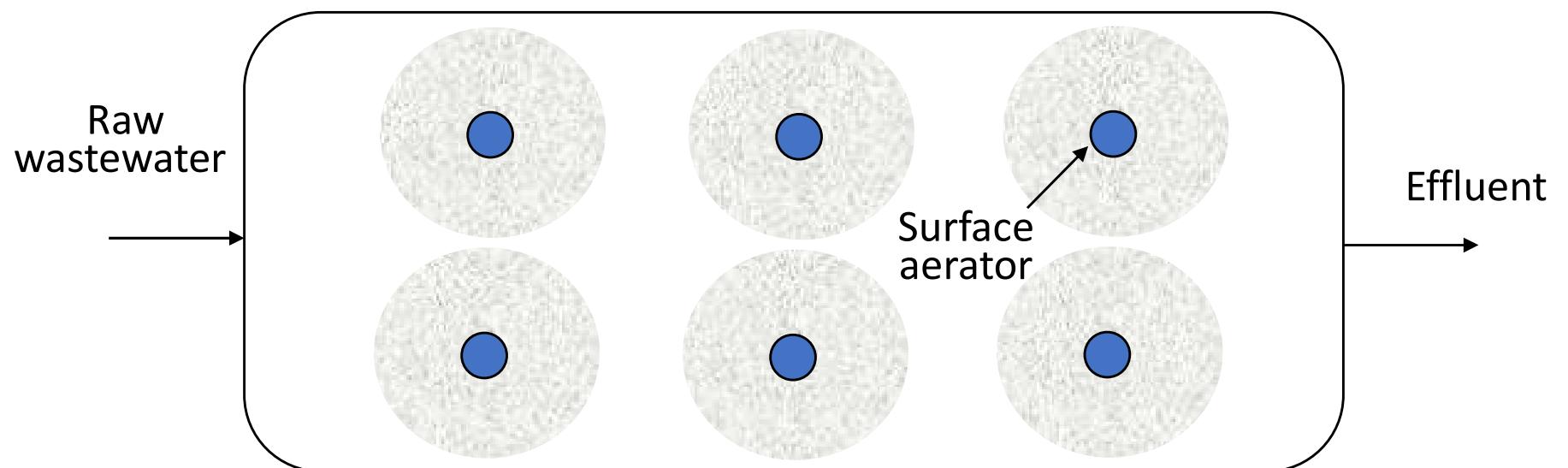
Open evaporation of Leachate in lagoons

Closed evaporation of leachate (MEE- Multiple effective evaporator )



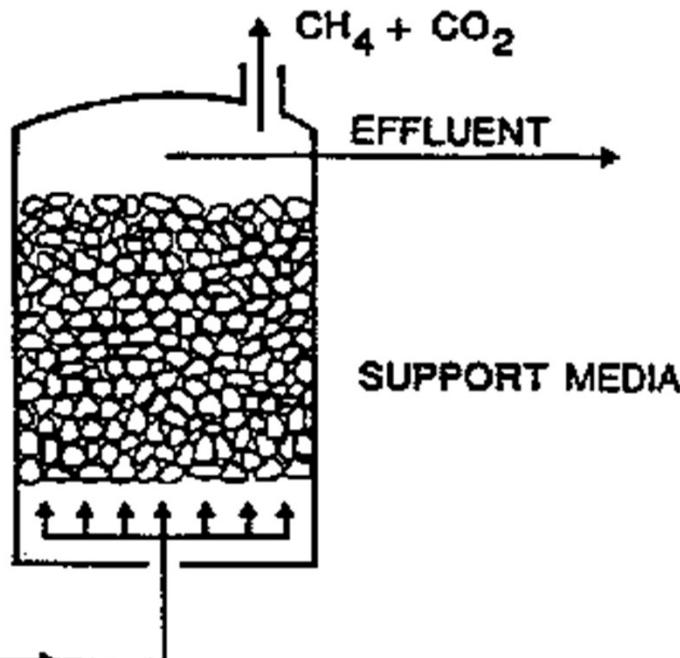
# Aerated Lagoons

- Suspended growth system
- Completely mixed mode
- Contact time limited to hydraulic retention time due to no recycle of sludge
- Limited effluent quality



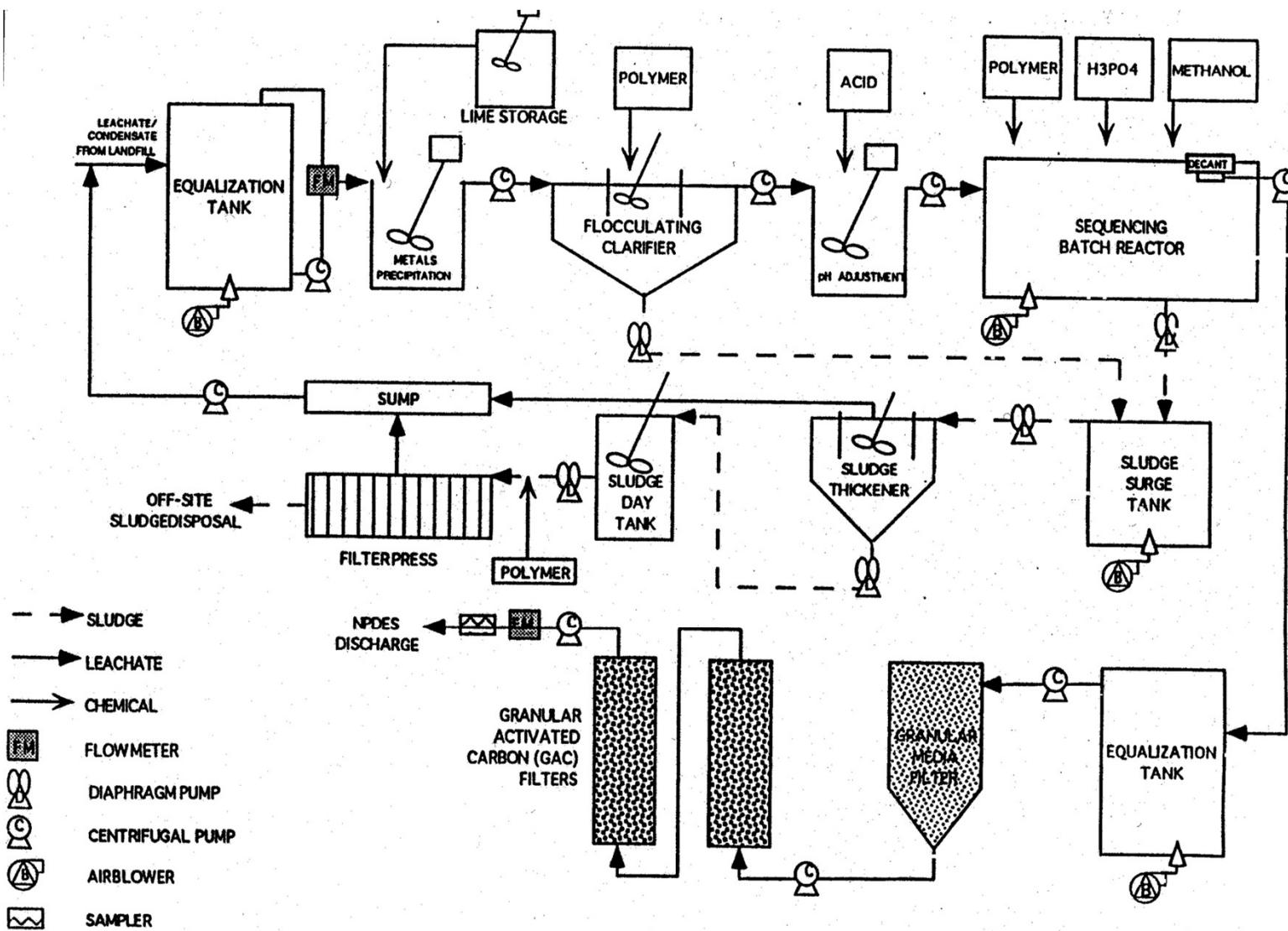
# Anaerobic reactor

- Sludge age: > 100 days      VSS: > 20,000 mg/L
- Increased efficiency and rapid elution of toxic sludge
- Not good for wastes containing a large portion of particulates and/or carbohydrates due to clogging
- Possible to treat low strength waste at nominal temperatures economically



- Effluent recycle (sufficient alkalinity) to raise pH to 7
- Possible buildup of nonbiodegradable solids in reactor
- Landfill leachate: pH 5.4, COD 54,000 mg/L, 45% fatty acids, loading 7.9 kg COD/m<sup>3</sup>·day → 89% removal
- Observation – 50-60m<sup>3</sup> of gas production with 57% methane

# Leachate treatment flow



# Leachate treatment systems in HIMS

# Leachate Treatment Methods in HIMS

## **System -1 ( 2000 KLD)**

- Leachate Pre-treatment
- Mechanical Vapor re compression system

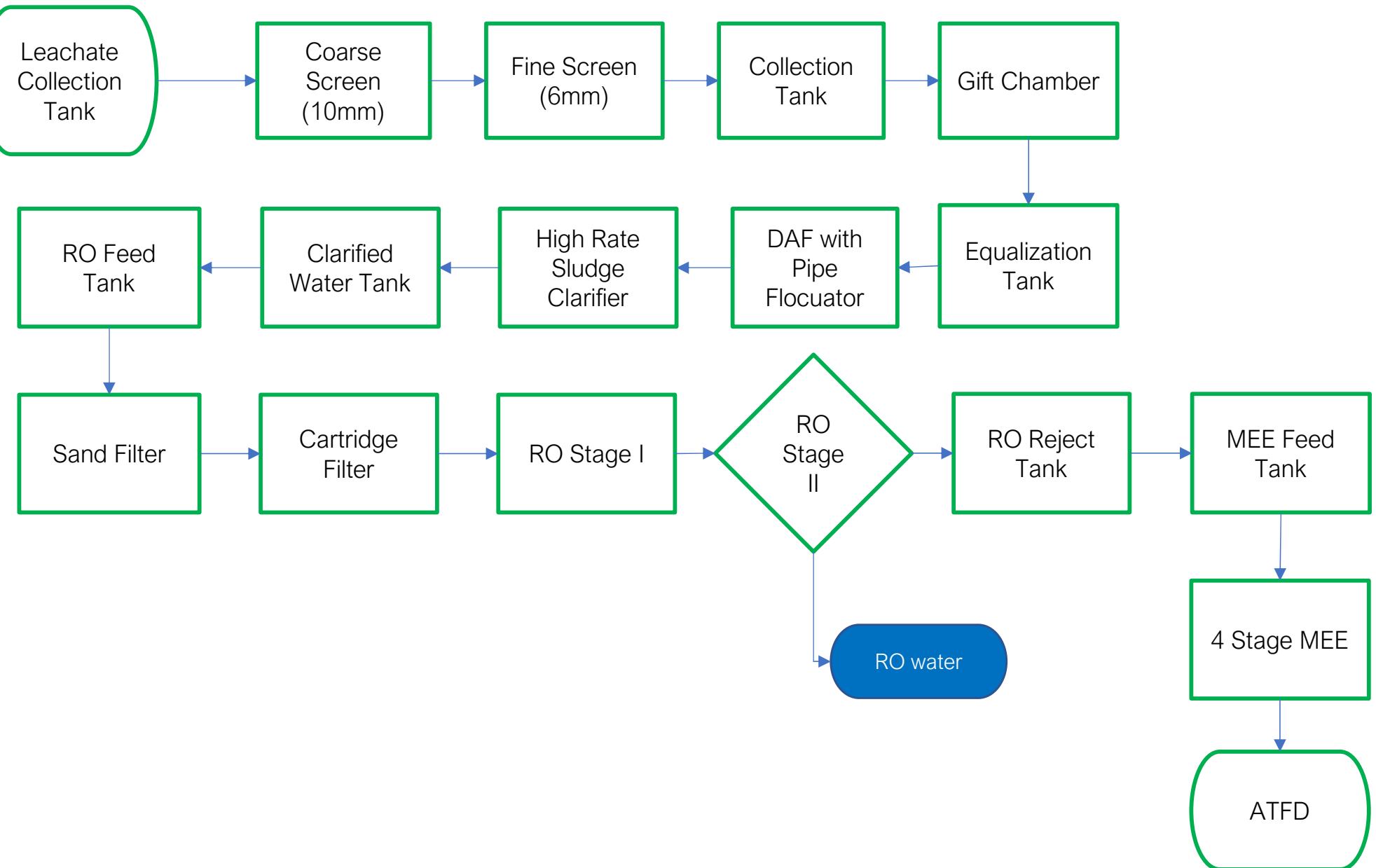
## **System -2 (1000 KLD)**

- Leachate Pre-treatment
- Reverse Osmosis (2 Stage)
- Multiple Effect evaporator
- Agitated Thin Film Dryer





# Process flow of leachate treatment



# Leachate Pretreatment

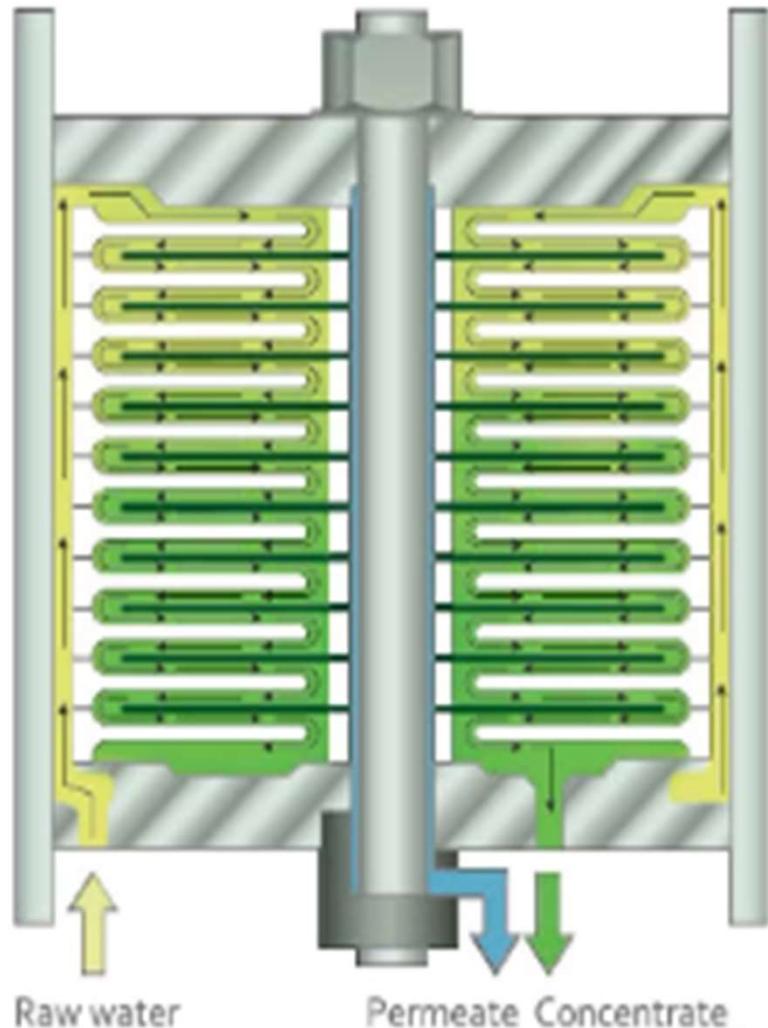
- The focus on reduction of total suspended solids with the help of chemical by using coagulation and flocculation

Chemical Type	Examples	Role in Treatment
Coagulants	PAC, Alum, FeCl <sub>3</sub>	Destabilize Colloidal Particles
Flocculants	Polymers	Enhance Floc Formation
PH Adjuster	Lime, NaOH	Optimize Coagulation Condition

# Leachate Filtration System

## Technology Highlights

- Disc Tube Reverse Osmosis (DTRO): Modular membrane system with open-channel design.
- Handles high silt density index (SDI 5–15), shock loads, and scaling risks.



# Thermal methods

## **Low Heat evaporation**

- Mechanical Vapor Recompression (MVR)

## **High Heat Evaporation**

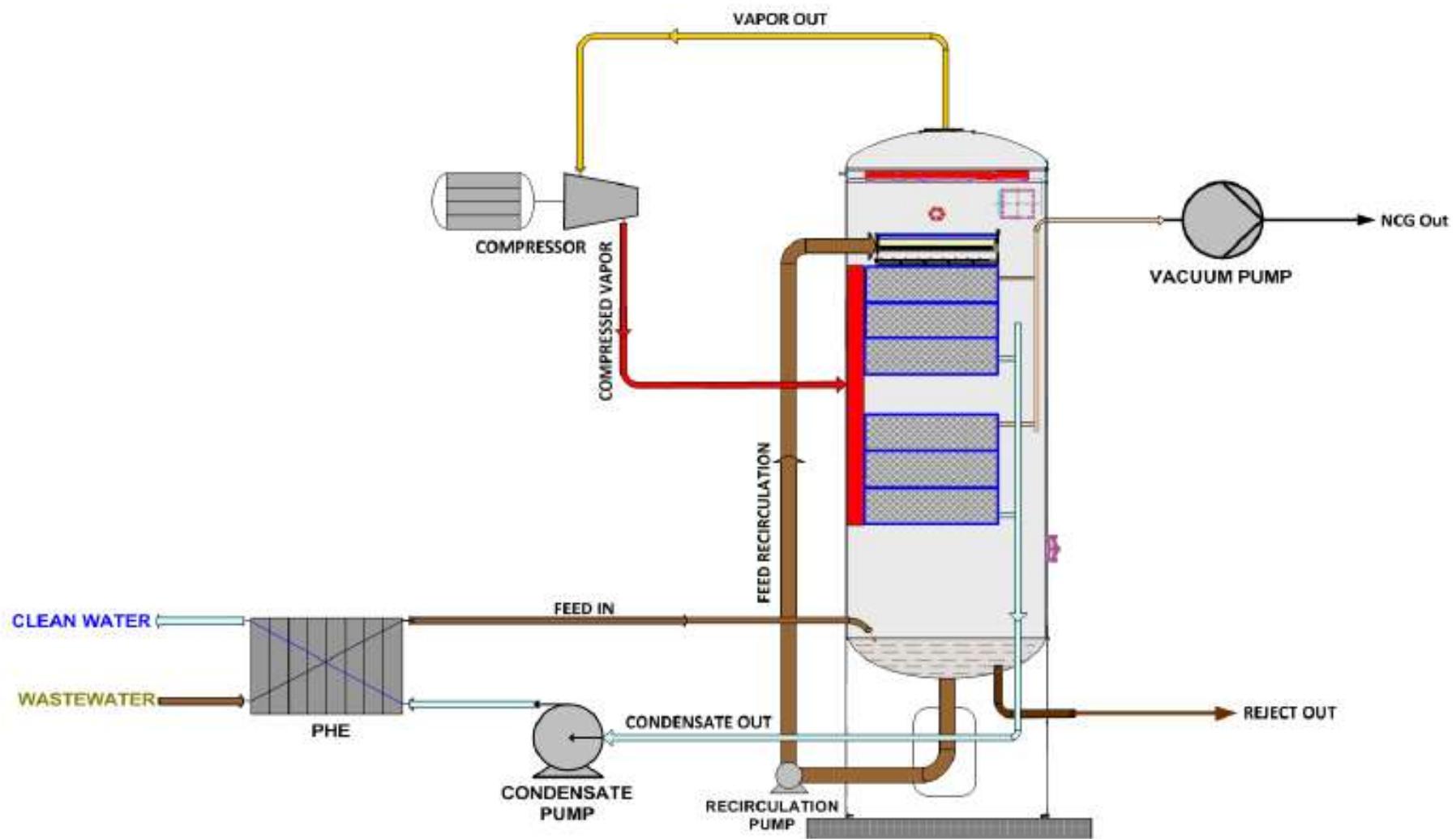
- Multi effect evaporator (MEE)
- Agitated Thin Film Dryers (ATFD)

# MVR-Mechanical Vapor recompression

The preheated effluent is pumped into a horizontal cylindrical vessel, where it is evenly distributed over a patented polymer-based heat transfer surface. These polymeric heat exchanger modules are arranged sequentially along the vessel's length. As the effluent flows downward, evaporation occurs. The resulting vapors are drawn in by a high-speed centrifugal fan, which elevates both pressure and saturation temperature. These saturated vapors then condense on the inner surface of the polymeric heat exchanger, releasing latent heat back into the effluent

# Mechanical Vapor recompression

Process Flow Diagram



# MEE

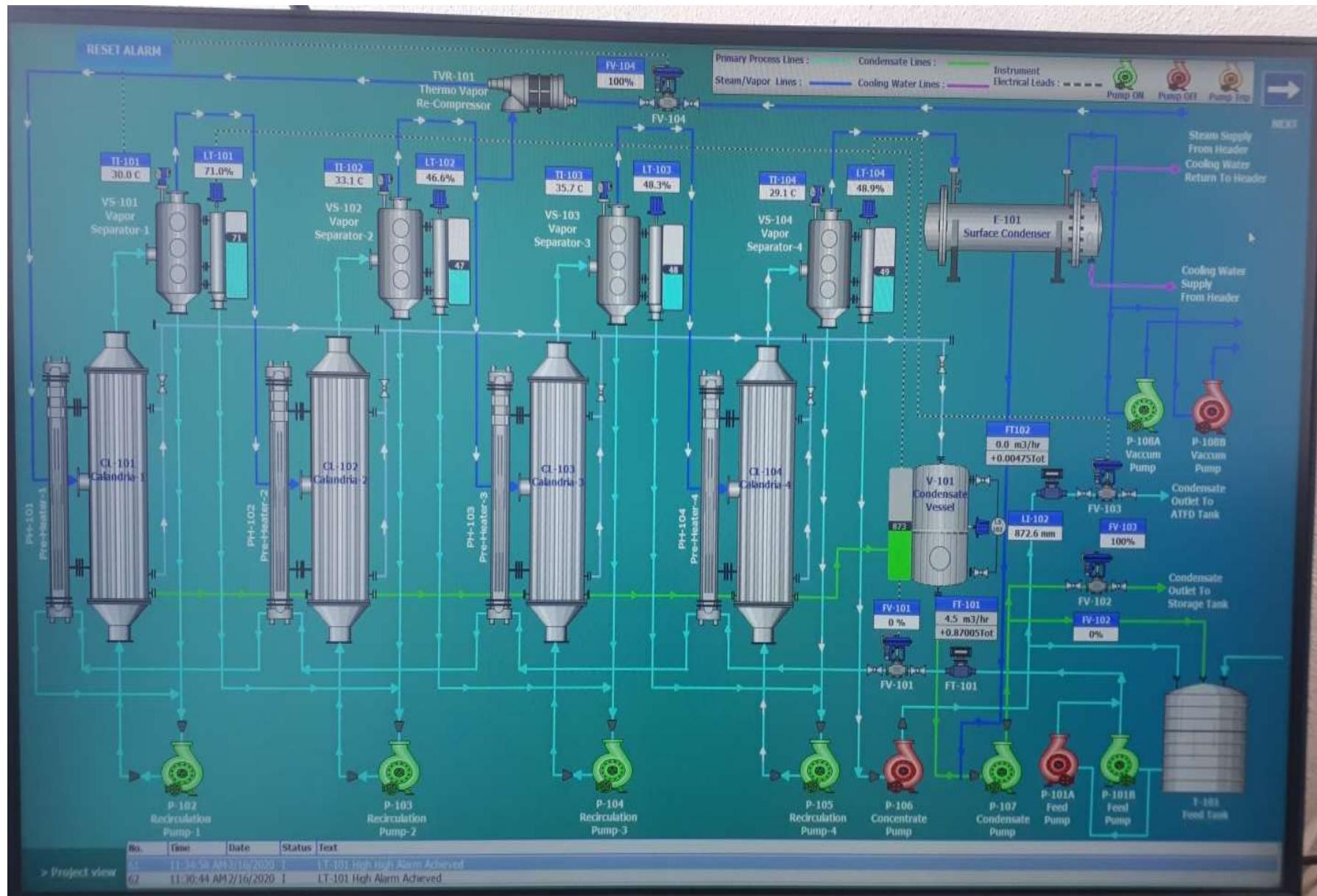
- The RO reject after High Pressure RO is concentrated in the MEE type Evaporators Multiple Effect Evaporator (MEE) with Agitated thin Film dryer (ATFD) An Agitated Thin Film Dryer (ATFD) is used for dry salt recovery through evaporation of highly concentrated mother liquor (from MEE).

# How it works ?

Evaporation occurs in 3 steps:

- Pre heating of solution prior to evaporation
- Removal of water as vapor by steam heating
- Condensing the vapor removed

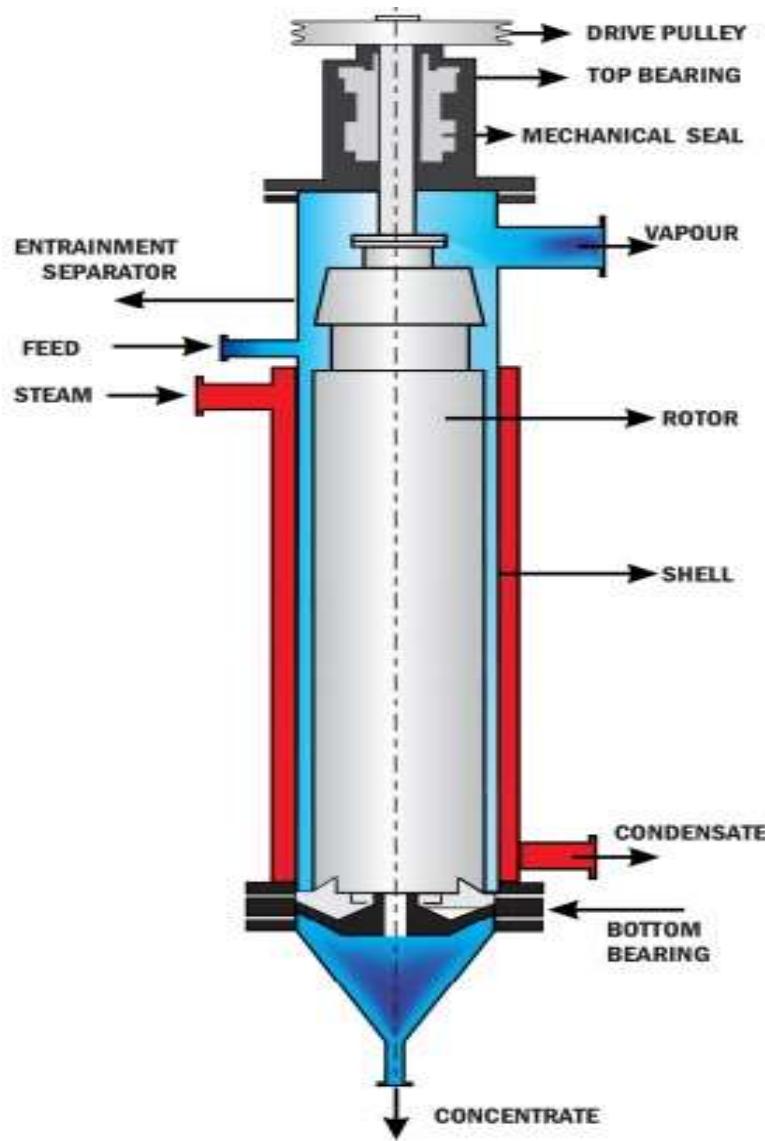
# Process flow of MEE (4 effect)



# ATFD – Agitated Thin Film Dryer

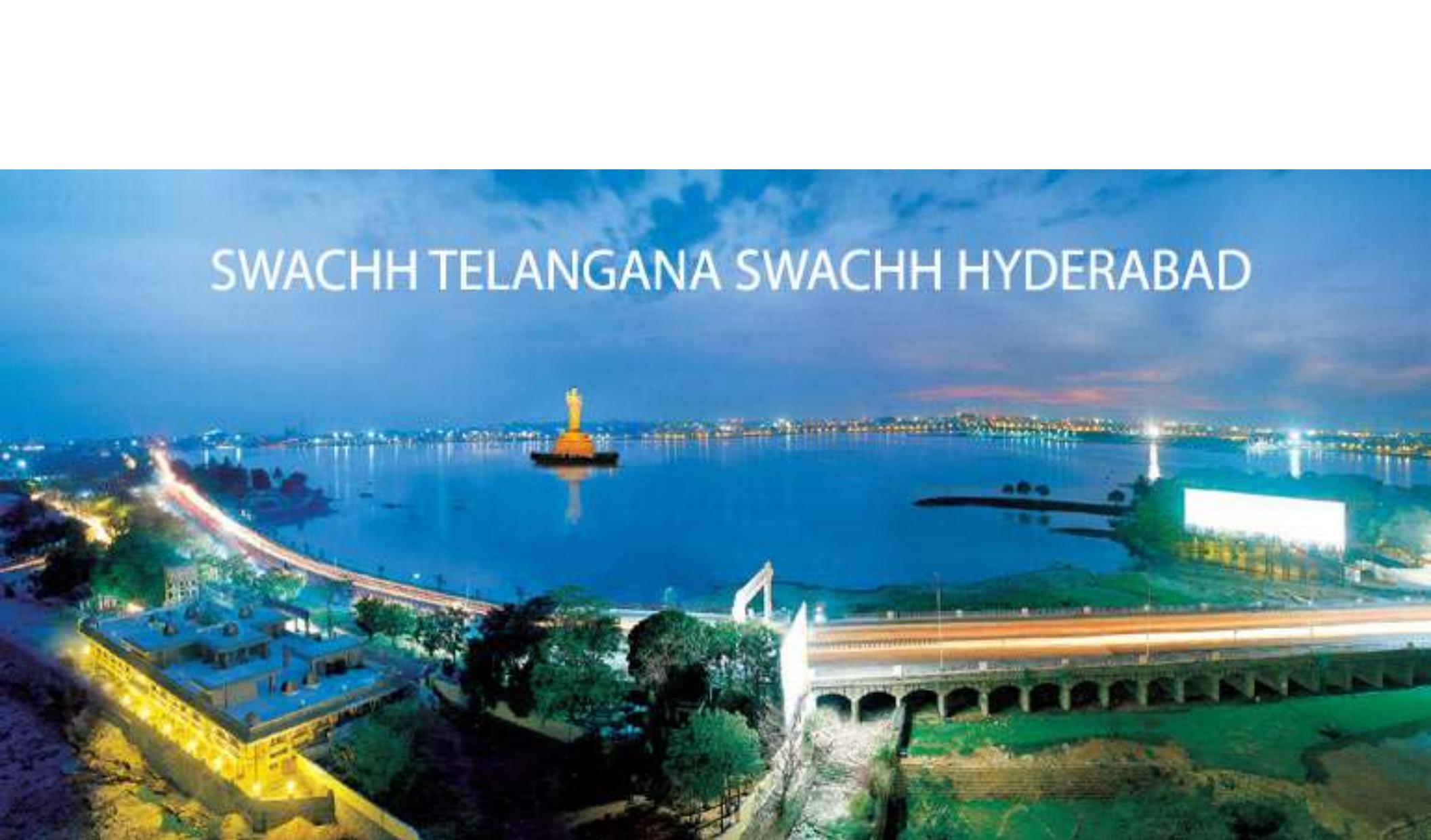
Agitated thin-film dryers (ATFDs) are used to produce dry free-flowing powder from slurry/solution-type feed and widely implemented in pharmaceutical, chemical, food industries and metal industries. The feed passes through the ATFD in several forms such as solution/slurry and successively becomes paste, wet powder, and dry powder.

# ATFD



# LTP Disposal levels in HIMS W

	Parameter	Quality		
		Land disposal	System 1	System-2
1.	Suspended solids, mg/l, max	200	22	25
2.	Dissolved solids (inorganic) mg/l, max.	2100	565	1280
3.	pH value	5.5 to 9.0	7.26	7.49
4.	Ammonical nitrogen (as N), mg/l, max.	-	4.6	1.2
5.	Total Kjeldahl nitrogen (as N), mg/l, max	-		
6.	Biochemical oxygen demand (3 days at 27° c)max (mg/l)	100	65	28
7.	Chemical oxygen demand, mg/l, max	-	242	175
8.	Arsenic (as As), mg/l, max	0.2	<0.2	<0.2
9.	Mercury (as Hg), mg/l, max	-	<0.1	<0.1
10.	Lead (as Pb), mg/l, max	-	<0.1	<0.1
11.	Cadmium (as Cd), mg/l, max	-	<0.1	<0.1
12.	Total Chromium (as Cr), mg/l, max	-	<0.1	<0.1
13.	Copper (as Cu), mg/l, max	-	<0.1	<0.1



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Thank you