2nd WORLD CONGRESS AND EXPO ON RECYCLING,
BERLIN, GERMANY

INNOVATIVE ZERO LIQUID DISCHARGE BASED EFFLUENT TREATMENT SYSTEM FOR API INDUSTRY CLUSTERS IN INDIA

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Pharmaceutical Sector – Current Scenario

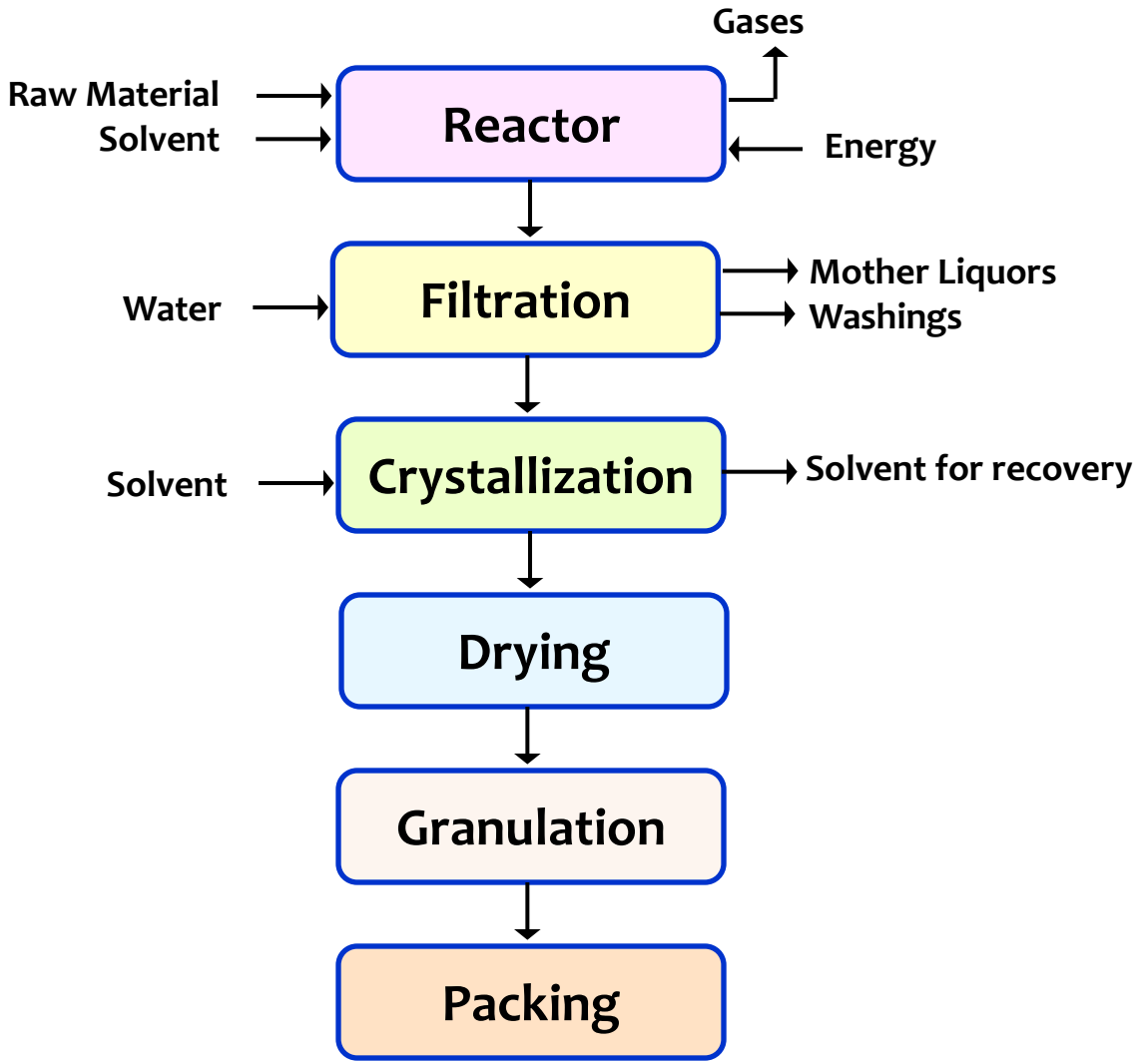
- API and Generics turnover in 2014 US $ 15 BILLION
- Projected Turnover By 2020 US $ 55 Billion
- India holds 20% of world wide generic market
- Approximate number of manufacturing units : 20000
- API Manufacturing Units : 4600
- Geographic Spread : Telangana, Andhra Pradesh, Tamilnadu, West Bengal, Maharashtra
- Contribution to turnover from Telangana State : 20%
- Approximate number of manufacturing units : 670
- Geographical spread in Telangana : 75% of units located in 6 Clusters
- Number of Small and Medium Scale API units : 490

Cluster of API Manufacturing Units - Hyderabad

Environmental Concerns

- Larsons report -2007, presence of traces of antibiotics in surface and ground water
- Prevalence of anti microbial resistance (AMR)
- Genetic changes in species
- Nordia Report - 2016, Government intends to pursue vigorous industrialization regardless of Human Social and Environmental Costs

API Manufacturing Process – Schematic Diagram



Types of Effluent

S.No	Type of Effluent	Source	Concentration
1	High TDS	a. Process b. Washings c. Scrubbers d. RO Rejects	COD: 20000 to 40000 mg/l TDS: 50000 to 100000 mg/l Salts: 5.0 to 10.0 %
2	Low TDS	a. Utility Blow downs b. Condensate from MEE and ATFD	TDS: 3000 to 8000 mg/l

MEE ***Multiple Effect Evaporator***

ATFD ***Agitated Thin Film Dryer***

Evolution of Treatment Systems – API Units

- **Solar Evaporation**

  Release of VOC's, Ground Water and Soil Contamination

- **Conventional Biological Treatment followed by on Land Disposal**

  Ineffective, release VOC's, Soil Contamination, Contamination of Surface Water Courses

- **Forced Evaporation**

  Release of VOC's, High Moisture containing bottom salts – not acceptable for Secured Land Fill, Contamination of Surface Water Courses

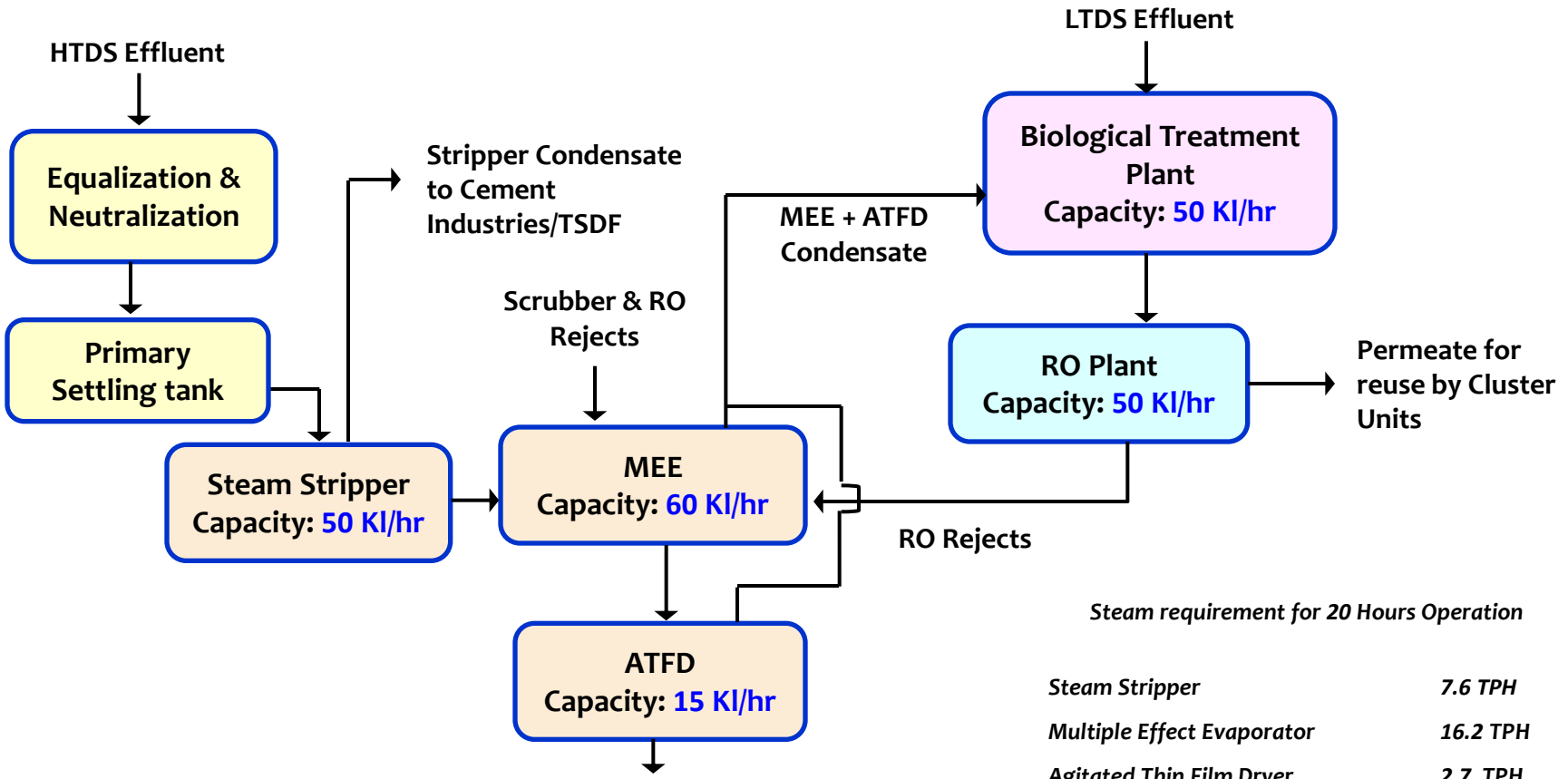
- **Forced Evaporation, RO, Spray Dryer**

  Release of VPC's, Odour from Spray Dryer, Contamination of Ground Water due to disposal of Semi Treated Wastewater.

- **Zero Liquid Discharge Based Treatment System**

  Effluent Segregation, Effective Treatment, Complete Reuse, Transformation of COD into Incinerable Organics, and TDS Into Dry Salts for Disposal in Secured Landfill

Zero Liquid Discharge Based Treatment System



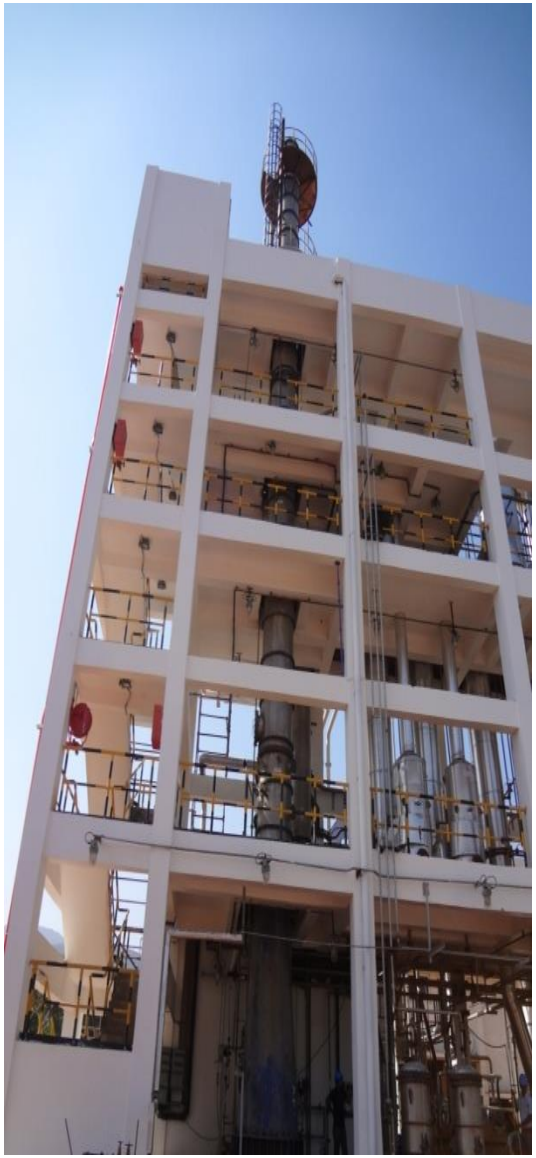
HTDS	*High Total Dissolved Solids*
LTDS	*Low Total Dissolved Solids*
MEE	*Multiple Effect Evaporator*
ATFD	*Agitated Thin Film Dryer*
RO	*Reverse Osmosis*
TSDF	*Treatment Storage and Disposal Facility*

Steam requirement for 20 Hours Operation

Steam Stripper	*7.6 TPH*
Multiple Effect Evaporator	*16.2 TPH*
Agitated Thin Film Dryer	*2.7 TPH*

HTDS	*1000 KLD*
LTDS	*63 KLD*
Steam requirement	*22.1 TPH*
Power requirement	*415 HP*

Zero Liquid Discharge Effluent Treatment System



Stripper Column

Multiple Effect Evaporator

Agitated Thin Film Dryer

Zero Liquid Discharge Effluent Treatment System

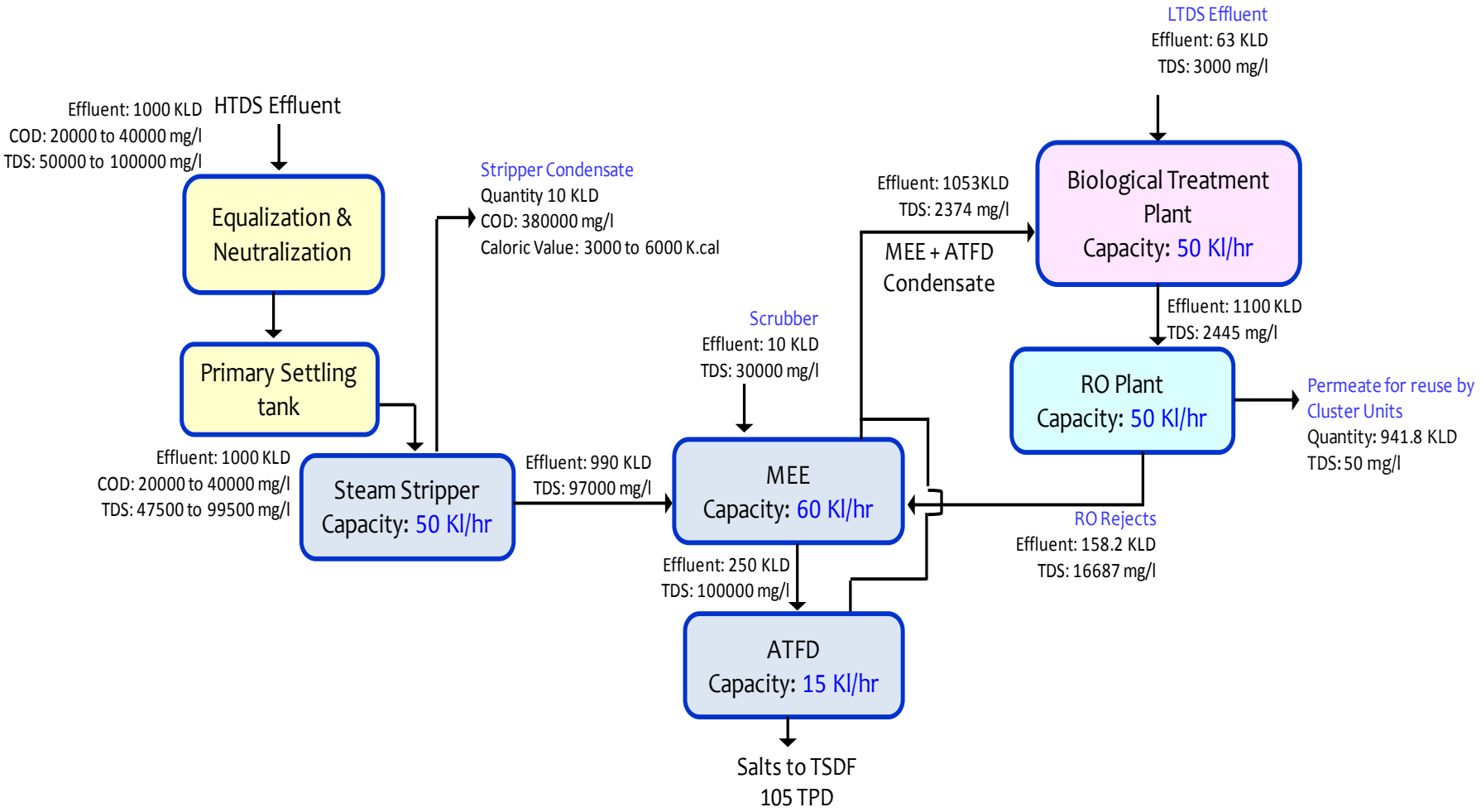
Biological Treatment Plant

RO Plant

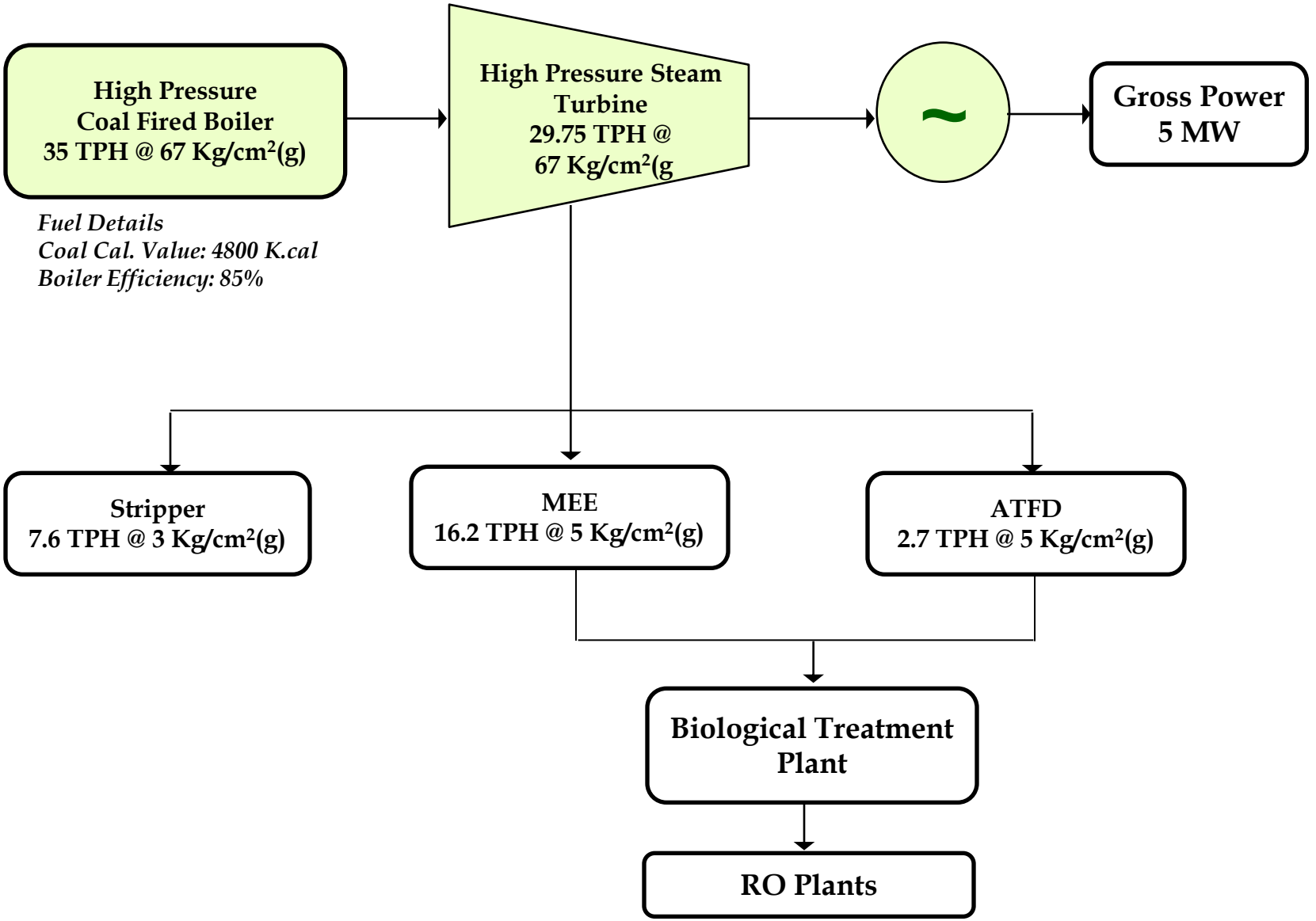
Hood System with Scrubber for Effluent Storage tanks

Stage Wise Effluent Physical Appearance

Stage Wise Reduction of Pollutant Concentration



Captive Power Plant with ZLD System



Cost Estimate

INR 100 = 1.35 €

S.No	Description	Cost	
		INR Million	Million €
1	Land	15	0.20
2	Civil Structures and Others	50	0.65
3	Boiler	35	0.46
4	Turbine	30	0.39
5	Stripper	18	0.23
6	Multiple Effect Evaporator	72.5	0.94
7	Agitated Thin Film Dryer	26	0.34
8	Cooling Towers	17.5	0.23
9	Biological Treatment Plant	40	0.52
10	RO System	21	0.27
11	Storage Tanks	25	0.33
	Total	350	4.55
	Annual Operating Cost		
1	Boiler	127.96	1.66
2	Stripper, MEE and ATFD	0.38	0.005
3	Biological Treatment Plant and RO Systems	10.91	0.14
	Total	139.24	1.81
	Annual Maintenance Cost		
1	Boiler	12.80	0.17
2	Stripper, MEE and ATFD	53.66	0.70
3	Biological Treatment Plant and RO Systems	4.51	0.06
	Total	71	0.92

Cost Benefit

INR 100 = 1.35 €

S.No	Description	Cost	
		INR Million	Million €
	Annual Income		
1	Power exported to Grid	218.6	2.84
2	Income from Cluster Units for 1000 KLD wastewater	187.8	2.44
	Total - I	406.4	5.3
	Annual Expenditure		
1	Power Usage	1.11	0.01
2	Operating Cost	139.2	1.81
3	Maintenance Cost	71	0.92
4	Depreciation	4.65	0.06
	Total - II	215.97	2.81
	Gross Profit (Total I - Total II) before Tax	190.44	2.48

Return of Investment

INR 100 = 1.35 €

S.No	Description	Cost per Annum	
		INR Million	Million €
1	1st Year	350	4.55
	Interest on Above	52.5	0.68
	Total - I	402.5	5.23
2	Balance for 2nd Year	212.1	2.76
	Interest on Above	31.8	0.41
	Total - II	243.9	3.17

S.No	Description	Cost per Annum	
		INR Million	Million €
3	Balance for 3rd Year	53.4	0.69
	Interest on Above	8.0	0.10
	Total - III	61.5	0.80
4	Balance for 4th Year	-129.0	-1.68
	Total - IV	-129.0	-1.68
5	Balance for 5th Year	-319.4	-4.15
6	Balance for 5th Year	-509.9	-6.63

Rate of Interest @ 15 %

Environmental Benefits

- Encourages small and medium industries to send effluent for treatment and reuse
- Small and medium industry will be more profitable and may spend the savings on treatment costs on other environmental management and mitigation measures
- No further contamination of ground and surface water streams ensured
- Can be adopted by other sectors which have High TDS effluents
- Alternative to incineration of mother liquors and High COD/TDS wastes – reduced CO_2 emissions.

THANK YOU

Technical Specifications of Effluent Treatment System

S.No	Description	Unit	Capacity
	Stripper for Process and Washings		
1	Design Capacity	KLD	1000
2	Feed Rate	Kl/hr	45-50
3	Specific Gravity of Feed	≈	1.03
4	Initial Feed COD	PPM	20000-40000
5	Feed Total Solid	%	2.0-5.0
6	High Heating Temperature	^{o}C	95 – 100
7	High COD Condensate recovery	Kl/hr	8.0-10.0
8	Dry Saturated Steam at 3.0Kg/cm² (g) Pr	TPH	7.6
9	Cooling Water circulation rate	m^3/hr	2.5-4.0.
10	Cooling Water Inlet Temperature	^{o}C	30 – 32
11	Cooling Water Outlet Temperature	^{o}C	38 – 40
12	Operating Condition		Atmospheric
	Multiple Effect Evaporator (MEE)		
1	Design Capacity	KLD	1200
2	Feed Rate	Kl/hr	50-55
3	Feed Concentration	mg/l	50000-100000
4	Feed Temperature	^{o}C	35
5	Initial Solids	%	5.0-10.0.
6	Solids in Concentrate	%	35.0-40.0
7	Concentrate Output	Kl/hr	10.0-14.0
8	Water Evaporation Rate	Kl/hr	35.0-45.0
9	Designed Water Evaporation Rate	Kl/hr	37.5
10	Dry Saturated Steam at 5.0Kg/cm² (g) Pr	TPH	16.2

S.No	Description	Unit	Capacity
	Multiple Effect Evaporator (MEE)		
11	Cooling Water Circulation Rate at 30 – 32°C	m^3/hr	5.0-7.0
12	Cooling Water Inlet Temperature	^{o}C	30 – 32
13	Cooling Water Outlet Temperature	^{o}C	38 – 40
	Agitated Thin Film Dryer (ATFD)		
1	Design Capacity	KLD	300
2	Feed Rate	Kl/hr	12.0-14.0
3	Initial Feed Solid Content	%	35.0-40.0
4	Final Moisture in Dry Bag-gable Product	%	3.0-5.0
5	Water Evaporation Rate	Kl/hr	10.0-14.0
6	Designed Water Evaporation	Kl/hr	12.5
7	Solid Output in Bag-gable at 5% moisture	Kl/hr	4.0-5.0
8	Dry Saturated Steam at 5.0Kg/cm² (g) Pr	TPH	2.7
9	Cooling Water Circulation Rate at 30 – 32°C	m^3/hr	1.0-2.0
10	Cooling Water Inlet Temp	^{o}C	30 – 32
11	Cooling Water Outlet Temp	^{o}C	38 – 40

Technical Specifications of Effluent Treatment System

S.No	Description	Unit	Capacity
Biological Treatment Plant			
1	Design Capacity	KLD	1200
2	Equalization Tanks	KL	1200 (2no.s)
3	Bio Aeration Tank –I	KL	1200
4	Clarification Tank - I	KL	1200
5	IInd Stage Bio Aeration	KL	1200
6	Clarification Tank –II	KL	1200
7	Holding Tank	KL	800 (2no.s)

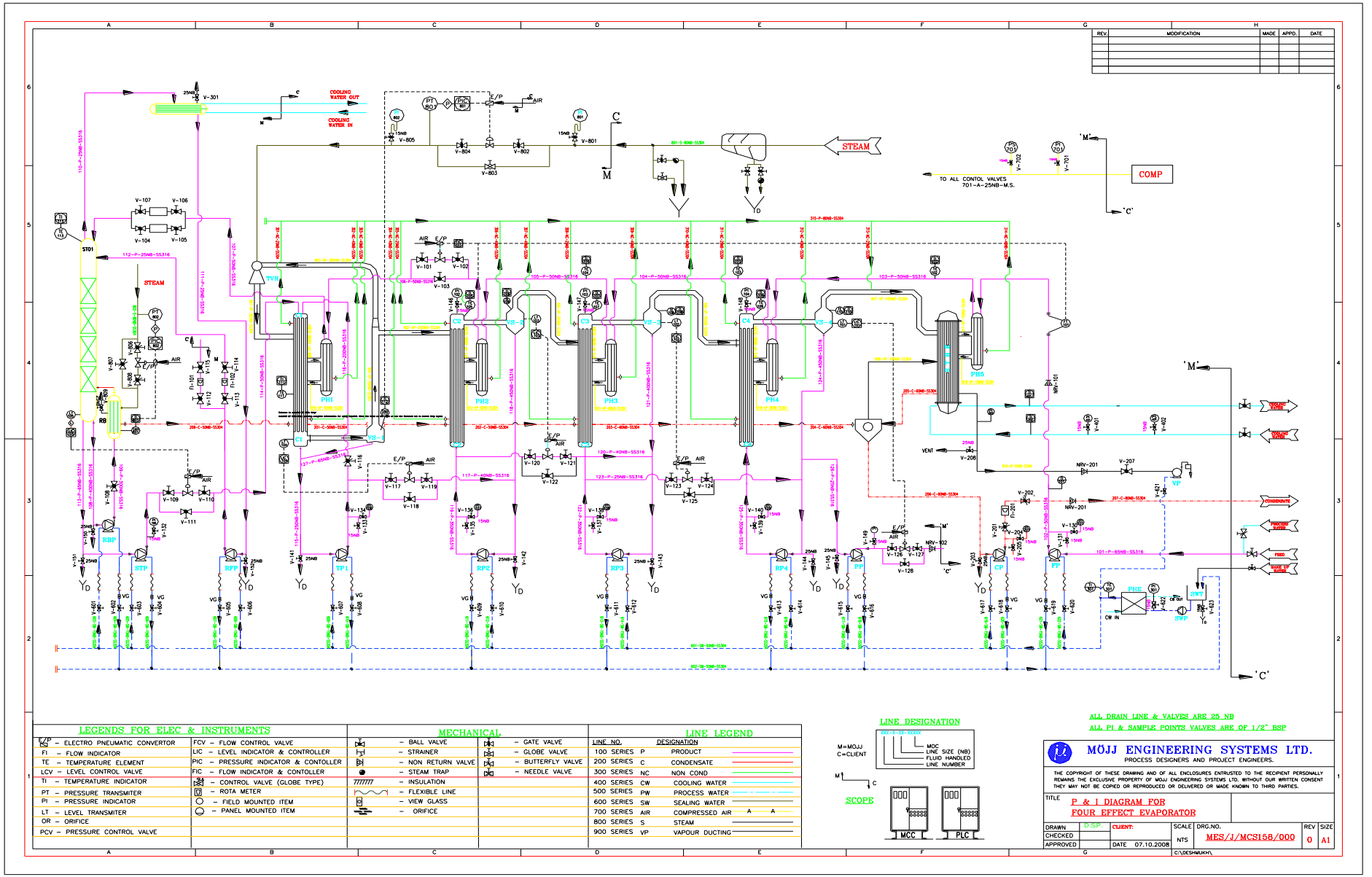
S.No	Description	Unit	Capacity
RO Plant - I			
1	Design Capacity	KLD	1200
2	Operating Capacity	KLD	989
3	Feed pH		6.5 (max)
4	Permeate	KLD	593
5	Plant Efficiency	%	60
6	Rejects	KLD	395
RO Plant – II			
1	Design Capacity	KLD	500
2	Operating Capacity	KLD	395
3	Feed pH		6.5 (max)
4	Permeate	KLD	237.3
5	Plant Efficiency	%	60
6	Rejects	KLD	158.2

List of Facilities at ZLD System

- ❑Collection Tanks
- ❑Neutralization Tanks
- ❑Setting Tanks
- ❑Stripper
- ❑ Step Down Turbine
- ❑ Multiple Effect Evaporator (MEE)
- ❑ Agitated Thin Film Dryer (ATFD)
- ❑ Biological Treatment Plant
- ❑ RO System

CETP - JETL, Jeedimetla - Inlet Effluent Characteristics
Low TDS Effluent: TDS<5000 & COD<15000

Stripper and Multiple Effect Evaporator P&ID



Stage Wise Load reduction