Chapter-5
Environmental Management Plan

5.1 OBJECTIVE

The purpose of the environmental management plan (EMP) is to minimize the potential environmental impacts from the project and to mitigate the consequences. EMP reflects the commitment of the project management to protect the environment as well as the neighboring populations. The potential environmental impact envisaged from the project is studied on the following environmental components:

- Air pollution from the boiler stacks
- Fugitive emissions during the construction phase
- Raw material handling and consumption
- Fugitive emissions from the process & effluent treatment
- Water pollution due to the wastewater generation
- Soil pollution due to solid waste disposal

5.2 ENVIRONMENTAL MANAGEMENT PLAN

Preparation of environmental management plan is required for the formulation and monitoring of environmental protection measures during and after construction of the proposed expansion. The plan should indicate the details as to how various measures proposed to be taken for mitigation of adverse impacts if any from the proposed expansion project.

The following sections describe the environmental management plan for the proposed expansion during the construction as well as the operation phases.

5.2.1 Construction Phase

Construction activity envisaged as part of expansion is addition of one production block for manufacturing bulk drugs and pharmaceuticals. Excepting for this construction activity no major site levelling activities are envisaged. However during construction activities if any dust is generated, it will be controlled by using water spraying on roads and other dust generating sources.

No additional sanitation facilities are required as all such facilities are already available. Use of existing toilet and restroom facilities even by the construction workers is recommended and suggested for implementation.

The effect of noise on the nearby habitation during construction activities will be negligible as the nearest habitat is more than 0.5 km from the plant. However construction labor would be provided with noise protection devices like ear muffs, and occupational safety ware. Moreover it is recommended that all noise generating equipments are to be stopped during night time. The waste oil generated by the construction equipment would be disposed by it to authorized recyclers and any unauthorized dumping of waste oil is prohibited.

The effects due to the construction of the marine outfall will be negligible as all precautions will be taken while laying the pipeline. The removed topsoil all along the route of the pipeline will be replaced back thus preventing soil erosion. The dredgers used for digging will be regularly oiled and maintained to prevent noise pollution and the dust generated while laying the pipeline will be settled by sprinkling water.

5.2.2 Operation Phase

The unit has always aimed at sustainable development and in this context only it has implemented several measures to curtail pollution to maximum extent. This is achieved by deploying technologies like scrubbers, multi cyclones, forced evaporation systems, incinerators and a full fledged effluent treatment plant. Matrix Laboratories Ltd has a dedicated green belt area and is also proposing to have acoustic enclosures for lowering the noise levels coming out from the DG set and other noise generating equipment. The pipeline carrying the effluents from the plant to the sea will be regularly monitored for leakages all along the route by manually employing persons or by placing sensors in the pipeline and the leakage if any will be immediately plugged to prevent any sort of environmental damage.

5.3 Air Pollution Control

The sources of air emission identified from the expansion of the plant are Process Emissions, Boiler Emissions and Fugitive Emissions.

5.3.1 Fugitive Emissions

Fugitive emissions from the plant operations are mainly resulted from solvent handling operations at storage and process units. Solvent losses can be controlled by installing chilled vent condensers and water circulators so that the losses are minimized. The principle fugitive emissions from the plant are in the form of

Methylene chloride, Toluene, Methanol, Chloroform, Ethoxy ethanol, Xylene, IPA, Acetonitrile, Ethyl acetate, THF which are controlled by installing chilled vent condensers. The solvent losses are kept to the minimum by having good preventive and operational controls, frequent checks of all moving equipment, replacement of glands and seals of pumps at regular intervals to minimize losses. In addition to controlling the solvent losses Matrix Laboratories Ltd is also proposing to recover (around 97-98%) of most of the solvents by adopting good engineering practices. These recovered solvents will be reutilized in the process thus bringing down not only the total requirement of the solvents during the manufacturing process but it also reduces the total cost incurred on purchasing the solvents by a huge margin. A typical fugitive emission control device adopted by MLL is given in the **Figure 5.1**, while in the following table the control measures proposed are furnished.

Table 5.1
Control Measures Proposed for Controlling Fugitive Emissions

S. No	Description	Control Measure
1	To Control losses during transferring from section to section	Dedicated pipelines, solvent storage tanks provided with proper flame arrestors.
2	To Control losses during manufacturing process	All vents are provided after the chillers

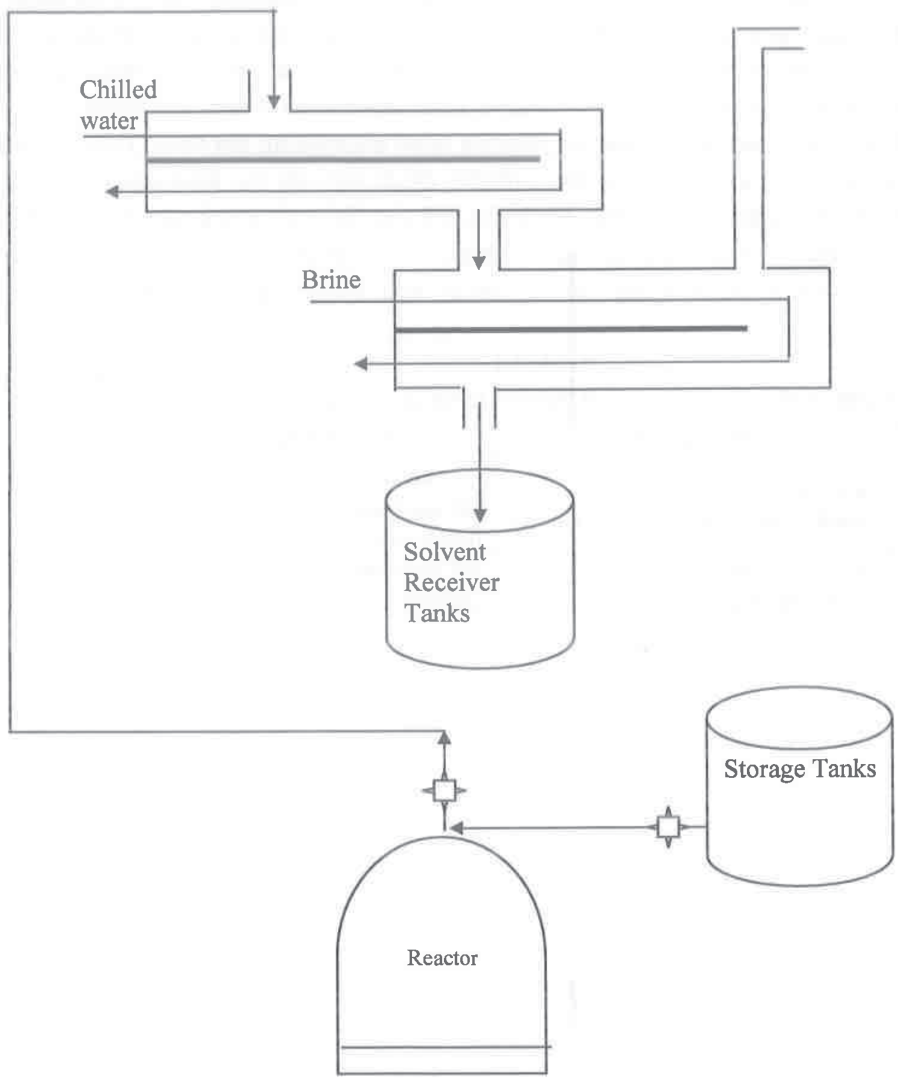


Figure 5.1
Typical Fugitive Emission Control Measure

5.3.2 Process Emissions & Control

The process emissions coming out from the products manufactured as part of expansion are Carbon dioxide, Hydrogen, HCl and Nitrogen and oxides of nitrogen, Dimethylamine, Sulfur dioxide and Ammonia. The Hydrogen Chloride and Sulfur dioxide gases are proposed to be scrubbed using

Caustic solution while Dimethyl amine gas will be scrubbed using water and the scrubbed effluent will be sent to the ETP for further treatment. Whereas other gases like Hydrogen, Nitrogen and Carbon dioxide are left into atmosphere as they are minimal in quantity. The schematic diagram of a typical scrubber employed at MLL is given in **Figure 5.2** and scrubber design at Matrix Laboratories Ltd is given as **Figure 5.3**. The process emissions along with quantification of emission rate from the existing products and the proposed products have been described in detail in Chapter-4.

5.3.3 Odour Control

Though Matrix Laboratories Ltd is not manufacturing or proposes to manufacture any product that would generate odorous gases, it however proposes to control whatever little odour that might be generated during the process by adopting physical adsorption techniques or by using chemical adsorbents and bio-scrubbers.

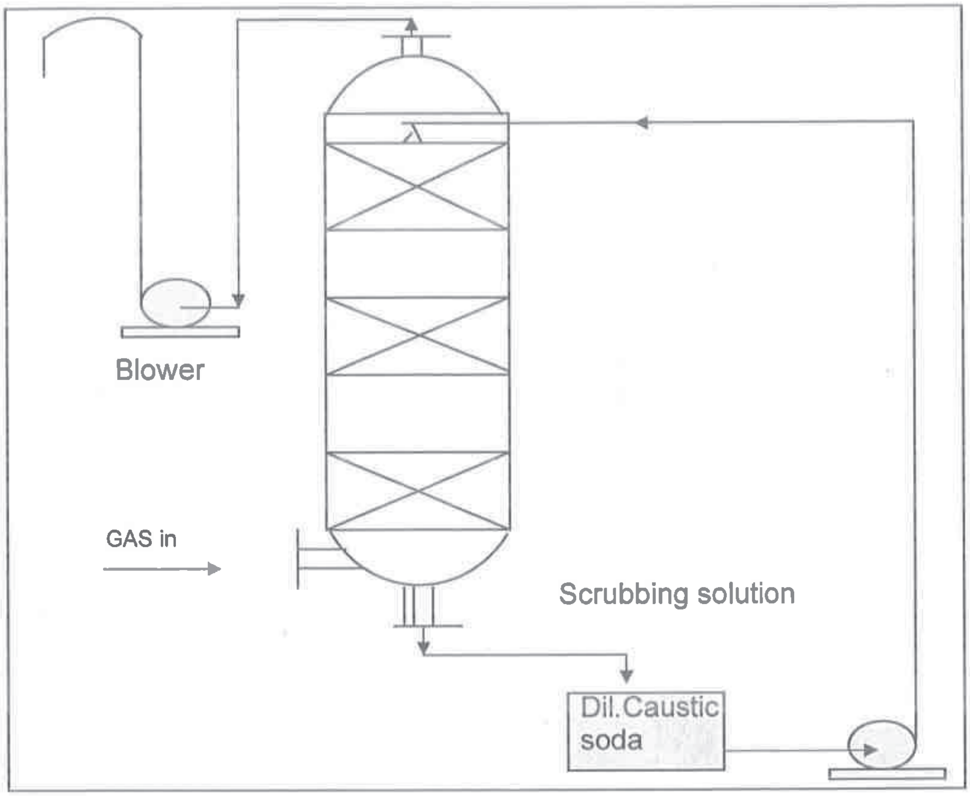
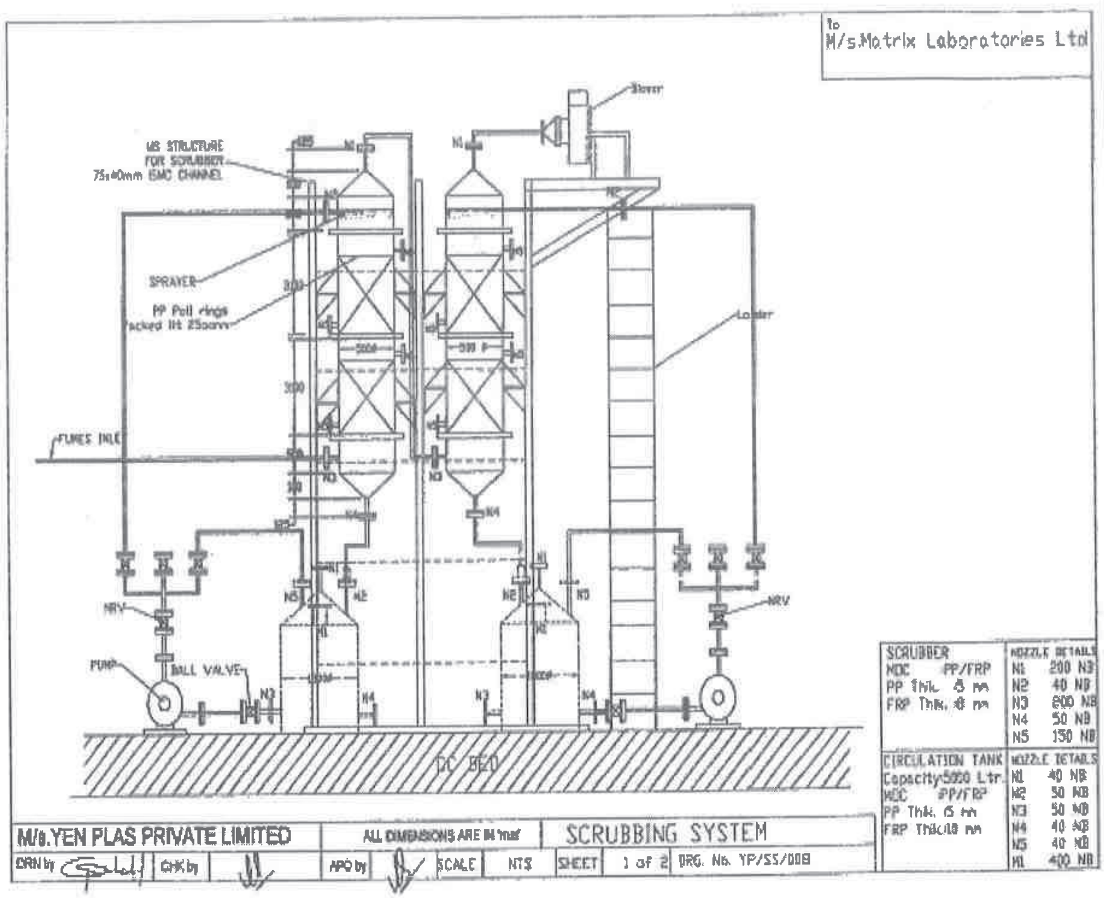


Figure-5.2
Scrubbers for Process Emissions

Figure 5.3

Scrubber at Matrix Laboratories Ltd



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5.3.4 Boiler Emissions – Control Measures

The plant has two coal fired boilers of 2 TPH and 5 TPH capacities and during proposed expansion Matrix Laboratories Ltd is proposing to add two boilers of capacities 4 and 15 TPH to meet the additional steam requirements. The control measure in place for the existing boilers is cyclone to control SPM and adequate stack height as required by CPCB guidelines for proper dispersion of Sulphur-dioxide and Oxides of Nitrogen. For the 15 TPH boiler, a bag filter and for the 5 TPH a cyclone is proposed to control the emissions and the same is shown as **Figure 5.4**. The estimated emissions are:

Table 5.2

Emissions from the Utilities

Source	**Stack Height Required as per MOEF #**	**SPM**	**SO_2**	**NO_x**	**Stack Heights**	**Compliance**
Existing	meters	mg/Nm^3			Meters	
Emission Standards as per APPCB		115	-	-		
2 TPH Coal Fired Boiler	18.4	107	19.1	77.1	30	Complies
5 TPH Coal Fired Boiler	21.4	126.3	27.8	85.2	30	Complies
500 KVA DG set	7.9	125.3	32.0	98.1	8	Complies
Proposed for Expansion						
4 TPH Boiler	22.7	48	149	119	30	Will Comply
15 TPH Boiler	33.7	105	328	262	35	Will Comply
Emission Standards as per MoEF for incinerator		30	200	200		Will Comply
Incinerator – 6500 kg/d	28.03	30	200	200	40	Will Comply
Note:	For SO_2 emissions from boiler required stack height is $14(Q)^{0.3}$ Where Q= SO_2 in Kg/hr For DG set stack height required is = H=h+0.2* Sqrt (KVA) Where h= Height of the building where DG set is installed in m, KVA= Total generation capacity					

Calculations for stack height				
Boiler	*2 TPH*	*5 TPH*	*4 TPH*	*15 TPH*
Coal consumption	*6TPD*	*10TPD*	*12 TPD*	*45 TPD*
Sulphur %	*0.5%*	*0.5%*	*0.5%*	*0.5%*
Sulphur dioxide content	*6000*0.005*2/24 = 2.5 kg/hour*	*10000*0.005*2/24 = 4.16 kg/hour*	*12000*0.05*2/24 =5 Kg/hr*	*45000*0.05*2/24* =18.75 Kg/hr
Stack Height H meters	*14 (SO_2 kg/hr)$^{0.3}$*	*14 (SO_2 kg/hr)$^{0.3}$*	*14 (SO_2 kg/hr)^{0}*	*14 (SO_2 kg/hr)$^{0.3}$*
Stack height as per MoEF	*= 14(2.5)$^{0.3}$ = 18.4*	*14(4.16)$^{0.3}$ = 21.4*	*=14*(5)$^{0.3}$=22.7m*	*=14(18.75)$^{0.3}$=33.7*
Existing stack height/ proposed stack height	*30 m*	*30 m*	*30 m*	*35 m*

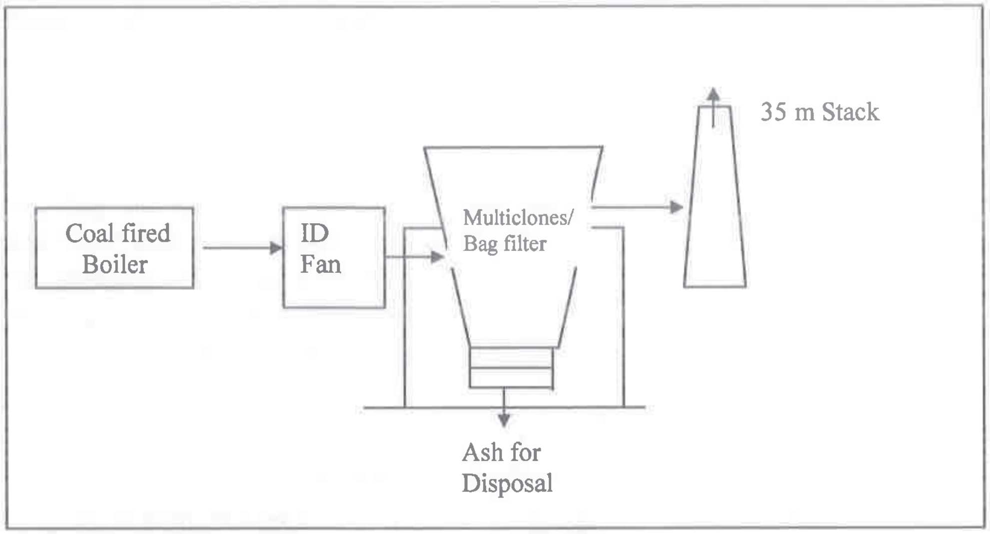


Figure 5.4
Air Pollution Control Systems for the Proposed Boiler

5.4 Water Pollution Control & Management

The wastewater generated from the plant are from process, reactor and floor washes and wastewater from utilities viz., Boiler blow down, Cooling tower blow downs, Forced evaporator condensate, DM plant ,Softener, Domestic wastewater etc.

5.4.1 Wastewater Treatment scheme

The wastewater treatment scheme at Matrix Laboratories Ltd is devised based on segregation approach i.e. High TDS and Low TDS.

- All high TDS effluent are first neutralized and then sent to onsite forced evaporation system.
- All low TDS effluent streams are treated in a well designed effluent treatment plant and then disposed off into sea through marine outfall after ensuring that the treated wastewater meets the marine disposal standards.

During manufacturing of the existing products the wastewater generated is 56.05 m^3/day out which 35.55 m^3/day is from process and utilities and the remaining is domestic wastewater. The high TDS streams is sent to forced evaporator and rest of the Low TDS process wastewater along with the forced evaporator condensate is sent to effluent treatment plant for treatment and the treated effluent is disposed off into the sea via a marine outfall after complying with the stipulated regulatory guidelines.

The same segregation approach is going to be followed to treat effluents resulted from the proposed expansion project.

5.4.2 Wastewater Characteristics of Process Streams after Expansion

The wastewater streams from all the individual stages have been studied for the pollution concentration levels with respect to TDS inorganic and organic. These concentrations have been estimated from the material balance of the products. The cut off mark taken for segregating the effluent streams into high TDS and low TDS is 30000 mg/l. The stages contributing for high TDS effluent have been segregated for the proposed expansion products and are presented below.

Table 5.3

Product Wise High TDS effluents- After Expansion

		Pollution Load in kg/day				Concentration in mg/l		
Product	**Stage**	**Process wastewater**	**In organics**	**Organics**	**COD**	**Fixed solids**	**Organics**	**Total COD**
Tiaprofenic acid	I	1142.9	52.1	0	0	45562.5	0	0
	II	879.1	66.3	0	0	75455.2	0	0
Naproxen Sodium	I	64208.9	3522.7	0	0	54862.7	0	0
	III	15560.4	773.8	67.7	150.3	49730.7	4351.6	9660.5
Trazodone Hydrochloride	I	1589.7	130.2	206.9	455.6	81930.1	130174.4	286585.1
	II	937.5	61.9	0	0	66046.7	0	0
Abacavir Sulfate	II	42.5	22.6	0	0	530857.7	0	0
Citalopram Hydrobromide	II	4000	288.1	24.0	75.1	72036.0	6000.0	18780.0
	III	2736.8	784.0	15.5	24.6	286465.9	5676.7	8969.2
Gabapentene	I	5541.7	3763.8	189.4	397.8	679190.0	34180.0	71778.0
	II	14649	4358.9	409.7	921.8	297553.9	27967.6	62927.0
Ciprofloxacin Hydrochloride	II	7591.0	376.5	1094.6	1117.4	49603.7	144191.3	147191.7
	III	19420.2	962.7	95.1	142.7	49570.2	4897.2	7345.8
Total		**138299.5**	**15163.7**	**2103.0**	**3285.2**	**109643.8**	**15205.9**	**23753.9**

Table 5.4

Product Wise Low TDS effluents - After Expansion

		Pollution Load in kg/day				Concentration in mg/l		
Product	**Stage**	**Process wastewater**	**In organics**	**Organics**	**COD**	**Fixed Solids**	**Organics**	**Total COD**
Naproxen sodium	II	74368.6	1474.7	587.6	464.9	19830.09	7901.7	6251.3
Naproxen ntermedaite	I	41500	1012.1	684.8	1190.8	24389.0	16500.0	28693.5
Trazadone Hydrochloride	III	1629.4	16.1	0	0	9880.9	0	0
Allopurinol	II	15359.6	77.7	57.8	152.7	5061.3	3765.8	9941.6
	III	9877.3	126.2	0	0	12774.3	0	0
Nabumetone	I	1800.0	0	21.5	29.3	0	11892.9	16237.1
	II	2.37	0	0	0	0	0	0
Efavirenz	I	31308.3	115.08	379.8	416.7	3675.7	12132.4	13309.2
	II	21875.0	115.63	89.7	18.83	5285.7	4100.0	861.0
Abacavir Sulfate	I	3120.5	0	0	0	0	0	0
	III	45.6	1.21	0	0	26585.4	0	0
Nelfinavir mesylate	I	760.0	13.71	43.9	114.4	18042.1	57642.1	150445.9
	II	4800.0	0	3.8	109.4	0	790	22790
Indinavir Sulfate	I	3037.7	84.1	137.9	351.3	27667.2	45412.8	115644.3
	II	47.7	0	4.9	12.9	0	104000	269360.0
CME Intermediate	III	8993.2	15.5	458.4	1049.7	1725.6	50963.7	116718.8
Citalopram Hydrobromide	IV	3264.0	95.5	243.7	444.9	29250.0	74676.5	136291.01
	V	1041.6	9.6	25.6	60.9	9216.6	24577.6	58463.9
Ciprofloxacin Hydrochloride	I	41500	1160.5	287.7	224.4	27963.3	6931.7	5406.7
	IV	9890.8	296.0	620.5	1803.3	29923.01	62727.3	182314.0
	V	17115.3	249.0	24.3	55.0	14548.4	1414.5	3210.8
	VI	2203.0	28.0	41.5	67.6	12558.9	18838.3	30675.0
Zidovudine	I	9469.7	0	1392.3	4122.3	0	147020.0	435315.6
	II	27462.0	786.01	1081.6	1924.04	28624.2	39386.3	70061.8
	III	77054.05	2268.2	182.5	450.8	29436.2	2368.2	5849.5
	IV	16515.8	219.9	1192.0	2802.8	13313.7	72170.3	169701.2
Total		**435989.2**	**8423.2**	**8603.8**	**17895.4**	**19319.8**	**19734**	**41045.5**

5.4.3 Combined Effluent Characteristics of Effluents going to ETP after Expansion

The combined effluent characteristics of the effluent going to the ETP are presented in the Table below.

Table 5.5
Combined Wastewater Characteristics of Raw Effluent to ETP

S.No	Source	Flow	Fixed solids	Organics	Total COD	Final Disposal
		(m^3/d)	mg/l	mg/l	mg/l	
1	Low TDS process effluent	436	19319.8	19734	41045.5	To onsite ETP
2	Reactor washings	10	2000	1500	3000	
3	Boiler blow down	15.5	5000	25	50	To reverse osmosis plant and the reject to marine outfall
4	Cooling tower bleed off	15.5	1000	25	50	
5	DM Plant	30	10000	75	100	
6	Softener	30	5000	100	150	
7	Domestic	25	750	700	400	To onsite ETP
	Subtotal	**562**	**16023.5**	**15378.3**	**31930.4**	
8	FE Condensate	138	0	3041.2	4750.8	To onsite ETP
	Total	**700**	**12864.5**	**13159.4**	**26572.1**	

5.4.4 Details of Effluent Treatment Plant

i) Existing ETP scheme

Wastewater from the process reactions, the reactor and floor washings and the boiler blow down is collected in a collection sump of capacity (247.5 m^3) and is pumped into a screening chamber (2.43 m^3) while passing it through a primary oil and grease chamber or trap (8.7 m^3) to remove oil and grease from the effluents. Then the effluent is subjected to equalization in an equalization tank to achieve homogeneity of the effluents. After equalization, the effluent is neutralized to bring down the pH to neutral conditions or at least to ensure a uniform pH for the entire effluent by adding buffers. After neutralization, the effluent is subjected to sedimentation in a primary sedimentation tank (72 m^3) to remove any settleable solids. After removing the solids, the effluent is subjected to anaerobic treatment in an anaerobic tank of capacity 900 m^3 and is passed through an intermediate clarifier (85 m^3) to further remove solids. Then the effluent is subjected to recalculation by diffusing system in a bio tower (46 m^3) and then followed by an activated sludge unit (378 m^3) to remove BOD and into a final clarifier of 49 m^3 to remove any settleable solids. This effluent is collected in a collection sump of capacity to store 22.1 m^3 and is subjected to filtration through pressurized sand filters (5 m^3/hr) and carbon filter of 7 m^3/hr. The final treated effluent is collected in a sump of capacity 22.5 m^3 and is pumped to the pumping station (500 m^3) near the sea and finally into the sea through the marine outfall.

The marine outfall has been designed to carry effluents up to 30 m^3/hour and is more than enough to cater to the proposed expansion loads also. The existing ETP units and their capacities is given in **Table 5.6** while effluent characteristics is shown in **Table 5.7**.

Table 5.6
ETP Units-Capacities-Existing

S. No	Unit	Capacity
1	Primary oil and grease chamber	8.7 m^3
2	Screen chamber	2.43 m^3
3	Secondary oil and grease chamber	49.6 m^3
4	Collection cum neutralization tank	247.5 m^3
5	Neutralization tank	352.8 m^3
6	Primary Sedimentation tank	72 m^3
7	Anaearobic tank	900 m^3
8	Intermediate clarifier	85 m^3
9	Biotower I & II	46 m^3
10	Activated sludge unit-II	378 m^3
11	Final clarifier	49 m^3
12	Treated water collection sump	22.1 m^3
13	Duel filter	5 m^3/hr
14	Carbon filter	7 m^3/hr
15	Final collection sump	22.5 m^3
16	Pumping station near sea	500 m^3

Table 5.7
Effluent Characteristics-Existing

		Existing		
Parameter	**Unit**	**ETP Inlet**	**ETP Outlet**	Marine discharge Standards as per GSR 422E
pH	-	6.5-8.0	7.0-7.5	**5.5-9.0**
TSS	mg/l	1800	<100	**100**
TDS-Inorganic	mg/l	12863	<12000	-
BOD	mg/l	21000	<100	100

Besides having a full fledged ETP as discussed above and as shown in the schematics there are other infrastructure facilities like solar evaporation ponds, sludge drying beds and forced evaporation system. The detailed schematic diagram of the existing ETP facilities is shown in **Figure 5.5** and **Figure 5.6** respectively.

Figure 5.5 Schematics of Existing ETP

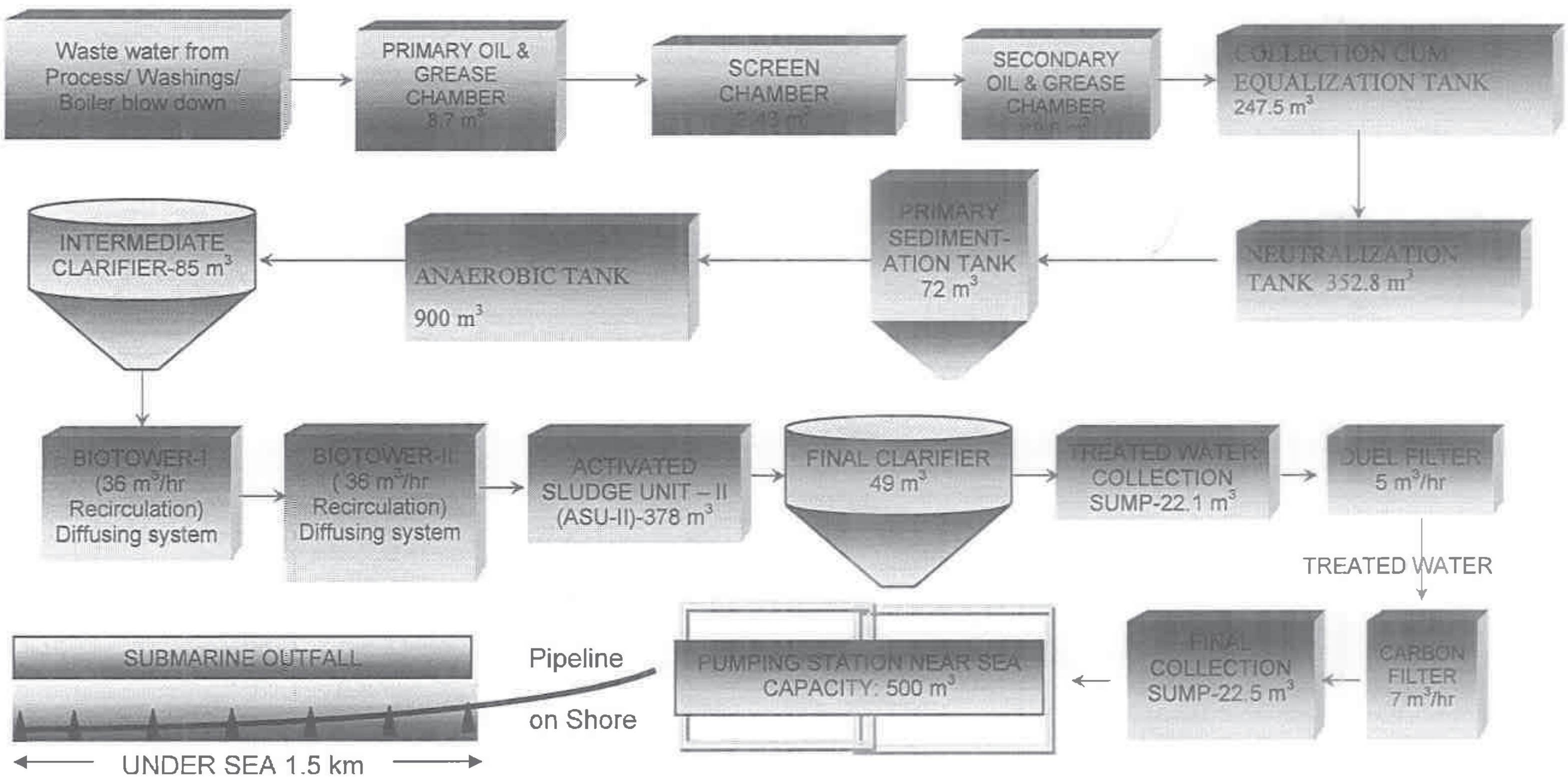
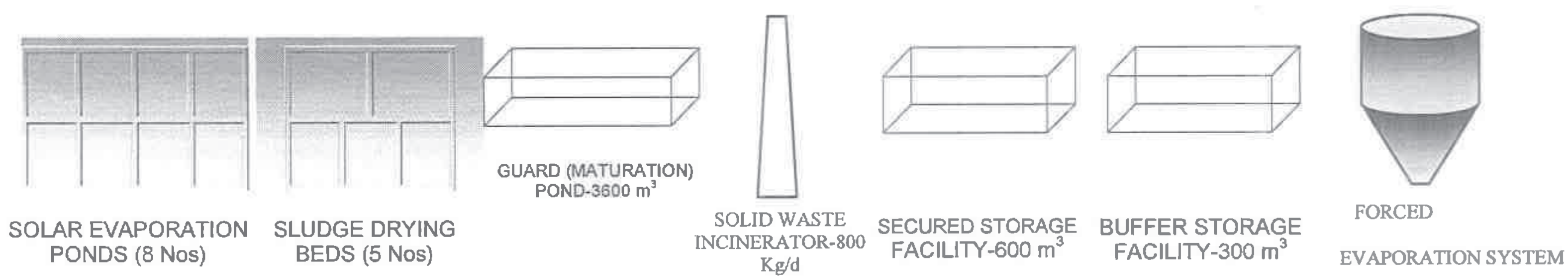


Figure 5.6
Additional Facilities at the ETP- Existing



5.4.5 Details of Proposed ETP for Expansion

The existing ETP capacity is 100 m^3/day. The wastewater quantity after expansion is 700 m^3/day. Therefore it is required to upgrade the existing ETP to meet the requirements of the expansion project. The effluent treatment scheme for the expansion plant will be based on the existing treatment schemes for both High TDS and Low TDS effluents. The High TDS effluent of about 138 m^3/d will be subjected to forced evaporation, the low TDS process effluent along with washings, domestic wastewater, and forced evaporator condensate of about 609 m^3/d will be sent to the onsite ETP. The non process wastewater like boiler blow down, cooling tower bleed off, DM Plant regeneration and Softener water of 91 m^3/d will sent to the reverse osmosis plant and the water from this plant will be recycled and reused for the plant operations while the RO reject will be disposed off into the sea via marine outfall. The new effluent treatment plant will be constructed to meet the requirements of the increased flow after expansion. The design of the new effluent treatment plant will be on the similar lines as that of the existing one but with an increased capacity.

In the present proposal, in order to meet the treatment requirements of the increased effluent quantity, Matrix Laboratories Ltd is proposing to add two treatment units of 300 m^3 /day capacity in the same lines as the existing ETP schematics.

In addition to this M/s Matrix Laboratories Ltd is also proposing to install reverse osmosis plant to recover and reutilize the wastewater generated from the utilities like boiler blow down, cooling tower condensate, DM Plant and Softener for the plant operations. The details of the proposed Forced evaporator, Reverse osmosis system and Multiple effect evaporator are given in subsequent sections of this chapter.

The detailed sketch of the proposed ETP is given as **Figure 5.7** and the description of the Design of the proposed ETP is given below.

Proposed Scheme Of Treatment:

The treatment comprises of primary stage (physico- chemical treatment) followed by secondary stage (bio-chemical treatment) and tertiary stage (chemical oxidation and filtration, adsorption and absorption) to achieve the stipulated standards. The characteristics of the raw wastewater going to the ETP are presented in **Table 5.8**.

Table 5.8
Characteristics of Raw Wastewater

S. No	Parameter	Concentration*
1	pH	6 – 9
2	Suspended solids	2000 - 3000
3	COD	25000 - 30000
4	BOD	8000 – 10000

The scheme of treatment is described below and the proposed scheme of treatment for the process effluents is depicted in **Figure 5.7** and that of the non process effluents is depicted in **Figure 5.8**.

Primary Treatment: The process wastewater is led directly to the screen chamber. In the drains, screens shall be provided for retaining coarse matter. The screens are manual type and are to be cleaned at regular intervals. Two stages of screens are provided i.e. coarse screen followed by fine screens. The wastewater is then taken to grit, oil and grease chamber for removal of grit, oil and grease. Two such units are provided and are to be used in a cyclic manner. Cleaning of grit, oil and grease chamber is to be done manually. The wastewater is then led to an equalization tank for attenuation of variation in waste flow rate and characteristics. For mixing, and to avoid solids from settling in the equalization tank, air shall be bubbled in the equalization tank through a grid placed at the base of the tank. Wastewater from the equalization tank is pumped to the flash mixing tank where chemicals (alum, lime, and polyelectrolyte) are homogenously mixed with the wastewater. The wastewater then flows into the flocculation chamber where a slow paddling allows for suspended particles to agglomerate. The flocculated wastewater is then taken to a settling tank (provided as a tube deck settling tank) where the sludge settles to the bottom. The sludge collected in the bottom of the settling tank is periodically withdrawn and applied on sludge drying beds for dewatering and drying. Clarified water i.e. supernatant from the settling tank is provided further treatment. Up to this stage the ETP is provided in a single module catering for 600 cum/day. From this stage, the ETP shall be provided in 2 modules with each module catering to 300 cum/day.

Secondary Treatment: The primary treated wastewater is subjected to bio-chemical oxidation in 2 stages. The first stage is an aerated lagoon with sludge recycling. The proposed size of each of the aerated lagoon is 22 m X 88 m X 5 m SWD. Aeration shall be done by diffused air aeration with the help of fine bubble diffusers connected to air blowers. Excess sludge from the aerated lagoons shall be taken for sludge dewatering and drying.

The second stage of treatment shall be done in FAB (fluidized aerobic bed reactors) which is an attached growth system working on extended aeration principle. Aeration is done by diffused air aeration with the help of medium bubble diffusers connected to air blowers. For immobilizing the bacteria/micro-organisms, high surface area to volume media (UV treated PVC) shall be put in the aeration tanks. For each module there shall be 2 aeration tanks with each of size 5.5 m X 5.5 m X 4.2 m SWD. Following the FAB aeration tanks, the wastewater is led to a tube deck settling tank for solid – liquid separation. The sludge collected in the settling tank is taken for dewatering and drying. The overflow from the settling tank is subjected to tertiary treatment.

Tertiary treatment: Overflow from the secondary clarifier is taken to chemical oxidation tank for chemically oxidizing the residual pollutants. Oxidising chemical shall be added for chemical oxidation. The chemical oxidation unit shall have a detention time of 30 minutes to ensure proper contact and reaction. The wastewater from chemical oxidation is then collected in a sump and pumped to a pressure sand filter for removal of particulate matter. The wastewater is then taken through an activated carbon column for removal of trace organics and pollutants (chlorine, color, trace organics etc.,) and finally through an organic scrubbing bed. The backwash of the pressure sand filters and activated carbon column are taken to sludge drying beds for dewatering and drying. Underflow from the sludge drying beds is taken back to equalization tank. The overflow is discharged as marine outfall.

The sizes and specifications of the various units for the proposed ETP are presented in tables below.

Sizes and Specifications of Various Units for the Proposed Plant

Civil Works

Specification Table

Unit	Screen Chamber
Duty	For removal of coarse matter
No. of units	Two (to be used in alternately)
Size	2.0 m X 1.0 m X 0.8 m SWD
MOC	RCC M-20

Unit	Oil And Grease Trap
Duty	To enable removal of oil and grease.
No. of units	Two (to be used alternately)
Size	1.66 m X 5 m X 1.5 m SWD
MOC	RCC M-20

Unit	Equalization Tank
Duty	To attenuate variation in flow and characteristics.
Number of Units	Two (to be used alternately)

Unit	Equalization Tank
Size	10 m X 10 m X 3.0 m SWD
Volume	about 300 cum
MOC	RCC M-20

Unit	Primary Settling Tank
Duty	To enable solid-liquid separation
Number of Units	One
Type	Tube deck
Size	3.6 m X 3.6 m X 2.5 m SWD
M.O.C.	RCC M-20

Upto this stage the units are designed for a flow of 600 cum/day. From this stage the ETP is in 2 modules with each module catering for 300 cum/day.

Unit	Extended Aeration Tank
Duty	To enable bio chemical oxidation of the wastewater
Number of Units	Two
Size	88 m X 22 m X 5 m SWD
MOC	RCC M-20

Unit	Aeration Tank
Duty	To enable bio chemical oxidation of the wastewater
Number of Units	Four
Size	13.4 m X 13.4 m X 4.2 m SWD + 0.5 m FB
MOC	RCC M-20

Unit	Secondary Settling Tank
Duty	To enable solid-liquid separation
Number of Units	One
Type	Tube deck

Unit	Secondary Settling Tank
Size	2.7 m X 2.7 m X 2.5 m SWD;
M.O.C.	RCC M-20

Unit	Chemical Oxidation Tank
Duty	To chemically oxidize the treated wastewater.
Number of Units	One
Size	6 m X 2.0 m X 1.0 m SWD+ 0.3m FB
M.O.C.	RCC M-20

Unit	Sump
Duty	To hold treated wastewater for tertiary treatment
Number of Units	One
Size	8.7 m X 8.7 m X 2.0 m SWD
Volume	about 150 cum
MOC	RCC M-20

Unit	Sludge Drying Beds
Duty	For dewatering and drying of sludge.
Number of Units	Sixteen (to be used in a cyclic manner)
Size	15.0 m X 15.0 m X 0.6 m SWD + 0.4 m FB
MOC	Base in PCC and walls in brick work.
Provisions	Splash pad, underdrains, filling of media

Alternately a sludge dewatering system such as a filter press can be adopted which would reduce the area of sludge drying beds.

Mechanical works:

Specification Tables

Unit	Screens
Duty	To retain coarse matter in wastewater
No. of units	Two (coarse followed by fine screen in each chamber)
Size	To suit drain size; with 15 mm and 6 mm

Unit	Screens
	opening.
Type	Bar screen made of MS flats 25 X 5 mm
MOC	MSEP.

Unit	Aeration Grid For Equalization Tank
Duty	To bubble air for mixing and to avoid solids from settling
No. of units	One
Size	To suit size of equalization tank.
Type	Piping network with header and laterals.
MOC	HDPE / PVC.

Unit	Pumps
Duty	To pump wastewater for onward treatment.
No. of units	Two (one as 100% stand-by)
Capacity	25 cum/hr.
Head	10 m.
Type	Non clog, self priming centrifugal pumps.

Unit	Flash Mixing Tank
Duty	To enable mixing of chemicals and wastewater.
Number of Units	One
Size	0.5 m X 0.5 m X 2.0 m SWD
MOC	MSEP
Provision	Provision is to be made for housing of flash mixer

Unit	Flash Mixer
Duty	To homogenously mix chemicals and wastewater in the flash mixing tank
Number of Units	One
Capacity	To suit flash mixing tank
MOC	Shaft and propeller in SS.

Unit	Chemical Tanks
Duty	To enable preparation, holding and feeding of chemical solutions for treatment.

Unit	Chemical Tanks
Number of Units	Three (alum, lime and polyelectrolyte)
Capacity	1000 lts – 2No ; 50 lts – 1 No.
MOC	HDPE

Unit	Agitator
Duty	To enable preparation of chemical solutions
No. of units	Three
Rating	1.0 HP
Type	Slow speed paddle type
MOC	Shaft & paddle in SS 316
Drive	Electric motor coupled to speed reduction gear box.

Unit	Alum And Lime Dosing Pump
Duty	To dose alum in a regulated manner
Number of Units	Four (2 working +2 standby)
Capacity	0-6 lph each
Type	Electronic variable dosing
Make	e- dose, Etatron

Unit	Polyelectrolyte Dosing Pump
Duty	To dose polyelectrolyte in a regulated manner
Number of Units	Two (1 working +1 standby)
Capacity	0-6 lph each
Type	Electronic variable dosing
Make	e- dose, Etatron

Unit	Flocculator Tank
Duty	To enable flocculation of coagulated wastewater
Number of Units	One
Size	1.8 m X 1.8 m X 2.0 m SWD
MOC	MSEP
Provision	Provision is to be made for housing of flocculator

Unit	Flocculator
Duty	To enable flocculation if coagulated wastewater.
Number of Units	One
Capacity	To suit flocculation tank.
MOC	Shaft in SS and paddles in wood
Drive	Electric motor coupled to speed reduction gear box.

Unit	Tube Deck Media (Primary)
Duty	To enable solid – liquid separation
No. of units	One
Quantity	One lot, as required
MOC	Chevron type UV treated PVC

Unit	Diffusers For Extended Aeration Tank
Duty	To supplement air in aeration tank for bio-chemical oxidation.
No. of units	Four lots (one for each aeration tank)
MOC	PVC/HDPE grid and coarse bubble diffusers.

Unit	Aeration Grid For Extended Aeration Tank
Duty	To supply air from blower to diffusers.
Number of Units	Two (one for each aeration tank)
Size	To suit size of aeration tank.
MOC	PVC/HDPE

Unit	Blowers For Extended Aeration Tank
Duty	To supplement air to the air grid.
No. of units	Eight (one as 100% stand-by)
Rating	25.0 HP each.
Type	Twin lobe rotary type.

Unit	Diffusers
Duty	To supplement air in aeration tank for bio-chemical oxidation.
No. of units	Four lots (one for each aeration tank)
MOC	PVC/HDPE grid and coarse bubble diffusers.

Unit	Aeration Grid For Aeration Tanks
Duty	To supply air from blower to diffusers.
Number of Units	Two (one for each aeration tank)
Size	To suit size of aeration tank.
MOC	PVC/HDPE

Unit	Blowers
Duty	To supplement air to the air grid.
No. of units	Four (one as 100% stand-by)
Rating	30.0 HP each.
Type	Twin lobe rotary type.

Unit	Fab Media
Duty	High surface area to volume ratio of media shall be provided in the aeration tank for immobilizing the microbes.
Quantity	One lot, as required
MOC	UV treated PP.

Unit	Tube Deck Media (Secondary)
Duty	To enable solid – liquid separation
No. of units	One
Quantity	One lot, as required
MOC	Chevron type UV treated PVC

Unit	Hypochlorite Tank
Duty	To hold hypochlorite solution
No. of units	One
Volume	500 liters
MOC	HDPE

Unit	Chlorine Dosing Pump
Duty	To dose chlorine solution in a regulated manner
Number of Units	Two (1 working +1 standby)
Capacity	0-6 lph each @ 5 m head
Type	Electronic variable dosing

Unit	Chlorine Dosing Pump
Make	e- dose, Etatron

Unit	Filter Feed Pumps
Duty	To pump wastewater for onward treatment.
No. of units	Two (one as 100% stand-by)
Capacity	30.0 cum/hr.
Head	30 m.
Type	Non clog, self priming centrifugal pumps.

Unit	Pressure Sand Filter
Duty	To enable removal of fine suspended particles.
No. of units	One.
Size	1.8 m dia., 1.8 m HOS
MOC	MS.

Unit	Activated Carbon Column
Duty	To enable removal of trace pollutants.
No. of units	One
Size	1.8 m dia., 1.8 m HOS.
MOC	MS.

Unit	Organic Scrubbing Bed
Duty	To scrub organics in the wastewater.
No. of units	One
Size	1.8 m dia., 1.8 m HOS.
MOC	MSEP.

Unit	Motor Control Center
Duty	*For operation and protection of all electrical items.*
Incoming	*MCCB of adequate rating, ammeter, voltmeter, copper bus bar and phase indicating lamps.*
Out going	Contactors of suitable rating of DOL type for motor rating up to 10 HP and Star-Delta type for motor ratings above 10 HP, thermal overload relay with built-in single phase preventer and HRC fuses for extra protection.

Make	All electrical items shall be of L&T, English Electric, GEC, Crompton, IMP, MECO or Siemens. Separate panels shall be provided for each of the streams being fed to the RO
Electrical cabling	All interconnecting cabling within ETP shall be in PVC insulated, armored /unarmored, aluminum conductor of standard make. Cabling, as far as practicable, shall be underground.

Unit	**Interconnecting Piping And Valves**
Duty	Interconnection between the various units of the STP.
Type	a) Piping: Generally all piping shall be in HDPE/PVC/GI/CI and of suitable size & pressure rating. b) All valves shall be of polypropylene/CI/GM

Characteristics of treated wastewater: The expected characteristics of the treated wastewater on adopting the scheme of treatment are given in table below and shall be complying with 4SR 422(E) for discharge into marine outfall.

Table 5.9
Characteristics Of Treated Wastewater

S. No	Parameter	Concentration*
1	pH	6.5 - 8
2	BOD (5 day at 20 ^{0}C)	$\leq$ 100
3	COD	$\leq$ 250
4	TSS	$\leq$ 30
5	Other parameters	As per limits stipulated in 4SR 422(E) for marine outfall.

**All parameters except pH expressed as mg/l*

Figure 5.7
Schematics of Proposed ETP

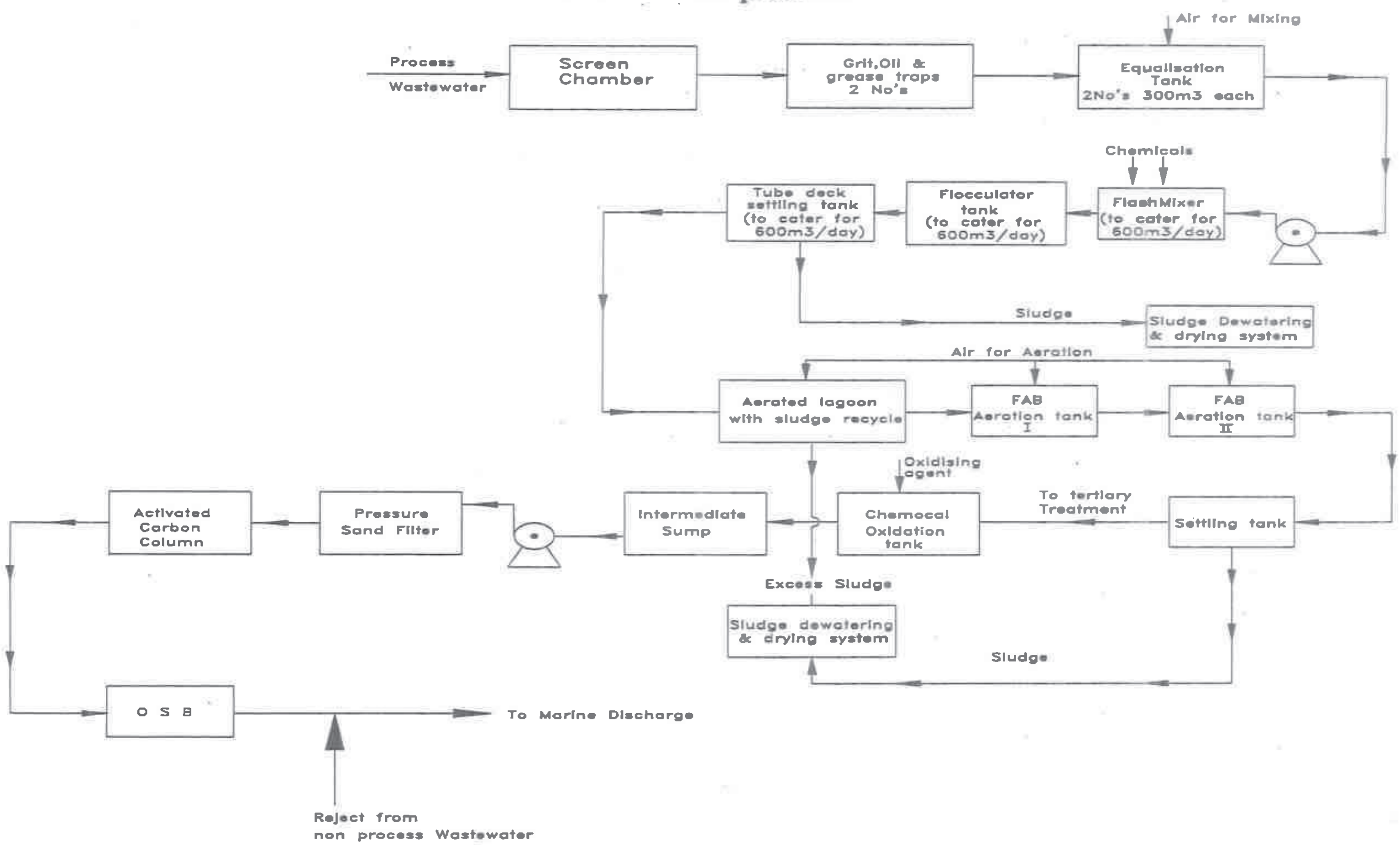
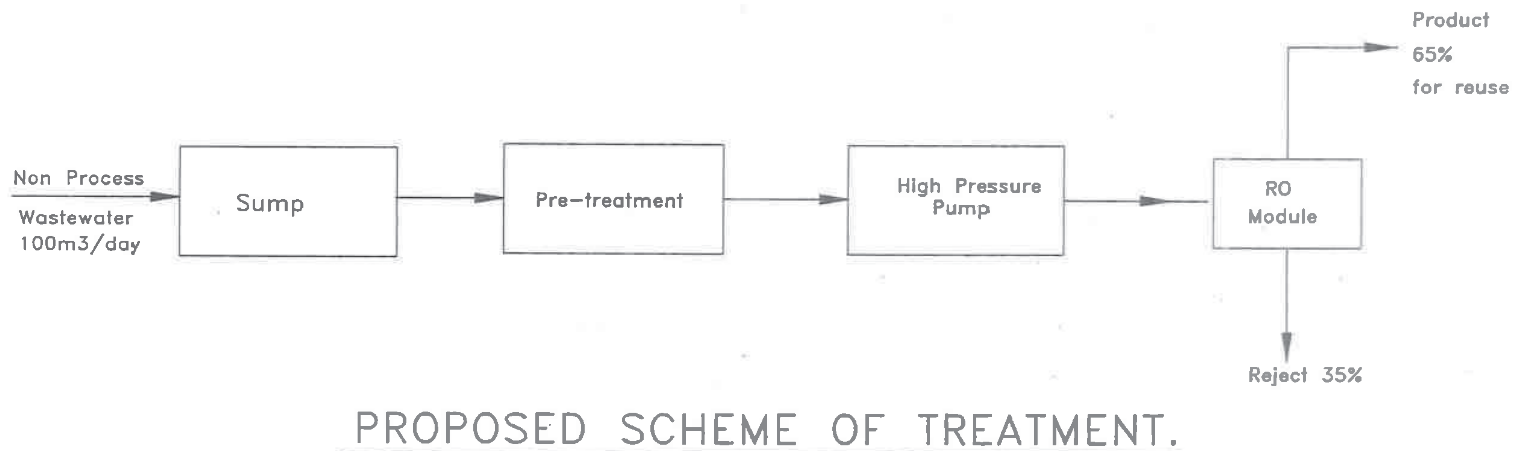


Figure-5.9
Treatment Scheme for Non- Process Effluents



5.4.5.1 Forced Evaporation System

i) Existing

The forced evaporation system at unit-8 is of 25 KL multi- stage evaporator with bottom cone type shell and tube. The total number of evaporators installed are two in total with a condenser of 40 m^2 capacity and 1.5 lakh liter capacity RCC/LDPE line bitumen coated collection tank. The utilities required for the above process are steam of about 2.5 to 4.0 Kg/cm^2 and RT water for cooling. The system has a capacity of treating about 9-10 m^3 of high TDS effluents at a distillation rate of about 500-600 liters per hour and a solar evaporation of 800 M^2 surface area.

ii) Proposed

In addition to the above forced evaporator of capacity to evaporate 25 KLD an additional evaporator of 150 KLD is being proposed to cater to the increased high TDS wastewater quantity of 138 m^3/d generated following the proposed expansion. The condensate from the forces evaporator will be sent to the onsite ETP for further treatment and disposal and the salts resulting from the forced evaporator will be sent to the TSDF. The operating procedure for the forced evaporation system is as follows:

1. The high TDS effluent is collected from various process streams in a common collection tank and is subjected to equalization by adjusting the pH to neutral and the neutralized effluent is pumped into another sump at 5-6 m^3 at a time.

2. The high TDS streams are transferred to the evaporators I & II till it overflows through cock valve at 3000 liters each

3. A known steam pressure of 3-5 Kg/cm^3 is applied to the evaporator I and the vapors are allowed to the evaporator II where the evaporator II gets heated up due to water vapor of the evaporator I

4. Due to the high pressure of vapors from evaporator I, the effluents in the evaporator II gets converted into vapor which on passing through condenser, the distillation of water starts. The distillation is continued

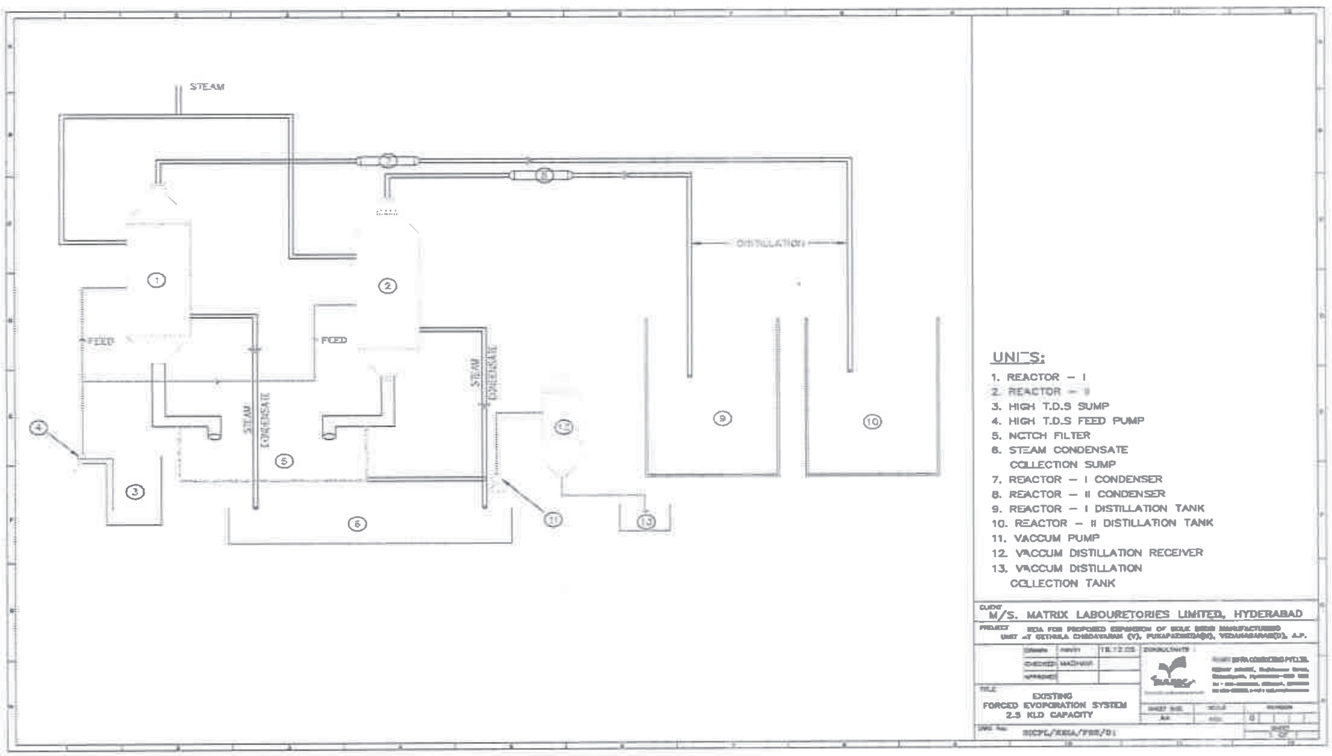
5. The pump is started and the rate of pumping is adjusted in such a way that the distillation from the evaporator is continued keeping the rate of distillation and rate of transfer of high TDS effluents into vapors same

6. The bottom valve of the cone is slowly opened while distillation is being done and to check only residue should be dropped or else it is closed till distillation of 9000 to 10000 liters of high TDS is completed

7. Finally, the residue is drained and is sent to solar evaporation ponds for drying. After the proposed expansion, Matrix Laboratories Ltd is planning to put up a Multiple effect evaporator to treat the increased effluent quantity.

A detailed sketch of the forced evaporation system is given as **Figure 5.9**.

Figure 5.9
Forced Evaporation System



5.4.5.2 MULTIPLE EFFECT EVAPORATOR

Combined high TDS stream from different sections (having an average TDS content of about 10% fixed solids) is fed to calendria after pre-heating. The plant is specially designed for handling the high TDS Effluent. The description is as below:

The preheated feed is then fed to calandria No1 at top, which works on falling film principle. The feed get well distributed to all the tubes due presence of a properly designed efficient liquid distributor. The liquid looses its flash heat if any and accounts for flash evaporation at top of calandria. The liquid has natural free fall and falls in each tube as falling film across the full wall of each tube. The liquid gains heat by heat transfer due to condensing hot vapors on out side surface of tubes. The liquid starts evaporating at constant boiling temperature and both liquid film and evaporated vapors travel down.

The concentrate is collected at bottom portion of calandria from where it is pumped further. The evaporated vapors enter the vapor separator connected at the bottom where due to centrifugal action the droplets get separated out. These droplets are pooled back to the concentrate leaving the bottom portion of calandria. The vapors leave the vapor separator from the top.

Vapors from VS 1 of Calandria No.1 is fed to shell side of Calandria No.2 and part of vapors fed to TVR suction and compressed by high pressure steam to reduce steam consumption and which increases steam economy.

Part of the product moved out from bottom portion of calandria is recycled back to top portion of calandria to maintain required wetting, in the tubes. The balance product is fed into calendria 2. Calendria 2 also works on same Falling Film Principle as Calendria 1.

Second stream i.e Process feed (High TDS) with 20% initial solids is also fed as additional feed to Cal 3. Calandria No. 3 works on forced circulation principle as it handles higher concentration of product. Centrifugal pump takes the product from flash vessel and circulates through the Calandria from the bottom. Adequate velocities are maintained in tubes for better heat transfer and also to retard fowling. The product gains sensible heat as it travels up inside the tubes. Hot vapors on shell side condense and provide the required heat.

The Hot liquid enters the flash vessel through a pressure-reducing device and gets flash evaporated inside the flash vessel. The concentrate gets recycled as explained above and the evaporated vapors move out from center at top of flash vessel. The feed to the forced circulation evaporator is introduced through a side tapping at suction line of pump, and product is discharged from another side tapping at discharge of pump.

Calandria No. 4 also works on same forced circulation principle as Calandria No.3, as it handles further concentrated product. The description is same as that of Cal 3. However, here separate product pump takes out the product. Final concentrate of both feed steams combined is taken out from effect 4.

The condensate generated in effect No1 is taken out from shell side at bottom and flashed on shell side for calendria 2 & similarly from Calandria No. 2 to Calendria No. 3, Calendria No.3 to Calendria No.4. Finally combined condensate is pumped out by a common condensate pump at the lowest temperature. This flash heat recovery greatly helps steam economy.

The non condensables from each effect shell side are drawn parallely and sent to shell side of condenser. The total non condensables are continuously pumped out by a vacuum pump connected to shell side of condenser.

The concentrated mass from the last calendria is taken out in the crystallizer, cooled and filtered to obtain the solids. Solids thus obtained will be collected to bags and transferred to temporary storage shed and then to TSDF. The Instrumentation and control Philosophy for Evaporator is given below:

A central Instrumentation and control panel facilitates the operator to start, stop and monitor the plant from one central place. All the push buttons required for the plant are housed in this panel. Temperature measurement at various places like all pre heater input / output temperature, calandria No.1 shell side temperature, each vapor separator boiling temperatures, cooling water in/out temperatures, calandria outlet vapour temperature for forced circulation evaporator etc are sensed by individual temperature sensors (RTDs) and displayed in sequence in a single scrolling type temperature scanner/indicator housed on panel. One can read these temperatures automatically in sequence or manually at any of the above points randomly. This helps operator to monitor the plant effectively.

An inter lock sequence provided ensures starting and stopping of plant in pre-determined correct sequence only and not other wise due to any mistake in operation. Further interlock for tripping of one pump ensures tripping of all pumps for safety reason.

An alarm enunciator indicates tripping of any pump and abnormal parameters if any. This part provides a facility to monitor the plant and indicates the operator for corrective action.

An automatic PID level control loop checks the level in the bottom of calendria and regulates product flowing out from each evaporator to next evaporator and finally from last effect out. As a result it ensures constant levels and avoids fluctuations in performance of total plant. The loop consists of a level sensor, a PID controller electronic type, an E/P converter (convert electronic signal to pneumatic signal) and a pneumatic control valve.

An automatic PID pressure control loop on inlet steam line ensures constant and safe steam supply to plant ensuring the constant pressure in the calendria no.1.

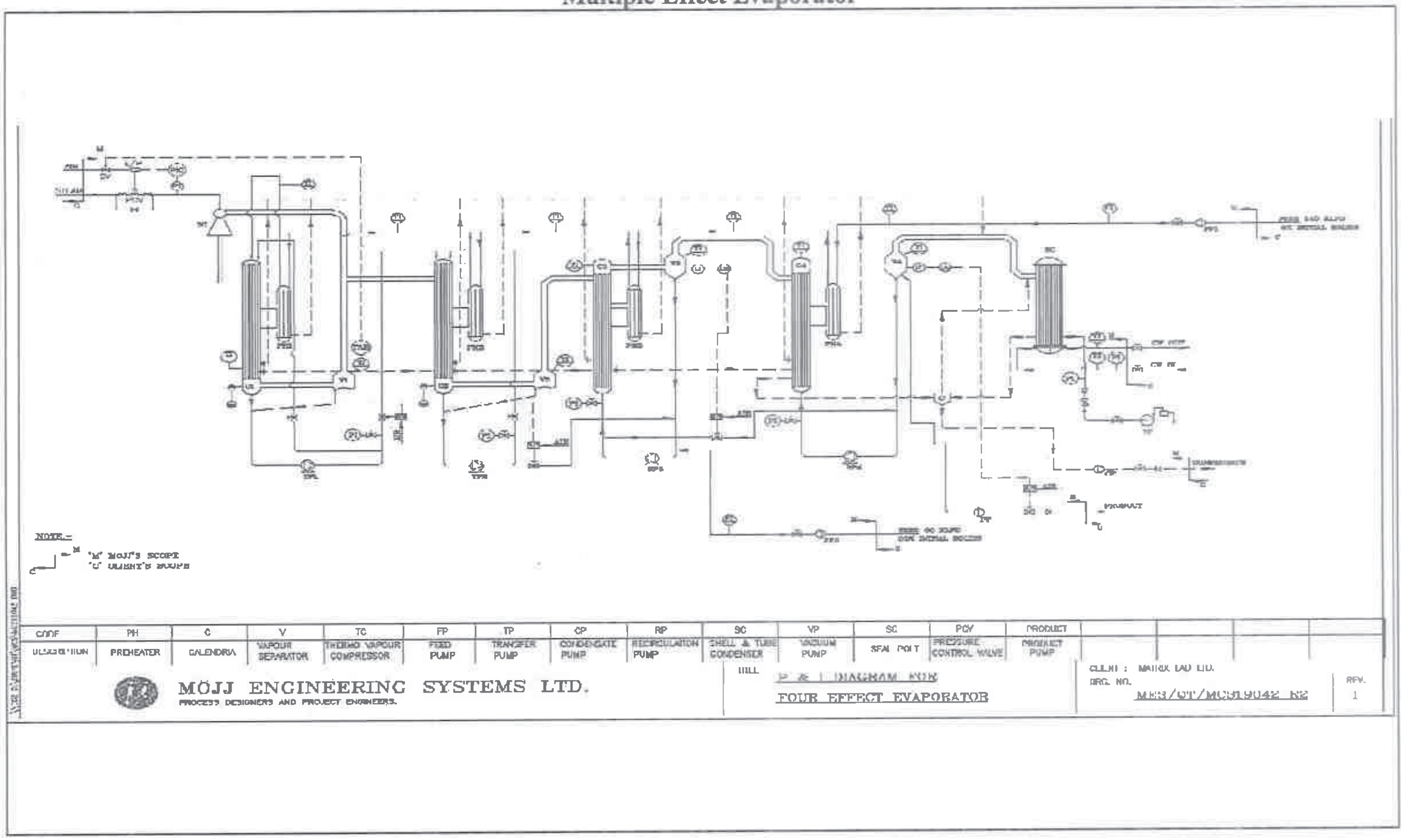
This ensures uniform steam supply to plant and there by uniform performance of plant. This also ensures temperature of first effect not to cross pre-determined value. A solenoid valve loop provided extra ensures safe boiling temperature in effect No 1. These safe temperatures ensure no over heating of product at any stage, which other wise may cause, un desired fowling of tubes.

A magnetic type flow meter is provided on the feed line of the plant so that operator can read and adjusts the feed rate to plant exactly.

With above one can maintain a constant feed rate to plant. A constant supply of steam to plant. As a result the performance of plant is expected to be uniform. Further due to monitoring of safe maximum temperatures on heating and boiling side of first effect no over heating of tubes can occur and as a result charring of product on tubes is avoided.

The detailed sketch of the proposed Multiple Effect Evaporator is given as **Figure 5.10**.

Figure 5.10
Multiple Effect Evaporator



5.4.5.3 Reverse Osmosis System

M/s Matrix Laboratories Limited is proposing to reutilize the non process effluents of about 91 m^3/d coming from the plant i.e the wastewater coming from the Boiler blow down, Cooling tower bleed off, DM Plant , Softener by subjecting them to reverse osmosis system. The reject from the reverse osmosis plant will be disposed off into the sea via marine outfall. The detailed operating procedure of the R.O system is provided here under.

1. Reverse osmosis, also known as hyper filtration, is the finest filtration known. This process will allow the removal of particles as small as ions from a solution.

2. Reverse osmosis is used to purify water and remove salts and other impurities in order to improve the color, taste or properties of the fluid. The most common use for reverse osmosis is in purifying water. It is used to produce water that meets the most demanding specifications that are currently in place.

3. Reverse osmosis uses a membrane that is semi-permeable, allowing the fluid that is being purified to pass through it, while rejecting the contaminants that remain.

4. Reverse osmosis technology uses a process known as cross-flow to allow the membrane to continually clean itself. As some of the fluid passes through the membrane the rest continues downstream, sweeping the rejected species away from the membrane.

5. The process of reverse osmosis requires a driving force to push the fluid through the membrane, and the most common force is pressure from a pump. The higher the pressure, the larger the driving force. As the concentration of the fluid being rejected increases, the driving force required to continue concentrating the fluid increases.

6. Reverse osmosis is capable of rejecting bacteria, salts, sugars, proteins, particles, dyes, and other constituents that have a molecular weight of greater than 150-250 Daltons.

7. The separation of ions with reverse osmosis is aided by charged particles. This means that dissolved ions that carry a charge, such as salts, are more likely to be rejected by the membrane than those that are not charged, such as organics. The larger the charge and the larger the particle, the more likely it will be rejected.

5.4.5.4 Artificial Recharging of Ground Water

Besides putting up a full fledged effluent treatment plant and other infrastructure for treating wastewater from the process and domestic sources in the plant area, M/s Matrix Laboratories Ltd is keen on protecting the natural resources in the area by designing artificial recharge pits for recharging the ground water being drawn for the plant operations.

Percolation pits or Rain water harvesting pits are designed at every 5m intervals all along the periphery of the site and all the pipes transferring the storm water is connected to the pit. The design and the construction of the percolation pit is done in a way to ensure maximum percolation and recharge. The design of the percolation is graphically shown in the following figure.

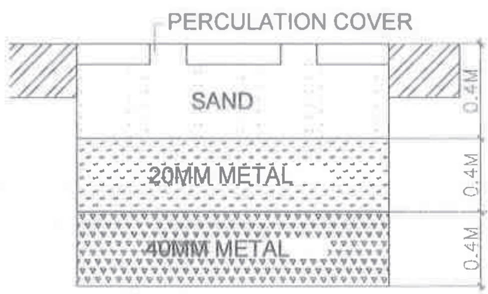


Figure 5.11
Percolation Pits in the Plant Site

5.4.5.5 Depth of Ground Water and Variations

Dug wells are more common in the study area. Nearly 33% of the wells are shallow type and water table is within 6m depth. The deep dug wells are up to a depth of 20 m.

The study of fluctuation in ground water levels by the ground water board (CGWB) reveals that the fluctuation is in the order of 1.65m to 4.42m with an average fluctuation of 3.13 m annually.

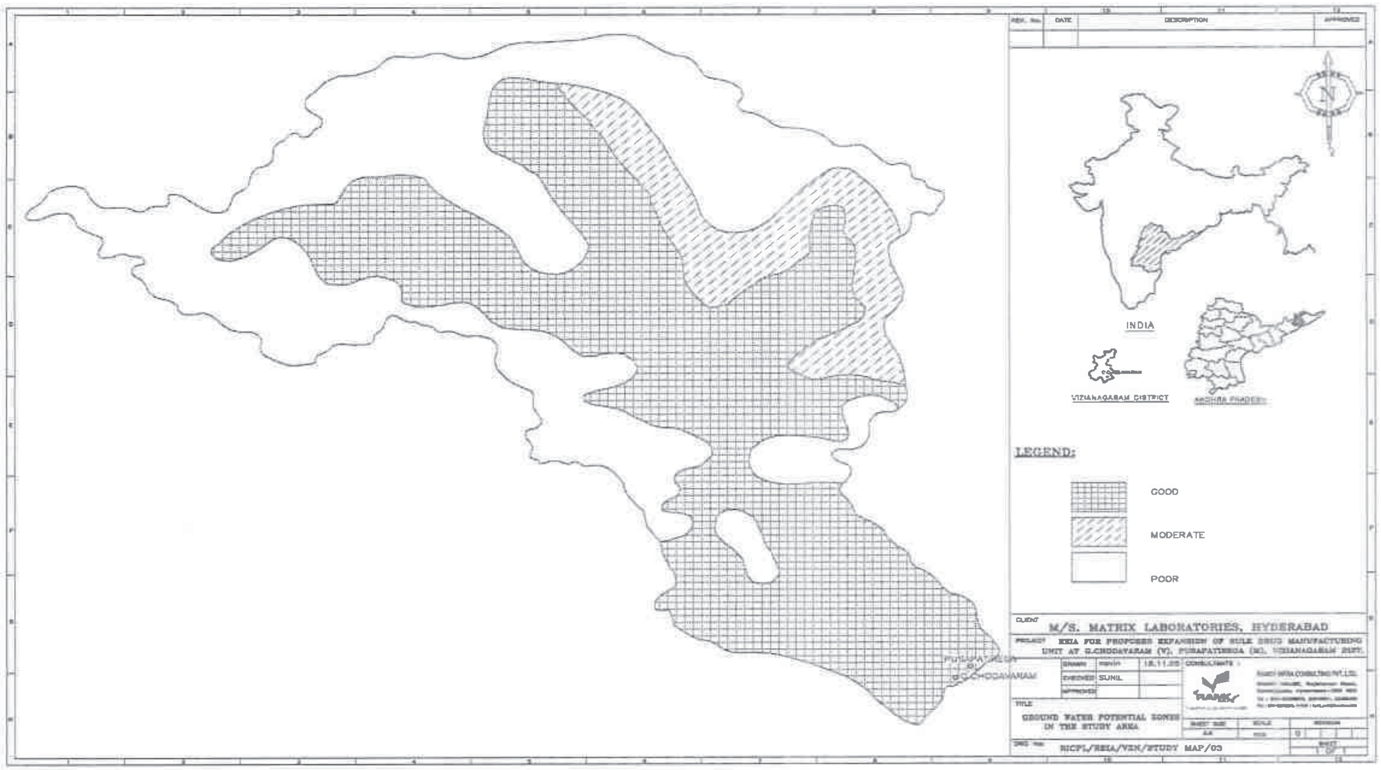
5.4.5.6 Nature of Aquifer

Ground water in the study area occurs under phreatic and semi-confined conditions, the hydro-geological regime of the area is influenced by Champavathi river. Out of the observation wells monitored by the CGWB and the state government, most of them were occurring in the plains followed by ones in the hilly terrains and a few in coastal plains. The static water levels in the pre-monsoon and post-monsoon ranged from 12.10 to 1.72 m bgl and 6.6 to 1.15 m bgl in the area respectively.

The top layer consists of red soil/ sandy loam and Laterite soils with a total thickness of 2-10 m. This layer is underlain by weathered zone in turn underlain by hard rock at many places. But in a few places, the weathered zone is followed by fractured zone. These zones together have the thickness of about 50-80 m has been inferred from the well inventory and soundings. The highest water table fluctuation is observed in hilly terrain and medium to the lowest in Vizianagaram plains and coastal plains. Various landforms formed by the river in the area influence the occurrence, distribution and fluctuations of the water table.

The areas of potential recharge in the study area clearly identified on the district map of Vizianagaram and given as **Figure 5.12**.

Figure 5.12
Ground Water Potential In The Study Area



5.5 MANAGEMENT OF SOLID WASTES

Solid wastes from the proposed bulk drug expansion includes organic residue, spent carbon and hyflow waste, metallic constituents added as catalysts, the sludge from the effluent treatment plant, salts from Forced evaporator etc. The plant has a solid waste incinerator of capacity 800 kg/d and an additional solid waste incinerator of 5000 kg/d and liquid waste incinerator of 1500 kg/d is proposed to be added during expansion.

The characteristics of the sludge from the effluent treatment plant and the incinerator ash have been collected and subjected to analysis for critical parameters. The characteristics of the sludge and the ash are given in the table below.

Table 5.10
Solid Waste Characteristics

Parameter	Unit	ETP Sludge	Incinerator Ash
pH	-	7.61	6.91
Total Volatile Solids	%	75	1-2%
Total Fixed Solids	%	25	98-99%
Chlorides	mg/kg	3091	148102
Sulfates	mg/kg	237	20637
Nitrates	mg/kg	250	1346
Phosphates	mg/kg	11.8	26.9

It is pertinent to mention that both the above wastes are sent to land fill for disposal. The sludge and the incinerator wastes are presently sent to the CHWTSDF at Hyderabad and in future may be sent to the nearest CHWTSDF which is being planned at Visakhapatnam. The characteristics of the wastes and the classifications as per the Hazardous Wastes Handling and Management Rules, 2003 is given in Chapter-IV.

5.5.1 Solid Waste Incinerator

The existing solid waste incinerator of 800 Kg/d was installed by Thermax. The total process solid waste that would be generated following expansion of the unit amounts to about 6500 kg/d. In order to cater to the increased quantity of the solid waste that would be generated following expansion M/s Matrix laboratories limited is proposing to add one solid waste incinerator and one liquid waste incinerator of 5000 kg/d and 1500 kg/d capacities respectively. These incinerators will be installed by Allied furnaces.

Significant solid waste generation from the bulk drug manufacturing unit in the existing form and after the expansion is from the boiler fly ash which is due to the usage of coal as the boiler fuel. The fly ash generated shall be disposed to the local brick manufacturers and the characterization of the fly ash is inert in nature. M/s Matrix Laboratories Ltd is also planning to recover economically important organic solid wastes like Acetyl yara yara, DMF and TEA and plans to sell them to the third parties while the rest will be sent to the onsite incinerator. This procedure not only reduces the waste generated from the plant but also generates income incurred to the plant. The stage wise solid waste generated from the proposed products is given in detail in chapter 4 of this report.

The characteristics and the quanity of the solid waste going to incinerator are given in **Table 5.11**.

Table 5.11
Solid Waste Quantity and Composition

S. No	Type of waste	Composition	Average CV	Type of waste	Feed rate Kg/hr
1	Solid Waste	90% Organics 5% In organics 5% Moisture	4000	5000	250
2	Liquid Waste	100% Organics	6000	1500	75
3	High TDS stream	Water	Nil	20 Kl	1000

System Description and Operational Methodology

Rotary kiln is a versatile chamber for handling all kinds of waste. Rotary Kiln mainly consists of rotating horizontal shell fixed with charging and discharge hoods at both ends, supported by two sets of trunion and thrust roller assembly. The shell will be rotated by girth gear and pinion sprocket mechanism using the reduction gear box with variable speed drive to adjust the required kiln speed. The charging hood has openings for the, burner, charging chute, liquid waste injection nozzle.

The Rotary Kiln will be of direct firing type with burner at front end. The products of combustion flow with the moving waste will transfer the heat to wastes co-currently. The gases evolved from the wastes will be routed to the post combustion chamber. The ashes and non-combustible matters if any will be collected at the discharge end of the kiln.

Liquid waste injection

Pumpable liquid / aqueous wastes will be sprayed in the Rotary Kiln through lances

Solid waste handling

A cart dumper lifts the packets to the mouth of hopper. The waste drops into the hopper.

Operation

The kiln rotation / tumbling action exposes the waste to heat continuously resulting incomplete removal of organics. The waste retention time, which is a function of kiln geometry and rotation speed, can be varied by a variable speed drive (VVF)

Ash Discharge Mechanism

Kiln is operated in non-slagging mode, by controlling the temperature, to avoid melting of salts. The ash tumbles out of the Rotary Kiln through the bottom opening of the discharge hood. The hot ash will be then collected in a bin with quench arrangement.

Post Combustion Chamber

The volatile gases from the kiln will be incinerated at post combustion chamber by thermal oxidation. The necessary air for combustion will be provided at the post combustion chamber. The burner provided here will ignite these gases and will act as the support flame for sustaining the combustion of the gases. The chamber will be maintained at a temperature of 11000°C ± 100°C with 2 seconds residence time to enable the complete oxidation of the gases. Fuel will be added to maintain this temperature, and sufficient turbulence is provided using air jets and baffle wall arrangement. Thus the 3 Ts of incineration i.e. time, temperature and turbulence is achieved

Maximum Oxidation Efficiency

To get high oxidation efficiency for the destruction of all volatile organic compounds, post combustion chamber will be designed to assure the minimum values of the following operating conditions for 99.99% destruction and removal efficiency.

- Temperature
- Residence time
- Turbulence

Temperature

Temperature is controlled by controlling the fuel burning rate through the burners automatically.

Residence Time

Sufficient residence time for flue gases will be provided in the post combustion chamber. The dimensions of the chamber itself are such as to give the residence time more than 2 seconds under all operating conditions.

Turbulence

Good turbulence is assured by proper design of inlet suction to the post combustion chamber. It is positioned such that the incoming V.O.C. laden flue gases should pass through the burner flame under excess air condition. In addition, the direction of flame assure a swirling vortex action which maximizes turbulence of the burning mass.

Interconnecting Ductings

All interconnecting ductings considered by us in our offer will be made out IS : 2062 grade-A, 5 mm thick plates with refractory lining from inside / external insulation, as required. Flange joints are provided as per requirement.

COMBUSTION SYSTEM

The combustion system mainly consists of :

- Burners
- Combustion air fan
- Necessary pipelines and valves.

The combustion system covered under our offer consists of fuel burners suitable for Gas, complete with combustion air blower fuel heating and pumping unit and air pipings, valves, etc., within our battery limit. The burners will be external mix low air pressure atomisation type and complete with sequence burner control, auto ignition system, flame failure device, etc.

The components are sufficient to ensure smooth and safe operation of the burners with controls on low / high pressure, no flame, high / low temperature of chambers, etc. The components are of reliable make. The burners will be of low NO_x type to maintain the NO_x level.

A separate combustion air blower is provided to give necessary air required for the combustion of fuel and wastes in the post combustion chamber. The necessary piping with valves and gauges will be provided for the air line upto the chamber. These pipelines will be of ERW `B' class and flange jointed.

Gas Cooling System

The gases leaving the post combustion chamber and Spray Incinerator are at 1100°C.These gasses are first cooled by air to around 800 and quenched to 200°C with high TDS water in spray drier. The evaporator is of co-current type. Here your RO Rejects free can be sprayed into the chamber to cool the products of combustion from the post combustion chamber.

The water / high T.D.S. effluent is sprayed into the chamber with the help of a centrifugal pump and atomized using disc atomiser. Water absorbs heat from the hot gases for its latent heat of evaporation thereby reducing the temperature of the total mixture. The evaporator works on the principle of spray dryer, and salts can be collected at bottom. Thus you get indirect heat recovery as well as Zero Liquid Discharge form your system. Rapid quenching of flue gases from 800°C to 200°C ensures that dioxins & furons are not formed.

The evaporator is of vertical cylindrical construction and is made of IS:2062 grade-A, 5mm plate with adequate gussets and stiffeners. Equipment is suitable refractory lining in order to avoid heat losses and to maintain the low skin temperature. Multiple cyclone separators are used for trapping of solids

Scrubbing System

The scrubbing system consists of:

- Venturi scrubber - for SPM trapping and gas scrubbing
- Droplet separator - for gas – liquid separation

- Demister pad - for moisture removal
- Recirculation tanks and pumps are used for circulating the scrubber liquor
- Parameters like SO_2, HCl and suspended particulate matters that are generated in the process are reduced to acceptable level in the flue gas scrubbing system. At this stage, acidic polluting gases are absorbed and transferred from gases into neutralised liquid according to the following chemical reaction:

$$HCl + NaOH \longrightarrow NaCl + H_2O$$

$$SO_2 + \frac{1}{2} O_2 + 2\ NaOH \longrightarrow Na_2SO_4 + H_2O$$

I.D Fan

Induced draught fan of reputed make will be supplied along with the system. It will be of centrifugal type and will be complete with motor, pulleys, V-belts, etc. The impeller and shaft of the I.D. fan will be of SS-316 material. The I.D. Fan is meant to ensure a negative pressure throughout the working system. V.V.V.F. drive is provided to vary the speed of fan since the load variation can be taken care. This will avoid any toxic gases escaping to the atmosphere without proper incineration.

Chimney

The off gases after cleaning will be discharged into the atmosphere through a stack of 40 metres height having a top diameter of 1200 mm. The stack will have sampling point at 15 m. Elevation, manhole, drain point, ladder and platform upto the sampling nozzle, lightning arrestor with conductor strip. The top edge, of 300 mm height, will be of SS-316 to avoid edge corrosion. The chimney is of self supporting type broadly conform to IS 6533 standards.

Refractories and Insulation

Refractory bricks manufactured by dry press process with high quality selected and blended fireclays, pre-calcined to high temperature will be used. Special shaped bricks will be used to form circles and circular shapes wherever required. The bricks will be with low impurities percentage and high refractoriness, volume stability at high temperature, spalling resistance and ability to withstand slag penetration. The refractories will conform to Indian Standard Specifications [IS : 8]. The castable material wherever used will be of standard A.C.C. make and will be hydraulic setting type. M.S. Anchors welded to the plate at regular spacing will hold the castable in position and keep the lining monolithic.

Motor Control Centre Panel

Self standing, sheet metal cubicle, fabricated from 14 SWG CRCA steel, complete with relays, contactors, fuse meters, control instruments, busbar, gland plates, indicating lamps, alarm hooter, selector switch, etc. The panel will be suitable for front operation. The housing of motor control centre will be dust and vermin proof design conforming toIP:54 as per IS:2147. The minimum size of wire for control circuit will be 1.5 mm2, whereas it will be 2.5 mm2 for power circuit. This panel will be non-compartmental, non-draw out type. The control circuit will operate at 240volts, A.C., 50 hz, single phase supply available from phase and neutral.

P.L.C. - P.C. Based Control System

A P.L.C. based control panel will be supplied for carrying out all temperature control and logical operations. A commercial P.C. based operator work station linked to the P.L.C. will also be provided with the supervisory SCADA package. Alarm annunciations, trenchings and mimics will be developed using the SCADA package. P.L.C. Panel will control the following functions of the process:

[1] All safety controls and interlocks
[2] Temperatures at primary chamber, post combustion chamber and quencher
[3] Pressure control of water spray at quencher
[4] Suction pressure control at chambers

P.I.D. loops required will be generated in the P.L.C. software and no separate P.I.D. controllers will be used. The entire system will be supplied with one no. printer. While using the P.C. based operator panel, all operations of the above equipment will be handled from the P.C. which replaces most of the selector switches, push buttons, indicating lamps which would have been in the control system when contactor logic and discrete controllers are used instead of P.L.C. All digital and analog input / output modules will be arranged on the rack with C.P.U. and power supply inside the P.L.C. panel. All I/Os will be wired upto the terminal blocks provided for cable termination from the field. Sufficient M.C.B.'s will beprovided for I/O modules and C.P.U. to safeguard the modules. P.L.C. used will be from Siemens / Ge-Fanuc / Allen Bradley or equivalent makes.

Quality of Residues After Incineration

Based on the analysis and from our past experience, ash / residue after incineration can be easily collected at discharge hood this can be collected in water sealed pot arrangement. The salts evenly spread are unlikely to come together as a fusion mass because percentage of salts present in the waste are comparatively less. Carbon will be comfortably oxidised leaving the salts free.

Achievement / Control of Emission Limits

The burners installed at Rotary Kiln and post combustion chamber are of low air pressure type with controlled air supply ensuring lower NO_x formation. At the post combustion chamber, the incineration process is done with excess air well distributed to avoid formation of phosgene, CO or HC. The other parameters like SO_2, HCl and suspended particulate matters that are generated in the process are reduced to acceptable level in the flue gas scrubbing system. At this stage, acidic polluting gases are absorbed and transferred from gases into neutralized liquid according to the following chemical reaction

Prevention of Dioxins

The system is designed to provide sufficient residence time, high temperature [above 10000°C] with sufficient turbulence. This ensures total destructions of all organics and suppression of release of free Chlorine from waste with enough Hydrogen potential. Since high oxygen potential is also maintained, all hydrocarbons are oxidised. The rapid cooling the flue gasses from 1000°C to around 200°C, reduces the chances of Dioxin formation.

Emission Norms

System is designed to meet the following PCB emission norms:

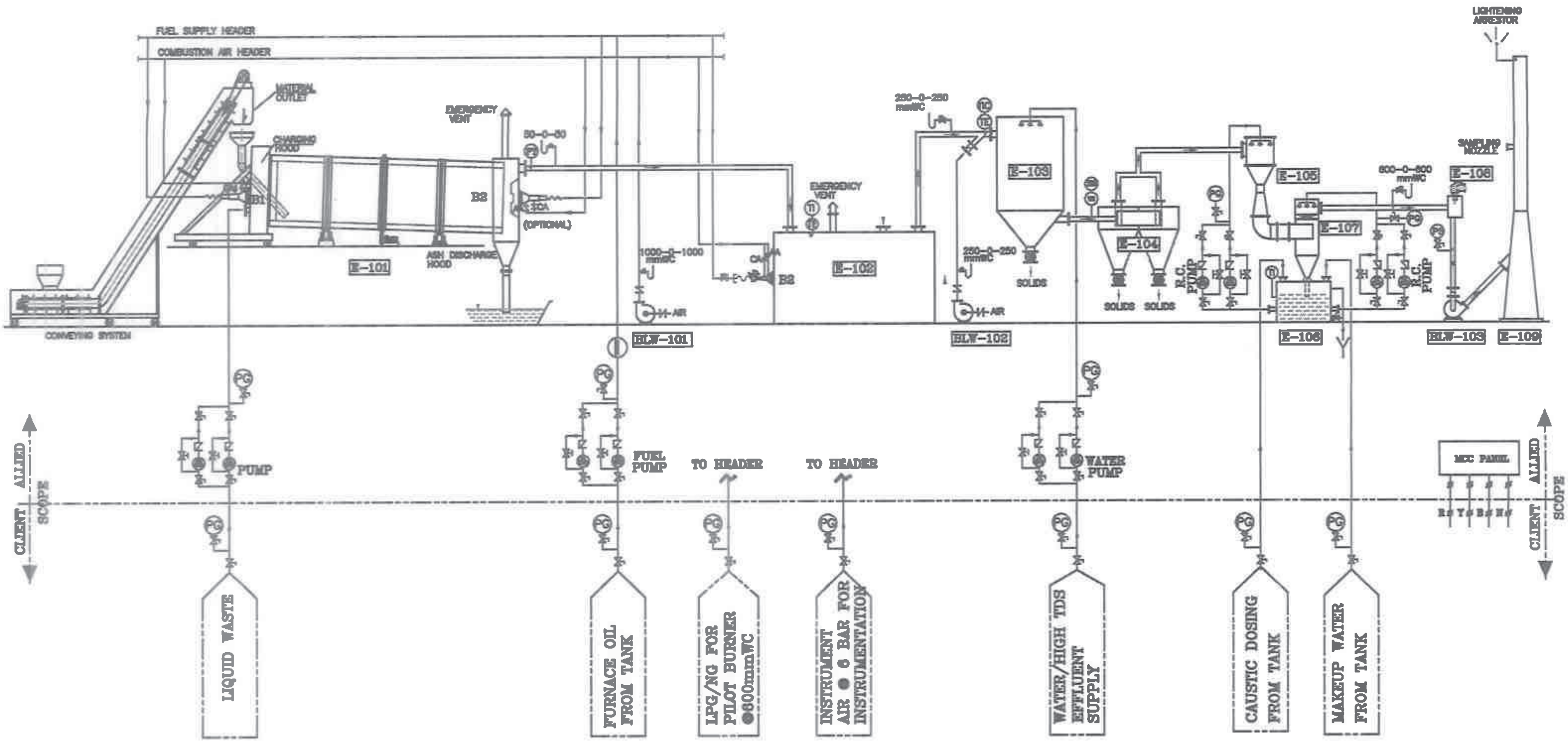
- Particulates : 50 mg/Nm^3
- SO_2 : 200 mg/Nm^3
- CO : 100 mg/Nm^3
- HCl : 50 mg/nm^3
- NO_x : 400 mg/Nm^3

Technical specifications Of the Proposed Incinerator

The general specifications of the incinerator are given in the table below.

Equipment	Rotary Kiln Incinerator
Location of Installation	Vishakapatnam
Operation Hours	Continuous
Capacity of Incinerator	250 Kg/hr Solid waste and 75 Kg/hr Liquid waste

The complete technical specifications for all the units of the incinerator have been attached as annexure at the end of this chapter and the design of the incinerator has been given in **Figure 5.13**.



NO.	EQPT. NAME
E-101	ROTARY KILN
E-102	POST COMBUSTION CHAMBER
E-103	SPRAY EVAPORATIVE COOLER
E-104	MULTI CYCLONE
E-105	VENTURI SCRUBBER
E-106	RECIRCULATION TANK
E-107	DROPLET SEPERATOR
E-108	REHEATER
E-109	STACK
BLW-101	COMBUSTION AIR BLOWER
BLW-102	EXCESS AIR BLOWER
BLW-103	I.D.FAN
B1-B2	FUEL BURNER

LEGEND
BALL VALVE
BUTTERFLY VALVE
GATE VALVE
GLOBE VALVE
AIR VENT
NEEDLE VALVE
NON RETURN VALVE
'U' TUBE MANOMETER

LEGEND
LEVEL INDICATOR
DAMPER
OPEN DRAIN
HEATER
PROCESS LINING
FLUE DUCT

ALLIED FURNACES
ALLIED HOUSE 1st ROAD, CHEMBUR, MUMBAI -400 071

DRN.	YOGESH	22.6.06
CHD.	NKM	
APPD.		
SCALE	N.T.S.	
WT. IN kgs.	-	

CLIENT:- MATRIX LABORATORIES LTD. VISHAKHAPATNAM
EQUIPMENT :- INCINERATION SYSTEM
TITLE :- FLOW DIAGRAM

JOB No.	DRG. No.:-	REV.:-
AF/Q06/196	AF/Q06/196/01	0

5.6 CONTROL OF NOISE POLLUTION

The noise generating units in the plant is boiler, DG set, Compressors etc. The noise drops to 45 dB (A) at a distance of 1.5 km from the project site. As the nearest habitat is more than 1.5 km from the project site the impact on the general public will be minimal. However all necessary precautionary measures like ear plugs to workers, regular maintenance of noise generating equipment will be carried out to reduce the noise levels. The ambient noise levels recorded in the plant area are presented in table below.

Table 5.12
Noise Levels in the Plant Area

S. No	Location	Noise Levels dB(A)
1	Security Room	56.1
2	Canteen	55.5
3	Production Block-I	68.1
4	Production Block-II	67.8
5	Near Boiler House	52.6 (Shut down)
6	Near Administrative Block	57.7
7	Store Yard	49.1
8	DG Set	56.2 (Shut Down)
9	Cooling Tower	80.2
10	Chilling tower	62.0

The noise levels at the boundary of the plant are 50 dB(A).

5.6.1 Noise Pollution Management

The existing noise pollution management measures are;

- Acoustic Enclosure for all the high noise level equipments
- All the design/installation precautions as specified by the manufacturers with respect to noise control are strictly adhered to

- High noise generating sources are insulated adequately by providing suitable enclosures;
- Other than the regular maintenance of the various equipment, ear plugs are provided to the personnel close to the noise generating units;
- All the openings like covers, partitions are designed properly.

5.7 GREEN BELT DEVELOPMENT

MLL has an area of 20.00 Ha allocated for green belt. The same is being retained now without any disturbances. The green belt is well developed and helps to capture the fugitive emissions, attenuate the noise generated and improve the aesthetics. Attempts are always being made to ensure that all open spaces, where tree plantation may not possible, will be covered with shrubs and grass to prevent erosion of topsoil. Adequate attention is being paid to maintenance and protection of green belt.

5.8 WASTE MINIMIZATION OPTIONS

Matrix Laboratories Ltd is a cGMP certified bulk drug and activated pharmaceutical ingredients manufacturer. It is a corporate philosophy at Matrix Laboratories Ltd that there should be maximum resource conservation in order to conserve the natural resources available and thus making a way for a sustainable development regionally as well as globally. In this context, Matrix Laboratories Ltd is implementing the following waste minimization options.

❖ Recycle and reuse of condensate water from the utilities like DM plant for boiler feed to meet the steam requirement and thus reducing the dependency on fresh water for utilities.

❖ Solvent recovery to ensure that no fugitive emissions are let out during the handling of raw materials and also during the operations. This is also done because most of the solvents used in the manufacturing process are expensive. Almost 97-98% of the solvents are recovered so as to reduce costs towards buying them.

- Process emissions are scrubbed and if any gas is found to be useful in the process it shall be used.
- Certain organic residues are recovered and sold to authorized dealers
- Fly ash is utilized for brick manufacturers in the area

5.9 ENVIRONMENTAL MANAGEMENT CELL

An efficient environmental management cell exists at Matrix laboratories Ltd. The Environmental Cell is headed by the General Manager followed by the senior Manager (Environment). They are supported by engineers and chemists and horticulturist along with other technicians.

The department is the nodal agency to co-ordinate and provides necessary services on environmental issues during operation of the project. This environmental group is responsible for implementation of environmental management plan, interaction with the environmental regulatory agencies, reviewing draft policy and planning. This department interacts with Andhra Pradesh State Pollution Control Board (APPCB) and other environment regulatory agencies. The department also interacts with local people to understand their problems and to formulate appropriate community development plan.

5.10 COMPLIANCE TO CONSENT CONDITIONS AS PER SCHEDULE-B

As per the existing CFE/ CFO, Matrix Laboratories Ltd, Unit-8 was directed to comply to the following conditions as per the Schedule-B to which Matrix Laboratories Ltd, Unit-8 has complied. The details of the compliance to the Schedule-B of the consent are given below in **Table 5.13**.

Table 5.13
Compliance to Schedule-B of the Consents

Consent Condition	Compliance
Industry shall not manufacture any new products without obtaining CFE of the Board	No new products without obtaining CFE are being manufactured
The industry shall comply with CREP recommendations with reference to Bulk Drugs Manufacturing	CREP recommendations are being complied and the CREP is given at the end of this report
Industry shall install flow meter with totalizer at the Pumping Station at Thammayyapalem to record the effluent pumped into sea	A flow meter has been installed at the Pump House at Thammayyapalem
The industry shall carryout groundwater monitoring in their premises through groundwater department by providing 2-3 observation wells	2 observations wells are being monitored regularly by third party agencies and periodically by the groundwater department
The industry shall submit monthly data to the R.O/Z.O of APPCB regarding production and wastewater disposal	Monthly reports are being submitted to the R.O
The industry shall comply with Hazardous Wastes (Management & Handling) Rules, 1989 abd Amendments thereof	Complied
The industry shall remit water cess amounts, as and when assessment orders are issued by the Board	Complied
The industry shall restrict the production to the quantities permitted by the Board scrupulously	Complied

5.11 POST PROJECT MONITORING

A well-defined environmental monitoring program exists and the same would be followed for the expansion project. It would be ensured that trained and qualified staff supervises the monitoring of ambient air, stack gases, effluents, noise, etc. to see that prescribed standards laid down in the consent are obtained. The post project monitoring works is summarized in the following table:

Table 5.14
Environmental Management Plan

Environmental Component	Locations	Frequency	Parameters
Ambient Air quality	Three AAQ stations located at 120^0 angle between each	-Once in a month	For SPM, SO_2, NO_x
Stack Emissions	Plant site	Boilers and DG set	For SPM, SO_2 and NO_x
Process Emissions	Production Block, storage area	Once in a month	All solvents.
Wastewater quality	ETP(Inlet & Outlet)	Once in a month	pH, EC, TDS, SS, COD, BOD, Cl, SO_4, O & G.
Groundwater Quality	Borewells inside the plant	Once in 6 months	For IS 10500 parameters
Solid waste	Storage area	Every container sent to TDSF	-

In order to comply with the environmental protection measures as suggested in the above sections, Matrix Laboratories Ltd has allotted Rs. 12.0 Crores towards the following described in **Table 5.15**.

Table 5.15
Costs Towards Environmental Infrastructure

Environmental Protection Measures	Costs in INR in Lakhs
Water Pollution Control & Management	
1. Effluent Treatment Plant	400.00
2. Reverse Osmosis System	100.00
3. Multiple Effect Evaporator	200.00
4. On-shore pipeline for marine disposal	100.00
Air Pollution Control & Management	
1. Scrubbers	20.00
2.Multiclones	10.00
Hazardous Wastes Management	
Incinerator	250.00
Environmental Monitoring & Analysis	20.00
Total	**1200.00**

The six months stack monitoring data for both the boiler and the incinerator, the treated effluent characteristics and the ambient air quality as monitored in the plant site at various locations have been presented in tables below.

Table 5.16
Air Quality (Stack Emissions)

S. No	Parameter	Units	Month					
			April	March	February	January	December	November
			2006				2005	
Stack attached to 5.0 TPH Coal Fired Boiler								
1	PM	mg/Nm^3	92	187	93	90	90	83
2	SO_2	mg/Nm^3	90	77	88	77	76	77
3	NO_X	mg/Nm^3	66	49	61	55	55	44
Stack attached to the 800 Kg/d Incinerator								
4	PM	mg/Nm^3	73	72	80	90	74	78
5	SO_2	mg/Nm^3	41	42	37	48	35	39
6	NO_X	mg/Nm^3	36	44	41	38	40	41

- From the above table it can be observed that the stack emissions for both the boiler and the incinerator were within the permissible limits.

Table 5.17

Treated Effluent Analysis (From ETP)

S. No	Parameter	Units	APPCB Standard	Month					
				April	March	February	January	December	November
1	pH	-	6.5-8.5	7.4	7.9	7.7	7.9	7.4	7.9
2	COD	mg/l	250	192	177	184	175	195	177
3	BOD	mg/l	100	88	79	86	83	90	81
4	TSS	mg/l	100	57	52	44	50	57	40

- As seen from the above table all the parameters monitored were well within the permissible limits.

Table 5.18
Ambient Air Quality in the Plant Site

S. No	Parameters	Units	Standard	Months					
				April	March	February	January	December	November
Security Gate (E)									
1	TSPM	$\mu g/m^3$	200	138	143	160	153	165	166
2	RSPM	$\mu g/m^3$	100	40	52	47	34	42	44
3	SO_2	$\mu g/m^3$	80	11.4	11.6	11	12	12.4	13.4
4	NO_X	$\mu g/m^3$	80	19.8	24.2	22.3	20.5	22	24.7
Production Block-4 (W)									
5	TSPM	$\mu g/m^3$	200	146	144	141	140	147	133
6	RSPM	$\mu g/m^3$	100	52	49	44	43	43	39
7	SO_2	$\mu g/m^3$	80	11.6	10.8	10.2	9.7	11	11.2

S. No	Parameters	Units	Standard	Months					
				April	March	February	January	December	November
8	NO_X	µg/m³	80	21.3	22.4	22.8	23	23.5	19.8
Back Side of ETP (S)									
9	TSPM	µg/m³	200	122	117	129	141	152	152
10	RSPM	µg/m³	100	45	35	36	37	46	47
11	SO_2	µg/m³	80	8.8	11	9.9	10.4	12	11.6
12	NO_X	µg/m³	80	17.6	22.5	20.6	24	21.8	21.5

- All the values were within the permissible limits given for the rural areas.

The details of the VOC,s monitored in the plant and the methodology adopted have been presented below.

Table 5.19
Details Of VOCs Monitoring Locations

S. No	Manufacturing Block	Location	Solvents in usage in Mfg. While monitoring VOC
1	PB-01	Centre of the PB-01 At Ground Floor	Toluene
2	PB-02	Tray Dryer (TD-201), (TD-202) Room	Ethyl Acetate, Ethanol, Methanol
3	PB-03	Centre of the PB-03 At First Floor & Second Floor	Methanol, Toluene
4	PB-04	Centre of the PB-04 At First Floor	Toluene, Acetone, Methanol

Table 5.20
VOC Concentration In The Air

S. No	Manufacturing Block Location	Exposure of Volatile Ogranic Compound (with TLV Limit)	Total VOCs Value
1	PB-01: Centre of the PB-01 at Ground Floor	Toluene (50 ppm)	15 ppm
2	PB-02: Tray Dryer (TD-201), (TD-202) Room	Ethyl Acetate (400 ppm), Ethanol (1000 ppm), Methanol (200 ppm)	382 ppm
3	PB-03: Centre of the PB-03 at First Floor & Second Floor	Methanol (200 ppm), Toluene (50 ppm)	21 ppm
4	PB-04: Centre of the PB-04 at First Floor	Toluene (50 ppm), Acetone (500 ppm), Methanol (200 ppm)	35 ppm

Methodology Adopted

The Total Volatile Organic Compounds (TVOCs) monitor is a dual channel Photo Ionization Detector (PID) and consists of an electrodeless discharge UV lamp as the high energy Photon source for the PID. Both channels of the Detector are located in the ionization chamber. As organic vapour pass by the lamp, they are photo-ionized and the ejected electrons are detected as current.

The first channel current primarily results from the ionized gases. The second channel current measured the ionized gases plus photoelectric emission of electrons from the metal surface, which is a function of the UV light intensity. The dual channel currents can thus be used to compensate the variation of the light intensity due to lamp contamination and degradation.

The dual channel structure allows the VOC monitor to determine the ionizable gas concentration accurately to a ppm (parts per million) level without frequent calibrations. The PID sensor detects a broad range of organic vapours. The standard lamp yields the best resolution and sensitivity. The lamp is powered with high photon energies to measure a greater number of compounds, whereas, low photon energies are selectively for easily ionizable compounds such as aromatics.

The PID sensor for the VOC monitor is constructed as a small cavity in front of the UV lamp. A diaphragm inside the monitor continuously draws air through the sensor and then discharges it through a gas outlet port on the side of the monitor.

A single chip microcomputer is used to control the operation, which measures the sensor readings and calculates the gas concentrations based on calibration to know standard gases.

This VOCs monitor has the capacity to measure VOCs in the range of low levels (1 ppm) to 1000 ppm. PID provides a compact, accurate, affordable and reliable real time gas monitoring of Total Volatile Organic Compounds.

VOC Monitor Details

Monitoring has been performed by using VOC monitor manufactured by RAE Systems INC., USA; Model: Mini RAE; Equipment Serial No.: 900144. The content of total Volatile Organic Compounds has been monitored at each and every place in the particular Block/Location, but the VOC value represented here in this document is only the overall highest value observed. In principle, the equipment is being calibrated before and after the monitoring of the VOCs. The VOC monitor is calibrated by Isobutylene gas (concentration 100 ppm, Lot No. 85054 Cyl 33, Expiry Date of Isobutylene: July 2008)