PUNJAB ALKALIES AND CHEMICALS LTD.
NANGAL-UNA ROAD, NAYA NANGAL.
PUNJAB

ENVIRONMENTAL STATEMENT
FOR THE YEAR 2020-2021

M. 2021/ 01 **September, 2021**

PREPARED BY

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(See Rule 14)

Environmental statement for the financial year ending the 31st March 2021

PART-A

1.	Name and address of the owner / occupier of the industrial operation or process	:	Sh. Naveen Chopra Managing Director M/s Punjab Alkalies and Chemicals Ltd. Naya Nangal, District – Ropar Punjab
2.	Industry Category Primary-(STC Code) Secondary (SIC Code)	:	Large 2812
3.	Production Capacity Unit – I Unit - II	:	 100 TPD Caustic Soda 200 TPD Caustic Soda
4.	Year of Establishment	:	Plant commissioned in 1984
5.	Date of the last Environmental Statement submitted	:	29st February, 2020

PART-B

WATER AND RAW MATERIAL CONSUMPTION

(i) Water Consumption (m^3/year)

Process : 214084
Cooling : 150183
Domestic : 27375

Name of Products	Process water consumption per unit Of product output	
	During the previous Financial year (2019-2020)	During the current financial year (2020-2021)
	1	2
(i) CAUSTIC SODA LYE	3.894 M^3/MT	2.541 M^3/MT

(ii) Raw Material Consumption

*Name of Raw Materials	Name of Products	Consumption of raw material per unit of output (MT/Year)	
		During the previous financial year (2019-2020)	During the current financial year (2020-2021)
Salt	Caustic soda	1.590	1.590
Soda Ash	Caustic soda	0.0022	0.0033
Barium Carbonate	Caustic soda	0.0076	0.0055
Hydrogen	Hydrochloric acid	0.008215	0.006
Chlorine	Hydrochloric acid	0.2215	0.2901
Chorine Tailings	Sodium hypo chloride	0.0967	0.0969
Caustic Soda Lye	Caustic Soda	0.0448	0.0346

* Industry may use codes if disclosing details of raw material would violate contractual obligations, otherwise all industries have to name the raw materials used.

PART-C

Pollution Discharged to Environment/unit of Output

(PARAMETER AS SPECIFIED IN THE CONSENT GRANTED)

UNIT-I

Pollutants		Quantity of pollutants discharged (mass/day)	Concentration of pollutants in discharges (mass/volume)	Prescribed Standards	Percentage of variation from prescribed standards with reason
(a)	**Water**	Zero Discharge			
	pH	-	-	5-9	-
	Total Suspended Solids	-	-	100 mg/l	-
(b)	**Air**				
	Hypo stack Chlorine	-	-	15 mg/Nm^3	-
	HCl vent, HCl content	-	-	35 mg/Nm^3	-

PART-C (CONTD.)

Pollution Discharged to Environment/unit of Output

(PARAMETER AS SPECIFIED IN THE CONSENT GRANTED)

UNIT-2

Pollutants		Quantity of pollutants discharged (mass/day)	Concentration of pollutants in discharges (mass/volume)	Prescribed Standards	Percentage of variation from prescribed standards with reason
(a)	**Water**	Zero Discharge			
	pH	-	7.53	5-9	Within limits
	Total Suspended Solids	3.24 kg/day	25.00 mg/l	100 mg/l	(-)75.0
(b)	**Air**				
	Hypo stack Chlorine	0.0019 kg/day	9.75 mg/Nm^3	15 mg/Nm^3	(-)35.0
	HCl vent, HCl content	0.00201 kg/day	10.07 mg/Nm^3	35 mg/Nm^3	(-)71.2

-ve indicates % variation w.r.t standards (within limits)

PART-D

HAZARDOUS WASTES

(As specified under Hazardous Wastes (Management and Handling) Rules, 2000)

Hazardous Wastes	Total Quantity (Kg)	
	During the previous Financial year (2019-2020)	During the Current financial year (2020-2021)
(a) From process		
(i) Used Transformer Oil	222 Liters	NIL
(ii) Used Lubricating Oil	NIL	NIL
(iii) Used Furnace Oil	NIL	NIL
(iv) MEE Sludge		44.64
(b) From pollution control facilities	NIL	NIL

PART-E

SOLID WASTES (NON HAZARDOUS)

	Total Quantity (ON DRY BASIS MT)	
	During the previous financial year (2019-2020)	During the Current financial year (2020-2021)
(a) From process	**1813**	**1854**
(b) From pollution control facilities (from tanks/vessels)	Nil	Nil
(c) (1) quantity recycled or re-utilised within the unit (2) Sold Disposed	Nil	Nil

PART-F

CHARACTERISTICS OF SOLID WASTES (BRINE SLUDGE)

Sl. No.	Parameter	Unit	Membrane Cell, Unit-I	Membrane Cell, Unit-II
1.	Loss on Drying (Water)	%	-	32.94
2.	NaCl	%	-	11.75
3.	Calcium as CaCO3	%	-	11.32
4.	Magnesium as Mg(OH)2	%	-	9.22
5.	Acid insoluble	%	-	34.79

QUANTITY OF SOLID WASTE (BRINE SLUDGE) ON DRY BASIS

Solid waste	Unit-I	Unit-II	Total
Brine Sludge from Drum Filter /Decanter(MT)	-	410.935	410.935
Brine Sludge from Brine sludge Pits, MT	-	1155.431	1155.431
Precipitation Tanks / Vessels, MT	19.895	81.812	101.707
Sludge from salt saturator MT	47.042	138.420	185.462
Total Solid waste Generated, MT	**66.937**	**1786.598**	**1853.535**

PART-G

M/s Punjab Alkalies and Chemicals Ltd., Naya Nangal, has taken pollution control measures since commissioning of the plant. Though several pollution control measures have been taken by them, still efforts are on to preserve natural resources. In the manufacturing process of sodium hydroxide, chlorine gas is produced as a by-product. A major portion of the gas is processed and liquefied to liquid chlorine for sale. The other major portion is utilized in the production of hydrochloric acid. The tail chlorine gas from all the sections of plant such as chlorine liquefaction, chlorine storage, chlorine filling etc. are neutralized in the caustic soda solution resulting in the formation of sodium hypochlorite liquor.

Automatic chlorine detectors have been installed around the industry to check any chlorine leakage.

The management of industry is alive to necessity of the conservation of natural resources. In the continued efforts, the industry has planted many trees and shrubs in its drive for afforestation.

PART-H

The management of industry is quite conscious of the issues of environmental protection. Number of measures has been taken by the industry to protect the environment as detailed below:-

1. The waste HCl generated during regenerating of ION Exchange Column going to the ETP, which was neutralized with caustic soda/lime solution for pH adjustment. Now the above waste acid is being collected in storage tank and reused in the ETP for pH adjustment. This has been adopted in both units.
2. The brine drained during sample collection at various points was earlier passing to the ETP increasing the chloride and TDS content. The same has now been re-circulated and reused in the system.
3. In the precipitated tank area the pump gland leakages was also passing to the ETP. The same is stopped totally and this also has reduced the TDS load in the ETP.
4. Continuous recording of effluent discharged with graphs in Control Room.
5. Tanker inspection platform provided.
6. Company is certified under ISO 9001:2008 and ISO 14001, 2004.
7. System for pre-treatment of chlorine section effluent is installed and the same is taken to ETP for further treatment.
8. Three new high volume samplers and one handy sampler are procured replacing the old ones.
9. Periodic measurement and monitoring of sound level at various locations inside the Plant has been implemented to control sound pollution.
10. The additional sod. Hypo tower installed in sod .hypo plant to scrub all the waste chlorine gas in complete soda so for capacity of the sod. Hypo plant U-2 is increased.
11. A green belt has been developed in side the plant premises.
12. All the solid sludge (Brine sludge) are stored in side the plant premises.
13. Proper storage facilities provided to store used lubricating oil as transformer oil (hazardous waste)
14. The mercury bearing brine sludge generated from 1984-1998 with mercury cells stored in side the plant premises in impervious brine sludge pit no.1 as referred under non-hazardous waste (Management & Handling) 1989. Now PPCB has declared it as Non-Hazardous Waste Brine Sludge.

PART- I

(Any other particulars for improving the quality of the environment.)

Detailed Report Enclosed

CHAPTER – 1

EXECUTIVE SUMMARY

- For preparation of Environmental Statement (Environmental Audit) for the assessment year 2020-2021, M/s Punjab Alkalies and Chemicals Ltd., Nangal-Una Road, Naya Nangal, Punjab retained M/s. Mantec Consultants Pvt. Ltd., New Delhi.

- M/s. Punjab Alkalies and Chemicals Ltd. are manufacturing Caustic Soda Lye as the principal product, Chlorine and Hydrogen as co-products and Hydrochloric Acid, Sodium Hypochlorite and Spent Sulphuric Acid as by-products.

- Detailed manufacturing process for the production of principal and by products has been described in this Environmental Statement. Different manufacturing units have been dealt with individually, giving chemical reactions of various processes.

- A statement of quality and quantities of raw material, consumed vis-a-vis products and by-products manufactured has been projected.

- Material balancing of raw material utilized and products & by-products manufactured has been carried out and mentioned in the report. Tables clearly giving the inputs & outputs have been presented. Such balancing indicates that negligible quantities of raw material, products and by-products are coming out in the form of waste. On the whole, the materials are getting balanced comprehensively.

- The quality and quantity of pollution generated in the form of liquid, solid and gaseous emissions have been assessed. Their method of treatment and disposal has been described as pollution control measures.

  It has been observed that the air emissions coming out of the treatment facilities conform to the prescribed standards. Satisfactory measures have been adopted for the storage of sludge generated from the process and treatment facilities.

- Impacts of such pollution control measures have been assessed and described. The study reveals that with such measures there are no negative impacts on different environmental media viz. Ground water, surface

water, soil, atmosphere, flora & fauna. There are no cultural site/ ancient monuments, etc in the vicinity of the industry.

- Energy consumption for air and water pollution control equipment for the year 2020-2021 has been detailed.

- The industry has well taken care the area of development of vegetation. The management has planted about 6600 trees/shrubs.
- The management of the industry being conscious of environmental protection has taken several steps in this direction and have made several significant achievements.

- Overall, the industry is doing well for conserving the environment and has taken the appropriate steps for controlling the pollution levels.

CHAPTER-2

PREAMBLE

2.1 GENERAL

In pursuance of the Gazette Notification No. 155.GSR383(E) dated 28th April, 1993 by Govt. of India, Department of Environment, Ministry of Environment & Forests (MoEF), M/s Punjab Alkalies & Chemicals Ltd. (PACL), Naya Nangal, appointed M/s. Mantec Consultants Pvt. Ltd., New Delhi for carrying out Environmental Audit (Presently called Environmental Statement), under the provision of Law. This report has been prepared on the basis of data / information furnished by the industry.

2.2 BRIEF COMPANY PROFILE

M/s. Punjab Alkalies and Chemicals Ltd. (PACL), Naya Nangal, is a Chlor-alkali unit, manufacturing Sodium Hydroxide (Caustic Soda) from Sodium Chloride (Brine) by electrolytic process, generating the attendant by- products viz., chlorine hydrogen, hydrochloric acid and bleach liquor (sodium hypochlorite).

The plant was commissioned in January 1984 at a cost of Rs 35 crores, with technical collaboration from Uhde-Gmbh, Germany with a production capacity of 33,000 TPA of Caustic soda. Due to the enhanced market potential, PACL augmented caustic soda production capacity from 33,000 TPA to 40,730 TPA in 1989-90 and subsequently it was further increased to 73,750 TPA in the year 1995-96 by installing 100 TPD membrane cell plant. The membrane cell plant converted to 200 TPD from 170 TPD in the year 1998. The present production capacity of the plant is approximately 99,000 TPA.

The management being conscious for the welfare of its employees has provided facilities of a canteen, rest room, personal protective equipment etc. By way of perks, canteen allowance, liveries and washing allowances have been granted to the entitled employees.

2.3 LOCATION

The Punjab Alkalies & Chemicals Ltd., Naya Nangal complex is located west of Sutlej River, 1 km from Nangal-Una State Highway No. 22. It is 16 km from Bhakra Dam, on a sprawling plot area of approximately 35 hectares (86 acres), with corporate office at Chandigarh.

CHAPTER – 3

MANUFACTURING PROCESS

3.1 GENERAL

The basic ingredients for the manufacture of main products (Caustic soda, chlorine & hydrogen) and by-products (hydrochloric acid, sodium hypo-chlorite is sodium chloride (common salt) and water.

Detailed manufacturing processes of products and by-products are as follows:-

3.2 MANUFACTURING PROCESS BY MEMBARANE CELL TECHNOLOGY

3.2.1 Salt Handling & Brine Treatment

For the manufacture of sodium hydroxide, principal raw material is industrial grade sodium chloride. This salt of approximately 97% purity, procured mainly from Gujarat is transported to the plant by railway wagons & trucks. The salt unloaded inside the factory is manually transferred to the salt yard from where it is fed to the saturators through bucket elevators. The saturated brine of about 310 gm/liter concentration flows to the precipitation tank, where the impurities of calcium, magnesium, sulphates, iron and other insoluble contents are removed by treating it with chemicals like soda ash, caustic soda, barium carbonate and flocal. The treated brine flows to the clarifier where the impurities are allowed to settle and removed as sludge.

3.2.2 Brine Clarification

From the precipitation tank, the brine overflows to the central inlet of the clarifier. Here, a definite quantity of flocculent solution is mixed with the brine. In the clarifier, the major portion of solids is removed from the brine and are discharged from the underflow to the vacuum drum filter. From the clarified brine tank, it is pumped to the anthracite filters.

3.2.3 Brine Filtration and Polishing

To remove any residual solid impurities, the clarifier brine is filtered through two stage of filtration:

First Stage of Filtration : Anthracite Filters
Second Stage of filtration : Polishing Filters

Polished brine is collected in a polished brine tank and is pumped through a recuperator in order to heat the brine to 65^{o} C (approximately).

3.2.4 Secondary Brine Purification

From the brine recuperator, the polished brine is sent to the secondary purification section. This section serves to remove the calcium and magnesium cations still contained in the brine to the residual content of less than 30ppb. The brine is purified in two ion exchange columns connected in series. The pure brine passes to the brine head tank via brine heat exchangers which serve to heat brine during the start up and also serve to cool brine during shut down.

3.2.5 Electrolyser Section

Pure brine of 310 ± 10 gm per liter NaCl is fed to anodic side of electrolyser. Membrane, which is partition between anodic and cathodic cells, selectively allows only Na ions and does not allow OH and Cl ions to pass through. Also 3-4 moles of H2O per mole of Na+ ions penetrate through membrane towards cathodic side (cathode is of Nickel and anode is of Titanium construction). Cl evolves at anodic side and H_2 evolves on cathodic side. Anolyte coming out of the cells is of 200-220 gm/liter i.e. depletion is 90-110 gm/liter of NaCl. A portion of the catholyte is pumped to caustic concentration unit for further concentration of the product to 47.5% from 32$\pm$ 2 %. Anolyte from cells is passed to anolyte tank, which after dechlorination and pH adjustments, termed as lean brine, is pumped to the brine saturators.

3.2.6 Chlorate Destruction

To a purge stream of anolyte, HCl is added and heat is applied through steam. This causes the chlorate to break up to give chlorine, which is sent to the chlorine system. The acidified anolyte free from chlorate is sent back to the anolyte steam.

3.2.7 Catholyte and Hydrogen

Catholyte and H_2 mixture from catholyte side of electrolysers are sent to the catholyte tank from where 32-33 % caustic is pumped to the storage tanks and a part of it is pumped back to the electrolyser through a cooler after adding DM water to it. Hydrogen is separated in a catholyte header itself and is sent for processing. H_2 is cooled in a heat exchanger to about 45^0 C and is sent to demister through a safety vessel and is finally transferred to HCl synthesis unit and to other destinations like boiler, flakers and bottling units.

3.2.8 Hydrogen Handling

Hydrogen gas is separated from catholyte and is pumped from gasholder to (i) HCl plant for making hydrochloric acid, (ii) to fusion plant for the use as a fuel (iii) a neighboring hydrogen bottling plant and (iv) to the boiler.

3.2.9 Chlorine Handling and Filling

Chlorine liberated in the anode compartment of the electrolyser is saturated with anolyte and the same after separation is treated in the chlorine section of the plant. In this section the gas is cooled, dried with sulphuric acid and compressed to a pressure of 3.2 Kg/ cm^2. The compressed gas is liquefied in the liquefier using freon 22 as refrigerant. The liquid chlorine flows to one of the four insulated MS storage bullets. From the bullets, tonners are filled with 900 Kg. Chlorine, inspected and tested before dispatch.

3.2.10 Hydrochloric Acid Unit

A portion of chlorine gas after Cl2 compressors is diverted to HCl plant and is burnt with hydrogen gas in a furnace to form hydrochloric acid following the reaction given below:

$H_2 + Cl_2 \longrightarrow 2HCl$

The HCl vapours are absorbed in water to form 30-33% HCl. The residual unabsorbed HCl gas coming out of the primary absorber is now absorbed in water in the tail gas absorber forming weak acid which flows to primary absorber to form concentrated acid. HCl is stored in three FRP/MS rubber lined tanks.

3.2.11 Sodium Hypochlorite Production

In this section of the plant, fugitive chlorine gases from all sources are taken for neutralization with caustic soda to form sodium hypochlorite bleach liquor so that the chlorine emission to the environment is eliminated. This not only minimizes the emissions of dangerous chlorine to the atmosphere but also adds to revenue generation. The process involves the following reactions:

Sodium hypochlorite (NaOCl)

$2NaOH + Cl2 \longrightarrow NaOCl + NaCl + H2O$

CHAPTER -4

PRODUCTION IN THE YEAR OF 2020-2021

4.1 PRODUCTS

List of products manufactured by PACL with quantities as reported by the management, are given below in Table - 4.1

Table - 4.1

PRODUCTION DETAILS

S. No.	Name of the Product	Units	Production in the year 2020-21
1.	Caustic Soda Lye Gross (Net Production)	MT	84243.459 (81327.995)
2	Liquid Chlorine	MT	61665.910
4	Hydrochloric Acid	MT	44911.656
5	Hydrogen gas	Nm^3	23588169.3
6	Sodium Hypochlorite	MT	13418.310

CHAPTER-5

MATERIAL BALANCE

5.1 SODIUM HYDROXIDE UNIT

5.1.1 Input / Output Statement for the year 2020-2021

Annual Input				Annual Output		
Sl. No.	**Input**	**Unit**	**Quantity**	**Output**	**Unit**	**Quantity**
i.	Salt	MT	133947.113	NaOH	**MT**	84243.459
ii.	Soda Ash	MT	277.500	Cl_2 (gas)	**MT**	74639.700
iii.	Barium Carbonate	MT	466.560	H_2	**Nm3**	23588169.3
iv.	Flocculants	KGS	1361.500	Liquid Chlorine	**MT**	61665.910
v.	Water	KL	391642	SodiumHypo	**MT**	13418.310
vi.				Hydrochloric Acid	**MT**	44911.656

5.1.2 Material Balancing for the year 2020-2021

a. Basis

i. $2NaCl + 2H_2O \rightarrow 2NaOH + Cl_2 + H_2$

$116.91 + 36.032 \rightarrow 80.016 + 70.91 + 2.016$

ii. Average Purity of crude NaCl = 98.80%

iii. Average cell efficiency = 95% (Unit I-95%, Unit II-95%)

b. Calculation

Pure NaCl available in crude salt 133947.113 x 0.965 per annum= 129258.964

Product	Calculation based on stoichiometric equation	Theoretical Production (MT)	Actual Production (MT)	Percentage Variation
NaOH	(129258.964 x 80.016 / 116.91) x 0.988	88467.92633	84243.459	(+)0. 236%
Cl_2 (gas)	(129258.964 x 70.91/116.91) x 0.988	78400.07818	74639.7	(+)0.214%
H_2	(129258.964 x 2.016 / 116.91) x 0.988	2228.945954	2290.822	(+)7.566%

The variation in actual production is due to variation in current efficiency caused by deterioration in membrane conditions.

5.2 CHLORINE BALANCE

5.2.1 Chlorine Utilization Statement for the year 2020-2021

Generation	Quantity (MT)	Utilization	Quantity (MT)
Chlorine Gas Produced	74639.700	Production of liquid chlorine	61665.910
Chlorine gas from tonner purging	1356.674	Chlorine gas to HCl plant	13030.098
		Chlorine gas from process neutralized in Sod hypo plants	1300.366
Total chlorine generated	**75996.374**	Total chlorine utilized	**75996.374**

5.3 HYDROGEN BALANCE

5.3.1 Hydrogen Utilization Statement for the year 2020-2021

Generation)	Quantity(NM3)	Utilization (Nm^3)	Quantity(NM3)
H_2 Gas produced	23588169.3	H_2 in HCl plant	6009379.4
		H_2 dispatched	2486989.0
		H_2 for Boilers	11761704
		H_2 Vent	3330096.9
Total	**23588169.3**	**Total**	**23588169.3**

5.4 HYDROCHLORIC ACID PLANT

5.4.1 Input Output Statement for the year 2020-2021

Input	Quantity(MT)	Output	Quantity(MT)
Chlorine gas	13030.098	Hydrochloric acid	44911.656
Hydrogen gas	537	Average Conc.	30.20%
Water (DM Water)	-	HCl Content (100%)	13563.320

5.4.2 Material Balancing for the year 2020-2021

a. Basic

i. H_2 + Cl_2 → 2HCl
2.016 + 70.91 → 72.926

ii. Average concentration of product HCl = 30.20%

b. Calculation

(14738.491x 72.926 x 100) / (30.20 x 70.91) = 50190.437

Theoretical Production (MT)	Actual Production (MT)	% age Variation	Remarks
50190.437	53759.027	(+) 8.457%	Concentration variation

5.4.3 Material Balancing for the year 2020-2021

Chlorine utilized for Sodium Hypo Product = 1823.671 MT
Quantity of sodium hypochlorite liquor produced = 18843.01 MT
Chlorine input in Sodium Hypochlorite liquor = 1823.671 MT

$2\ NaOH + Cl_2 \rightarrow NaOCl + NaCl + H_2O$

5.5 SODIUM HYPOCHLORITE PLANTS

5.5.1 Input Output Statement for the year 2020-2021

Input	Quantity(MT)	Output	Quantity(MT)
Chlorine gas for Sodium hypo	1300.366	Sodium Hypo Chlorite Liquor	13418.310
Caustic soda for Sodium hypo MT	2112.365	Available Chlorine (%)	9.691%
Total chlorine input	1300.366	Total chlorine output	1300.366

5.6 WATER BALANCE

5.6.1 Water Utilization Statement for the year 2020-2021

Input	Quantity (m^3)	Output	Quantity (m^3)
Water drawn from RIVER SATLUJ	391642	Water consumed for process	214084
Water drawn from PACL Colony Bore well	343743	Domestic water consumption inside plant	27375
		Domestic water consumption in PACL Housing colony	343743
		Water consumed for Industrial cooling	150183
Total water drawn	**735385**	**Total water Utilization**	**735385**

CHAPTER-6

POLLUTION GENERATION

6.1 INDUSTRIAL LIQUID EMISSIONS (WASTE WATER)

6.1.1 Raw Water

The main source of raw water for M/s PACL, Naya Nangal is River Satluj flowing across the Naya Nangal town. As given in Table 6.1 the total water consumption of PACL for financial year 2020-2021was 391642 m^3 out of which 27375 m^3 was used for domestic purpose, 214084 m^3 was used in the process and 150183 m^3 was used for industrial cooling. Based on the data provided by PACL, the quality of process water is given at Table 6.1 Since there are substantial losses through evaporation in process of industrial cooling, the figure given above reflects only the make-up water. As on an average 40000 m^3 per month of industrial cooling water from different units is recycled through cooling towers, the make-up water or evaporation losses work out to mere 3.5% of water recycled.

Table-6.1

Water Utilization Statement

Total water drawn in 2020-2021	391642 m^3
Total water used in 2020-2021 for	
Domestic	27375 m^3
Process	214084 m^3
Industrial Cooling	150183 m^3
	…….
	391642 m^3

Table – 6.2
Process Water Quality
(2020-2021)

Sl. No.	Parameter	Concentration Values		
		Min.	Max.	Avg.
1.	pH	7.0	7.8	7.4
2.	Total Hardness as $CaCO_3$	95	110	105
3.	Chlorides as Cl	7.10	10.2	8.85

Note:- Except pH all values are in mg/l

6.1.2 Effluent Generation

Approximately 79.827m^3/day of waste water is generated from process which is discharged after treatment.

6.1.3 Effluent Treatment

M/s PACL consumed 27375 m^3 of water for domestic purpose and 214084 m^3 for process in 2020-2021. The characteristic of the process is given in Table-6.2. A part of this water is consumed and the remaining comes out as effluent. The month-wise characteristics showing minimum, maximum and average values of relevant parameters in process effluent are given at Table 6.3. These tables show that the characteristics of effluent after treatment are within the stipulated standards.

Table – 6.3

Treated Effluent Quality (Per Month)

Month	pH	Total Suspended Solids (mg/l)	Total Residual Chlorine (mg/l)
April, 2020	7.6	25	Nil
May, 2020	7.6	25	Nil
June, 2020	7.6	24	Nil
July, 2020	7.6	24	Nil
August, 2020	7.6	26	Nil
September, 2020	7.5	26	Nil
October, 2020	7.6	25	Nil
November, 2020	7.6	26	Nil
December, 2020	7.6	25	Nil
January, 2021	7.6	26	Nil
February, 20221	7.6	26	Nil
March, 2021	7.5	27	Nil

Table – 6.4

Treated Effluent Quality (2020-2021)

Sl. No.	Parameter	Concentration Values		
		Min.	**Max.**	**Avg.**
1	pH	7.3	7.8	7.5
2	Total Suspended solids	20	30	25.00
3	Total Residual Chlorine	Nil	Nil	Nil

Note:- Except pH all values are in mg/l

6.2 INDUSTRIAL GASEOUS EMISSIONS

6.2.1 Source of Gaseous Emission

Following are the source of gaseous emission from the industry.

i. **HCl Plant:** In the hydrochloric acid plant, hydrogen and chlorine are burned to produce hydrochloric acid. During the process, there is a high probability of emission of vapors and mist of hydrochloric acid and unburned chlorine. To capture such emission, the secondary absorber has been provided. Residual chlorine in the tail gas is absorbed in water to make weak acid, which is fed to the primary absorber.

ii. **Chlorine Gas:** In this plant unutilized gas from the process is fed to the waste air dechlorination unit where it is reacted with caustic solution to form sodium hypo separately. The capacity of the dechlorination units are sufficient to neutralize the waste gas of the plant. The emission of chlorine from hypo vent remains well within the limits.

iii. **Boilers:** There are three oil boilers:

a) Thermax Boiler of capacity 5 MT and fuel used is H2-Gas / Furnace Oil.
b) Sterling Boiler of capacity 10 MT and fuel used is H2-Gas / Furnace Oil. Hydrogen gas, a by-product of the industry, is used as fuel along with fuel oil in the boilers which is a non polluting fuel.
c) Third Boiler i.e HUSK FIRED BOILER of capacity 8 MT , Rice Husk is used as fuel having bag filters as APCD.

The design of the boilers is such that the resultant gaseous emissions are within the limits as prescribed by the regulatory agencies.

6.2.2 Emission Characteristics

The major gaseous pollutants emitted from PACL, Naya Nangal are hydrochloric acid vapor and mist from HCl plant, hydrogen from hydrogen vent and chlorine from hypo stack. The industry is continuously monitoring their stacks through out the year and results are submitted every month to Punjab Pollution Control Board. The emission characteristics of different stacks of Unit-I and Unit-II are given in Table 6.4 and 6.5.

TABLE-6.5

STACK MONITORING DATA (MONTHLY)

Month	Membrane Cell, Unit-I		Membrane Cell, Unit-II	
	Hypo Stack	HCL Stack	Hypo Stack	HCl Stack
	Chlorine, mg/m^3	HCl, mg/m^3	Chlorine, mg/m^3	HCl, mg/m^3
April, 2020	-	-	9.62	10.19
May, 2020	-	-	9.72	10.00
June, 2020	-	-	9.84	9.89
July, 2020	-	-	9.64	10.17
August, 2020	-	-	9.55	10.34
September, 2020	-	-	9.66	10.12
October, 2020	-	-	9.76	10.04
November, 2020	-	-	9.60	10.19
December, 2020	-	-	10.40	10.60
January, 2021	-	-	9.21	9.82
February, 2021	-	-	10.23	9.91
March, 2021	-	-	9.76	9.59

TABLE-6.6

SOURCES OF AIR EMISSIONS AND POLLUTION LOAD IN UNIT-I & II (2020-2021)

Sl. No.	Source of Air Pollution	Pollutant	Avg. Conc. of Pollutants (mg/Nm^3)		Pollution Load (kg./day)	
			Unit-I	Unit-II	Unit-I	Unit-II
1.	HCI Vent	HCl	-	10.07	-	2.01 X 10^-3
2.	Hypo Stack	Chlorine	-	9.75	-	1.95 X 10^-3

6.3 SOLID WASTE

6.3.1 Source

There is continuous generation of non-hazardous waste from the process of PACL. Following are the sources of its generation.

Sl. No.	Type	Source
1.	Non-hazardous solid waste (Brine sludge)	Saturator Precipitation tank Chemical tank/pits Drum filter/Decanter Brine clarifier

6.3.2 Generation

The total non-hazardous waste generated from PACL for the assessment year 2020-2021 was **2763.995** MT (wet basis) and **1853.535 MT** (dry basis). The quantities of sludge generated from Unit-I and Unit-II from different sections are given in Table-6.7 and 6.8.

Table – 6.7

QUANTITY OF SLUDGE FROM PACL SOLID WASTE (BRINE SLUDGE) PER MONTH

Moth	Basis	Membrane Cell, Unit-I				Membrane Cell, Unit-II			
		Brine sludge from drum filter/ decanter, MT	Brine sludge from brine sludge pits, MT	Brine sludge from precipitation tanks/ vessels, MT	Sludge from brine saturator, MT	Brine sludge from drum filter/ decanter, MT	Brine sludge from brine sludge pits, MT	Brine sludge from precipitation tanks / vessels, MT	Sludge from brine saturator, MT
April, 2020	Wet	-	-	-	-	55.451	197.032	16.043	18.951
	Dry	-	-	-	-	34.850	128.465	10.460	12.356
May, 2020	Wet	-	-	-	-	69.003	233.226	6.076	15.229
	Dry	-	-	-	-	42.480	147.865	3.852	9.655
June, 2020	Wet		30.570		72.730	75.404	241.276	14.373	25.280
	Dry		19.895		47.042	48.560	155.382	9.256	16.280
July, 2020	Wet	-	-	-	-	60.597	126.800	11.410	21.450
	Dry	-	-	-	-	38.321	80.240	6.411	12.520
August, 2020	Wet	-	-	-	-	46.907	178.470	0.000	21.440
	Dry	-	-	-	-	29.270	111.365	0.000	10.820
September,2020	Wet	-	-	-	-	63.250	67.452	11.250	18.044
	Dry	-	-	-	-	38.660	42.562	6.325	11.386
October, 2020	Wet	-	-	-	-	23.450	135.193	18.450	15.820
	Dry	-	-	-	-	14.260	84.563	12.466	9.255
November,2020	Wet	-	-	-	-	71.650	150.520	0.000	19.852
	Dry	-	-	-	-	46.720	98.363	0.000	11.440
December, 2020	Wet	-	-	-	-	53.487	148.625	14.420	15.004
	Dry	-	-	-	-	33.456	92.465	8.523	9.385
January, 2021	Wet	-	-	-	-	30.845	62.325	7.310	24.242
	Dry	-	-	-	-	19.278	36.466	4.231	14.632
February, 2021	Wet	-	-	-	-	56.553	156.452	12.402	15.652
	Dry	-	-	-	-	36.420	98.365	7.216	9.266
March, 2021	Wet	-	-	-	-	46.120	119.310	21.325	17.964
	Dry	-	-	-	-	28.660	79.330	13.072	11.425

Table – 6.8

QUANTITY OF SLUDGE FROM PACL
SOLID WASTE (BRINE SLUDGE)

Sludge	Unit-I		Unit-II		Total	
	Wet (X1)	Dry (Y1)	Wet (X2)	Dry (Y2)	Wet (X1+X2)	Dry (Y1+Y2)
Brine Sludge from Drum Filter/Decanter (MT)	30.570	19.895	652.717	410.935	683.287	430.830
Brine Sludge from brine sludge Pits, MT	-	-	1816.681	1155.431	1816.681	1155.431
Brine Sludge from precipitation Tanks / Vessels, MT	-	-	133.059	81.812	133.059	81.812
Sludge from brine saturator, MT	72.73	47.042	228.928	138.420	301.658	185.462
Total Solid Waste Generated, MT	**103.3**	**66.937**	**2831.385**	**1786.598**	**2934.685**	**1853.535**

6.3.3 Characteristics of Solid waste generated.

Quality of solid wastes generated is continuously monitored and recorded. The characteristics of solid waste generated from various sections during the year 2020-2021 are given in table 6.9.

Table – 6.9
PUNJAB ALKALIES & CHEMICALS LTD.

Average Quality of Brine Sludge Generated During Year 2020-2021

Sl. No.	Parameter	Unit	Membrane Cell, Unit-I	Membrane Cell, Unit-II
1	Loss on Drying (water)	%	33.14	32.94
2	NaCl	%	12.01	11.75
3	Calcium as $CaCO_3$	%	11.34	11.32
4	Magnesium as $Mg(OH)_2$	%	8.74	9.22
5	Acid insoluble	%	34.77	34.79

CHAPTER – 7

POLLUTION CONTROL

7.1 EFFLUENT TREATMENT

The industry has two process streams (Unit-I & Unit-II) to produce caustic soda and chlorine with membrane cell technology. Each process unit is having separate effluent treatment plant. The effluent from various sections such as Primary Brine Section, Secondary Brine Section, DM Water, Cell House, HCl Plant, Utility Section, Boiler Section etc., are taken to the effluent treatment plant through in-plant effluent collection channels. The streams may be acidic or alkaline in nature. There is no other contamination in the effluent. The effluent is neutralized by proper pH adjustment by adding caustic or HCl and is finally pumped to RO plant for further treatment and the return water from RO is used in the process in cooling towers as makeup water.

Effluent Treatment Plant in Unit-I

The flow diagram of effluent treatment plant is given in Fig. 7.1. Effluent treatment plant in unit-I has one collection pit, two settling chambers and one final chamber. Size and capacity of unit-I ETP is as under:

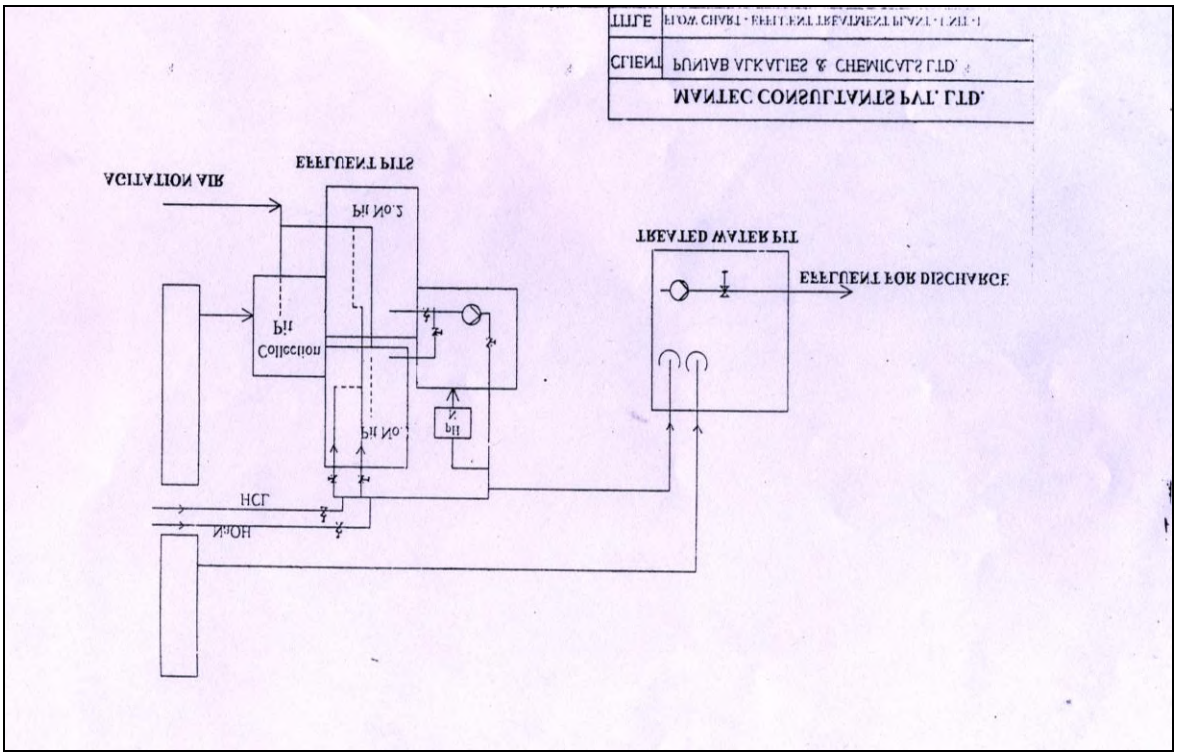
Pit/Chamber	**Size**		
Units	**Length**	**Breadth**	**Depth**
Collection pit	1.3 M	1.3 M	2.1 M
Mixing cum settling chamber-I	7.75 M	5.70 M	3.3 M
Mixing cum settling chamber-II	7.75 M	5.70 M	3.3 M
Treatment Chamber	10.9 M	4.6 M	3.3 M

Treatment capacity: 500 m^3/day

Effluent from various sections of Unit-I is collected in the collection pit and is taken to one of the two settling chambers where it is allowed to mix properly. Spurger's are provided for spurging compressed air. After proper mixing it is allowed to settle. One settling chamber remains under operation while the other is kept as a standby, which is taken into line when last one is taken out for mixing and settling.

From the mixing cum settling chambers, the effluent is pumped to treatment chamber where a chemical such as caustic soda or HCl is added from overhead storage tank for pH adjustment of the effluent. pH is continuously monitored and the required caustic or hydrochloric acid is added. Air is passed through spurges provided in the chamber for proper mixing and it is circulated through a pump. The capacity of the pump is 40m^3/hr. After the pH is maintained at round 8, the effluent is pumped through HDPE pipeline to RO plant (capacity 300m^3/day) for further purification to achieve the desired TDS value of less than 500 ppm. The RO return water is used in the process in cooling towers as makeup Water.

Fig 7.1 Flow Charts –Effluent Treatment Plant, Unit-1



Effluent Treatment Plant in Unit-II

The effluent treatment plant for Unit-II is given in Figure 7.2. The treatment plant has been renovated and following provisions has been made:

a. Effluent treatment plant is divided into two sections and each section having 2 compartments. Effluent can be taken independently to each of the sections for treatment.
b. Additional two pumps have been provided so that each section of ETP can be operated independently.
c. Chemical dosing such as caustic soda and IICI, required for neutralization of acid/alkali is provided separately for each section of the ETP. Continuous pH measurements for determining the quality of effluent and also automatic flow measurements have been provided.

Details of effluent treatment plant

	Size		
Units	**Length**	**Breadth**	**Depth**
Collection pit	4.0 M	5.58 M	2.35 M
Settling chamber and Treatment chamber	19.95 M	5.595 M	2.35 M

Treatment Capacity: 750 m^3/day

There are two such units and each unit is taken for use alternatively. Effluent from all the sections of the plant is taken to the collection pit to one section of the ETP through in-plant channels into effluent collection chamber are allowed to settle and the overflow from first chamber goes to 2nd chamber. After it is filled up, the incoming effluent to this section is stopped and the same is taken to the collection pit of the 2nd section of the ETP. Effluent taken to the 1st section is first mixed by spurging with compressed air for which one air compressor has been installed and spurging has been provided in the 2nd chamber. The effluent is circulated and the pH is maintained through on line pH analyzer. According to requirement, caustic and HCl is added to neutralize the effluent to get a pH value of 8. After reaching the desired pH, addition of alkali or acid is stopped and the effluent is further circulated till constant pH is maintained.

Thereafter other parameters such as TDS, TSS, and chlorine are measured. If chlorine is found in excess then same is destroyed with sodium bisulphite. After the quality of the related effluent meets the desired specification, the same is pumped through HDPE pipe line to RO plant (capacity 300m^3/day) for further purification to achieve the desired TDS i.e. less than 500 ppm and the return water from RO plant is used in the process in cooling towers as makeup water.

To further check the effluent analysis are carried out at regular basis. The minimum, maximum and average values of the effluent from Unit-I and Unit-II are given in Table-7.1.

Table – 7.1

Treated Effluent Quality (2020-2021)

Sl. No.	**Parameter**	**Concentration Values**		
		Min.	**Max.**	**Avg.**
1	pH	7.4	7.7	7.6
2	Total Suspended solids	20	30	25.00
3	Total Residual Chlorine	Nil	Nil	Nil

Note:- Except pH all values are in mg/l

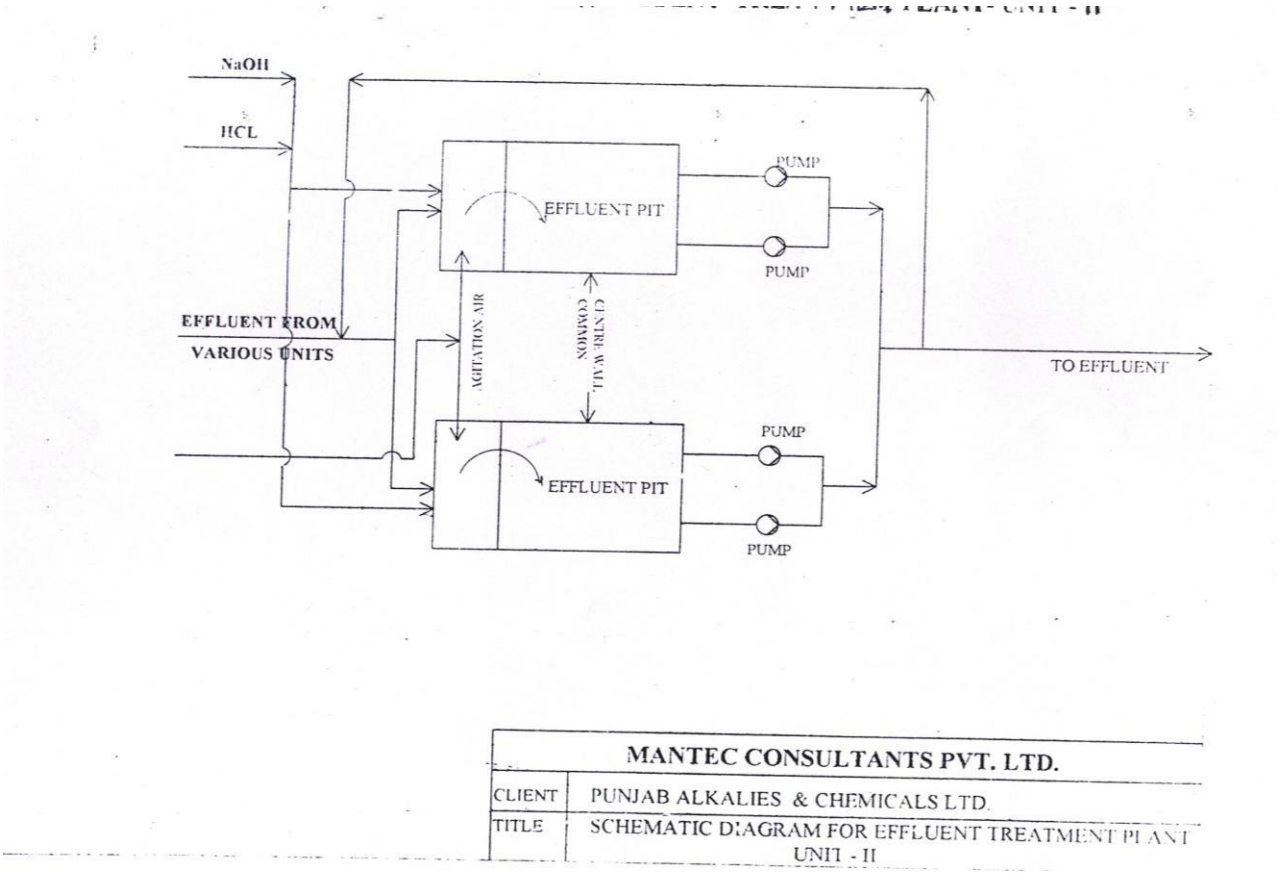


Fig 7.2 Schematic Diagram –Effluent Treatment Plant, Unit-II

7.2 AIR POLLUTION CONTROL

Chlorine gas and HCl fumes are the main sources of air pollution generated in the plant from various process streams, tanks, vessels, process equipments, pipe lines during manufacturing, storing or handling of chlorine etc. All the fugitive emissions of chlorine gas are sucked through a blower and are passed through waste air dechlorination unit where waste chlorine gas is neutralized with caustic soda solution. Similarly HCl fumes generated from the storage tank and during HCI preparation are taken to the above unit where it is neutralized with the alkali.

Chlorine gas produced in the electrolyzer is taken for cooling, drying, compression and liquefaction for making liquid chlorine. The unliquidified chlorine gas is known as sniff gas which is taken to HCl plant for burning with hydrogen to make HCl and the sniff gas which can not be burned in HCl plant is taken to waste air dechlorination units. If the hydrogen content in the chlorine is higher then the sniff gas will have higher percentage of hydrogen gas. Beyond 4% hydrogen in chlorine forms explosive mixture and therefore the liquefaction

efficiency is maintained to keep the hydrogen percentage in sniff chlorine gas below 4%. Thus, it is possible to liquify the gas to a maximum possible in membrane cell plant.

Under normal plant conditions, about 500 kgs. of chlorine gas is required to be neutralized in Unit-I and 1000 kgs of chlorine is required to be neutralized in Unit-II.

A unit wise detail of the air pollution treatment and control system is given below:

In the waste air dechlorination plant of Unit-I, there are three sodium hypo towers where caustic soda and chlorine reacts counter currently. The waste chlorine gas enters into the first tower and the caustic soda enters into third tower. The caustic overflows from the third tower, goes to second tower and the overflow from the second tower goes to the first tower. Chlorine reacts with the caustic in the first tower and forms sodium hypochlorite, which overflows to the sodium hypo receiver and is withdrawn periodically as a product. The un-neutralized chlorine gas goes to the second tower where it reacts with caustic solution to make weak sodium hypo. The third tower acts as a buffer tower. In case, un-reacted chlorine gas leaves the second tower, then the same will get neutralized in that tower. In case of excess flow of chlorine to the first tower, the same is controlled/neutralized by automatic opening of caustic lye to the hypo tower no. I.

1. The flow of chlorine gas and caustic to the first tower is controlled by reduction
   Potential which is measured continuously in the first tower.

2. Neutralization capacity of the plant = 5 MT/day of chlorine gas

3. Caustic circulation pump capacity = 2 Nos. 20 m^3/hour capacity each

4. Hypo circulation pump capacity = 3 nos. 60 m^3/hour capacity each

Unit-II

In the waste air dechlorination plant of unit-II there are three sodium hypo towers and two calcium hypo towers in series. Under normal plant operation, waste chlorine gas from all sections of the plant is first taken to the sodium hypo towers where sodium hypo chlorite is formed by absorbing chlorine gas in caustic soda lye. Sodium Hypo Chlorite is collected in receiver and is withdrawn

periodically as a product. The unreacted chlorine gas is further passed to 2nd and 3rd tower for complete absorption in caustic soda lye and the final product is collected for sale. Similarly when the first sodium hypo tower gets exhausted the second hypo is taken in line.

i. Neutralization capacity of sodium hypo plant = 532 kg/hr. chlorine gas
ii. Neutralization capacity of calcium hypo plant = 500 kg/hr. chlorine gas
iii. Pump capacity

a. Sodium hypo circulation pump capacity = 3nos. 50 m^3 /hr. each
b. Calcium hypo circulation pump capacity = 2 numbers of 50 m^3/hr capacity each.

HCI Vapors

Each HCI furnace is provided with tail gas absorber. HCI vapor from the first absorber of the HCI furnace is taken to the tail gas absorber where acid mist is absorbed in waste to make weak HCI acid, the same is fed to the first absorber.

HCI vapor from tanks is taken to the waste air dechlorination unit for neutralization through the exhaust blower and pipeline arrangement.

A new HCI absorber has been installed in unit II to absorb all the gas from the road tanker during filling.

In order to keep a watch on the emission from various stacks, periodic monitoring of emission is carried out. Apart from this, ambient air quality is also monitored from time to time. The average ambient quality monitored at PACL is given in Table-7.2.

Table – 7.2

PUNJAB ALKALIES & CHEMICALS LIMITED, NAYA NANGAL
AMBIENT AIR MONITORING DATA (MONTHLY)

Month	Location of Respirable dust sampler		Parameter										
		PM_{10}, $\mu g/m^3$	**$PM_{2.5}$,** $\mu g/m^3$	**SO_2,** $\mu g/m^3$	**NO_2,** $\mu g/m^3$	**CO,** mg/m^3	**NH_3,** $\mu g/m^3$	**O_3,** $\mu g/m^3$	**Pb** $\mu g/m^3$	**As,** $\mu g/m^3$	**Ni,** $\mu g/m^3$	**Banzene**	**Benzo [a]pyrene**
April, 2020	Railway siding area	34	25	22	22	0.5	160	34	Nil	Nil	Nil	Nil	Nil
May, 2020	Railway siding area	32	28	25	20	0.5	150	32	Nil	Nil	Nil	Nil	Nil
June, 2020	Railway siding area	35	24	20	22	0.4	156	35	Nil	Nil	Nil	Nil	Nil
July, 2020	Railway siding area	30	28	24	25	0.4	150	36	Nil	Nil	Nil	Nil	Nil
Aug. 2020	Railway siding area	34	30	20	22	0.5	152	34	Nil	Nil	Nil	Nil	Nil
Sep. 2020	Railway siding area	32	26	22	20	0.4	148	36	Nil	Nil	Nil	Nil	Nil
Oct. 2020	Railway siding area	30	28	20	18	0.4	154	32	Nil	Nil	Nil	Nil	Nil
Nov. 2020	Railway siding area	32	25	18	20	0.5	145	35	Nil	Nil	Nil	Nil	Nil
Dec. 2020	Railway siding area	36	28	22	24	0.5	150	34	Nil	Nil	Nil	Nil	Nil
Jan. 2021	Railway siding area	32	24	20	22	0.4	160	32	Nil	Nil	Nil	Nil	Nil
Feb. 2021	Railway siding area	34	26	22	22	0.5	150	32	Nil	Nil	Nil	Nil	Nil
March 2021	Railway siding area	32	28	20	24	0.5	150	32	Nil	Nil	Nil	Nil	Nil

Table – 7.3

PUNJAB ALKALIES & CHEMICALS LIMITED, NAYA NANGAL
AMBIENT AIR MONITORING DATA
Average Annual data 2020-2021

Sl. No.	Location of High Volume Sampler	Parameters		
		Chlorine, $\mu g/m^3$	HCl, $\mu g/m^3$	SPM, $\mu g/m^3$
1.	Railway Siding Area	NIL	NIL	67.59
2.	Near Electrical Sub-station	NIL	NIL	64.27
3.	Near South–west Boundary	NIL	NIL	65.74

Note:- At all the locations, ambient air found within the prescribed limit (prescribed limit of SPM = 500 $\mu g/m^3$)

For ambient air monitoring three locations were selected to cover the entire plant area. The distance, direction and position selected for high volume sampler are as follows:-

Table – 7.4

AIR MONITORING LOCATIONS

Sl. No.	Location	Distance from Centre of the Plant	Direction
1.	Railway siding area	300 meters	E
2.	Electrical sub-stations	250 meters	N
3.	Near South–West Boundary	200 meters	S -W

7.3 SOLID WASTES GENERATION (BRINE SLUDGE)

The brine sludge presently generated in plant is non-hazardous as per Schedule – 1 of the hazardous waste Management & Handling Rules 2000 and the same is being stored in the old Calcium Hypo lagoon No-1.

7.4 NON HAZARDOUS WASTE STORAGE (BRINE SLUDGE FROM MERCURY PROCESS)

Approx 26642 M.T of Sludge generated earlier in Mercury cell process is stored in impervious brine sludge pit No-1 and the same is closed. It has been now declared as non-hazardous waste by PPCB.

7.5 HAZARDOUS WASTE GENERATION

(A) Used Transformer Oil and Used Lubricating Oil

Used transformer oil and used lubricating oil are the hazardous wastes generated from the process. These wastes are disposed by sale to authorized preprocessors under intimation to PPCB. Quantities of waste transformer oil and used lubricating oil generated during the year 2020-2021 are given below.

(i) Used Transformer Oil NIL Liter
(ii) Used Lubricating Oil NIL Liter

7.6 GROUND WATER QUALITY MONITORING

Ground water samples from five hand pumps installed inside the plant Premises at locations authorized by Punjab Pollution Control Board are regularly tested twice in every month and reports submitted to PPCB on monthly basis.

Hand pump no.	**Location**
1	**Near factory gate no. 1**
2	**Near Horticulture nursery**
3	**Near NFL boundary**
4	**Opposite stores building**
5	**Near raw water storage tank**

Physio-chemical qualities of ground water from above hand pumps tested during the year 2018-2019 are detailed in tables 7.6 (1), 7.6(2). 7.6 (3), 7.6 (4) and 7.6(5)

Table-7.6(1)
THE PHYSICO-CHEMICAL QUALITY OF HAND PUMP NEAR GATE NO.1

Parameter	April 2020		May 2020		June 2020		July 2020		August 2020		September 2021	
Date of Sampling	02.04.20	28.04.20	03.05.20	20.05.20	04.06.20	28.06.20	01.07.20	-	02.08.20	31.08.20	04.09.20	28.09.20
pH	7.5	7.3	7.4	7.5	7.6	7.4	7.5	-	7.5	7.7	7.5	7.6
Total Dissolved Solids,(mg/l)	260	264	260	262	262	280	272	-	290	278	280	285
Hardness(Total) as $CaCO_3$,(mg/l)	235	238	238	236	235	245	240	-	255	248	245	250
Chlorides as $CaCO_3$, (mg/l)	10	12	12	12	10	14	15	-	18	14	16	15
Sulphate as SO_4, (mg/l)	8	10	10	10	8	12	10	-	14	10	12	14
Mercury (mg/l)	NIL	NIL	NIL	NIL	NIL	NIL	NIL	-	NIL	NIL	NIL	NIL

The samples were colourless and odourless. Free Chlorine, Total Chlorine, and Ammonia were below detection limit.

At all the location noise found within the prescribed limit.

Prescribed permissible limits are:-

pH	:	6.5-8.5
Total Dissolved Solids, mg/l	:	2000
Total Hardness, mg/l	:	600
Chlorides as $CaCO_3$, mg/l	:	1000
Sulphate as SO_4, mg/l	:	400
Mercury, mg/l	:	No Relaxation

Table-7.6(1) (Contd…)

Parameter	October 2020		November 2020		December 2020		January 2021		February 2021		March 2021	
Date of Sampling	05.10.20	26.10.20	04.11.20	27.11.20	06.12.20	26.12.20	04.01.21	20.01.21	03.02.21	21.02.21	03.03.21	23.03.21
pH	7.4	7.5	7.6	7.4	7.5	7.5	7.5	7.6	7.5	7.5	7.5	7.6
Total Dissolved Solids,(mg/l)	280	272	268	280	280	280	272	280	278	290	280	278
Hardness(Total) as $CaCO_3$,(mg/l)	248	245	240	246	245	245	240	235	248	248	240	242
Chlorides as $CaCO_3$, (mg/l)	14	10	10	14	14	16	15	16	15	15	16	15
Sulphate as SO_4, (mg/l)	12	10	12	15	14	12	10	10	12	10	10	10
Mercury (mg/l)	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil

The samples were colourless and odourless. Free Chlorine, Total Chlorine, and Ammonia were below detection limit.
At all the location noise found within the prescribed limit.
Prescribed permissible limits are:-

pH	:	6.5-8.5
Total Dissolved Solids, mg/l	:	2000
Total Hardness, mg/l	:	600
Chlorides as $CaCO_3$, mg/l	:	1000
Sulphate as SO_4, mg/l	:	400
Mercury, mg/l	:	No Relaxation

Table-7.6(2)
THE PHYSICO-CHEMICAL QUALITY OF HAND PUMP LOCATED AT HORTICULTURE NURSERY

Parameter	April 2020		May 2020		June 2020		July 2020		August 2020		September 2020	
Date of Sampling	02.04.20	28.04.20	03.05.20	20.05.20	04.06.20	28.06.20	01.07.20	30.07.20	02.08.20	31.08.20	04.09.20	28.09.20
pH	7.4	7.5	7.4	7.3	7.5	7.4	7.6	7.5	7.4	7.7	7.6	7.7
Total Dissolved Solids,(mg/l)	258	260	265	270	274	290	280	292	285	275	268	282
Hardness(Total) as $CaCO_3$,(mg/l)	232	236	235	240	242	250	245	260	254	248	240	248
Chlorides as $CaCO_3$, (mg/l)	10	12	12	14	14	16	12	15	14	12	10	15
Sulphate as SO_4, (mg/l)	8	10	10	12	12	15	14	12	12	10	10	14
Mercury (mg/l)	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL

The samples were colourless and odourless. Free Chlorine, Total Chlorine, and Ammonia were below detection limit.
At all the location noise found within the prescribed limit.
Prescribed permissible limits are:-

pH	:	6.5-8.5
Total Dissolved Solids, mg/l	:	2000
Total Hardness, mg/l	:	600
Chlorides as $CaCO_3$, mg/l	:	1000
Sulphate as SO_4, mg/l	:	400

Table-7.6(2)
THE PHYSICO-CHEMICAL QUALITY OF HAND PUMP LOCATED AT HORTICULTURE NURSERY

Parameter	October 2020		November 2020		December 2020		January 2021		February 2021		March 2021	
Date of Sampling	05.10.20	26.10.20	04.11.20	27.11.20	06.12.20	26.12.20	04.01.21	20.01.21	03.02.21	21.02.21	03.03.21	23.03.21
pH	7.5	7.6	7.5	7.7	7.7	7.6	7.6	7.5	7.5	7.6	7.6	7.6
Total Dissolved Solids,(mg/l)	275	288	280	270	268	292	280	275	280	280	276	280
Hardness(Total) as $CaCO_3$,(mg/l)	245	250	244	240	240	260	244	250	240	244	244	248
Chlorides as $CaCO_3$, (mg/l)	12	16	14	12	12	14	14	12	12	12	12	14
Sulphate as SO_4, (mg/l)	10	15	16	10	10	10	12	12	10	10	10	12
Mercury (mg/l)	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL

The samples were colourless and odourless. Free Chlorine, Total Chlorine, and Ammonia were below detection limit.

At all the location noise found within the prescribed limit.

Prescribed permissible limits are:-

pH	:	6.5-8.5
Total Dissolved Solids, mg/l	:	2000
Total Hardness, mg/l	:	600
Chlorides as $CaCO_3$, mg/l	:	1000
Sulphate as SO_4, mg/l	:	400
Mercury, mg/l	:	No Relaxation

Table-7.6(3)
THE PHYSICO-CHEMICAL QUALITY OF HAND PUMP NEAR NFL BOUNDARY

Parameter	April 2020		May 2020		June 2020		July 2020		August 2020		September 2020	
Date of Sampling	02.04.20	28.04.20	03.05.20	20.05.20	04.06.20	28.06.20	01.07.20	30.078.20	02.08.20	31.08.20	04.09.20	28.09.20
pH	7.5	7.6	7.4	7.7	7.7	7.5	7.6	7.5	7.6	7.4	7.7	7.5
Total Dissolved Solids,(mg/l)	284	276	282	268	295	290	285	296	290	282	278	294
Hardness(Total) as $CaCO_3$, (mg/l)	250	245	248	240	255	250	248	260	255	250	242	255
Chlorides as $CaCO_3$, (mg/l)	18	15	16	12	18	15	16	18	15	14	15	18
Sulphate as SO_4, (mg/l)	12	14	12	14	10	12	10	15	14	12	14	15
Mercury (mg/l)	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL

The samples were colourless and odourless. Free Chlorine, Total Chlorine, and Ammonia were below detection limit.

At all the location noise found within the prescribed limit.

Prescribed permissible limits are:-

pH	:	6.5-8.5
Total Dissolved Solids, mg/l	:	2000
Total Hardness, mg/l	:	600
Chlorides as $CaCO_3$, mg/l	:	1000
Sulphate as SO_4, mg/l	:	400
Mercury, mg/l	:	No Relaxation

Table-7.6(3)
THE PHYSICO-CHEMICAL QUALITY OF HAND PUMP NEAR NFL BOUNDARY

Parameter	October 2020		November 2020		December 2020		January 2021		February 2021		March 2021	
Date of Sampling	05.10.20	26.10.20	04.11.20	27.11.20	06.12.20	26.12.20	04.01.21	20.01.21	03.02.21	21.02.21	03.03.21	23.03.21
pH	7.6	7.4	7.7	7.5	7.6	7.5	7.6	7.7	7.6	7.5	7.6	7.5
Total Dissolved Solids,(mg/l)	285	292	286	290	278	282	288	290	284	285	288	288
Hardness(Total) as $CaCO_3$, (mg/l)	250	252	250	252	242	250	260	248	244	255	244	248
Chlorides as $CaCO_3$, (mg/l)	16	18	15	18	16	15	16	15	15	15	15	16
Sulphate as SO_4, (mg/l)	14	16	14	16	15	14	12	14	14	15	15	15
Mercury (mg/l)	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL

The samples were colourless and odourless. Free Chlorine, Total Chlorine, and Ammonia were below detection limit.

At all the location noise found within the prescribed limit.

Prescribed permissible limits are:-

pH	:	6.5-8.5
Total Dissolved Solids, mg/l	:	2000
Total Hardness, mg/l	:	600
Chlorides as $CaCO_3$, mg/l	:	1000
Sulphate as SO_4, mg/l	:	400
Mercury, mg/l	:	No Relaxation

Table-7.6(4)
THE PHYSICO-CHEMICAL QUALITY OF HAND PUMP LOCATED OPPOSITE STORES

Parameter	April 2020		May 2020		June 2020		July 2020		August 2020		September 2020	
Date of Sampling	02.04.20	28.04.20	03.05.20	20.05.20	04.06.20	28.06.20	01.07.20	30.07.20	02.08.20	31.08.20	04.09.20	28.09.20
pH	7.6	7.7	7.5	7.6	7.7	7.4	7.6	7.4	7.7	7.5	7.8	7.6
Total Dissolved Solids, (mg/l)	270	280	275	264	292	270	285	280	294	285	275	290
Hardness (Total) as $CaCO_3$, (mg/l)	235	246	245	232	255	240	245	242	255	250	245	252
Chlorides as $CaCO_3$, (mg/l)	14	16	15	14	16	12	18	15	18	16	12	16
Sulphate as SO_4, (mg/l)	12	12	10	12	15	10	12	14	15	12	10	14
Mercury (mg/l)	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL

The samples were colourless and odourless. Free Chlorine, Total Chlorine, and Ammonia were below detection limit.

At all the location noise found within the prescribed limit.

Prescribed permissible limits are:-

pH	:	6.5-8.5
Total Dissolved Solids, mg/l	:	2000
Total Hardness, mg/l	:	600
Chlorides as $CaCO_3$, mg/l	:	1000
Sulphate as SO_4, mg/l	:	400
Mercury, mg/l	:	No Relaxation

Table-7.6(4)
THE PHYSICO-CHEMICAL QUALITY OF HAND PUMP LOCATED OPPOSITE STORES

Parameter	October 2020		November 2020		December 2020		January 2021		February 2021		March 2021	
Date of Sampling	05.10.20	26.10.20	04.11.20	27.11.20	06.12.20	26.12.20	04.01.21	20.01.21	03.02.21	21.02.21	03.03.21	23.03.21
pH	7.5	7.7	7.4	7.6	7.5	7.5	7.6	7.6	7.5	7.6	7.6	7.6
Total Dissolved Solids, (mg/l)	284	278	288	274	275	292	280	285	294	290	280	285
Hardness (Total) as $CaCO_3$, (mg/l)	250	245	250	244	245	246	255	240	244	248	248	244
Chlorides as $CaCO_3$, (mg/l)	14	14	10	12	14	14	14	16	16	18	18	18
Sulphate as SO_4, (mg/l)	12	16	12	12	12	12	10	14	14	12	14	14
Mercury (mg/l)	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL

The samples were colourless and odourless. Free Chlorine, Total Chlorine, and Ammonia were below detection limit.\

At all the location noise found within the prescribed limit.

Prescribed permissible limits are:-

pH	:	6.5-8.5
Total Dissolved Solids, mg/l	:	2000
Total Hardness, mg/l	:	600
Chlorides as $CaCO_3$, mg/l	:	1000
Sulphate as SO_4, mg/l	:	400
Mercury, mg/l	:	No Relaxation

Table-7.6(5)
THE PHYSICO-CHEMICAL QUALITY OF HAND PUMP NEAR RAW WATER STORAGE TANK

Parameter	April 2020		May 2020		June 2020		July 2020		August 2020		September 2020	
Date of Sampling	02.04.20	28.04.20	03.05.20	20.05.20	04.06.20	28.06.20	01.07.20	30.07.20	02.08.20	31.08.20	04.09.20	28.09.20
pH	7.4	7.6	7.5	7.6	7.6	7.4	7.5	7.6	7.7	7.5	7.8	7.6
Total Dissolved Solids, (mg/l)	270	278	280	264	280	292	288	285	290	278	286	275
Hardness (Total) as $CaCO_3$, (mg/l)	242	245	245	232	245	250	246	250	252	246	248	240
Chlorides as $CaCO_3$, (mg/l)	14	15	16	14	15	18	16	15	17	14	18	16
Sulphate as SO_4, (mg/l)	10	12	12	12	14	16	12	12	15	10	16	12
Mercury (mg/l)	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL

The samples were colourless and odourless. Free Chlorine, Total Chlorine, and Ammonia were below detection limit.

At all the location noise found within the prescribed limit.

Prescribed permissible limits are:-

pH	:	6.5-8.5
Total Dissolved Solids, mg/l	:	2000
Total Hardness, mg/l	:	600
Chlorides as $CaCO_3$, mg/l	:	1000
Sulphate as SO_4, mg/l	:	400
Mercury, mg/l	:	No Relaxation

Table-7.6(5)
THE PHYSICO-CHEMICAL QUALITY OF HAND PUMP NEAR RAW WATER STORAGE TANK

Parameter	October 2020		November 2020		December 2020		January 2021		February 2021		March 2021	
Date of Sampling	05.10.20	26.10.20	04.11.20	27.11.20	06.12.20	26.12.20	04.01.21	20.01.21	03.02.21	21.02.21	03.03.21	23.03.21
pH	7.5	7.7	7.5	7.6	7.7	7.7	7.6	7.7	7.6	7.5	7.6	7.5
Total Dissolved Solids, (mg/l)	280	276	285	275	278	285	288	280	278	290	280	280
Hardness (Total) as $CaCO_3$, (mg/l)	245	241	249	246	246	249	250	246	252	248	246	248
Chlorides as $CaCO_3$, (mg/l)	15	14	16	12	14	14	16	15	15	18	15	16
Sulphate as SO_4, (mg/l)	12	11	14	11	11	12	14	12	12	12	12	14
Mercury (mg/l)	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL

The samples were colourless and odourless. Free Chlorine, Total Chlorine, and Ammonia were below detection limit.

At all the location noise found within the prescribed limit.

Prescribed permissible limits are:-

pH	:	6.5-8.5
Total Dissolved Solids, mg/l	:	2000
Total Hardness, mg/l	:	600
Chlorides as $CaCO_3$, mg/l	:	1000
Sulphate as SO_4, mg/l	:	400
Mercury, mg/l	:	No Relaxation

7.6 POLLUTION CONTROL AND TESTING LABORATORY IN PACL

A well-equipped laboratory with qualified and trained manpower and also with modern analytical instruments is in round the clock functioning in PACL. A list of instruments and other lab equipments available if PACL lab is given below in table no. 7.7(1).

Table – 7.7(1)

LIST OF INSTRUMENTS IN POLLUTION CONTROL LABORATORY

Sl. No.	Name of Equipment / Instrument	Quantity (Nos.)
1.	pH meter/ Conductivity meter(Hach)	1
2.	Spectrophotometer(Hach DR3900 & DR6000)	2
3.	Fractional Weights (set)	1
4.	Mettler Balance(ME204)	1
5.	Mettler Balance(B205-S)	1
6.	Mettler Balance (ML204)	1
7.	Gas Chromatograph (AIMIL)	2
8.	Gas Chromatograph (AIMIL)	1
9.	Metrohm Coulometer(Metrohm)	1
10.	Melting point apparatus	1
11.	Flash Point Apparatus	1
12.	Electric oven (New ACMAS)	2
13.	Muffle furnace(New)	1
14.	Bomb Calorimeter (Tosniwal)	2
15.	Sound Level Meter	1
16.	Oxygen Analyser Nucon 101-H	1
17.	High volume sampler (Polltech)	3
18.	Handy Sampler KIMOTO/POLLTECH	2
19.	Flue gas Analyser (KM/Endee)	2
20.	Dew point apparatus	2
21.	Magnetic Stirrers(Remi)	2
22.	Flue gas sampler	2
23.	Stack Monitoring Kit	1
24.	Explosive Metter	3
25.	Water Bath (ASV Analytical)	1
26.	Digital ultrasonic Cleaner	1
27.	Bulk Density Apparatus (ASV Analytical)	1
28.	Turbidity Meter (QC-O1219)	1
29.	Vacuum Pump	1
30.	ICP-OES (Prekin)	1

7.8 NOISE LEVEL MONITORING INSIDE THE PLANT

Noise level monitoring is carried out on monthly schedule at various plant locations to check and control noise pollution. Observations are recorded. Average noise levels measured at five locations of plant boundaries are given below.

Sl.No	Location	Noise Level dB(A)
1	Near Gate No-1 (North West)	61.0
2	Near Gate No-2 (West direction)	61.0
3	North West Boundary	62.0
4	Railway Siding (eastern boundary)	61.0
5	South Side corner	62.0

At all the location noise found with in the prescribed limit.

CHAPTER-8

ENERGY CONSUMPTION FOR POLLUTION CONTROL

8.1 ENERGY CONSUMPTION FOR POLLUTION CONTROL

Energy consumption for running liquid and air pollution control equipments and for solid waste handling in both units are monitored and records are maintained on daily and monthly basis. Consumption reports are sent to PPCB on monthly basis.

The energy consumption for water and air pollution control equipment and for solid waste handling for Unit-I and Unit-II are given in Table-8.1.1

Table – 8.1.1

ENERGY CONSUMPTION FOR POLLUTION CONTROL FOR THE PERIOD APRIL 2019 TO MARCH 2020 (IN KWH UNIT)

MONTH	Solid Waste Pollution Control Equipments			Liquid Effluents Pollution Control Equipments			Air Pollution Control Equipments		
	U – 1	U – 2	TOTAL	U – 1	U – 2	TOTAL	U – 1	U – 2	TOTAL
April 20	0	9520	9520	66	6120	6186	7373	38160	45533
May 20	0	9560	9560	90	6124	6214	13029	38280	51309
June 20	0	8500	8500	72	5800	5872	12179	37200	49379
July 20	0	9400	9400	78	5870	5948	21711	37800	59511
August 20	0	9550	9550	156	5900	6056	19578	38000	57578
September 20	0	9100	9100	180	6134	6314	16779	37880	54659
October 20	0	9300	9300	228	6040	6268	20025	38200	58225
November 20	0	9500	9500	390	6250	6640	19240	37800	57040
December 20	0	9400	9400	468	6300	6768	18217	37600	55817
January 21	0	9300	9300	606	6110	6716	13772	37720	51492
February 21	0	9400	9400	480	6080	6560	11896	38000	49896
March 21	0	9430	9430	402	6088	6490	11677	38040	49717
Total	**0**	**111960**	**111960**	**3216**	**72816**	**76032**	**185476**	**454680**	**640156**
Average	**0**	**9330**	**9330**	**268**	**6068**	**6336**	**15456**	**37890**	**53346**

CHAPTER-9

BY-PRODUCT RECOVERY

9.1 Hydrochloric Acid, Sodium Hypo Chlorite and Spent H_2SO_4 are established by-products in a chlor-alkali plant, caustic soda being the principal product.

9.2 Sulphuric Acid is used for drying Chlorine .The dilute spent H_2SO_4 generated from the plant is sold as a by-product.

CHAPTER-10

AFFORESTATION

10.1 GENERAL

Ecological degradation has assumed alarming proportions as the rapid pace of environmental destruction through deforestation and pollution etc. is affecting the lives of millions of people all over the country.

PACL being environmentally conscious have been taking all precautionary measures right from the design stage for the prevention of water and environmental pollution due to the effluent and wasteful products from their factory and are contributing their mite to combat this problem by planting trees on a massive scale in and around Naya Nangal.

10.2 The management of M/s PACL is alive to the necessity of the conservation of natural resources. In its continued efforts, PACL has planted the following trees and shrubs in its drive for afforestation.

POSITION OF PLANTATION IN PACL FACTORY / COLONY

A. FACTORY

Sl. No.	Variety	No. of Trees
(I).	**TREES**	
01	Kachnar	06
02	Cassia Semmia	25
03	Silver Oak	160
04	Bottle Brush	30
05	Gulmohar	09
06	Legerstiomia	30
07	Acassia Auricali Formos	07
08	Kanak Champa	125
09	Amaltas	29
10	Bottle Palm	30
11	Saroo	07
12	Ashoka Pondula	255
13	Arjun	65
14	Gulmohar, Silver Oak, Eucalyptus, Jakranda Arithina, Causoriva, Kanak Champa (Mixed in Nursery)	--
15	Eucalyptus, Process Water Tank area in unit-2 and fire wood Jantar Mantra	120
16	Eucalyptus (South, West & East of Unit-1), Phlsa, Shabool & fire Wood mixed Jantar Mantar.	710

17	Palm	195
18	Casorina	--
19	Molsari	95
20	Cheel	04
21	Rubber Plant	12
22	Lstonia	51
23	Shetoot	10
24	Aerucaria	10
25	Koral tree	06
26	Chakrassia	15
27	Dek	200
28	Chandni	60
29	Cassia Gulaca	72
30	Neem	15
31	Palmeria Champa	18
32	Fruit Trees (Mango, Guava & Jamun)	50
33	Fycus	28
34	Pattranjeeva	65
35	Sukhchain	80
36	Bamboo Tree	1100
	Total	**3709**
(II)	**SHURBS – All Mixed**	
01	Bougenvillia, Chandni, Rat-Ki-Rani, Gulmohar, Hivigenx, Muraia, Molsari, Rubber Plant (All Mixed), Poinsetta	382

B. Housing Colonies

DETAILS REGARDING TREE PLANTATION

(I)	**In Old Housing Colony**		**In New Housing Colony**
Sl. No.	**A. Type/Variety of Tree**	**No. of Trees**	**Location**
1.	Ashoka Pandula	25	Cell House Unit II Area
2.	Arica Palm	17	Cell House Unit II Area
3.	Golden Cypress	10	Cell House Unit II Area
4.	Lady Palm	32	Cell House Unit II Area
5.	Bamboo Palm	08	Cell House Unit II Area
6.	Phinix Palm	01	Cell House Unit II Area
7.	Palmeria Champa	06	Cell House Unit II Area
8.	Bismarkia Palm	06	Main Gate Out Side Park
9.	Phonix Palm	10	Main Gate Out Side Park
10.	Arica Palm	15	Main Gate Out Side Park
11.	Ashoka Pandula	21	Near Canteen Area Park
12.	Foxtail Palm	02	Near Canteen Area Park
13.	Lady Palm	04	Near Canteen Area Park

14.	Fycus Panda	02	Near Canteen Area Park
15.	Arica Palm	12	Near Canteen Area Park
16.	Golden Cypress	04	Main Office Area
17.	Arica Palm	13	Main Office Area
18.	Golden Thuja	04	Main Office Area
19.	Arica Palm	05	Near Mech. Workshop Area Unit
20.	Bismarkia Palm	01	Near Mech. Workshop Area Unit
21.	Bottle Palm	15	Flow Tech Area
22.	Arica Palm	09	Flow Tech Area
23.	Ashoka Pandula	46	Flow Tech Area
24.	Golden Cypress	63	Gate No. I Area
25.	Lady Palm	20	Gate No. I Area
26.	Arica Palm	23	Gate No. I Area
27.	Bismarkia Palm	03	Gate No. I Area
28.	Fycus Starlight	04	Gate No. I Area
29.	Tpory	06	Gate No. I Area
30.	Trishool Champa	14	Gate No. I Area
	Total **B. Shrubs/All Mixed**	564	

POLLUTION CONTROL