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

ENVIRONMENTAL AUDIT /STATEMENT
FOR THE YEAR 2021-2022

M. 2022/ 01 **AUGUST, 2022**

PREPARED BY

MANTEC CONSULTANTS PVT. LTD.

805, VISHAL BHAWAN, 95 NEHRU PLACE, NEW DELHI – 110 019
PH. (011) 26429294/5/6, FAX: (011) 26842531
E-mail: envmantec@yahoo.co.in
www.mantecconsultants.com

FORM-V

(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	:	 70 TPD Caustic Soda 370 TPD Caustic Soda
4.	Year of Establishment	:	Plant commissioned in 1984
5.	Date of the last Environmental Statement submitted	:	September, 2021

PART-B

WATER AND RAW MATERIAL CONSUMPTION

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

Process : 319004
Cooling : 179636
Domestic : 8432

Name of Products	Process water consumption per unit Of product output	
	During the previous Financial year (2020-2021)	During the current Financial year (2021-2022)
	1	2
(i) CAUSTIC SODA LYE	2.541 M^3/MT	2.750 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 (2020-2021)	During the current financial year (2021-2022)
Salt	Caustic soda	1.590	1.59
Soda Ash	Caustic soda	0.0033	0.0044
Barium Carbonate	Caustic soda	0.0055	0.0084
Hydrogen	Hydrochloric acid	0.006	0.0113
Chlorine	Hydrochloric acid	0.2901	0.2656
Chorine Tailings	Sodium hypo chloride	0.0969	0.0999
For Caustic Soda Lye	Caustic Soda	0.0346	0.0082

* 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	0.000797 kg/day	8.59 mg/Nm^3	15 mg/Nm^3	(-)42.7
	HCl vent, HCl content	0.00223 kg/day	11.15 mg/Nm^3	35 mg/Nm^3	(-)68.1

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	-	7.51	5-9	Within limits
	Total Suspended Solids	3.32 kg/day	25.67 mg/l	100 mg/l	(-)74.33
(b)	**Air**				
	Hypo stack Chlorine	0.000865 kg/day	9.75 mg/Nm^3	15 mg/Nm^3	(-)37.8
	HCl vent, HCl content	0.000857 kg/day	10.07 mg/Nm^3	35 mg/Nm^3	(-)73.6

-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 (2020-2021)	During the Current financial year (2021-2022)
(a) From process		
(i) Used Transformer Oil	NIL	NIL
(ii) Used Lubricating Oil	NIL	NIL
(iii) Used Furnace Oil	NIL	NIL
(iv) MEE Sludge	44.64	82.23 MT
(b) From pollution control facilities	NIL	NIL

PART-E

SOLID WASTES (NON HAZARDOUS)

	Total Quantity (ON DRY BASIS MT)	
	During the previous financial year (2020-2021)	During the Current financial year (2021-2022)
(a) From process	**1854**	**1853.53**
(b) From pollution control facilities (from tanks/vessels)	Nil	Nil
(c) (1) quantity recycled or re-utilized 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)	%	-	32.62
2.	NaCl	%	-	9.10
3.	Calcium as CaCO3	%	-	11.34
4.	Magnesium as Mg(OH)2	%	-	10.58
5.	Acid insoluble	%	-	35.09

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 are also produced Chlorine gas and Hydrogen as 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 is neutralized with caustic soda 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 9001:2015, ISO 14001: 2015, ISO 22000:2018 and ISO 50001:2018.
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) is 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 . The sludge samples @ different depths were got tested twice in the past from NABL lab to check Mercury if any. It was not detected and accordingly the industry as retain to PPCB for declaring mercury bearing brine sludge as non-hazardous as the same has become inert over a period of about 24 years.

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 2021-2022, 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 2021-2022 has been detailed.

- The industry has well taken care the area of development of vegetation. The management has planted about 8140 trees/shrubs.
- The management of the industry being conscious of environmental protection has taken several steps in this direction and has 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 mercury cell plant converted to 200 TPD membrane cell plant from 170 TPD mercury cell plant in the year 1998 and total capacity increases to 99,000 TPA. The present production capacity of the plant is approximately 1,65,000 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 32.6174 hectares (80.6 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 2021-2022

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 2021-22
1.	Caustic Soda Lye Gross (Net Production)	MT	116001.324/ (112022.731)
2	Liquid Chlorine	MT	89088.800
4	Hydrochloric Acid	MT	51847.086
5	Hydrogen gas	Nm^3	32480370.00
6	Sodium Hypochlorite	MT	17837.250

CHAPTER-5

MATERIAL BALANCE

5.1 SODIUM HYDROXIDE UNIT

5.1.1 Input / Output Statement for the year 2021-2022

Annual Input				Annual Output		
Sl. No.	**Input**	**Unit**	**Quantity**	**Output**	**Unit**	**Quantity**
i.	Salt	MT	184442.101	NaOH	**MT**	112022.731
ii.	Soda Ash	MT	477.600	Cl_2 (gas)	**MT**	102777.165
iii.	Barium Carbonate	MT	909.530	H_2	**Nm3**	32480370.00
iv.	Flocculants	KGS	1777.500	Liquid Chlorine	**MT**	89088.800
v.	Water	KL	391642	Sodium Hypo	**MT**	17837.250
vi.				Hydrochloric Acid	**MT**	51847.086

5.1.2 Material Balancing for the year 2021-2022

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 = 95%

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

b. Calculation

Pure NaCl available in crude salt 184442.101 x 0.988 per annum= 182228.795

Product	Calculation based on stoichiometric equation	Theoretical Production (MT)	Actual Production (MT)	Percentage Variation
NaOH	(182228.795 x 80.016 / 116.91) x 0.95	118485.6587	112022.731	(-)5. 769%
Cl_2 (gas)	(182228.795 x 70.91/116.91) x 0.95	105001.7254	102777.165	(-)2.164%
H_2	(182228.795 x 2.016 / 116.91) x 0.95	2985.241551	2919.335	(-)2.258%

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 2021-2022

Generation	Quantity (MT)	Utilization	Quantity (MT)
Chlorine Gas Produced	102777.165	Production of liquid chlorine	89088.800
Chlorine gas from tonner purging	1866.364	Chlorine gas to HCl plant	13772.005
		Chlorine gas from process neutralized in Sod hypo plants	1782.724
Total chlorine generated	**104643.529**	Total chlorine utilized	**104643.529**

5.3 HYDROGEN BALANCE

5.3.1 Hydrogen Utilization Statement for the year 2021-2022

Generation)	Quantity(NM3)	Utilization (Nm^3)	Quantity(NM3)
H_2 Gas produced	32480370.0	H_2 in HCl plant	6583560.0
		H_2 dispatched	2879133.0
		H_2 for Boilers	19089683.0
		H_2 Vent	3927994.0
Total	**32480370.0**	**Total**	**32480370.0**

5.4 HYDROCHLORIC ACID PLANT

5.4.1 Input Output Statement for the year 2021-2022

Input	Quantity(MT)	Output	Quantity(MT)
Chlorine gas	13772.005	Hydrochloric acid	51847.086
Hydrogen gas	6583560.0	Average Conc.	30.50%
Water (DM Water)	-	HCl Content (100%)	15813.361

5.4.2 Material Balancing for the year 2021-2022

a. Basic

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

ii. Average concentration of product HCl = 30.50%

b. Calculation

(13772.005 x 72.926 x 100) / (30.50 x 70.91) = 46437.8645

Theoretical Production (MT)	Actual Production (MT)	% age Variation	Remarks
46437.8645	51847.086	(+) 10.433%	Concentration variation

5.4.3 Material Balancing for the year 2021-2022

Chlorine utilized for Sodium Hypo Product = 1782.724 MT
Quantity of sodium hypochlorite liquor produced = 17837.250 MT
Chlorine input in Sodium Hypochlorite liquor = 1782.724 MT

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

5.5 SODIUM HYPOCHLORITE PLANTS

5.5.1 Input Output Statement for the year 2021-2022

Input	Quantity(MT)	Output	Quantity(MT)
Chlorine gas for Sodium hypo	1782.724	Sodium Hypo Chlorite Liquor	17837.250
Caustic soda for Sodium hypo MT	3029.523	Available Chlorine (%)	9.994 %
Total chlorine input	1782.724	Total chlorine output	1782.724

5.6 WATER BALANCE

5.6.1 Water Utilization Statement for the year 2021-2022

Input	Quantity (m^3)	Output	Quantity (m^3)
Water drawn from RIVER SATLUJ	507072	Water consumed for process	319004
Water drawn from PACL Colony Bore well	78400	Domestic water consumption inside plant	8432
		Domestic water consumption in PACL Housing colony	78400
		Water consumed for Industrial cooling	179636
Total water drawn	**585472**	**Total water Utilization**	**585472**

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 2021-2022 was 585472 m^3 out of which 86832 m^3 was used for domestic purpose, 319004 m^3 was used in the process and 179636 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 2021-2022		585472 m^3
Total water used in 2021-2022 for		
	Domestic	86832 m^3
	Process	319004 m^3
	Industrial Cooling	179636 m^3
	.....	
		585472 m^3

Table – 6.2
Process Water Quality
(2021-2022)

Sl. No.	Parameter	Concentration Values		
		Min.	Max.	Avg.
1.	pH	7.1	7.7	7.4
2.	Total Hardness as $CaCO_3$	92	112	104
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 86832 m^3 of water for domestic purpose and 319004 m^3 for process in 2021-2022. 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, 2021	7.5	24	Nil
May, 2021	7.6	26	Nil
June, 2021	7.5	26	Nil
July, 2021	7.5	26	Nil
August, 2021	7.4	27	Nil
September, 2021	7.5	25	Nil
October, 2021	7.4	26	Nil
November, 2021	7.6	25	Nil
December, 2021	7.6	26	Nil
January, 2022	7.5	25	Nil
February, 20222	7.5	26	Nil
March, 2022	7.5	26	Nil

Table – 6.4

Treated Effluent Quality (2021-2022)

Sl. No.	Parameter	Concentration Values		
		Min.	**Max.**	**Avg.**
1	pH	7.4	7.6	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 H_2-Gas / Furnace Oil.
b) Sterling Boiler of capacity 10 MT and fuel used is H_2-Gas / Furnace Oil. Hydrogen gas, a product of the industry, is also used as fuel 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 Acid mist from HCl plant stack , 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, 2021	-	-	9.76	9.89
May, 2021	-	-	9.64	9.65
June, 2021	-	-	9.30	9.74
July, 2021	-	-	9.64	9.39
August, 2021	-	-	9.80	9.56
September, 2021	9.07	-	9.38	9.21
October, 2021	9.69	-	9.91	8.98
November, 2021	9.04	-	9.30	9.56
December, 2021	4.11	-	4.79	4.28
January, 2022	9.69	-	9.91	9.74
February, 2022	9.04	-	10.23	10.69
March, 2022	9.47	11.15	10.14	10.17

TABLE-6.6

SOURCES OF AIR EMISSIONS AND POLLUTION LOAD IN UNIT-I & II (2021-2022)

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	11.15	9.24	-	2.23 X 10^-3
2.	Hypo Stack	Chlorine	8.59	9.32	-	1.71 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 2021-2022 was **3485.405** MT (wet basis) and **2313.557 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, 2021	Wet	0.00	0.00	0.00	0.00		34.04	3.55	9.11
	Dry	0.00	0.00	0.00	0.00		23.211		
May, 2021	Wet	0.00	0.00	0.00	0.00	71.74	100.48	3.55	6.59
	Dry	0.00	0.00	0.00	0.00	45.488	66.563	2.375	4.404
June, 2021	Wet	0.00	0.00	0.00	0.00		200.62	4.991	26.35
	Dry	0.00	0.00	0.00	0.00		132.905	5.538	16.546
July, 2021	Wet	0.00	0.00	0.00	0.00	24.05	74.531	3.355	31.185
	Dry	0.00	0.00	0.00	0.00	15.341	50.131	2.201	20.635
August, 2021	Wet	0.00	0.00	0.00	0.00	35.515	200.46	3.02	16.725
	Dry	0.00	0.00	0.00	0.00	22.507	132.8	19.57	16.937
September,2021	Wet	0.00	0.00	0.00	0.00	201.531	0.00	0.00	81.6
	Dry	0.00	0.00	0.00	0.00	184.509	0.00	0.00	51.57
October, 2021	Wet	0.00	0.00	0.00	0.00	71.45	481.43	0.00	0.00
	Dry	0.00	0.00	0.00	0.00	44.522	262.798	0.00	0.00
November,2021	Wet	0.00	0.00	0.00	0.00	95.643	409.28	0.00	0.00
	Dry	0.00	0.00	0.00	0.00	60.155	273.055	0.00	0.00
December, 2021	Wet	0.00	0.00	0.00	0.00	69.54	285.513	0.00	0.00
	Dry	0.00	0.00	0.00	0.00	42.531	189.297	0.00	0.00
January, 2022	Wet	0.00	0.00	0.00	0.00	110.543	100.44	0.00	0.00
	Dry	0.00	0.00	0.00	0.00	70.527	66.537	0.00	0.00
February, 2022	Wet	0.00	0.00	0.00	0.00	50.28	301.003	0.00	37.1
	Dry	0.00	0.00	0.00	0.00	31.546	201.404	0.00	34.184
March, 2022	Wet	0.00	0.00	0.00	0.00	100.03	200.41	0.00	39.75
	Dry	0.00	0.00	0.00	0.00	62.532	134.767	0.00	26.471

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)	-	-	830.322	579.658	830.322	579.658
Brine Sludge from brine sludge Pits, MT	-	-	2388.207	1533.468	2388.207	1533.468
Brine Sludge from precipitation Tanks / Vessels, MT	-	-	18.466	29.684	18.466	29.684
Sludge from brine saturator, MT	-	-	248.410	170.747	248.410	170.747
Total Solid Waste Generated, MT	**0.00**	**0.00**	**3485.405**	**2313.557**	**3485.405**	**2313.557**

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 2021-2022 are given in table 6.9.

Table – 6.9
PUNJAB ALKALIES & CHEMICALS LTD.

Average Quality of Brine Sludge Generated During Year 2021-2022

Sl. No.	Parameter	Unit	Membrane Cell, Unit-I	Membrane Cell, Unit-II
1	Loss on Drying (water)	%	--	33.62
2	NaCl	%	--	9.10
3	Calcium as $CaCO_3$	%	--	11.34
4	Magnesium as $Mg(OH)_2$	%	--	10.85
5	Acid insoluble	%	--	35.09

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. Both process units are having common 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 i.e permeate from RO is used in the process in cooling towers as makeup water and RO reject is send to MEE(Evaporators). MEE permeate is taken in the permeate pit for use in cooling towers and MEE rejects is taken in the drying beds from where MEE sludge is collected and filled in properly labeled LDPE bags and same is stored separately and sent to common TSDF facility at Nimbua. Left behind leachate from drying beds is collected in a separate low lying pit, from where it is pumped to RO reject pit for feeding to MEE.

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

……

Effluent Treatment capacity: 500 m^3/day

Effluent from various sections of Unit-I & Unit-II 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 and RO reject is send to MEE(Evaporators). MEE permeate is taken in the permeate pit for use in cooling towers and MEE rejects is taken in the drying beds from where MEE sludge is collected and filled in properly labeled LDPE bags and same is stored separately and sent to common TSDF facility at Nimbua. Left behind leachate from drying beds is collected in a separate low lying pit, from where it is pumped to RO reject pit for feeding to MEE.

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

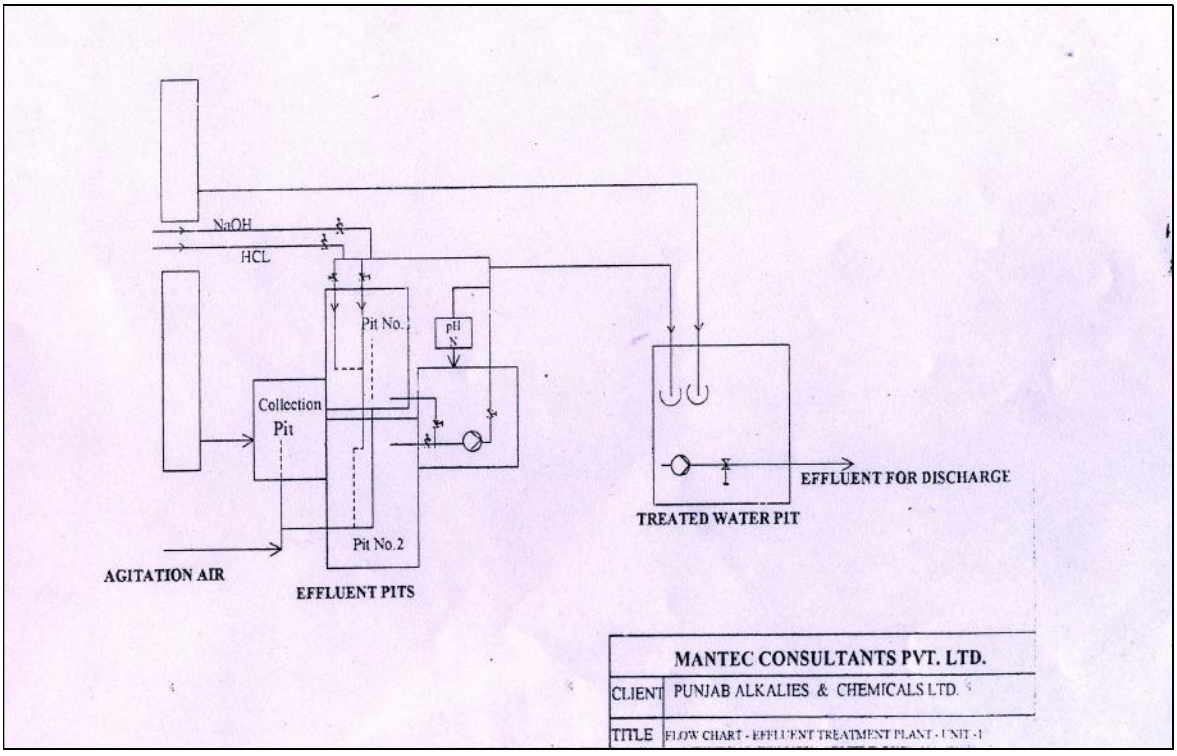

Table – 7.1

Treated Effluent Quality (2021-2022)

Sl. No.	Parameter	Concentration Values		
		Min.	**Max.**	**Avg.**
1	pH	7.4	7.6	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

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 1000 kgs. of chlorine gas is required to be neutralized in Unit-I and 2500 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 four sodium hypo towers where caustic soda and chlorine reacts counter currently. 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 = 1000 kg/hr. chlorine gas
ii. Pump capacity
iii Sodium hypo circulation pump capacity = 6 nos. 100 m^3 /hr. 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, ng/m^3	Ni, ng/m^3	C_6H6 $\mu g/m^3$	B(a)P ng/m^3
April, 2021	Railway siding area	38	23	16	16	0.3	120	32	Nil	Nil	Nil	Nil	Nil
May, 2021	Railway siding area	34	21	18	15	0.4	140	31	Nil	Nil	Nil	Nil	Nil
June, 2020	Railway siding area	32	20	15	17	0.2	128	34	Nil	Nil	Nil	Nil	Nil
July, 2021	Railway siding area	39	27	19	15	0.3	134	37	Nil	Nil	Nil	Nil	Nil
Aug. 2021	Railway siding area	40	28	20	17	0.4	142	30	Nil	Nil	Nil	Nil	Nil
Sep. 2021	Railway siding area	37	23	17	16	0.5	141	37	Nil	Nil	Nil	Nil	Nil
Oct. 2021	Railway siding area	38	24	18	15	0.3	128	34	Nil	Nil	Nil	Nil	Nil
Nov. 2021	Railway siding area	39	25	16	15	0.3	118	36	Nil	Nil	Nil	Nil	Nil
Dec. 2021	Railway siding area	38	23	16	19	0.4	130	33	Nil	Nil	Nil	Nil	Nil
Jan. 2022	Railway siding area	41	27	19	16	0.3	134	35	Nil	Nil	Nil	Nil	Nil
Feb. 2022	Railway siding area	36	23	16	20	0.4	122	33	Nil	Nil	Nil	Nil	Nil
March 2022	Railway siding area	38	25	17	16	0.5	132	34	Nil	Nil	Nil	Nil	Nil

Table – 7.3

PUNJAB ALKALIES & CHEMICALS LIMITED, NAYA NANGAL
AMBIENT AIR MONITORING DATA
Average Annual data 2021-2022

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	67.27
2.	Near Electrical Sub-station	NIL	NIL	67.94
3.	Near South–west Boundary	NIL	NIL	66.60

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 2016 and the same is being stored in active brine sludge pit.

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

Approx 26642 M.T of Sludge generated earlier in Mercury cell process(till 1998) is stored in environment friendly impervious brine sludge pit No-1 and the same is closed with good earth and over grown with the green plants. The sludge samples @ different depths were got tested twice in the past from NABL lab to check Mercury if any. Mercury was not detected and accordingly the industry as retain to PPCB for declaring mercury bearing brine sludge as non-hazardous as the same has become inert over a period of about 24 years.

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 2021-2022 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 2021		May 2021		June 2021		July 2021		August 2021		September 2021	
Date of Sampling	04.04.2021	20.04.2021	07.05.2021	21.05.2021	06.06.2021	21.06.2021	10.07.2021	21.07.2021	08.08.2021	21.08.2021	07.09.2021	21.09.2021
pH	7.6	7.6	7.5	7.6	7.5	7.5	7.6	7.6	7.6	7.5	7.5	7.5
Total Dissolved Solids,(mg/l)	280	280	276	278	280	276	278	278	278	276	276	278
Hardness(Total) as $CaCO_3$,(mg/l)	248	242	248	246	248	250	248	248	248	246	246	248
Chlorides as $CaCO_3$, (mg/l)	16	16	14	16	16	18	18	18	16	18	18	16
Sulphate as SO_4, (mg/l)	12	10	12	12	12	12	12	10	12	12	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(1) (Contd…)

Parameter	October 2021		November 2021		December 2021		January 2022		February 2022		March 2022	
Date of Sampling	07.10.2021	22.10.2021	06.11.2021	21.11.2021	07.12.2021	20.12.20	07.01.22	20.01.22	05.02.22	22.02.22	07.03.22	24.03.22
pH	7.6	7.6	7.6	7.5	7.6	7.6	7.6	7.6	7.5	7.5	7.5	7.5
Total Dissolved Solids,(mg/l)	280	290	272	285	290	280	280	285	290	280	290	296
Hardness(Total) as $CaCO_3$,(mg/l)	250	248	250	248	250	250	252	250	250	248	250	250
Chlorides as $CaCO_3$, (mg/l)	18	18	16	18	18	18	16	18	18	18	18	18
Sulphate as SO_4, (mg/l)	10	12	12	14	14	12	12	14	12	14	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(2)
THE PHYSICO-CHEMICAL QUALITY OF HAND PUMP LOCATED AT HORTICULTURE NURSERY

Parameter	April 2021		May 2021		June 2021		July 2021		August 2021		September 2021	
Date of Sampling	04.04.2021	20.04.2021	07.05.2021	21.05.2021	06.06.2021	22.06.2021	10.07.2021	23.07.2021	08.08.2021	21.08.2021	07.09.2021	21.09.2021
pH	7.5	7.5	7.6	7.6	7.5	7.5	7.6	7.5	7.6	7.6	7.5	7.5
Total Dissolved Solids,(mg/l)	276	278	280	276	278	280	278	276	280	270	270	280
Hardness(Total) as $CaCO_3$,(mg/l)	244	240	248	250	250	248	250	248	244	250	244	242
Chlorides as $CaCO_3$, (mg/l)	12	12	12	14	14	14	14	12	12	12	12	14
Sulphate as SO_4, (mg/l)	10	10	12	10	12	12	14	12	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

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

Parameter	October 2021		November 2021		December 2021		January 2022		February 2022		March 2022	
Date of Sampling	07.10.2021	23.10.2021	06.11.2021	21.11.2021	07.12.2021	20.12.2021	07.01.2022	20.01.22022	05.02.2022	22.02.2022	07.03.2022	24.03.2022
pH	7.5	7.6	7.6	7.6	7.6	7.5	7.5	7.6	7.6	7.6	7.6	7.6
Total Dissolved Solids,(mg/l)	280	278	276	278	280	278	280	286	280	284	290	284
Hardness(Total) as $CaCO_3$,(mg/l)	248	242	246	250	250	254	254	254	254	252	250	254
Chlorides as $CaCO_3$, (mg/l)	12	14	12	14	16	15	16	16	16	14	16	16
Sulphate as SO_4, (mg/l)	10	10	12	12	14	12	14	14	16	14	16	16
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 2021		May 2021		June 2021		July 2021		August 2021		September 2021	
Date of Sampling	04.04.2021	20.04.2021	07.05.2021	21.05.2021	06.06.2021	22.06.2021	10.07.2021	23.07.2021	08.08.2021	21.08.2021	07.09.2021	21.09.2021
pH	7.6	7.6	7.5	7.5	7.6	7.5	7.5	7.6	7.5	7.5	7.5	7.5
Total Dissolved Solids,(mg/l)	288	290	290	288	290	296	292	290	296	292	292	294
Hardness(Total) as $CaCO_3$, (mg/l)	248	244	248	250	255	250	260	265	260	255	260	260
Chlorides as $CaCO_3$, (mg/l)	16	16	16	18	18	16	18	18	16	15	15	16
Sulphate as SO_4, (mg/l)	14	14	14	16	14	16	16	14	14	14	14	16
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 2021		November 2021		December 2021		January 2022		February 2022		March 2022	
Date of Sampling	07.10.2021	23.10.2021	06.11.2021	21.11.2021	07.12.2021	20.12.2021	07.01.2022	20.01.2022	05.02.2022	22.02.2022	07.03.2022	24.03.2022
pH	7.5	7.5	7.5	7.6	7.6	7.6	7.5	7.5	7.5	7.5	7.5	7.5
Total Dissolved Solids,(mg/l)	286	290	290	286	286	290	286	286	286	290	288	290
Hardness(Total) as $CaCO_3$, (mg/l)	260	255	260	260	260	254	254	250	254	254	254	254
Chlorides as $CaCO_3$, (mg/l)	16	15	15	16	16	16	16	18	18	18	18	18
Sulphate as SO_4, (mg/l)	14	14	14	14	14	16	16	16	16	14	16	16
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 2021		May 2021		June 2021		July 2021		August 2021		September 2021	
Date of Sampling	04.04.2021	20.04.2021	07.05.2021	21.05.2021	06.06.2021	22.06.2021	10.07.2021	23.07.2021	08.08.2021	21.08.2021	07.09.2021	21.09.2021
pH	7.5	7.6	7.6	7.5	7.5	7.5	7.5	7.5	7.6	7.5	7.5	7.5
Total Dissolved Solids, (mg/l)	280	286	278	290	286	290	294	290	280	285	280	280
Hardness (Total) as $CaCO_3$, (mg/l)	246	248	248	250	250	250	250	248	244	246	242	244
Chlorides as $CaCO_3$, (mg/l)	16	18	18	18	18	18	18	16	18	16	16	14
Sulphate as SO_4, (mg/l)	12	14	14	12	14	14	14	14	14	15	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(4)
THE PHYSICO-CHEMICAL QUALITY OF HAND PUMP LOCATED OPPOSITE STORES

Parameter	October 2021		November 2021		December 2021		January 2022		February 2022		March 2022	
Date of Sampling	07.10.2021	22.10.2021	06.11.2021	21.11.2021	07.12.2021	20.12.2021	07.01.2022	20.01.2022	05.02.2022	22.02.2022	07.03.2022	24.03.2022
pH	7.5	7.5	7.5	7.6	7.6	7.5	7.6	7.5	7.5	7.6	7.6	7.6
Total Dissolved Solids, (mg/l)	290	285	280	285	285	290	290	286	290	290	288	290
Hardness (Total) as $CaCO_3$, (mg/l)	244	248	244	246	250	254	254	252	254	252	252	254
Chlorides as $CaCO_3$, (mg/l)	16	18	16	16	18	16	18	16	16	18	18	18
Sulphate as SO_4, (mg/l)	14	15	14	15	14	15	15	15	16	15	16	16
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 2021		May 2021		June 2021		July 2021		August 2021		September 2021	
Date of Sampling	04.04.2021	20.04.2021	07.05.2021	21.05.2021	06.06.2021	22.06.2021	10.07.2021	23.07.2021	08.08.2021	21.08.2021	07.09.2021	21.09.2021
pH	7.6	7.5	7.6	7.6	7.6	7.6	7.6	7.5	7.5	7.4	7.5	7.5
Total Dissolved Solids, (mg/l)	278	280	278	278	282	286	280	278	278	285	278	286
Hardness (Total) as $CaCO_3$, (mg/l)	248	248	252	250	250	252	252	252	250	246	250	245
Chlorides as $CaCO_3$, (mg/l)	16	16	16	15	15	16	15	16	16	16	15	15
Sulphate as SO_4, (mg/l)	12	14	14	12	12	14	14	14	12	14	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

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

Parameter	October 2021		November 2021		December 2021		January 2022		February 2022		March 2022	
Date of Sampling	07.10.2021	23.10.2021	06.11.2021	21.11.2021	07.12.2021	21.12.2021	07.01.2022	20.01.2022	05.02.2022	22.02.2022	07.03.2022	24.03.2022
pH	7.6	7.5	7.5	7.5	7.5	7.6	7.6	7.5	7.5	7.5	7.5	7.5
Total Dissolved Solids, (mg/l)	280	280	278	278	280	278	280	282	284	282	286	286
Hardness (Total) as $CaCO_3$, (mg/l)	246	248	246	250	254	250	254	250	254	254	250	254
Chlorides as $CaCO_3$, (mg/l)	16	15	14	15	16	14	16	14	16	16	16	16
Sulphate as SO_4, (mg/l)	14	14	14	14	14	16	14	15	15	14	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

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	Ind./ Imported	Quantity (Nos.)	Year of Mfg.
1.	Gas Chromatograph	Indigenous(AIMIL / NUCON)	01	2018
2.	Gas Chromatograph	Indigenous-do-	01	2018
3.	DR 6000 Spectrophotometer	Imported(HACH)	01	2018
4.	Balance Electrical	Indigenous	01	2005
5.	DR 3900 Spectrophotometer	Imported(HACH)	01	2016
6.	Electronic Balance ME204	Imported (Mettler)	01	2014
7.	Electronic Balance ME204	Imported (Mettler)	01	2017
8.	Electronic Balance ML 204T	Imported (Mettler	01	2018
9.	pH Meter	Indigenous	01	2017
10.	Conductivity Mtere	Imported(HACH)	01	2013
11.	Turbidity Meter	Indigenous	01	2019
12.	AVIO 200_ICP-OES	Imported PERKINELMER	01	2019
13.	Muffllle Furnace PT-350	Indigenous	01	2019
14.	Hot Air Oven ACM-22066T	Indigenous	01	2019
15.	Bomb Calorimeter-Digital	Indigenous	02	2019
16.	High volume Samplers APM-430	Indigenous	03	2017
17.	Handy Sampler APM-821	Indigenous	01	2019
18.	Stack Kit VSS1	Indigenous	01	2019
19.	Flue Gas Analyser & Stack Monitoring Testo-340	Indigenous	01	2019
20.	Portable Oxygen Gas Analyser 101-HH	Indigenous	01	2017

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)	62.0
2	Near Gate No-2 (West direction)	60.0
3	North West Boundary	60.0
4	Railway Siding (eastern boundary)	62.0
5	South Side corner	60.0

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 2021 TO MARCH 2022 (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 21	0	9480	9480	432	6250	6682	12821.00	38080	50901.00
May 21	0	9350	9350	300	6192	6492	18649.00	37920	56569.00
June 21	0	9380	9380	216	6172	6388	16394.00	38080	54474.00
July 21	0	9420	9420	126	6182	6308	16132.00	37840	53972.00
August 21	0	9460	9460	174	6186	6360	19574.00	37720	57294.00
September 21	0	9510	9510	102	6188	6290	19995.00	37880	57875.00
October 21	0	9480	9480	240	6184	6424	21220.00	37840	59060.00
November 21	0	9520	9520	270	6192	6462	15100.00	38040	53140.00
December 21	0	9500	9500	270	6188	6458	20205.00	38000	58205.00
January 22	0	9460	9460	24	6182	6206	20729.00	37960	58689.00
February 22	0	9430	9430	30	6186	6216	17606.00	37880	55486.00
March 22	0	9490	9490	180	6188	6368	17511.00	37800	55311.00
Total	0	113480	113480	2364	74290	76654	215936.00	455040	670976
Average	0	9456.67	9456.667	197	6190.833	6387.833	17994.67	37920	55914.67

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	25
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