Project 0499: Destruction of HFC-23 at refrigerant (HCFC-22) manufacturing facility of Chemplast Sanmar Ltd

First Monitoring Report

Monitoring Period: 16 February 2007 – 31st August 2007

Version: 3.0

Project Participant: Chemplast Sanmar Limited

CERs claimed in First Monitoring Period

68777 tCO_2e

1. **Destruction of HFC-23 at refrigerant (HCFC-22) manufacturing facility of Chemplast Sanmar Ltd**

   First Monitoring Report: Version 3.0, 26/10/2007

   Monitoring Period: 16/02/2007 to 31/08/2007

2. **Description**

   The purpose of this monitoring report is to calculate the Greenhouse Gas emission reduction achieved by the project activity from 16th February 2007 to 31st August 2007 i.e. first monitoring period.

S. No.	Activity	Date
1.	Start date of crediting period	16/02/07
2.	Storage of HFC 23 started	02/03/07
3.	Thermal oxidation dates	14/08/07 to 29/08/07
4.	First monitoring period (this report)	16/02/2007 to 31/08/07[1]

   The emission reduction is estimated for HFC 23 incinerated during this time period.

3. **Reference**

   The project is based on approved baseline methodology, AM0001; Version 3/Sectoral Scope 11 / 13 May 2005.

   Registered PDD: Destruction of HFC-23 at refrigerant (HCFC-22) manufacturing facility of Chemplast Sanmar Ltd; Version 1.1, dated 10th January 2006.

4. **About the project activity.**

4.1 Project activity

The project activity aims to reduce Green House Gas (GHG) emissions by decomposing HFC-23 at refrigerant (HCFC 22) manufacturing facility of Chemplast Sanmar Limited (CSL). CSL belongs to the Sanmar Group of companies. HFC-23 is an inevitable by-product generated during production of HCFC-22. HFC-23 has a high Global Warming Potential (GWP) (11700 - reference: The IPCC 2nd Assessment Report).

[1] The credit period start date for the project activity is 16th February 2007 (same as registration date). Production of HCFC22 and HFC23 started from 17th February 2007 (The plant started on 17th February after completion of preventive maintenance). However HFC23 is collected in Storage only after achieving desired purity. The purification system for HFC23 requires the HFC23 produced to be refluxed back to the distillation columns. Hence actual collection in Storage Tank started from 2nd March 2007 (SAP records available) even though production of HFC23 started from 17th February 2007. The incinerator was commissioned on 14th August 2007.

The project proponents have started storing HFC-23 from 17th February and the same is being incinerated and emission reductions are calculated as per estimation method described in PDD. (Project reference: 499).

4.2 Project Participants as on date of this Monitoring Report

a. Chemplast Sanmar Limited (CSL)

4.3 Location of Project

The project activity plant is located in the existing HCFC 22 production plant of CSL. CSL plant is near the Mettur Dam at Mettur. Mettur latitude is around 11.520N and the longitude is 77.500E. The nearest airport is at Coimbatore, which is 150 km from the plant, and the nearest railway station is at Salem, around 45 km from the plant location.

4.4 Technology employed in Project activity

The project activity uses Thermal Oxidation to decompose HFC-23. This technology completely (~99.999%) decomposes the waste stream comprising of HFC-23.

Thermal Oxidation (Incineration) is an engineered process designed to effect complete oxidation of the organic materials present in waste streams. The process is fully controlled and stable and involves rapid high temperature flame combustion in a continuous process in the presence of a stoichiometric excess of oxygen and without treatment of the intermediate products of combustion.

The incineration of HFC 23 – Organic waste generated from the process of manufacturing HCFC 22 involves the oxidation of HFC-23 at a temperature about 1200°C by providing excess air to ensure complete combustion. As HFC 23 has a very low calorific value, supplemental fuel has to be given for maintaining the temperature. For the complete conversion of the halocarbons to their respective hydrogen halides, the supplemental fuel should also provide the Hydrogen for the conversion. Hence Hydrogen is chosen as the supplemental fuel.

The annual discharge of HFC23 waste stream is approximately 46 MT. Plant has facility to store up to 20 MT of HFC23 waste streams. The storage is required to ensure minimum quantity (so that the operation is optimally used) and also to act as buffer in the rare possibility of interruption in the plant operation.

Plant Description:

The incinerator unit is designed to incinerate vent gas containing HCFC22 and HFC23. It comprises a combustion system and a wet flue gas treatment system, in order to achieve approximately 12 -15% hydrofluoric acid. The unit is designed for the disposal of gaseous waste containing fluorine and chlorine, resulting in a Hydrogen Fluoride concentration in the flue gas of approx. 135 g/Nm³ before the scrubbing system. As the concentration of the Hydrogen fluoride in the Flue gas from the incinerator chamber is high, this could reduce the refractory lifetime and hence a combustion chamber with short duct system is designed to improve the life of the refractory. The plant will be designed for automatic operation with very high ‘state of the art’ safety system.

Start-up, operation and shutdown of the plant can be carried out automatically by an integrated Programmable Logic Control (PLC) system. In case of a failure, the plant automatically falls into safe shutdown, triggered automatically by the PLC. This safety system protects the plant and its machinery and furthermore provides safety of personnel.

Process Description:

The vent gas containing HCFC 22 and HFC23 is oxidized in a refractory lined combustion chamber. The chamber is equipped with main burner, pilot burner and ignition burner. The vent gas is introduced into the combustion chamber together with combustion air and supplemental fuel. The combustion stage will ensure the destruction and oxidation of all organic waste components.

Oxygen, which is necessary for the oxidation of the organic waste compounds, will be fed to the chamber by a combustion air blower. For the control of the oxygen content in the flue gas, an oxygen analyzer is provided. In order to control a proper temperature profile and also to ensure complete combustion excess amount of combustion air will be fed to the chamber.

The pilot burner is used for initial heating of the combustion chamber and Hydrogen is used as the fuel. The entire combustion chamber is heated with the fuel (hydrogen) to reach 1200 deg C and then the waste gas is fed to the incinerator. The hot flue gas, leaving the combustion chamber is fed directly to a counter current pipe quench, where the flue gas will be cooled to adiabatic saturation temperature and saturated with water vapor. In order to protect the system against high temperature, an emergency water supply line to the quench system is provided. In case of malfunction of the quench system, the incinerator will be shut down and emergency water will be injected to the quench.

The cooled flue gas is routed from the quench to the absorber column. In order to achieve a 12 - 15% hydrofluoric acid the absorber column is equipped with multi stage packed tower and a droplet separator.

The absorber is designed as counter-current wet scrubber, operated with pure water as scrubbing liquid. The flue gas, leaving the quench passes the lower packed stage of the absorber, which is operated with a liquid circulation loop. Passing the lower stage, HF and HCL are removed from the flue gas and the quench/scrubbing water is concentrated up to 15% hydrofluoric acid. The lower stage is also designed to cool the flue gas to an exit temperature of 50°C.

The flue gas from the absorber then passes through a second stage alkaline scrubber. The alkaline scrubber is a counter current scrubber with Sodium hydroxide and sodium sulphite solution being circulated to absorb any contamination in the flue gas. The flue gas is then vented to the atmosphere through a stack. The blower aids to overcome the pressure drop in the thermal oxidizer unit.

5. Monitoring Methodology and Plan

The monitoring methodology is based on approved monitoring methodology AM0001 version 3.

This methodology is applicable to HFC-23 (CHF3) waste streams from an existing HCFC-22 production facility with at least three (3) years of operating history between beginning of the year 2000 and the end of the year 2004 where the project activity occurs and where no regulation requires the destruction of the total amount of HFC-23 waste. The present project activity satisfies these conditions.

Note 1: The revised methodology suggests "Most of the time, under normal operation, both flow meters measure the same amount of HFC 23 flows simultaneously. Where the flow-meter readings differ by greater than twice their claimed accuracy (for example 10% if the accuracy is claimed to be ±5%), then the reason for the discrepancy is investigated and the fault remedied. For the sake of conservativeness, the lower value of the two readings will always be used to estimate the HFC 23 waste flows."

The readings of both flow meters were checked against and maximum difference of 1.1 % was noted between both the readings. The flow meters have an accuracy of ±1%, thereby the difference is less than twice i.e. 2%.

Variable	Data type	Measured / Estimated	Data variable	Data unit	Recording Frequency
1. q_HFC23_y	Mass	m	Quantity of Waste Stream supplied to the destruction process.	Tonnes – HFC	Continuous
2. P_HFC23_y	%	m	Purity of HFC23 in waste stream supplied to destruction facility.	%	Every shift
3. ND_HFC23_y	Mass	m	Quantity of HFC-23 in gaseous effluent from destruction process.	Tonnes – HFC	Monthly and also when the thermal oxidizer stops, analysis of the effluent gas is done to check the leaked HFC23 by sampling
4. Q_HCFC_y	Mass	m	The quantity of HCFC22 produced in the plant generating the HFC23 waste.	Tonnes – HFC22	Monthly
5. *HFC23_sold*	Mass	m	The quantity of HFC 23 sold by facility generating HFC 23 waste	Tonnes – HFC23	Monthly
6. r_y	Fraction	e	The fraction of the waste stream required to be destroyed by the regulations that apply during the year y.	%	Yearly
7. $Q\_F_{power, y}$	Energy	m	Quantity of power used in destruction process for year y.	KWh	Monthly
8. $E\_F_{power, y}$	Ratio of mass to energy	e	Greenhouse gas emissions factor for power during year y.	tCO_2/MWh	Monthly
9. $Q\__{NaOH\ y}$	Mass	m	Quantity of NaOH (caustic soda) used in the effluent treatment plant in the year y	Tonnes	Monthly
10. $F\__{NaOH, Power, y}$	Energy	e	Power used for production of 1MT of NaOH	KWh / t NaOH	Half yearly

11. $F_{\_NaOH, Fuel, y}$	Volume per unit mass	e	Fuel used for Transportation of 1MT of NaOH	KL / tonne of NaOH	Half yearly
12. $Q_{\_NA2SO3\ y}$	Mass	m	Quantity of Na2SO3 used in the effluent treatment plant in the year y	Tonnes	Monthly
13. $F_{\_Na2SO3\ power, y}$	Energy per unit mass	m	Power used for production of 1 MT of Na2SO3	KWh / t Na2SO3	Half yearly
14. $F_{\_Na2SO3\ fuel, y}$	Volume per unit mass	e	Fuel used for Transportation of 1MT of Na_2SO_3	KL / tonne of Na2SO3	Half yearly
15. $Q_{\_HYDROGEN, y}$	Volume	m	Quantity of Hydrogen used in the destruction process in the year y.	Nm^3	Daily
16. $F_{\_HYDROGEN, Power, y}$	Energy per unit volume	e	Power used for production of 1Nm3 of Hydrogen.	KWh/Nm^3	Monthly
17. $F_{\_HYDROGEN, Fuel, y}$	Volume per unit volume	e	Volume of fuel used in transporting 1 NM^3 of Hydrogen.	l/Nm^3	Monthly
18. $Q_{\_COMPRESSED\ AIR, y}$	Volume	m	Quantity of Compressed Air used in the destruction process in the year y.	Nm^3	Monthly
19. $F_{\_COMPRESSED\ AIR, Power, y}$	Energy per unit volume	c	Power used for production of 1Nm3 of Compressed Air	KWh/Nm^3	Monthly

In order to monitor data required for estimating emission reductions because of the project activity, project operator has detailed operational and management structure.

Project Management Structure:

In order to monitor data required for estimating emission reductions because of the project activity, project operator has set up following operational and management structure.

CSL has nominated a technically qualified senior person with experience of plant operations as CDM Project Director. CDM Project Director is responsible for overall monitoring management. A CDM project team has been constituted with participation from relevant departments. This team is responsible for data collection and archiving. This team meets periodically to review CDM project activity, check data collected, emissions reduced, etc. In case of any irregularity observed, it is informed to the concerned person for necessary actions. On a monthly basis, these reports are checked by CDM project director.

CDM Project Director: Overall responsibility for compliance with the CDM monitoring plans.

Head - production: Responsibility for completeness of data, reliability of data (calibration of meters), and monthly report generation

Shift In-charge/ shift supervisor: Responsibility of data collection

An operating procedure manual for the project activity is developed. This operating manual includes details of data to be monitored, quality assurance procedures, periodic meter testing and calibration schedules etc. A GHG performance procedural manual is also in place for all the personal directly and indirectly involved and associated with monitoring of project activity. The manual describes the responsibility delegation for monitoring of parameters.

Data to be monitored:
As per Appendix-1 of this monitoring report

Data Collection Frequency:
The frequency for data monitoring shall be as per the monitoring details in section 5.0 of the monitoring report.

Day to day data collection and record keeping:
Plant data shall be collected on operation under the supervision of the respective Shift-in-charge and record are kept in daily logs.

Day Archiving:
Data is archived in electronic/paper form (as per AM0001) and will be kept for crediting period + 2 years.

Training of CDM team personnel:
The training of the CDM team and plant personnel was carried out on thermal oxidation technology by the technology supplier. The CDM team was also briefed about CDM concepts and data monitoring plan.

Internal Audit Procedure:

There is an internal auditing system, to check the data collected as per monitoring plan. During the non – incinerating days the audits are ensured on a monthly basis and during incinerating periods the audits are done on fortnightly basis.

6. Quality Control(QC) and Quality Assurance(QA)

<u>QA/QC Procedures:</u>

QA & QC procedures are set and implemented in order to,

1. Secure a good consistency through planning to implementation of this CDM project,
2. Stipulate who has responsibility for what and,
3. Avoid any misunderstanding between people and organization involved.

The following QA QC procedure is followed at the plant for data monitoring and recording.

Step 1: The readings are taken by shift operator / shift engineer and cross checked by shift in-charge.

Step 2: Reports are generated by shift in-charge and forwarded to production in-charge as per frequency of recording and monitoring in monitoring Plan.

Step 3: This production in-charge cross checks data against log sheets etc. and compiled report is sent to CDM Project Coordinator (Head-operations).

Process Reliability:

Start up, operation and shut down of the plant can be carried out automatically by an integrated PLC system. In case of a failure, the plant automatically falls into safe conditions. This safety system protects the plant and its machinery and further more provides safety of any personnel. All operating parameters are recorded and saved.

In order to protect the system against high temperature, an emergency water supply line to the quench system is used. In case of malfunction of the quench system, the incinerator is shut down and emergency water will be injected to the quench.

Instrumentation and Controls:

The interlock and control system comprises of a control panel with failsafe burner management system and PLC interlock and control system. The digital and analogue function is handled by a programmable controller (Siemens PCS7). Any modification of the controlling device can be done from the PLC system in the control room. Additional to the PLC system an independent hardwired trip system is provided to assure an authorized shut down of the plant in case of emergency. The shut down devices are carried out with pre-alarms, which gives the operating personnel an adequate length of time to interfere before the automatic shut down starts.

Emergency shut down can be initiated manually by operating personnel on-site and/or at the control room independent of the PLC system. The PLC system assures that the plant is on duty in the shortest possible time span. This is important for short time interruption, e.g. power failure. Therefore a very high plant safety is available. The operational status of the plant is monitored on a color screen.

Calibration/Maintenance of Measuring and Analytical Instruments:

All measuring and analytical instruments are being calibrated as per the methodology AM0001 (All meters are calibrated every month as per accepted norms except for the measurement of HFC23 whose frequency is weekly to reduce error, a zero check is carried out every week for the purpose).

Emergency preparedness:
Refrigerant plant has a well documented emergency preparedness plan.

Start up, operation and shut down of the plant can be carried out automatically by an integrated PLC system. In case of a failure, the plant automatically falls into safe conditions. This safety system protects the plant and its machinery and further more provides safety of any personnel.

In order to protect the system against high temperature, an emergency water supply line to the quench system is used. In case of malfunction of the quench system, the incinerator will be shut down and emergency water will be injected to the quench.

The project activity does not result in any unidentified activity that can result in substantial emissions from the project activity. No need for emergency preparedness in data monitoring is visualized.

Report generation on monitoring:
After verification of the data and due diligence on correctness as required, an annual report on monitoring and estimations shall be maintained by the CDM team and record to this effect shall be maintained for verification.

Sustainable Development Indicators Monitoring:
The CDM project activity leads to following improvement and sustainable development for the society

- GHG reduction (Monitoring plan elaborated above)
- Employment Generation: CSL maintains data regarding employees involved in plant construction, plant operations & maintenance.

Environmental Impact:

Parameter	**Units**	**Measured**
Carbon Monoxide CO	PPM	<1.0
HCl	mg/Nm^3	13.5
HF	mg/Nm^3	2.42
Chloride as Cl	mg/L	72.3
Oxides of Nitrogen	mg/Nm^3	110.7
Sulphur Dioxide	mg/Nm^3	< 3.4
Carbon Dioxide	%	2.6
Hydrocarbons	PPM	<1.0
HFC-23	PPM	<0.1
pH at 25 C		7.2
BOD	mg/L	4.0

COD	mg/L	9.8
TSS at 105 C	mg/L	23.0

These measurements fall well within the local / national pollution norms.

Employment details and man days are reported in Monthly report.

For month of august total employment generated by the facility is approximately 1645 man days.

7. Emission Reduction Calculations

In this section the emission reduction calculation equations are explained. The formula for calculation of Emission Reductions is:

$$ER_y = (Q\_HFC23_y - B\_HFC23_y) * GWP\_HFC23 - E\_DP_y – L_y$$

ER_y = GHG emission reduction measured in tonnes of CO_2 equivalents (tonnes CO_2e).

Q_HFC23_y = the quantity of waste HFC 23 destroyed during the year measured metric tonnes,

B_HFC23_y = the baseline quantity of HFC 23 destroyed during the year measured in metric tonnes,

GWP_HFC23 = the Global Warming Potential converts 1 tonne of HFC 23 to tonnes of CO_2 equivalents (tonnes CO_2e/tonnes HFC 23). The approved Global Warming Potential value for HFC23 is 11,700 tonnes CO_2e/tonne HFC 23,

E_DP_y = GHG emission due to the destruction process, (tonnes CO_2e)

L_y = Leakage in the year y (tonnes CO_2e).

7.1 Calculation / Estimation of Q_HFC23_y

The quantity of waste HFC 23 destroyed (Q_HFC23y) would be calculated as the product of the quantity of waste HFC23 supplied to the thermal oxidation process (q_HFC23_y) measured in metric tonnes and the purity of the waste HFC 23 (P_HFC23_y) supplied to the destruction process that would be determined and expressed as the fraction of HFC 23 in the waste.

$$Q\_HFC23_y = q\_HFC23_y * P\_HFC23_y$$

Parameter	Value	Reference
q_HFC23_y	6.019 MT	Appendix -1
P_HFC23_y	97.682 %	Appendix -1
Q_HFC23_y	5.879 MT	Calculated

Check for Baseline:

Parameter	Value	Reference
HCFC23_sold (a)	0	Appendix -1
HCFC22 production allowable (b)	1694.59 MT	PDD
HCFC22 production during current year (c)	845.732 MT	Appendix -1
Waste stream containing HFC23 generation during current year (d)	20.402 MT	Appendix -2
Allowable HFC23 as % of HCFC22 (e)	2.723%	PDD

The HCFC22 production during a given year is limited to 1694.59 MT, and maximum possible percentage of HFC23 waste stream coming out is capped at 2.723%. So HFC23 that can be incinerated during a year is limited to 46.144 MT, provided total production of HCFC22 is ≤1694.59 MT.

In the project activity, from start of the monitoring period i.e. from 16/02/07 till now (first year only) the total HCFC22 production is 845.732 MT, which is below the annual cap of HCFC production. The cap on production quantity of HCFC22 and HFC23 quantity incinerated as percentage of HCFC22 (produced) shall be ensured on annual basis.

Total HFC23 (Q_HFC23) incinerated during this monitoring period is 5.879.

7.2 Calculation / Estimation of B_HFC23_y

The baseline quantity of HFC 23 destroyed is the quantity of the HFC 23 waste stream required to be destroyed by the applicable regulations. If the entire waste stream is destroyed, Q_HFC23y is the total amount of HFC 23 waste generated and the quantity required to be destroyed by the applicable regulations.

$B\_HFC23_y = Q\_HFC23_y * r_y$ is the baseline quantity of HFC 23 destroyed during the year measured in metric tonnes.

Where **r_y** is the fraction of the waste stream required to be destroyed by the regulations that apply during year y. In the absence of regulations requiring the destruction of HFC 23 waste, the typical situation in non-Annex B Parties, $r_y = 0$. In the absence of regulations on HFC 23 emissions, the HFC 23 waste is typically released to the atmosphere and so, the baseline is zero destruction.

Parameter	Value	Reference
Q_HFC23_y	5.879 MT	Section 7.1
r_y	0	Appendix -1
B_HFC23_y	0	Calculated

7.3 Calculation / Estimation of E_DP_y

The emissions due to the destruction process (E_DP_y) are the emissions due to HFC-23 not destroyed in the process and the greenhouse gas emissions of the destruction process. The fuel used is hydrogen hence there won't be any emissions associated with the fuel burning. However if in future natural gas is being used for destruction process, same should be monitored as per approved methodology.

$$\mathbf{E\_DP_y = ND\_HFC23_y * GWP\_HFC23 + Q\_HFC23_y * EF}$$

E_DP_y = Emission due to the destruction process, tCO_2e

ND_HFC23_y = Quantity of HFC23 not destroyed during the year, tonnes

GWP_HFC23 = Global Warming Potential of HFC23, tCO2e/t HFC23 **(11,700)**

Q_HFC23_y = Quantity of waste destroyed in the year y, tonnes

EF = Emission Factor for HFC23 destruction into CO2; value = 0.62857 = 44 / [70/1] i.e. 44/ [(molecular weight of HFC23/ (number of C in molecule of HFC23)]

Parameter	**Value**	**Reference**
ND_HFC23_y	.00000630[2]	Appendix -1
GWP_HFC23	11700	IPCC default value
Q_HFC23_y	5.879	Section 7.1
EF	0.62857	As per AM0001

E_DP_y = $(0.0000063 \times 11700) + (5.879 * 0.62857)$ t CO_2 e

[2] Calculated based on 0.1 ppm concentration of HFC23 in waste stream; constituted predominantly by combustion air flowing at rate of 164Nm^3 per hour. This is conservative estimate in comparison to 0.1 ppm of incoming waste stream.

= 0.074 + 3.70

= 3.77 tCO_2 e

Parameter	Value	Reference
E_DP_y	3.77 tCO_2 e	Calculated

7.4 Calculation / Estimation of L_y.

$$L_y = \Sigma_i (Q\_F_{i,y} * E\_F_{i,y}) + ET_y + \Sigma_j (Q\_F_{j,y} * E\_F_{j,y}) + \Sigma_k (Q\_F_{k,y} * E\_F_{k,y})$$

L_y = Leakage emissions in the year y, tCO2e

$Q\_F_{i,y}$ = the quantity of energy type F_i purchased for the destruction process during year y

$E\_F_{i,y}$ = the greenhouse gas emissions factor for energy type F_i during year y

ET_y = the greenhouse gas emissions associated with sludge transport during year y.

$Q\_F_{j,y}$ = the quantity of energy type F_j in the production of NaOH, Na2SO3, compressed air, hydrogen

$E\_F_{j,y}$ = the greenhouse gas emissions factor for energy type F_j

$Q\_F_{k,y}$ = the quantity of energy type F_k in the transportation of NaOH, Na2SO3, compressed air, hydrogen.

$E\_F_{k,y}$ = the greenhouse gas emissions factor for energy type F_k.

a. *Greenhouse gas (CO_2 and N_2O) emissions associated with the purchased energy (electricity)*

In the project activity only electrical power is purchased from outside, hence

$Q\_F_{i,y}$ = $Q\_F_{power,y}$ = the quantity of power consumed for the destruction process during year y; and

$E\_F_{i,y}$ = $E\_F_{power,y}$ = the greenhouse gas emissions factor for electrical power purchased during year y, t CO2e/ MWh

The greenhouse gas emissions factor for power is based on the emission rate of Southern grid power as CSL draws its requirement exclusively from the Tamil Nadu state electricity board, TNEB grid which in turn is connected to southern region grid. The emission factor is grid emission factor of southern grid,

$E\_F_{power,y}$ = 0.86 tCO_2e/ MWh or 0.00086 tCO_2e released per kWh of power consumed at CSL

Parameter	Value	Reference
$Q\_F_{power,y}$	4900 KWh	Appendix -1
$E\_F_{power,y}$	0.86 tCO2/MWh	Appendix -1

$\Sigma_i (Q\_F_{i,y} * E\_F_{i,y})$	4.214 tCO_2 e	Calculated

b. CO_2 emissions due to transport of sludge to the landfill

ET $_y$, the greenhouse gas emissions associated with sludge transport during year y. There is no sludge formation and hence no emissions for sludge transportation. However, if there is any sludge formation it is carried to the landfill site manually.

Parameter	**Value**	**Reference**
ET_y	0	PDD

c. CO_2 emissions due to production of NaOH, Na_2SO_3, compressed air, hydrogen.

NaOH, hydrogen and compressed air used in the process will be produced in-house with electrical power bought from TNEB. Productions of these require electrical energy and hence there are GHG emissions associated with its production. Na2SO3 is purchased. All these, except for the compressed air, require to be transported to the plant site.

The contributing factors to power consumption are as follows. This shall also take into account green house gas

Parameter	**Value**	**Reference**
$Q\_{NaOH\ y}$	.0176 MT	Appendix -1
$F\_{NaOH, Power,\ y}$	1231 KWh/MT	Appendix -1
$Q\_{Na2SO3\ y}$	0.181 MT	Appendix -1
$F\_{Na2SO3\ Power,\ y}$	475 KWh/MT	Appendix -1
$Q\_{HYDROGEN,\ y}$	27718 Nm3	Appendix -1
$F\_{HYDROGEN,\ Power,\ y}$	0.1 KWh/Nm3	Appendix -1
$Q\_{COMPRESSED\ AIR,\ y}$	56698.8 Nm3	Appendix -1
$F\_{COMPRESSED\ AIR,\ Power,\ y}$	0.0077 KWh/Nm3	Appendix -1
Total Power Consumed	**3316.1 KWh**	Calculated

Total emissions are calculated as sum of these individual power consumptions in various processes multiplied by Grid emission factor since all the power is drawn from TNEB grid.

$E\_F_{j,y} = E\_F_{NaOH,y} = F\_{}_{NA2SO3\ Power,y} = F\_{}_{HYDROGEN,\ Power,y} = F\_{}_{COMPRESSED\ AIR,\ Power,y} = 0.86$ tCO2/MWh

$\Sigma_j (Q\_F_{j,y} * E\_F_{j,y}) = \Sigma_j (Q\_F_{j,y})\ X\ E\_F_{j,y}$

$= 3316.1\ X\ 0.86\ X\ 0.001 = 2.852$ tCO_2 e

Parameter	**Value**	**Reference**
$\Sigma_j (Q\_F_{j,y} * E\_F_{j,y})$	2.852 tCO_2 e	Calculated

d. *CO_2 emissions due to transportation of NaOH, Na2SO3, compressed air, hydrogen*

All the above, but for compressed air, need to be transported to the plant site and carried through trucks and specialized tankers. It requires fuel burning in the vehicles resulting in emissions of GHGs.

The following are the data values to be monitored to calculate the emissions from transportation of material to site.

Parameter	**Value**	**Reference**
Q_NaOH_y	.0176 MT	Appendix -1
$F\_NaOH,_{Fuel,y}$	0.00025 KL/MT	Appendix -1
Q_Na2SO3_y	0.181MT	Appendix -1
$F\_Na2SO3_{Fuel,y}$	0.0725 KL/MT	Appendix -1
$Q\_HYDROGEN,_y$	27718 Nm^3	Appendix -1
$F\_HYDROGEN,_{Fuel,y}$	0.00165 L/Nm^3	Appendix -1
Total fuel consumption	**0.458 KL**	Calculated

Total emissions are calculated as sum of these individual fuel consumptions in various processes multiplied by emission factor for diesel since vehicles used for transportation use diesel. The emission factor is calculated as follows:

NCV (IPCC default for diesel)	43 TJ/Gg

Carbon Content (IPCC default)	20.2 Kg/GJ
Density of diesel	.870 tonne / KL
Emission factor for diesel = $E\_F_{k,y}$	= 43 X 20.2 X 44 /12 /1000 X 0.87 = 2.770 tCO2/KL of diesel

$\Sigma_k (Q\_F_{k,y} * E\_F_{k,y}) = \Sigma_k (Q\_F_{k,y}) \times E\_F_{k,y}$
$= 0.458 \times 2.770 = 1.269\ tCO_2\ e$

Parameter	**Value**	**Reference**
$\Sigma_k (Q\_F_{k,y} * E\_F_{k,y})$	1.269 tCO_2 e	Calculated

$$\mathbf{L_y = \Sigma_i (Q\_F_{i,y} * E\_F_{i,y}) + ET_y + \Sigma_j (Q\_F_{j,y} * E\_F_{j,y}) + \Sigma_k (Q\_F_{k,y} * E\_F_{k,y})}$$

Parameter	**Value**	**Reference**
$\Sigma_i (Q\_F_{i,y} * E\_F_{i,y})$	4.214 tCO_2 e	Calculated – Section 7.4 , a
ET_y	0	PDD
$\Sigma_j (Q\_F_{j,y} * E\_F_{j,y})$	2.852 tCO_2 e	Calculated – Section 7.4 c
$\Sigma_k (Q\_F_{k,y} * E\_F_{k,y})$	1.269 tCO_2 e	Calculated – Section 7.4 d
L_y	8.335tCO_2 e	Calculated

7.5 Emission Reduction Calculation

$$\mathbf{ER_y = (Q\_HFC23_y - B\_HFC23_y) * GWP\_HFC23 - E\_DP_y – L_y}$$

Parameter	**Value**	**Reference**
Q_HFC23_y	5.883	Calculated
B_HFC23_y	0	Calculated
GWP_HFC23	11700	IPCC default value
E_DP_y	3.77 tCO_2 e	Calculated
L_y	8.335 tCO_2 e	Calculated

ER $_y$	**68777tCO_2 e**	**Calculated**

Appendix – 1

Variable	Data unit	Value	Recording Methodology	QA / QC and assurance Procedure	Uncertainty level of data. High/medium/ low
1. q_HFC23_y	Tonnes – HFC	6.019	Two meters (FT001 and FT002) are in parallel and for the sake of conservativeness the lower value of the two readings will always be used to estimate the HFC 23 waste flows. Screen shots of the meters are taken each shift; The screenshots and data records in DCS are basis for recording the data into log books which is the final input to the SAP system. Procedure for Zero Check: 1. Waste feed to incinerator is shut-off through DCS. 2. Flow meters are isolated by closing the block valves. 3. After stabilization, screen shots for readings in DCS are taken, as well physical photographs of flow meters.[3]	For Flow meters zero check is done every week and calibration is done every six months. Where the flow meter readings differ by greater than twice their accuracy; then the reason for the discrepancy will be investigated and the fault shall be remedied.	Low
2. P_HFC23_y	%	97.682	Shift supervisor analyses the sample on GC and shift in-charge records it. GC records are available in hard and soft format. The readings are checked by shift in-charge and fed into excel sheet.	The readings are part of consolidated monthly report which is checked by Head-Production.	Low

[3] A detailed operation procedure is available at the plant site. If any deviation in zero reading is observed, it is rectified as per procedure detailed by manufacturer's manual.

3. *ND_HFC23_y*	Tonnes – HFC	0.00000630	An external lab (ISO 17025 accredited) is employed to test the effluent from incinerator on monthly basis. This parameter is also analyzed internally once the incinerator shuts down using international standard testing procedures. The production in-charge is responsible for checking reports.	VIMTA Labs is an ISO 17025 accredited agency, and test procedures are as per international standard. .	Low
4. *Q_HCFC_y*	Tonnes – HFC22	845.732	Actual HCFC plant production data is used. The HCFC storage tanks have liquefied gas and are fitted with level gauges. The level of tank is measured and quantity of gas produced is recorded based on level difference and standard calibration chart for level-mass conversion.	The production records can be checked against stock/sales records.	Low
5. *HFC23_sold*	Tonnes – HFC23	0	The sales record is maintained by the sales department. The records are part of SAP system.	These records can be checked against excise records.	Low
6. *r_y*	%	0	No national / state policy in effect that requires destruction of HFC23	-	Low
7. *$Q\_F_{power, y}$*	KWh	4900	Dedicated high accuracy energy meter for measuring power consumption in project activity is installed. The shift operator / shift in-charge takes the reading and is checked by Head-Production on monthly basis.	The energy meters are calibrated on a monthly basis by an external ISO 17025 accredited agencies.	Low
8. *$E\_F_{power, y}$*	tCO_2/MWh	0.86	The electricity is drawn from Southern Grid. The southern region Grid emission factor has been used. The data used for estimation of GEF is taken from Central Electricity Authority in India. CEA website: http://cea.nic.in/planning/c%20and%20e/Government%20of%20India%20website.htm	-	Low

9. $Q\_{NaOH\ y}$	Tonnes	0.0176	Caustic tank level readings are taken by shift supervisor on daily basis in log book. The NaOH consumption is recorded based on Caustic solution consumption on a monthly basis. The same is checked by Head-Production on a monthly basis.	The concentration of tank at the time of caustic solution preparation is available as test report	Low
10. $F\_{NaOH,\ Power,\ y}$	KWh / t NaOH	1231	Sourcing plant records for power consumption in production of NaOH. MIS report from the sourcing plant is basis.	-	Low
11. $F\_{NaOH,\ Fuel,\ y}$	KL / tonne of NaOH	0.00025	Estimated based on distance from sourcing plant, vehicle carrying capacity, and fuel emission factor and fuel type. The transportation records on vehicle type and vehicle carrying capacity are available.	The reports can be checked against transportation records.	Low
12. $Q\_{Na2SO3\ y}$	Tonnes	0.181	Tank level readings are taken by shift supervisor on daily basis in log book. The Na2SO3 consumption is recorded based on Na2SO3 solution consumption on monthly basis. The same is checked by Head-Production on a monthly basis.	-	Low
13. $F\_{Na2SO3\ power,\ y}$	KWh / t Na2SO3	475	Sourcing plant records for power consumption in production of Na2SO3. A certificate from manufacturer is available giving power consumption for per tonne of Na2SO3 production, for last three years. The highest of the three has been used for estimation of power consumption.	-	Low
14. $F\_{Na2SO3\ fuel,\ y}$	KL / tonne of Na2SO3	0.00725	Estimated based on distance from sourcing plant, vehicle carrying capacity, and fuel emission factor and fuel type. The transportation records on vehicle type and vehicle carrying capacity are available.	The reports are checked against transportation records.	Low

15. $Q_{\_HYDROGEN, y}$	Nm^3	27718	The hydrogen is measured for the number of hydrogen cylinders used for the incineration process. The hydrogen cylinders contain standard quantity of hydrogen volume.	The consumption records can be checked against the receipts.	Low
16. $F_{\_HYDROGEN, Power, y}$	KWh/Nm^3	0.1	Information from sourcing plant is received on monthly basis and same is used to estimate total power consumption in hydrogen manufacturing.	-	Low
17. $F_{\_HYDROGEN, Fuel, y}$	l/Nm^3	0.016	Estimated based on distance from sourcing plant, vehicle carrying capacity, and fuel emission factor and fuel type. The transportation records on vehicle type and vehicle carrying capacity are available.	The reports can be checked against transportation records.	Low
18. $Q_{\_COMPRESSED\ AIR, y}$	Nm^3	56698.8	Flow meters are used to monitor use of compressed air in combustion process. The shift in-charge is responsible for monitoring of air consumed. Screenshots of flow meter readings are used to record the same.	Flow meters are calibrated monthly.	Low
19. $F_{\_COMPRESSED\ AIR, Power, y}$	KWh/Nm^3	0.0077	Energy meter is in place to monitor the power consumption in compressed air supply. The shift in-charge takes daily record of the power consumption.	The energy meter is calibrated on monthly basis by ISO 17025 accredited agencies.	Low

Appendix-2

Material Balance and baseline check

Year (current)	HCFC22 prodcuced during current year, MT	HCFC production cap for current yr, MT	HFC23 waste stream supplied for destruction, MT (q_HFC23)	HFC23 (pure) incinerated, MT	HFC23 incinerated as percentage of HCFC22 produced during current year	Waste stream generated during current year, MT	Stored waste stream of HFC23 eligible for Carbon credits, MT
16/02/07 to 31/08/07	845.732	1694.59	6.019	5.879	0.70%	20.402	14.383

Cumulative HCFC22 produced during current year shall not be greater than production cap
HFC23 incinerated as percentage of HCFC22 prodcued shall not be greater than % cap i.e. 2.723%