

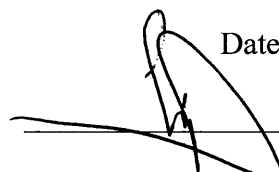


**CDM
MONITORING REPORT #2
of
“N2O Emission Reduction in Onsan,
Republic of Korea”
UNFCCC 0099**

**From: Oct. 23, 2006
To: Nov. 19, 2006**

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Date: Nov. 20th, 2006



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1 Introduction

The purpose of this monitoring report is to calculate and clarify GHG emission reduction quantity achieved by this project for periodic verification.

This monitoring report covers the activity from October 23rd 2006 to November 19th 2006 as the 2nd period.

Duration of the project activity period

The starting date of the project is defined as 01/09/2006.

2. Reference

Approved Baseline methodology :

Baseline Methodology for decomposition of N₂O from existing adipic acid production plants (AM0021)

Approved Monitoring methodology :

Monitoring Methodology for decomposition of N₂O from existing adipic acid production plants (AM0021)

Project Design Document :

N₂O Emission Reduction in Onsan, Republic of Korea.

Version number of the document : 8

Date : September, 1st 2005

CDM registration number :

“N₂O Emission Reduction in Onsan, Republic of Korea” – UNFCCC ref number 0099

3. Definition

y : Monitoring period (in this report, October 23rd 2006 to November 19th 2006.)

PDD : Project Design Document of this project “N₂O Emission Reduction in Onsan, Republic of Korea.” Version number of the document: 8, issued on September, 1st 2005

4. General description of project

Project activity

Nitrous oxide (N₂O) is a by-product of adipic acid production. It is of low toxicity but is a greenhouse gas (GHG), whose GWP is large (GWP=310 in the IPCC 2nd Assessment Report). Emissions of N₂O will be controlled under the Kyoto Protocol. As far as we are aware, there are however no national or regional regulations or restrictions on the emission of N₂O in South Korea. There are in fact no governmental regulations with quantified emission limits in any non-Annex I countries at this point.

In this project, Rhodia Polyamide Co. Ltd additionally installed N₂O collection and a thermal decomposition process equipment to the currently operating adipic acid manufacturing plant. This installation reduces the GHG emissions, which would otherwise be released to the atmosphere if the project was not implemented.

The decomposition facilities was installed in the factory site of Onsan Rhodia Polyamide Co., Ltd. in May 2006 and destruction of N₂O was started in September 2006.

The starting date of the project as well as the starting date of the crediting period is defined as 01/09/2006.

This project activity was registered at UNFCCC on November 27th 2005 with the number 0099.

Technical description of the project

Location of the project activity

The decomposition facilities were installed in the factory site of Onsan Rhodia Polyamide Co. Ltd, in May 2006. The surrounding area is the Onsan industrial complex area.

Technology to be employed by the project activity

A thermal oxidizer with 2 chambers is the technology used to decompose N₂O.

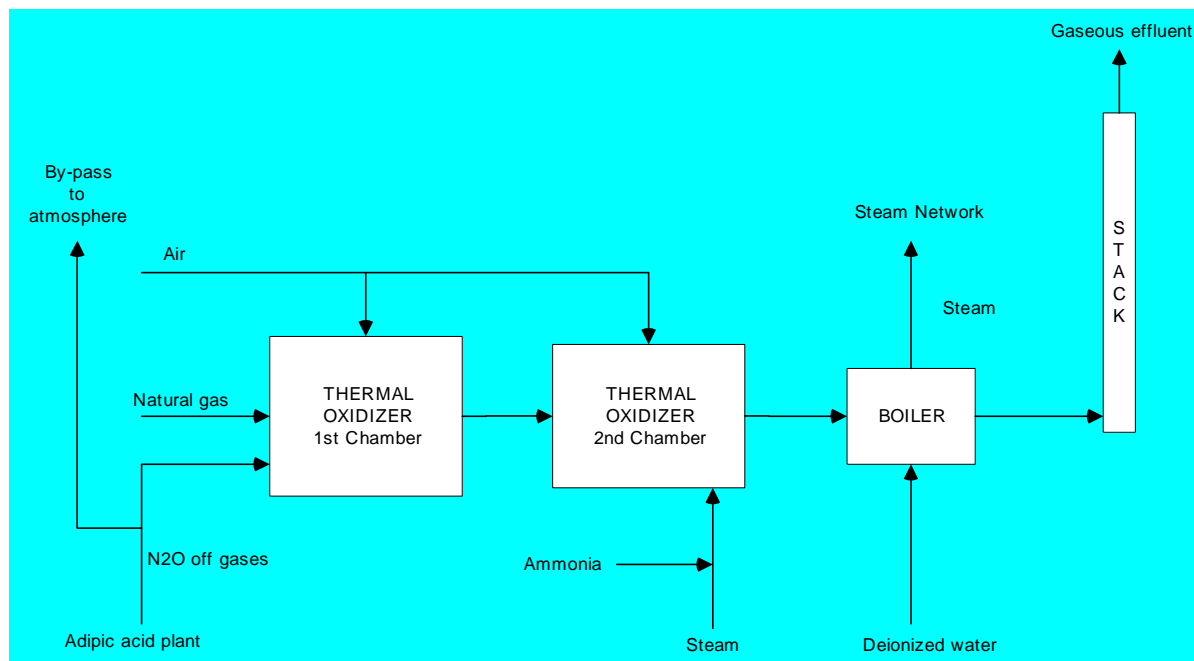
Natural gas is fed with the off gas adipic acid production containing N₂O and some air in a reduction chamber, where it burns (oxidizes) to carbon dioxide CO₂ and water vapour. N₂O is used as an oxidizer. Being oxygen deficient, the oxidation is not complete and carbon monoxide and hydrogen are present.



The temperature in the furnace is kept at about 1300°C and under fuel rich conditions, so as to promote the complete decomposition of N₂O while minimizing the formation of unwanted combustion by-products such as NO and NO₂.

The gas is then quenched with air to complete the combustion of carbon monoxide and hydrogen at a temperature of about 950°C in a second chamber. Steam and ammonia are injected to control the emission of NO and NO₂.

Before release to the stack, the flue gas coming from the thermal oxidizer is used to produce saturated steam, which is fed into the existing on-site steam network.

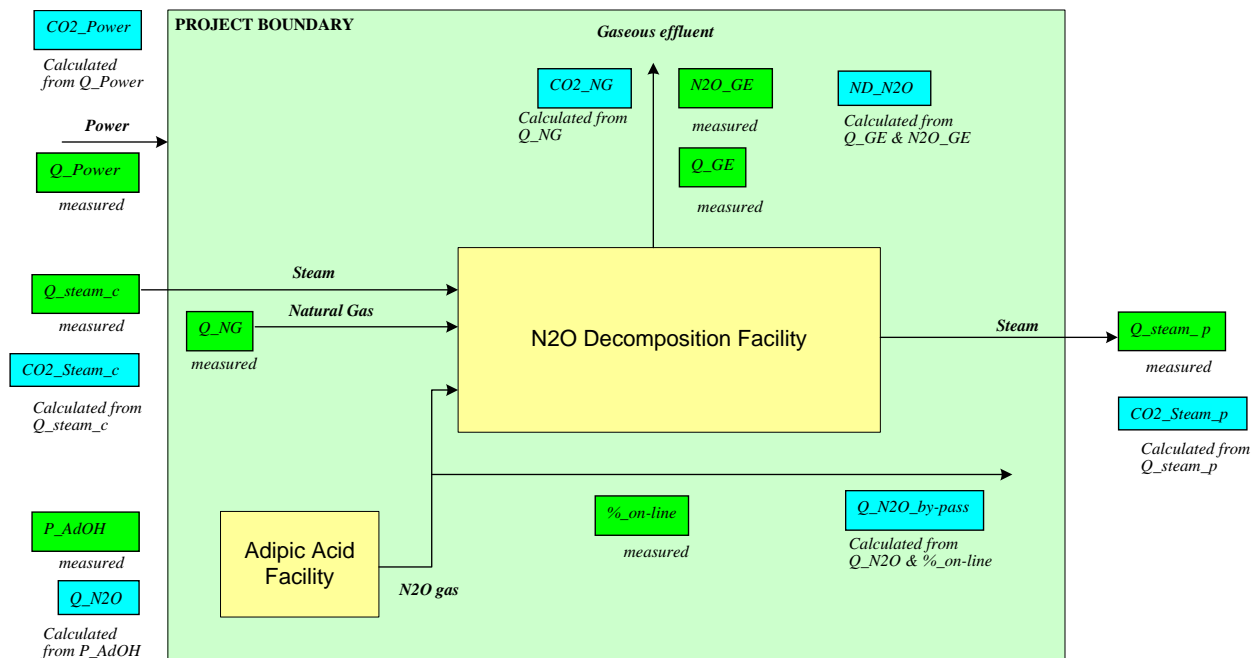


5. Baseline methodology

Approved baseline methodology AM 0021: “Baseline methodology for decomposition of N₂O from existing adipic acid production plants” (AM0021), is applied to this project

The project boundary related to the baseline methodology is shown below and this project boundary is used and explained in the PDD.

Potential sources of anthropogenic emissions by sources of GHG within the project boundary and emissions which are not included in the project boundary are also shown in below.



6. Monitoring methodology and plan

Approved monitoring methodology AM 0021 / version 1 is applied to this project

This methodology is applicable to projects which decomposes N₂O from an adipic acid production plant under the following conditions:

- either catalytic or thermal decomposition of the N₂O by-product of adipic acid production at existing production plants
- The methodology is spatially generic, being applicable across regions where the data (both related and project activity as well) exist to undertake the assessment
- The methodology is applicable only for installed capacity (measured in tonnes of adipic acid per year) that exists by the end of the year 2004.

The present project satisfies these conditions.

Data being collected to monitor the GHG reduction is given in the table below

ID	Data variable	Source of data	Data unit	Recording frequency	Reference
Q_GE	Volume of effluent gas leaving the stack	Flow meter	Nm ³	Monthly	Appendix 1
N ₂ O_GE	Concentration of N ₂ O in the effluent gas	Infra –Red online analyzer	ppm	Monthly	Appendix 2
ND_N2O	Quantity of N ₂ O in the effluent gas leaving the stack	Calculated from Q_GE and N ₂ O_GE	Kg- N ₂ O	Monthly	Appendix 3
Q_NG	Amount of natural gas burned	Natural gas meter	Nm ³	Monthly	Appendix 4
NGC	Natural gas composition required for calculation of E_NG	Gas supplier	-	Monthly	Appendix 5
%_on-line	% of production time the position switches on the by-pass valves are open	Position switches on bypass valves	% of production time	Monthly	Appendix 6
Q_N2O_by-pass	N2O by passing the decomposition facility	Calculated from Q_N2O and %_on-line	kg	Monthly	Appendix 7
P_AdOH	Amount of adipic acid production	Log sheet for packaged product and DCS for silo inventory	tonne AdOH	Monthly	Appendix 8
Nitric acid consumption (HNO ₃ _consumption) & physical losses in the adipic acid production process (HNO ₃ _physical)	All data required for calculation of HNO ₃ chemical and the N ₂ O emission factor N ₂ O_AdOH	Excel workbook based on the raw material consumption, DCS data and Lab data	-	Monthly	Appendix 9
Q N ₂ O reg	Per Korean regulation allowed N ₂ O emissions	South Korean regulation	kg	Date when relevant legislation is in place	Appendix 10

ID	Data variable	Source of data	Data unit	Recording frequency	Reference
N ₂ O reg/AdOH	Per Korean regulation allowed N ₂ O emissions per kg of adipic acid produced	South Korean regulation	kg	Date when relevant legislation is in place	Appendix 10
r _y	Per Korean regulation required share of N ₂ O emissions to be destroyed	South Korean regulation	%	Date when relevant legislation is in place	Appendix 10
P N ₂ O	Market price of N ₂ O	Estimated	€/t	Yearly	Appendix 11
Q_Steam_p	Amount of steam produced by the decomposition process	Steam meter	kg	Monthly	Appendix 12
Steam supplier data	All data required for calculation of E_Steam	External steam supplier and steam properties	-	Yearly	Appendix 13
Q_Power	Electric consumption of the decomposition facility	Electricity meter	kWh	Monthly	Appendix 14
Electricity grid data	All data required for calculation of E_Power according to AM0002	Korean Energy Economics Institute	-	Yearly	Appendix 15
Q_Steam_c	Amount of steam consumed by the decomposition facility	Steam meter	kg-steam	Monthly	Appendix 16
Steam suppliers data	All data required for calculation of E_Steam_c	Internal & External steam suppliers	-	Yearly	Appendix 17

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

7.1. Quality Management System

The thermal oxidation plant is operated by Rhodia operating personnel. Rhodia has assigned the responsibility for operating, monitoring and reporting to the Adipic Acid Plant Manager.

The operation, data transfer and reporting procedures are incorporated into the ISO 9001 procedures of the Onsan Adipic Acid plant

The personnel have been trained by the technology supplier i.e. M/s John Zink International Luxembourg.

7.2. Quality control (QC) and quality assurance (QA) procedures that are being undertaken for data monitored

The Onsan plant is certified according to ISO9001 and applies appropriate QA & QC procedures.

The equipment and analytical methods given by the technology supplier M/s John Zink International Luxembourg as well as those supplied by Rhodia are done according to internationally accepted standards.

The QA & QC procedures are set and implemented in order to:

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

Data (Indicate table and ID number e.g. 3.-1.; 3.2.)	Uncertainty level of data (High/Medium/ Low)	Explain QA/QC procedures planned for these data, or why such procedures are not necessary.
2a.1. (D.2.1.1) Q_GE	Low	<i>This flow meter is measured with an Averaging Pitot tube. This instrument is considered as a critical instrument in the QA/QC procedure.</i>
2a.2. (D.2.1.1) N ₂ O_GE	Low	<i>Existing procedures are applied to this analyzer for QA & QC.</i>
2a.4. (D.2.1.1) Q_NG	Low	<i>Is measured using natural gas meter from the supplier and as such is part of a regular procedure control between the Natural Gas supplier and Rhodia.</i>
2b.1. (D.2.1.3) P_AdoH	Low	<i>Is obtained from production records of the ONSAN adipic acid plant where the N₂O waste originates. A QA/QC procedure is implemented. Production quantity is based on the packaged product plus silo volume.</i>
2a.5. (D.2.1.1) %_on-line	Low	<i>Use opening of high integrity performance connecting valves to limit leaks. Procedures currently in place in Chalampé for monitoring N₂O emissions have been implemented in ONSAN to periodically check their tightness and assure their good operation. They have been added to the QA/QC existing procedures.</i>
2b.7. (D.2.1.3) Q_Steam_p	Low	<i>Steam meter placed on the list of critical instrument data in the QA/QC procedures</i>
3.1. (D.2.3.1) Q_Power	Low	<i>Electricity meter. Standard procedures are used. No QA/QC procedures implemented as this flow represents less than 0.01% of the baseline emissions.</i>
3.4. (D.2.3.1) Q_Steam_c	Low	<i>Steam meter placed on the list of critical instrument data in the QA/QC procedures.</i>

7.3. Calibration/Maintenance of Measuring and Analytical Instruments

All measuring and analytical instruments are being calibrated as per the methodology AM0021 and created as a protocol in Onsan's Quality management system procedures.

The maintenance methods and procedures have been incorporated as part of the ISO 9001 procedures and form an integral part of the systems and procedures for the organization.

7.4. Environmental Impact

The Thermal oxidation plant has been installed with on line analyzers to monitor constantly some parameters that are required by Korean legislation. Starting on July 1st 2007, those parameters will be transmitted automatically to the local government environmental agency as part of the Telemonitoring System (TMS) required by a revised environmental law. Until that date regular checking by government agencies can be made.

KumHo Environmental Co, Ltd had carried out 3 times in Oct. 2006 the analysis of the gas discharged from the N₂O stack. The analysis values were under the control specification limit of the Korea environmental regulation and the average value of those results are shown in the table below.

(KumHo company has an analysis license for air emission which is permitted by the Korean environmental government)

Table showing analysis Gaseous Emission for Thermal Oxidation plant

Parameter	Unit	Value as per applicable standard	Typical on-line analysis	Average value in October 2006
CO	ppm	50 max	< 10 ppm	NA
NO _x	ppm	200 max	< 100 ppm	55 ppm
NH ₃	ppm	50 max	< 10 ppm	1.9 ppm

8. GHG Calculations

Statement of GHG emission reduction in 2nd monitoring period.

As suggested by the methodology (AM0021/Version 1), the GHG emission reduction, (ER_y), achieved by the project activity for a given year is

$$ER_y = BE_y - PE_y - L_y$$

8.1. Calculation of Q_N₂O_y

It has been checked that there are no Korean regulation into place that would limit the quantity of N₂O emitted that can be taken into account for the calculation of the baseline emissions (see D.2.1.4. in the PDD).

The quantity Q_N₂O_y of N₂O emitted over the period can then be calculated by:

$$Q_{N_2O_y} = P_{AdOH} \times N_{2O_}/AdOH$$

Over the period of reference the emission factor from the adipic acid plant was above the capped value of 0.27 kg N₂O/kg AdOH. So the capped value is being used according to AM 0021.

Parameter	value	Reference
Q_N2O _y	2 871 045 kg	Calculated
P_AdOH	10 633.5 t	Appendix 8
N2O_/AdOH	0.27 kg N2O/kg AdOH	Appendix 9
Q_N2O _{reg}	No limit	Appendix 10
N2O _{reg} / AdOH	No limit	Appendix 10
r _y	NA	Appendix 10

The production of adipic acid during the year starting on November 20th 2005 that includes this period is below the nameplate capacity of the adipic acid plant, and as such the total production of this period can be used as such.

8.2. Calculation of baseline emissions

The amount of baseline emissions in the given period y (measured in t CO₂ eq.) is calculated by

$$BE_y = Q_{N2O_y} \times GWP_{N2O} + Q_{Steam_{py}} \times E_{Steam_y}$$

Parameter	value	Reference
BE_y	891 774 t CO₂ eq.	Calculated
Q_N2O _y	2 871 045 kg	Calculated in 8.1
GWP_N2O	310	Kyoto Protocol Rule. Decision 2/CP.3
Q_Steam _{py}	14 346 400 kg of steam	Appendix 12
E_Steam _y	0.122 kg-CO ₂ /kg of steam	Appendix 13

8.3. Calculation of (Q_N2O x (1-%_on-line))_y

The quantity of N₂O that has by-passed the decomposition facility is calculated from the adipic acid production made while by-passing the decomposition facility.

The quantity of adipic acid produced while by-passing the destruction facility is monitored and the quantity of N₂O that by-pass the decomposition facility is registered daily:

$$Q_{N2O_by-pass} = P_{AdOH} \times (1-\%_{on-line}) \times N2O_/AdOH$$

This value is a value by excess as during each connection/ disconnection phases the production is counted as completely by-passed.

The quantity of N₂O that by-passed the decomposition facility over the period is:

$$(Q_{N2O} \times (1-\%_{on-line}))_y = Q_{N2O_by-pass_y}$$

The %_{on-line_y} equivalent over the period is calculated as:

$$\%_{on-line_y} = 1 - (Q_{N2O_by-pass_y} / Q_{N2O_y})$$

Parameter	Value	Reference
Q_N2O_by-pass _y	448 659 kg	Appendix 7
P_AdOH	10 633.5 t	Appendix 8
N2O /AdOH	0.27 kg N2O/kg AdOH	Appendix 9
%_on-line _y	84.37 %	Appendix 6

8.4. Calculation of project emissions

The emissions due to the decomposition process PE_y are the emissions due to the N₂O that has not been sent to the decomposition process, the N₂O non destroyed by the decomposition process and the emissions due to the use of natural gas.

$$PE_y = ((Q_{N_2O_by-pass_y} \times (1 - \%_{on-line}_y)) + (Q_{GE} \times N_{2O_GE}_y) \times GWP_{N_2O} + Q_{NG_y} \times E_{NG_y})$$

$$PE_y = (Q_{N_2O_by-pass_y} + (Q_{GE} \times N_{2O_GE}_y) \times GWP_{N_2O} + Q_{NG_y} \times E_{NG_y})$$

The non-destroyed N₂O (ND_N₂O_y) is constantly monitored and obtained from the constant monitoring of the flow (Q_{GE}) and the concentration of N₂O (N₂O_{GE}) of the effluent gas:
 $ND_{N_2O} = Q_{GE} \times N_{2O_GE}$

$$PE_y = (Q_{N_2O_by-pass_y} + ND_{N_2O_y}) \times GWP_{N_2O} + Q_{NG_y} \times E_{NG_y}$$

Parameter	value	Reference
PE_y	141 019 t CO₂ eq.	Calculated
Q_N2O_by-pass _y	448 659 kg	Appendix 7
Q_GE	10 108 761 Nm ³	Appendix 1
N ₂ O_GE	5~6 ppm	Appendix 2
ND_N ₂ O _y	101 kg N ₂ O	Appendix 3
GWP_N ₂ O	310 kg CO ₂ eq./ kg N ₂ O	Kyoto Protocol Rule. Decision 2/CP.3
Q_NG _y	851 681 Nm ³	Appendix 4
E_NG _y	2.235 kg CO ₂ eq./ Nm ³	Appendix 5

8.5. Calculation of leakage

Leak emissions comprise the emissions associated with the energy sources used to generate any steam and electricity used by the decomposition plant.

Leakage amounts to:

$$L_y = Q_{Power} \times E_{Power} + Q_{steam_c_y} \times E_{steam_c_y}$$

Parameter	value	Reference
Ly	102 t CO2 eq.	Calculated
Q_Power	138 327 kWh	Appendix 14
E_Power	0.649 kg-CO ₂ /kWh	Appendix 15
Q_Steam_c _v	90 302 kg	Appendix 16
E_Steam_c _v	0.137 kg-CO ₂ / kg of steam	Appendix 17

8.6. Calculation of emission reduction

The total emission reduction achieved by this project activity during the first monitoring period is therefore,

$$ER_y = BE_y - PE_y - Ly$$

Or,

$$ER_y = 891\,774 \text{ t CO}_2 \text{ eq.} - 141\,019 \text{ t CO}_2 \text{ eq.} - 102 \text{ t CO}_2 \text{ eq.}$$

Or,

$$ER_y = 750\,653 \text{ t CO}_2 \text{ eq.}$$

The above emission reduction covers the generation of N₂O during the period from October 23rd 2006 to November 19th 2006.

Appendix 1

Name of item

Q_GE

Description

Volume of effluent gas leaving the stack

Value in period

10 108 761 Nm3

Method of monitoring

Annubar flow meter

Recording frequency

Monthly

Background data

Log sheet record / flowmeter

Period	Quantity of gaseous effluent Nm ³
Oct 23 rd – Oct 31 st	2 628 033
Nov 1 st – Nov 19 th	7 480 728
Oct 23 rd – Nov 19 th	10 108 761

Appendix 2

Name of item	N2O_GE
Description	Concentration of N ₂ O in the effluent gas
Value in period	5 - 6 ppm
Method of monitoring	Laser diode online analyzer
Recording frequency	Monthly
Background data	Log sheet record
Calculation method	<p>The instant values of the on-line analyzer are used to calculate the quantity of ND_N2O every 10 sec:</p> $ND_N2O = Q_GE * N2O_GE * Specific_gravity_of_N2O$ <p>The analyzer has a range of 0-200 ppm with a detection limit of 5 ppm, which is used as a default value when the measured value is below the detection limit.</p> <p>Cumulated value for ND_N2O is recorded (see appendix 3).</p> <p>At the end of the month/period based upon the flow Q_GE, and ND_N2O the concentration of N2O equivalent for the month/period is calculated.</p> <p>This value is for information as the constant calculation of ND_N2O is more accurate.</p>

Period	ND_N2O kg	Quantity of gaseous effluent Nm ³	Average concentration of N ₂ O_GE ppm
Oct 23 rd – Oct 31 st	26	2 628 033	5 - 6
Nov 1 st – Nov 19 th	75	7 480 728	5 - 6
Oct 23 rd – Nov 19 th	101	10 108 761	5 - 6

Appendix 3

Name of item	ND_N2O
Description	Quantity of non-destroyed N2O emitted by the decomposition facility
Value in period	101 kg N ₂ O
Method of monitoring	On-line DCS calculation
Recording frequency	Monthly
Background data	Log sheet record
Calculation method	Actual quantity of non destroyed N2O is calculated on-line in the DCS from the concentration of N2O and the flow rate of the gaseous effluent: $ND_N2O = Q_GE * N2O_GE * Specific_gravity_of_N2O$

Period	ND_N2O kg
Oct 23 rd – Oct 31 st	26
Nov 1 st – Nov 19 th	75
Oct 23 rd – Nov 19 th	101

Appendix 4

Name of item

Q NG

Description

Amount of natural gas used by the decomposition process

Value in period

851 681 Nm3

Method of monitoring

Natural gas consumption data

Recording frequency

Monthly

Background data

Log sheet record / flowmeter

Period	Q_{NG} Nm^3
Oct 23 rd – Oct 31 st	182 130
Nov 1 st – Nov 19 th	669 551
Oct 23 rd – Nov 19 th	851 681

Appendix 5

Name of item	E_NG
Description	Supplier data for natural gas for the calculation of E_NG
Value in period for E_NG	2.235 kg CO ₂ /Nm ³
Method of monitoring	Natural Gas Composition (NGC)
Recording frequency	Monthly
Background data	Composition data received from Kyung Dong City Gas Ltd, the natural gas supplier
Calculation method	The average number of C in a mole of NG is calculated from the composition = \sum (number of C in each mole) x (volume ratio) As November data are not available yet, October data are used for November.

Component	October Natural Gas Composition	November Natural Gas Composition	Number of C
CH ₄ (Methane)	90.62	90.62	1
C ₂ H ₆ (Ethane)	5.55	5.55	2
C ₃ H ₈ (Propane)	2.49	2.49	3
I-C ₄ H ₁₀ (I-Butane)	0.54	0.54	4
N-C ₄ H ₁₀ (N-Butane)	0.57	0.57	4
I-C ₅ H ₁₂ (I-Pentane)	0.01	0.01	5
N-C ₅ H ₁₂ (N-Pentane)	0.00	0.00	5
N ₂ (Nitrogen)	0.20	0.20	0
CO ₂ (Carbon dioxide)	0.00	0.00	1
Average number of C	1.137	1.137	
E_NG	2.235	2.235	

The CO₂ specific gravity in standard state is 1.965
 $E_{NG} = 1.965 \times (\text{average number of C in a mole of NG})$

Appendix 6

Name of item

%_on-line

Description

% of production time that the N₂O is sent to the decomposition facility

Value in period

84.37 %

Method of monitoring

Position of limit switches on the valves allowing to by-pass the decomposition facility

Recording frequency

Monthly

Background data

Log sheet record

Calculation method

Based upon the position of the limit switches on the valves by-passing the decomposition facility, the % of time that the production is connected to the facility is continuously counted and used to calculate Q_ N₂O_by-pass (See Appendix 7).

At the end of the period, %_on-line for the period is calculated as:

$$\%_{\text{on-line}_y} = 1 - (Q_{\text{N}_2\text{O}_{\text{by-pass}_y} / (P_{\text{AdOH}_y} \times \text{N}_2\text{O}_{\text{AdOH}}))$$

Period	Q_N ₂ O_by-pass _y kg	P_AdOH _y t	%_on-line _y %
Oct 23 rd – Oct 31 st	380 564	3214.5	56.15
Nov 1 st – Nov 19 th	68 095	7 419.0	96.60
Oct 23 rd – Nov 19 th	448 659	10 633.5	84.37

Appendix 7

Name of item	Q_N2O_by-pass
Description	N2O by-passing the decomposition facility
Value in period	448 659 kg
Method of monitoring	Production record and %_on-line DCS monitoring
Recording frequency	Monthly
Background data	Production & %_on-line log sheet record
Calculation method	<p>The quantity of adipic acid produced while by-passing the destruction facility is first calculated:</p> $\text{AdOH}_{\text{by-pass}} = \text{P}_{\text{AdOH}} \times (1 - \%_{\text{on-line}})$ <p>The quantity of N2O that by-pass the facility is then recorded daily.</p> $\text{N2O}_{\text{by-pass}_d} = \text{P}_{\text{AdOH}_d} \times \text{N2O}_{\text{}}/\text{AdOH} \times (1 - \%_{\text{on-line}})$ <p>At the end of the period the quantity of N2O that by-passed the facility is :</p> $\text{N2O}_{\text{by-pass}_y} = \Sigma (\text{N2O}_{\text{by-pass}_d})$

Period	N2O_by-pass _y kg
Oct 23 rd – Oct 31 st	380 564
Nov 1 st – Nov 19 th	68 095
Oct 23 rd – Nov 19 th	448 659

Appendix 8

Name of item

P_AdOH

Description

Adipic acid production

Value in period

10 633.5 t

Method of monitoring

Packaged production and silo inventory

Recording frequency

Monthly

Background data

Log sheet record

The production of adipic acid over the year ending on November 19th 2006 is below the capped value defined in the PDD.

The quantity of adipic acid produced during this period can then be fully used as such.

Month - year	Adipic acid production t
Oct 23 rd – Oct 31 st	3214.5
Nov 1 st – Nov 19 th	7419.0
Oct 23 rd – Nov 19 th	10 633.5

Appendix 9

Name of item	N2O_AdOH
Description	N2O emission factor for adipic acid production
Value in period	0.270 kg N2O/ kg AdOH
Method of monitoring	Adipic acid production, nitric acid consumption and physical losses
Recording frequency	Yearly
Background data	Log sheet records
Calculation method	Nitric acid physical losses (HNO3_physical) in the aqueous waste, the off gases, the adipic acid and the by-product are monitored. Those losses are deducted from the nitric acid consumption, (HNO3_consumption) to get the chemical consumption, (HNO3_chemical).

The N2O emission factor is then calculated over the period:

$$\text{N2O_AdOH} = \text{HNO3_chemical} / \text{P_AdOH} / 63 / 2 \times 0.96 / 44$$

This value is capped by a value of $\text{KE_N2O} = 0.27$, as specified in the PDD table D.2.1.3 and required by the methodology AM0021.

Year ending	Value calculated kg N2O/kg AdOH	KE_N2O kg N2O/kg AdOH	N2O_AdOH kg N2O/kg AdOH
Nov. 19 th 2006	> 0.270	0.270	0.270

Appendix 10

Name of item	Q_N ₂ O reg , N ₂ O_reg / AdOH and r _y
Description	<p>Evolution of Korean legislation that may require limitation of N₂O emissions using one of the following criteria:</p> <ul style="list-style-type: none"> - Q_N₂O reg : allowed N₂O emissions - N₂O_reg / AdOH : allowed N₂O emissions per kg of adipic acid produced - r_y : share of N₂O emissions required to be destroyed
Value in period	not applicable
Method of monitoring	Survey
Recording frequency	When relevant
Background data	<p>South Korean legislation</p> <p>No evolution of legislation since PDD emission.</p>

Period	Q_N ₂ O reg kg	N ₂ O_reg / AdOH kg	r _y %
Oct 23 rd – Nov 19 th	No limit	No limit	0.

Appendix 11

Name of item

Description

Value in period

Method of monitoring

Recording frequency

Background data

P_N₂O

Market price of N₂O in waste gas

0 €/t

Market survey

Yearly

No market for this low level of N₂O concentration

Year	P_N ₂ O
2005	0

Appendix 12

Name of item	Q_Steam_p
Description	Amount of steam produced by the decomposition facility
Value in period	14 346 400 kg
Method of monitoring	Flowmeter
Recording frequency	Monthly
Background data	Log sheet record

Period	Q_Steam_p kg
Oct 23 rd – Oct 31 st	3 037 900
Nov 1 st – Nov 19 th	11 308 500
Oct 23 rd – Nov 19 th	14 346 400

Appendix 13

Name of item	E_Steam
Description	CO ₂ emission factor for steam produced by the facility
Value in period	0.122 kg-CO ₂ /kg of steam
Method of monitoring	Supplier data
Recording frequency	Yearly
Background data	Monthly external natural gas data from supplier
Calculation method	<p>As we cannot get the data from the supplier, the calculation is made according to the monitoring plan.</p> <p>We first calculate the amount of natural gas required to generate steam in Nm³/t of steam in a very efficient boiler</p> $QNG_steam = \Delta H \text{ (kcal/t)} / (\text{LHV (kcal/Nm}^3\text{)} \times \eta \text{ (\%)})$ <p>The LHV data is the yearly average value for the gas supplied by Kyung Dong City Gas Co, Ltd and E_NGy is the yearly average value calculated in appendix 17.</p> <p>This leads to a conservative value of E_Steam as the steam from the external supplier is produced from coal.</p>

Year ending	LHV kcal/Nm ³	ΔH kcal/t	η %	QNG_tsteam Nm ³ /t of steam	E_NGy kg- CO ₂ /Nm ³	E_Steam kg-CO ₂ / kg of steam
Oct. 31 st 2006	10522	557960	97	54.669	2.240	0.122

Appendix 14

Name of item	Q_Power
Description	Electricity consumption by the decomposition facility
Value in period	138 327 kWh
Method of monitoring	Power consumption data
Recording frequency	Monthly
Background data	Log sheet record / counter

Period	Q_Power kWh
Oct 23 rd – Oct 31 st	30 890
Nov 1 st – Nov 19 th	107 437
Oct 23 rd – Nov 19 th	138 327

Appendix 15

Name of item	E_Power
Description	CO2 intensity for electric generation
Value in period	0.649 kg-CO₂/kWh
Method of monitoring	Survey of data publication
Recording frequency	Yearly
Background data	KEPCO data make publicly available by the Korean Energy Economics Institute (KEEI) for 2003, 2004 & 2005.
Calculation method	Calculated using the combined margin (CM) approach according to ACM0002. Conservative value used.

Date (year)	E_Power kg-CO ₂ /kWh
2006	0.649

Appendix 16

Name of item	Q_Steam_c
Description	Amount of steam consumed by the decomposition facility
Value in period	90 302 kg
Method of monitoring	Mass flowmeter
Recording frequency	Monthly
Background data	Log sheet record

Period	Q_Steam_c kg
Oct 23 rd – Oct 31 st	24 155
Nov 1 st – Nov 19 th	66 147
Oct 23 rd – Nov 19 th	90 302

Appendix 17

Name of item	E_Steam_c
Description	CO2 intensity for steam consumed in the facility
Value in period	0.137 kg-CO ₂ /kg of steam
Method of monitoring	Calculated from steam supplier data
Recording frequency	Yearly
Background data	Log sheet records / Composition from Kyung Dong City Gas Ltd, the natural gas supplier
Calculation method	<p>This steam is supplied by existing boilers on site. Steam production and natural gas consumption are monitored. From the monthly natural gas consumption and the monthly value of E_NG, monthly emissions of CO₂ for steam production are calculated and cumulated over the year.</p> <p>E_Steam is obtained from the ratio of yearly CO₂ emission over the yearly steam production.</p> <p>Q_NG_steam in Nm³/t of steam is obtained from the ratio of annual natural gas consumption over the annual steam production.</p> <p>The average factor E_NG_y over the year is obtained from $E_NG_y = Q_NG_steam / E_Steam$</p>

Year ending	Q_NG_steam Nm ³ /t of steam	E_NG _y kg-CO ₂ /Nm ³	E_Steam kg-CO ₂ / kg of steam
Oct. 31 st 2006	60.86	2.240	0.137