CDM
MONITORING REPORT #26
of
"N2O Emission Reduction in Onsan, Republic of Korea"
UNFCCC 0099

Revision 2

From: June. 5th, 2009
To: June. 16th, 2009

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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 June 5th, 2009 to June 16th, 2009 as the 26th crediting 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 version 1)

Approved Monitoring methodology :
Monitoring Methodology for decomposition of N2O from existing adipic acid production plants (AM0021 version 1)

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

Directly related EB guidance:
EB45 Annex13 "Guidance to calculate adipic acid production in cases where it cannot be measured directly" version 1, February 13th 2009

3. Definition

y : Monitoring period (period as defined in the first paragraph)
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

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4. General description of project

4.1 Project activity

Nitrous oxide (N_2O) 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 N_2O 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 N_2O 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 N_2O 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 N_2O was started in September 2006.
The starting date of the project is defined as 01/09/2006.
This project activity was registered at UNFCCC on November 27th 2005 with the number 0099.

4.2 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 N_2O.

Natural gas is fed with the off gas adipic acid production containing N_2O and some air in a reduction chamber, where it burns (oxidizes) to carbon dioxide CO_2 and water vapour. N_2O is used as an oxidizer. Being oxygen deficient, the oxidation is not complete and carbon monoxide and hydrogen are present.

$$CH_4 + 4\ N_2O \rightarrow CO_2 + 2\ H_2O + 4\ N_2$$

The temperature in the furnace is kept at about 1300°C and under fuel rich conditions, so as to promote the complete decomposition of N_2O while minimizing the formation of unwanted combustion by-products such as NO and NO_2.

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 NO_2.

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.

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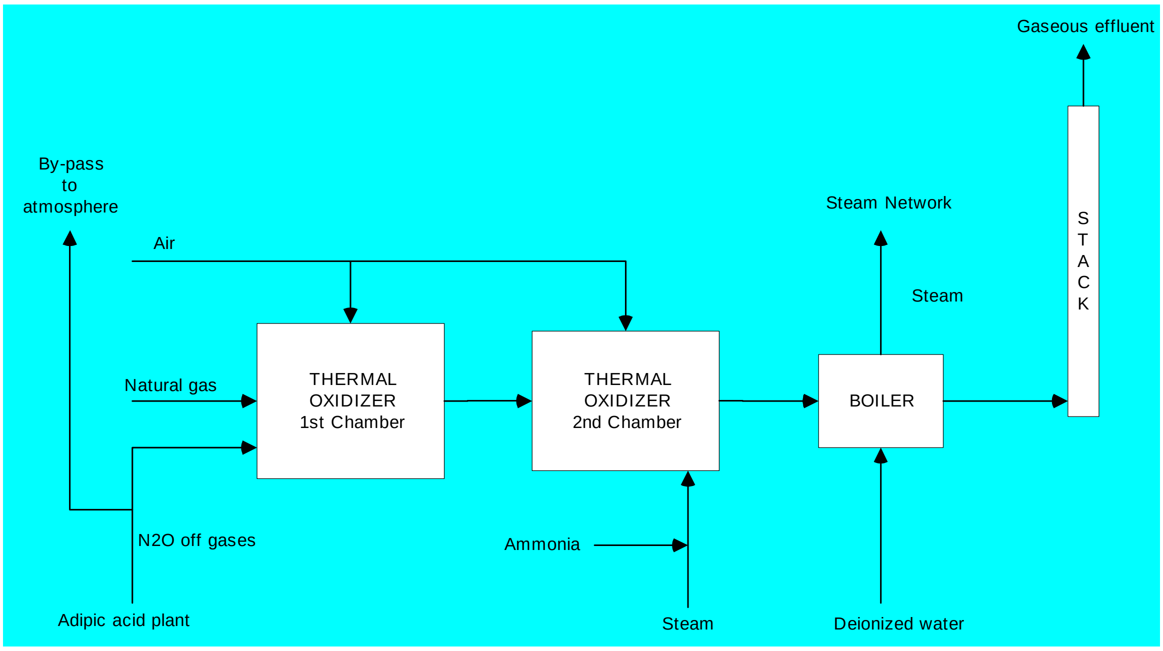


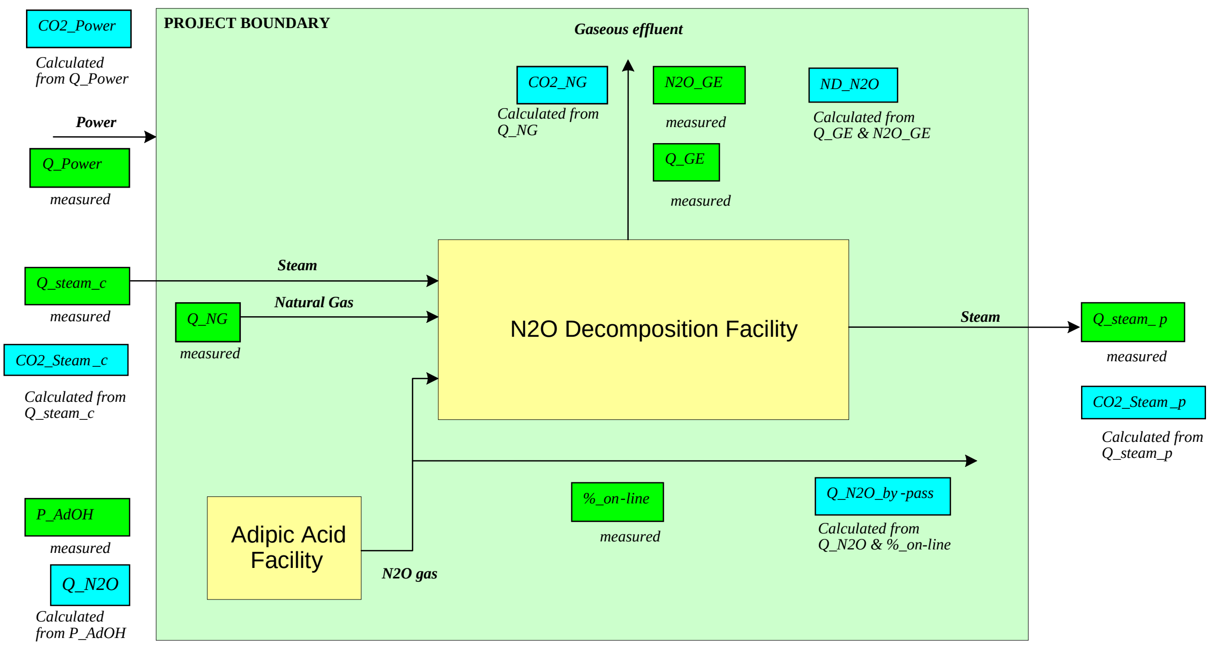
4.3 Implementation of the project

The project is fully implemented according to the description presented in the PDD. The project activity is completely operational.

5. Baseline methodology

Approved baseline methodology AM0021 version 1: "Baseline methodology for decomposition of N2O from existing adipic acid production plants", 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. Applicability of the methodology

Approved monitoring methodology AM0021 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 as

- Thermal decomposition of the N2O by-product of adipic acid production was implemented in an existing production plant

- All required data (see following paragraph) are available and used
- The production of adipic acid within the current year is below the installed capacity that exists by the end of the year 2004 and defined in the PDD.

For the sake of clarity, the amount of Emission Reductions can exceed the amount calculated in a year period in the PDD in "SECTION E. Estimation of GHG emissions by sources" as all data were conservative, in particular the performance of the N2O abatement unit (in fact, %_on-line (unit efficiency) > 85%, and destruction rate > 99%)

7. **Monitored Parameters**

According to the methodology AM0021 version 1 and the Monitoring Plan, the data being collected to monitor the GHG reduction are 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 on wet basis converted to standard conditions by temperature and pressure correction	Flow meter	Nm^3	Monthly	Appendix 1
N_2O_GE	Concentration of N_2O in the effluent gas on wet basis, in volume fraction	Laser diode online analyzer	vppm	Monthly	Appendix 2
ND_N2O	Quantity of N_2O in the effluent gas leaving the stack	Calculated from Q_GE and N_2O_GE (method D of EB guidelines)	Kg- N_2O	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 closed	Position switches on by-pass 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

ID	Data variable	Source of data	Data unit	Recording frequency	Reference
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 (HNO3_consumption) & physical losses in the adipic acid production process (HNO_3_physical)	All data required for calculation of HNO_3 chemical and the N2O emission factor N2O_AdOH	Excel workbook based on the raw material consumption, DCS data and Lab data	-	Monthly	Appendix 9
Q N_2O reg	Per Korean regulation allowed N_2O emissions	South Korean regulation	kg	Date when relevant legislation is in place	Appendix 10
N_2O reg/AdOH	Per Korean regulation allowed N_2O 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_2O emissions to be destroyed	South Korean regulation	%	Date when relevant legislation is in place	Appendix 10
P N_2O	Market price of N_2O	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

ID	Data variable	Source of data	Data unit	Recording frequency	Reference
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 ACM0002 version 2	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

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

8.1. 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 ISO9001:2000 procedures of the Onsan Adipic Acid plant

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

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

The Onsan plant is certified according to ISO9001:2000 and applies appropriate QA & QC procedures covering also the adipic acid plant and the N2O decomposition unit. The Quality Management System includes as part of the standard the Management Responsibility, the Resource Management, the Product Realization, and the Measurement, analysis and improvement.

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*	*This flow meter is measured with an Averaging Pitot tube. This instrument is considered as a critical instrument in the QA/QC procedure.*
2a.2. (D.2.1.1) N_2O_GE	*Low*	*Existing procedures are applied to this analyzer for QA & QC.*
2a.4. (D.2.1.1) Q_NG	*Low*	*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.*
2b.1. (D.2.1.3) P_AdOH	*Low*	*Is obtained from production records of the ONSAN adipic acid plant where the N_2O waste originates. A QA/QC procedure is implemented. Production quantity is based on the packaged product plus silo volume.*
2a.5. (D.2.1.1) %_on-line	*Low*	*Use opening of high integrity performance connecting valves to limit leaks. Procedures currently in place in Chalampé for monitoring N_2O emissions have be implemented in ONSAN to periodically check their tightness and assure their good operation. They have been added to the QA/QC existing procedures.*
2b.7. (D.2.1.3) Q_Steam_p	*Low*	*Steam meter placed on the list of critical instrument data in the QA/QC procedures*
3.1. (D.2.3.1) Q_Power	*Low*	*Electricity meter. Standard procedures are used. No QA/QC procedures implemented as this flow represents less than 0.01% of the baseline emissions.*
3.4. (D.2.3.1) Q_Steam_c	*Low*	*Steam meter placed on the list of critical instrument data in the QA/QC procedures.*

Main QC and QA procedures specific to the project activity:

706-30 Data handling protocol PR(Korean English).doc
706-31 Data review protocol.doc

8.3. Calibration/Maintenance of Measuring and Analytical Instruments

All measuring and analytical instruments are being calibrated as per the methodology AM0021 version 1 and created as a protocol in Onsan's Quality management system procedures.

Calibration frequency requirements for the measuring equipments are described in the Excel Workbook ER ONSAN, "Cal_Maint" worksheet.

The maintenance methods and procedures have been incorporated as part of the ISO9001: 2000 procedures and form an integral part of the systems and procedures for the organization.

During this period, we made Calibration/Maintenance of Measuring and analytical instruments according to PDD.

The Monitoring Equipment Calibration and Maintenance status is presented on Appendix 18.

8.4. Environmental Impact

The Thermal oxidation plant has been installed with on line analyzers to monitor constantly some parameters that are required by Korean legislation.
According to local government environmental low, NOx value is continually transmitted to local government agency as a part of the TeleMonitoring System (TMS) from July 1st 2007.

To make sure of the on-line analysis value, KumHo Environmental Co, Ltd had carried out the analysis of the gas discharged from the N2O stack during this monitoring period. The analysis values were under the control specification limit of the Korea environmental regulation and the average values 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	On-line analysis value of the period	Average value in monitoring period by KumHo
CO	ppm	50 max	< 5 ppm	Not measured
NH3	ppm	50 max	-	< 3 ppm
NOx	ppm	200 max	92 ppm	97.7 ppm

The project was compliant with all environmental Korean regulation.

9. GHG Calculations

A spreadsheet Excel file "ER ONSAN" containing all the values of the monitoring parameters and the emission reduction calculation according to the methodology (AM0021/version 1) and the PDD is submitted to the DOE and to the UNFCCC for the request of issuance.

Statement of GHG emission reduction in this monitoring period.

As suggested by the methodology (AM0021 Version 1), the GHG emission reduction, (ERy), achieved by the project activity for the period is
ERy = BEy - PEy - Ly

9.1. Calculation of Q_N2Oy

It has been checked that there are no Korean regulation into place that would limit the quantity of N_2O 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_N2Oy of N2O emitted over the period can then be calculated by (AM0021/version 1 equation (2)):

Q_N2Oy = P_AdOH x N2O_/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 (see appendix 9). So the capped value is being used according to AM0021 version 1.

Parameter	value	Reference
Q_N2Oy	1 456 252 kg	Calculated
P_AdOH	5 393.525 ton	Appendix 8
N2O_/AdOH	0.27 kg N2O/kg AdOH	Appendix 9
Q_N_2O reg	No limit	Appendix 10
N_2O_reg / AdOH	No limit	Appendix 10
r_y	NA	Appendix 10

As the total production of adipic acid over the year ending with the last day of this period is below the nameplate capacity of the adipic acid plant (information available in the Excel Workbook “ER ONSAN”, sheet AM, submitted to UNFCCC), the total production of this period can be used as such.
The Executive Board has confirmed on EB36 the application of a yearly Adipic acid production cap as required by the methodologies (issue 1of the Requests of review for the Monitoring Period #9 Aug 8th 2007 ~ Aug 31st 2007).

9.2. Calculation of baseline emissions

The amount of baseline emissions in the given period y (measured in t CO2 eq.) is calculated by (AM0021/version 1 equation (1)) :

$$BEy = Q\_N2O_y \times GWP\_N2O + Q\_Steam\_p_y \times E\_Steam_y$$

and rounded down in t CO2 eq. to get conservative consistency of final calculation of Emission Reductions formula.

Parameter	value	Reference
BEy	**452 364 t CO2 eq.**	Calculated
Q_N2O$_y$	1 456 252 kg	Calculated in 9.1
GWP_N2O	310	Kyoto Protocol Rule. Decision 2/CP.3
Q_Steam_p$_y$	7 591 570 kg of steam	Appendix 12
E_Steam$_y$	0.122 kg-CO2/kg of steam	Appendix 13

9.3. 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 x (1-%_on-line) x 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 x (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$_y$	0 kg	Appendix 7
P_AdOH	5 393.525 ton	Appendix 8
N2O_/AdOH	0.27 kg N2O/kg AdOH	Appendix 9
%_on-line$_y$	100 %	Appendix 6

9.4. Calculation of project emissions

The emissions due to the decomposition process PEy 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.

PEy = ((Q_ N_2O x (1-%_on-line))y + (Q_GE x N_2O_GE x Specific_gravity_of_N2O)y) x GWP_ N_2O + Q_NGy x E_NGy (AM0021/version 1 equation (6))
(The specific gravity of N2O is used to transform vppm in kg/ Nm3)

PEy = (Q_N2O_by-pass$_y$ + (Q_GE x N_2O_GE x Specific_gravity_of_N2O)y) x GWP_ N_2O + Q_NGy x E_NGy

The non-destroyed N_2O (ND_ N_2O y) is constantly monitored and obtained from the constant monitoring of the flow (Q_GE) and the concentration of N_2O (N_2O _GE) of the effluent gas:
ND_ N_2O = Q_GE x N_2O _GE x Specific_gravity_of_N2O

PEy = (Q_N2O_by-pass$_y$ + ND_ N_2O_y) x GWP_ N_2O + Q_NGy x E_NGy (AM0021/version 1 equation (5))

PEy is rounded up in t CO2 eq. to get conservative consistency in final calculation of emission reductions formula.

Parameter	Value	Reference
PEy	**972 t CO2 eq.**	Calculated
$Q\_N2O\_by\text{-}pass_y$	0 kg	Appendix 7
Q_GE	5 739 970 Nm^3	Appendix 1
N_2O_GE	5 vppm	Appendix 2
Specific _gravity_of_N2O	1.963 x 10^-6	Appendix 2 or 3
ND_ N_2O_y	57 kg N_2O	Appendix 3
GWP_ N_2O	310 kg CO2 eq./ kg N_2O	Kyoto Protocol Rule. Decision 2/CP.3 and IPCC
Q_NGy	431 424 Nm^3	Appendix 4
E_NGy	2.210 kg CO2 eq./ Nm^3	Appendix 5

Note :

1) The value of E_NGy shown above is the yearly moving average of E_NG as required by the PDD for calculation of E_Steam. The project emissions are more accurately calculated using monthly values of E_NG shown in Appendix 5, following the methodology AM0021 version 1 and the Monitoring Plan.
2) The value of ND_N2Oy is calculated by the DCS using every 10 second data of Q_GE and N2O_GE (see Appendix 2 and 3) and is more accurate than the value calculated using total average values.

9.5. 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 (AM0021/version 1 equation (7)):

$$L_y = Q\_Power \times E\_Power + Q\_steam\_c_y \times E\_steam\_c_y$$

Ly is rounded up in tCO2 eq. to get conservative consistency in final calculation of emission reduction formula.

Parameter	Value	Reference
Ly	**40 t CO2 eq.**	Calculated
Q_Power	49 551 kWh	Appendix 14
E_Power	0.685 kg-CO_2/kWh	Appendix 15
Q_Steam_ c_y	39 832 kg	Appendix 16
E_Steam_ c_y	0.132 kg-CO_2 / kg of steam	Appendix 17

9.6. Calculation of emission reduction

Following the PDD section D.2.4, the total emission reduction achieved by this project activity during this monitoring period is therefore,

ERy = BEy – PEy – Ly

Or,

ERy = **452 364 t CO2 eq. – 972 t CO2 eq. – 40 t CO2 eq.**

Or,

ERy = 451 352 t CO2 eq.

The above emission reduction covers the generation of N2O during this monitoring period.

9.7. Comparison of the emission reduction with the PDD estimates

In the PDD section E, the annual emission reduction is estimated to be 9 147 301 tCO2eq. So the PDD estimated emission reduction relative to the monitoring period of 12 days is 300 733 tCO2eq.

The increase of the actual emission reduction is explained by

(a) a higher performance of the N2O abatement unit (the %_on-line of 100% is higher that the value of 85% conservatively estimated in the PDD) thanks to excellent operational performance

(b) a higher level of production of adipic acid thanks to good unit operational performance. The adipic acid production used for the ex-ante emission reduction was conservatively taken at 130 000 t/y below the nameplate capacity of 151 475 t/y set in the PDD. It is important to note that according to the methodology AM0021/version1, that the eligible adipic acid that can be used in the baseline is yearly capped, so on a yearly basis this limits the emission reduction calculation claimed for CERs. Please see Appendix 8 for further detail.

The estimate of 85% in the PDD assumed a low performance rate of the destruction equipment given lack of experience with such equipment. Moreover, given the general experiences with consistent overestimation of CER volumes in the first years of CDM project development, Rhodia wanted to set a counter-example by doing the CER estimates in the PDD in a very conservative fashion, both regarding the parameters performance of the abatement equipment and the production level of adipic acid.

Appendix 1

Name of item	Q_GE
Description	Volume of effluent gas leaving the stack
Value in period	5 739 970 Nm3
Method of monitoring	Annubar flow meter
Recording frequency	Monthly
Background data	Log sheet record / flowmeter

Period	Quantity of gaseous effluent Nm^3
Jun 5th ~ Jun 16th	5 739 970

Appendix 2

Name of item	N2O_GE
Description	Concentration of N_2O in the effluent gas
Value in period	5 vppm
Method of monitoring	Laser diode online analyzer
Recording frequency	Monthly
Background data	Log sheet record
Calculation method	According to AM0021/version1, the instant values of the on-line analyzer are used to calculate the quantity of ND_N2O every 10 sec: ND_N2O = Q_GE * N2O_GE * Specific_gravity_of_N2O The specific_gravity_of_N2O = 44/22.414 x 10^-6 is used to transform vppm in kg/ Nm3 The analyzer has a range of 0-200 vppm with a detection limit of 5 vppm, which is used as a default value when the measured value is below the detection limit. Cumulated value for ND_N2O is recorded (see appendix 3). 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. N2O_GE = ND_N2O / (Q_GE x N2O_GE x Specific_gravity_of_N2O) This value is for information as the constant calculation of ND_N2O is more accurate.

Period	ND_N2O kg	Quantity of gaseous effluent Nm^3	Average concentration of N_2O_GE vppm
Jun 5th ~ Jun 16th	57	5 739 970	5

Appendix 3

Name of item	ND_N2O
Description	Quantity of non-destroyed N2O emitted by the decomposition facility
Value in period	57 kg N_2O
Method of monitoring	On-line DCS calculation
Recording frequency	Monthly
Background data	Log sheet record
Calculation method	According to AM0021/version1, the 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 The specific_gravity_of_N2O = 44/22.414 x 10^-6 is used to transform vppm in kg/ Nm3

Period	ND_N2O kg
Jun 5th ~ Jun 16th	57

Appendix 4

Name of item	Q_NG
Description	Amount of natural gas used by the decomposition process
Value in period	431 424 Nm3
Method of monitoring	Natural gas consumption data
Recording frequency	Monthly
Background data	Log sheet record / flowmeter

Period	Q_NG Nm^3
Jun 5th ~ Jun 16th	431 424

Appendix 5

Name of item	E_NGy with NGC
Description	Emission coefficients for natural gas combustion Natural Gas Composition (NGC) from Supplier for natural gas
Value in period for E_NG_y	2.210 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	Following the PDD Monitoring Plan 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) The June data are used to calculate monthly project emissions as required by the data handling protocol, document requested by the monitoring plan.

Component	June Natural Gas Composition	Number of C
CH4 (Methane)	91.25	1
C2H6 (Ethane)	5.45	2
C3H8 (Propane)	2.22	3
I-C4H10 (I-Butane)	0.46	4
N-C4H10 (N-Butane)	0.43	4
I-C5H12 (I-Pentane)	0.02	5
N-C5H12 (N-Pentane)	0.00	5
N2 (Nitrogen)	0.17	0
CO2 (Carbon dioxide)	0.00	1
Average number of C	1.125	
E_NG_m	2.210	

The CO2 specific gravity in standard state is 1.965
E_NG = 1.965 x (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	100 %
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	%_on-line is determined following the PDD. 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 the daily value of Q_ N2O_by-pass (See Appendix 7). The daily values of Q_ N2O_by-pass are added to determine the monthly values of Q_ N2O_by-pass, as required by the PDD At the end of the period, %_on-line for the period is calculated as: $\%\_on\text{-}line_y = 1 - (Q\_N2O\_by\text{-}pass_y / (P\_AdOH_y \times N2O\_/AdOH))$

Period	$Q\_N2O\_by\text{-}pass_y$ kg	P_AdOH_y t	$\%\_on\text{-}line_y$ %
Jun 5th ~ Jun 16th	0	5 393.525	100

Appendix 7

Name of item	Q_N2O_by-pass
Description	N2O by-passing the decomposition facility
Value in period	0 kg
Method of monitoring	Production record and %_on-line DCS monitoring
Recording frequency	Monthly
Background data	Production & %_on-line log sheet record
Calculation method	The quantity of adipic acid produced while by-passing the destruction facility is first calculated: AdOH_by-pass = P_AdOH x (1 - %_on-line) The quantity of N2O that by-pass the facility is then recorded daily and calculated following AM0021/version1. $Q\_N2O\_by\text{-}pass_d = Q\_N2O_d \times (1 - \%\_on\text{-}line)$ or $Q\_N2O\_by\text{-}pass_d = P\_AdOH_d \times N2O\_/AdOH \times (1 - \%\_on\ line)$ At the end of the period the quantity of N2O that by-passed the facility is : $Q\_N2O\_by\text{-}pass_y = \Sigma\ (Q\_N2O\_by\text{-}pass_d)$

Period	$Q\_N2O\_by\text{-}pass_y$ kg
Jun 5th ~ Jun 16th	0

Appendix 8

Name of item	P_AdOH
Description	Adipic acid production after cap application
Value in period	5 393.525 t
Method of monitoring	Packaged production and silo inventory
Recording frequency	Monthly
Background data	Log sheet records and DCS data for silo weight

The daily Adipic Acid production is measured directly by the weight of packed finished product and the silo weight difference between two consecutive days. The EB45 guidance in reference does not apply to such cases.
The production of adipic acid over the year ending with the last day of this period is below the capped value defined in the PDD (information available in the Excel Workbook "ER ONSAN", sheet AM, submitted to UNFCCC).
The quantity of adipic acid produced during this period can then be fully used as such.
The Executive Board has confirmed on EB36 the application of a yearly Adipic acid production cap as required by the methodologies (issue 1of the Requests of review for the Monitoring Period #9 Aug 8th,2007 ~ Aug 31st,2007).
.

Month - year	Adipic acid production t
Jun 5th ~ Jun 16th	5 393.525

Appendix 9

Name of item	HNO3_consumption & HNO3_physical
Description	Nitric acid consumption and losses in the adipic acid process
Value in period	(see table below)
Method of monitoring	Excel workbook based on monitoring data and analysis
Recording frequency	Monthly
Background data	Log sheet records
Calculation method	Nitric acid physical losses (HNO3_physical) in the aqueous wastes, 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) (AM0021/version 1 equation (3)).

Period	HNO3_consumption t	HNO3_physical t	HNO3_chemical t
Jun 5th ~ Jun 16th	4 618	84	4 534
Rolling year June. 16th , 2009	128 146	2 336	125 810

Name of item	N2O_AdOH
Description	N2O emission factor for adipic acid production
Value in period	0.270 kg N_2O/kg AdOH
Method of monitoring	Adipic acid production, nitric acid consumption and physical losses
Recording frequency	Yearly
Calculation method	The N2O emission factor is then calculated over the period on one year using the last rolling year data (AM0021/version 1 equation (4)):

N2O_AdOH = HNO3_chemical / P_AdOH / 63 /2 x 0.96 x 44

The calculated value for this period is above 0.270 and is then capped by the value of KE_N2O = 0.27, as specified in the PDD table D.2.1.3 and required by the methodology AM0021/version 1 referring to the IPCC Good Practice Guidance.

Period	Value N2O_AdOH calculated kg N2O/kg AdOH	KE_N20 kg N2O/kg AdOH	N2O_AdOH kg N2O/kg AdOH
Rolling year June. 16th , 2009	0.280	0.270	0.270

Appendix 10

Name of item	Q_N_2O reg , N_2O_reg / AdOH and r_y
Description	Evolution of Korean legislation that may require limitation of N_2O emissions using one of the following criteria: - Q_N_2O reg : allowed N_2O emissions - N_2O_reg / AdOH : allowed N_2O emissions per kg of adipic acid produced - r_y : share of N_2O emissions required to be destroyed
Value in period	not applicable
Method of monitoring	Survey
Recording frequency	When relevant
Background data	South Korean legislation Rhodia follows the evolution of Korean legislation part of its SIMSER+ procedures (System Integrating Management for Safety and Environment). SIMSER+ is covering ISO 14001 standard which requires to follow any updates on environmental regulations. For the monitoring of the new HSE (Hygiene, Safety and Environment) local and national regulations, Rhodia Korea has joined two committees: "Onsan Environment Management Society" and "Korea Environmental Engineers Federation". No evolution of legislation since PDD emission

Period	Q_N_2O reg kg	N_2O_reg / AdOH kg	r_y %
June 16th 2009	No limit	No limit	0.

Appendix 11

Name of item	P_N_2O
Description	Market price of N_2O in waste gas
Value in period	0 €/t
Method of monitoring	Market survey
Recording frequency	Yearly
Background data	Refers to study Background data Refers to study “N2O market study NITROUS OXIDE Korea” –update September 2008 Beside the very high investment cost in a purification-concentration-liquefaction unit to extract the N_2O from the exhaust flow of the adipic acid plant, neither the process nor the product will get the necessary certifications for the pharmaceutical (80% share), food and semiconductor markets. We can conclude that there is no N_2O market for the N_2O produced as by-product of adipic acid.

Year	P_N_2O
2009	0

Appendix 12

Name of item	$Q\_Steam\_p_y$
Description	Amount of steam produced by the decomposition facility
Value in period	**7 591 570 kg**
Method of monitoring	Flowmeter
Recording frequency	Monthly
Background data	Log sheet record

Period	$Q\_Steam\_p_y$ kg
Jun 5th ~ Jun 16th	7 591 570

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	As we cannot get the data from the supplier, the calculation is made according to the monitoring plan. We first calculate the amount of natural gas required to generate steam in Nm3/t of steam in a very efficient boiler QNG_tsteam = △H (kcal/t) / (HHV (kcal/Nm3) x η (%)) The HHV data is the yearly average value for the gas supplied by Kyung Dong City Gas Co, Ltd This leads to a conservative value of E_Steam as the steam from the external supplier is produced from coal.

Year ending	HHV kcal/Nm^3	△H kcal/t	η %	QNG_tsteam Nm3/t of steam	E_NG_y kg-CO_2/Nm3	E_Steam kg-CO_2/ kg of steam
June 16th 2009	10 413	557 960	97	55. 239	2.210	0.122

Appendix 14

Name of item	Q_Power
Description	Electricity consumption by the decomposition facility
Value in period	49 551 kWh
Method of monitoring	Power consumption data
Recording frequency	Monthly
Background data	Log sheet record / counter

Period	Q_Power kWh
Jun 5th ~ Jun 16th	49 551

Appendix 15

Name of item	E_Power
Description	CO2 intensity for electric generation
Value in period	0.685 **kg-CO_2/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 2008.
Calculation method	Calculated using the combined margin (CM) approach according to ACM0002 version 2 in file[1] (Grid_EF_SouthKorea 2008 rev1.xls).

Date (year)	E_Power kg-CO_2/kWh
2009	0.685

[1] [1] AM00021 version 1 requires calculation of E_Power as "the highest of the operating margin and the build margin according to ACM0002 version 2 for the grid connected to the facility". The way the emission factor is calculated follows exactly the requirement of the methodology for the following reasons:

(i) "according to ACM0002" means among other things to follow the combined margin CM approach (CM is the weighted average of OM and BM, with default weights of 50%/50%),

(ii) "the highest of the operating margin" means the simple OM as it is the highest operating margin of all alternatives listed in ACM0002 for calculation of the OM since the simple OM excludes all low-operating costs and must-run power plants which are nuclear power plants, hydro power plants and all renewable energy power plants, and

(iii) "the build margin" means the build margin (option 2 updated annually ex post) as required to be calculated following ACM0002 version 2.

Appendix 16

Name of item	Q_Steam_c
Description	Amount of steam consumed by the decomposition facility
Value in period	39 832 kg
Method of monitoring	Mass flowmeter
Recording frequency	Monthly
Background data	Log sheet record

Period	Q_Steam_c Kg
Jun 5th ~ Jun 16th	39 832

Appendix 17

Name of item	E_Steam_c
Description	CO2 intensity for steam consumed in the facility
Value in period	0.132 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	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. Q_NG_tsteam in Nm3/t of steam is obtained from the ratio of annual natural gas consumption over the annual steam production. The E_Steam_c is obtained from: E_Steam_c = E_NG_y x Q_NG_tsteam

Year ending	Q_NG_tsteam Nm3/t of steam	E_NG_y kg-CO_2/Nm3	E_Steam_c kg-CO_2/ kg of steam
June 16th 2009	59.625	2.210	0.132

Appendix 18 **INSTRUMENT CALIBRATION & MAINTENANCE STATUS** (see remarks in the Workbook ER Onsan, sheet Cal_Maint)

Related PDD parameter	Instrument / equipment	Tag number	Periodicity	Done by	2008												2009											
					1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
%_online	By-pass Valves Integrity Check	HV-57001	Annually	Rhodia						•									•									
%_online	By-pass Valves Integrity Check	HV-57003	Annually	Rhodia						•									•									
P_AdOH	Small bags and bags Balance	W42811	Annually	Rhodia				•												•								
P_AdOH	Big bags and bags Balance	W43741	Annually	Rhodia				•												•								
P_AdOH	Big bags and bags Balance	W43742	Annually	Rhodia				•												•								
Q_steam_c	Steam import to N2O system	FIQ-58082	Annually	Third party						•									•									
Q_steam_p	Steam production by N2O system	FIQ-58213	Annually	Third party						•									•									
Q_steam_P	Boiler feed water to N2O system	FIQ58204	Annually	Third party															•									
Q_steam_p	Boiler continuous purge flow rate	FIQ58303	Annually	Rhodia											•				•									
N2O_GE	Stack N2O analyzer (in-situ, laser diode)	AIT-58408	2 / year	Rhodia				•						•					•									
N2O_GE	Stack N2O analyzer (extractive infrared)	AI58418	weekly	Rhodia	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•						
Q_NG	Natural Gas burning	FQ91485A	Annually	Third party				•											•									
Q_NG	Natural Gas burning (Back up flow meter)	FQ91485B	Annually	Third party							•																	
Q_GE	Effluent Gas	FIQ-58407	Annually	Third party				•											•									
Q_Power	Electricity meter	LV22WH	Every 7 years	Third party														•										
Nitric Cons	Potentiometric titrator	Lab analyzer	weekly	Rhodia	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•						
Nitric Cons	HPLC	Lab analyzer	Daily	Rhodia	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•						
Nitric Cons	Truck Scale	W-90000	Annually	Third party									•															
Nitric Cons	FRESH NIITRIC ACID HANWHA	FT6C069	Annually	Third party				•											•									
Nitric Cons	FRESH NIITRIC ACID HANWHA	FT760CD	Annually	Third party										•														
Nitric Cons	FRESH NIITRIC ACID TANK R92000	LT-92005	Annually	Rhodia					•											•								
Nitric Cons	FRESH NIITRIC ACID TANK R92010	LT-92015	Annually	Rhodia					•												•							
Nitric Cons	NOX GAS DCN INLET	AYA-51526	4 / year	Rhodia	•			•			•			•		•		•		•		•						
Nitric Cons	LNOX E56010 TO A56020	AYA-56026	4 / year	Rhodia	•			•			•			•		•		•		•		•						
Nitric Cons	KAOP TO OXIDATION	FT-12701	Annually	Third party						•						•			•									
Nitric Cons	LNOX D51500 TO E55030	FQ-51525	Annually	Rhodia						•						•												
Nitric Cons	LNOX D52400 TO E56030	FQ-52428	Annually	Rhodia						•						•												
Nitric Cons	HPCE R61380 TO K83160	FQ-61782	Annually	Third party						•									•									
Nitric Cons	DBA TO F81200	FQ-81115	Annually	Third party						•									•									
Nitric Cons	DBA R81100 TO K83300	FQ-82351	Annually	Third party						•									•									
Nitric Cons	Waste water to R83200	FQ-83401	Annually	Third party						•									•									
Reference	KA OIL TANK R92100	LT-92106	Annually	Rhodia					•												•							
Reference	KA OIL TANK R92200	LT-92206	Annually	Rhodia					•												•							
P_AdOH	SILO R42500	W-42505	Annually	Rhodia						•						•			•									