



**CDM  
MONITORING REPORT #4  
of  
“N2O Emission Reduction in Paulinia,  
SP, Brazil ”  
UNFCCC 0116**

**From: April 1, 2007  
To: May 6, 2007**

**Rhodia Energy SAS  
Tour La Pacific. 11, cours Valmy La Defense 7  
92977 Paris La Defense, France  
TEL : +33 1 53 56 61 02  
FAX : +33 1 53 56 61 10**

Date: May 9<sup>th</sup>, 2007

A handwritten signature in blue ink, appearing to be 'P. Siegwart', is written over a horizontal line.

Pascal Siegwart, Rhodia Energy SAS



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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 April 1<sup>st</sup>, 2007 to May 6<sup>th</sup>, 2007 as the 4<sup>th</sup> period.

Duration of the project activity period

The starting date of the project is defined as 11/19/2006.

Note: In the PDD the original starting date of the project activity is 01/01/2007. A demand to the UNFCCC for anticipating the actual start up of the project activity to 11/19/2006 was made and approved. The new starting date of the project activity has been updated on the UNFCCC website.

## 2. Reference

### **Approved Baseline methodology :**

Baseline Methodology for decomposition of N<sub>2</sub>O from existing adipic acid production plants (AM0021)

### **Approved Monitoring methodology :**

Monitoring Methodology for decomposition of N<sub>2</sub>O from existing adipic acid production plants (AM0021)

### **Project Design Document :**

N<sub>2</sub>O Emission Reduction in Paulinia, SP, Brazil.

Version number of the document : 4

Date : October 12<sup>th</sup>, 2005

### **CDM registration number :**

“N<sub>2</sub>O Emission Reduction in Paulinia, SP, Brazil” – UNFCCC ref number 0116

## 3. Definition

y : Monitoring period (in this report, see dates § 1)

PDD : Project Design Document of this project “N<sub>2</sub>O Emission Reduction in Paulinia, SP, Brazil.” Version number of the document: 4, issued on October, 12<sup>th</sup>, 2005



#### 4. General description of project

##### Project activity

Nitrous oxide (N<sub>2</sub>O) 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<sub>2</sub>O 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<sub>2</sub>O in Brazil. There are in fact no governmental regulations with quantified emission limits in any non-Annex I countries at this point.

In this project, Rhodia Poliamida e Especialidades Ltda. additionally installed N<sub>2</sub>O 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 were not implemented.

The decomposition facility was installed in the factory site of Paulinia Rhodia Poliamida e Especialidades Ltda. in October 2006 and destruction of N<sub>2</sub>O was started in November 2006. The starting date of the project as well as the starting date of the first crediting period are defined as November 19<sup>th</sup>, 2006. It should be noted that the original starting date of the project activity is 01/01/2007 according to the PDD. However the start up of the project activity was anticipated to 11/19/2006, as formalized to and approved by the UNFCCC.

This project activity was registered at UNFCCC on December 25<sup>th</sup>, 2005 with the number 0116.

##### Technical description of the project

##### **Location of the project activity**

The decomposition facilities were installed in the factory site Rhodia Poliamida e Especialidades Ltda in Paulínia, SP, Brazil in October, 2006.

##### **Technology employed by the project activity**

A thermal oxidizer with 2 chambers is the technology used to decompose N<sub>2</sub>O.

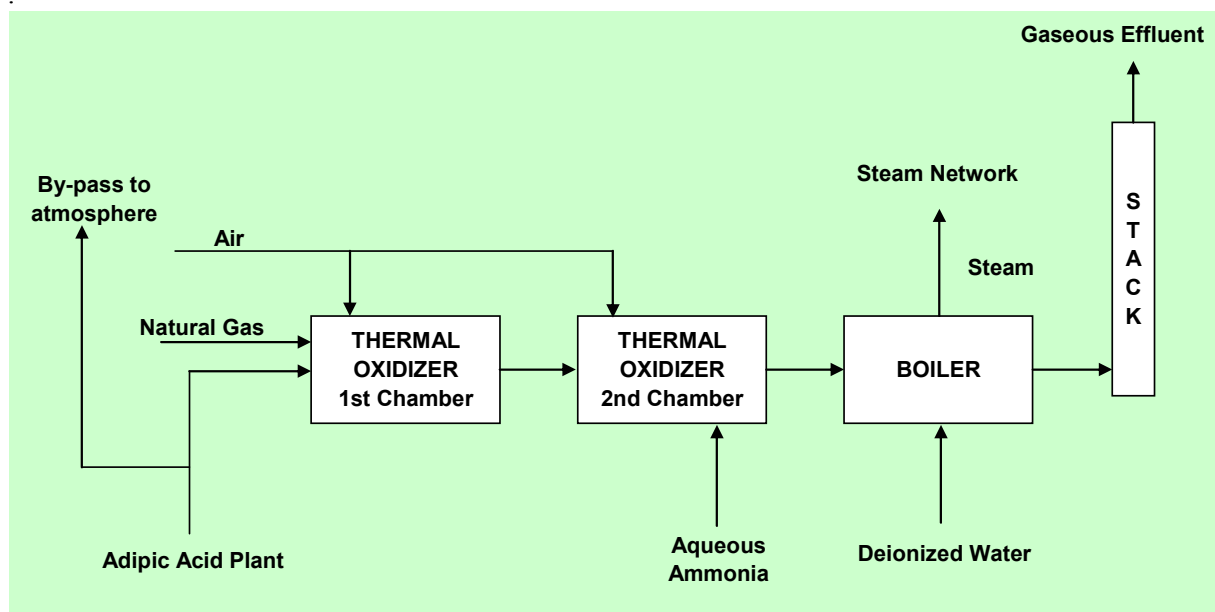
Natural gas is fed with the off gas adipic acid production containing N<sub>2</sub>O and some air in a reduction chamber, where it burns (oxidizes) to carbon dioxide CO<sub>2</sub> and water vapour. N<sub>2</sub>O is used as an oxidizer. Being oxygen deficient, the oxidation is not complete and carbon 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 N<sub>2</sub>O while minimizing the formation of unwanted combustion by-products such as NO and NO<sub>2</sub>.

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. Aqueous ammonia is injected to control the emission of NO and NO<sub>2</sub>.

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

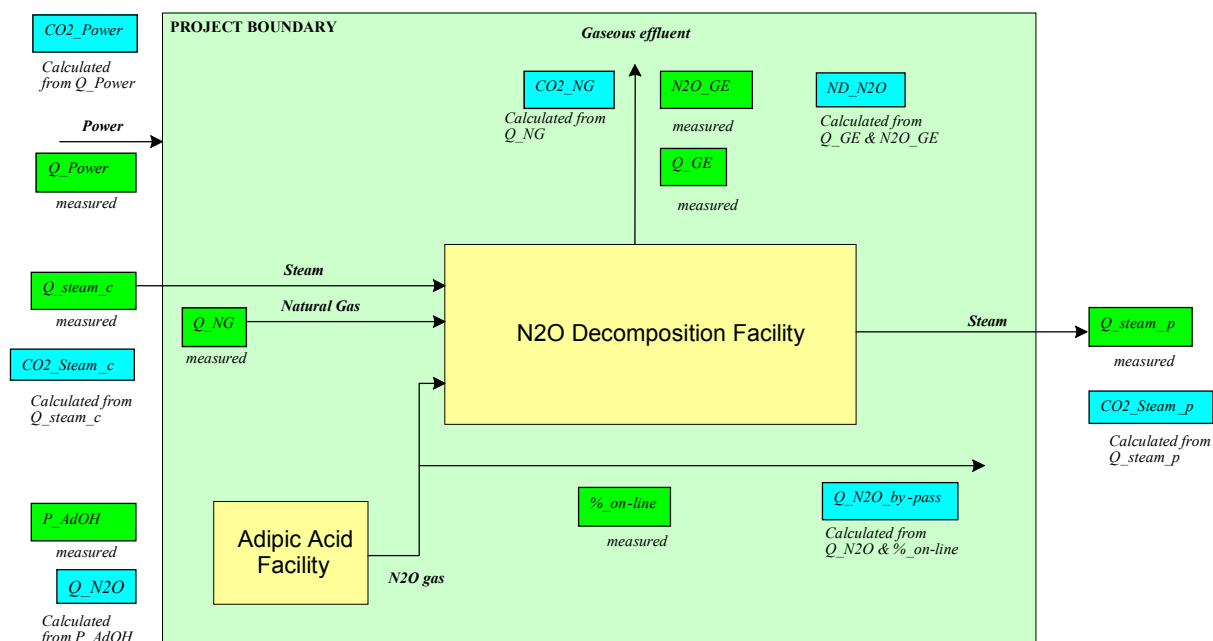


## 5. Baseline methodology

Approved baseline methodology AM 0021: “Baseline methodology for decomposition of N<sub>2</sub>O 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 decompose N<sub>2</sub>O from an adipic acid production plant under the following conditions:

- either catalytic or thermal decomposition of the N<sub>2</sub>O 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 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	Flow meter	Nm <sup>3</sup>	Monthly	Appendix 1
N <sub>2</sub> O_GE	Concentration of N <sub>2</sub> O in the effluent gas	Laser diode online analyzer	ppm	Monthly	Appendix 2
ND_N2O	Quantity of N <sub>2</sub> O in the effluent gas leaving the stack	Calculated from Q_GE and N <sub>2</sub> O_GE	kg	Monthly	Appendix 3
Q_NG	Amount of natural gas burned	Natural gas meter	Nm <sup>3</sup>	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 switch on the by-pass valve is closed	Position switches on bypass valve	% 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	Excel workbook for calculation of nylon salt production, AA slurry production and dry AA production	ton	Monthly	Appendix 8
Nitric acid consumption (HNO <sub>3</sub> _consumption) & physical losses in the adipic acid production process (HNO <sub>3</sub> _physical)	All data required for calculation of HNO <sub>3</sub> chemical and the N <sub>2</sub> O emission factor N <sub>2</sub> O_AdOH	Excel workbook based on the raw material consumption, DCS data and Lab data	ton	Monthly	Appendix 9

ID	Data variable	Source of data	Data unit	Recording frequency	Reference
Q N <sub>2</sub> O reg	Per Brazilian regulation allowed N <sub>2</sub> O emissions	Brazilian regulation	kg/a	Date when relevant legislation is in place	Appendix 10
N <sub>2</sub> O reg/AdOH	Per Brazilian regulation allowed N <sub>2</sub> O emissions per kg of adipic acid produced	Brazilian regulation	kg/kg	Date when relevant legislation is in place	Appendix 10
r <sub>y</sub>	Per Brazilian regulation required share of N <sub>2</sub> O emissions to be destroyed	Brazilian regulation	%	Date when relevant legislation is in place	Appendix 10
P N <sub>2</sub> O	Market price of N <sub>2</sub> 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	Rhodia Industrial Platform of Paulínia	-	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	Brazilian ONS (Operador Nacional do Sistema Elétrico)	-	Yearly	Appendix 15
Q_Steam_c	Amount of steam consumed by the decomposition facility	Steam meter	kg	Monthly	Appendix 16
Steam suppliers data	All data required for calculation of E_Steam_c	Rhodia Industrial Platform of Paulínia	-	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 Paulinia Adipic Acid plant

The personnel have been trained by Rhodia engineers who have been trained by the technology supplier i.e. John Zink Company LLC, USA.

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

The Paulinia adipic acid plant is certified according to ISO9001 and applies appropriate QA & QC procedures.

The equipment and analytical methods given by the technology supplier John Zink Company LLC, USA 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 rate is measured with an Averaging Pitot tube. This instrument is a critical instrument in the QA/QC procedure.</i>
2a.2. (D.2.1.1) N <sub>2</sub> O_GE	Low	<i>Measured using Laser Diode technology Specific procedures are applied to this analyzer for QA &amp; QC following the manufacturer's recommendation.</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 Paulinia Adipic Acid plant where the N<sub>2</sub>O waste originates. A QA/QC procedure is implemented. Production quantity is based on the packaged product plus slurry production used for the Nylon Salt production. Both dry adipic acid and nylon salt are weighed.</i>
2a.5. (D.2.1.1) %_on-line	Low	<i>Use high integrity performance by-pass valve to limit leaks. Procedures currently in place in Chalampe for monitoring N<sub>2</sub>O emissions have been implemented in Paulinia 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 using either existing or specifically created protocols in Paulínia'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

After commissioning the thermal oxidation plant, online analysis of the NO<sub>x</sub> content in the gaseous effluents is carried out to verify such discharge from the plant. Monitoring of the NO<sub>x</sub> content in the waste gas is required by local environmental legislation stated in the Commitment Agreement (TAC) signed with the Public Attorney of the State of São Paulo. NO<sub>x</sub> in the gaseous effluent can be randomly checked by the environmental agency Cetesb through sampling and analysis by an external laboratory. Analytical data show that the plant complies with the established environmental standard.

Table showing analysis Gaseous Emission for Thermal Oxidation plant

Parameter		Value as per applicable standard	Actual analysis
NO <sub>x</sub>	ppm	300 max	Less than 300

## 8. GHG Calculations

Statement of GHG emission reduction in this monitoring period.

As suggested by the methodology (AM0021/Version 1), the GHG emission reduction, (ER<sub>y</sub>), achieved by the project activity for a given year is  
 $ER_y = BE_y - PE_y - L_y$

### 8.1. Calculation of Q<sub>N2Oy</sub>

It has been checked that there are no Brazilian regulation into place that would limit the quantity of N<sub>2</sub>O 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<sub>N2Oy</sub> of N<sub>2</sub>O emitted over the period can then be calculated by:  
 $Q_{N2Oy} = P_{AdOH} \times N2O_{/AdOH}$

Over the period of reference the emission factor from the adipic acid plant was above the capped value of 0.27 kg N<sub>2</sub>O/kg AdOH. So the capped value is being used according to AM 0021.

Parameter	Value	Reference
Q_N2O <sub>y</sub>	2 318 870 kg	Calculated
P_AdOH	8 588 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 <sub>y</sub>	NA	Appendix 10

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, therefore 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 CO<sub>2</sub> eq.) is calculated by

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

Parameter	Value	Reference
<b>BE<sub>y</sub></b>	<b>720 243 t CO<sub>2</sub> eq.</b>	Calculated
Q_N2O <sub>y</sub>	2 318 870 kg	Calculated in 8.1
GWP_N2O	310	Kyoto Protocol Rule. Decision 2/CP.3
Q_Steam <sub>py</sub>	9 741 500 kg of steam	Appendix 12
E_Steam <sub>y</sub>	0.143 kg-CO <sub>2</sub> /kg of steam	Appendix 13

## 8.3. Calculation of (Q\_N2O x (1-%\_on-line))<sub>y</sub>

The quantity of N<sub>2</sub>O 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 N<sub>2</sub>O 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 N<sub>2</sub>O that by-passed the decomposition facility over the period is:

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

The %<sub>on-line<sub>y</sub></sub> 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 <sub>y</sub>	27 576 kg	Appendix 7
P_AdOH	8 588 t	Appendix 8
N2O_/AdOH	0.27 kg N2O/kg AdOH	Appendix 9
%_on-line <sub>y</sub>	98.81 %	Appendix 6

#### 8.4. Calculation of project emissions

The emissions due to the decomposition process PE<sub>y</sub> are the emissions due to the N<sub>2</sub>O that has not been sent to the decomposition process, the N<sub>2</sub>O non destroyed by the decomposition process and the emissions due to the use of natural gas.

$$PE_y = ((Q_{N_2O} \times (1 - \%_{on-line}))_y + (Q_{GE} \times N_2O_{GE})_y) \times GWP_{N_2O} + Q_{NGy} \times E_{NGy}$$

$$PE_y = (Q_{N_2O\_by-pass_y} + (Q_{GE} \times N_2O_{GE})_y) \times GWP_{N_2O} + Q_{NGy} \times E_{NGy}$$

The non-destroyed N<sub>2</sub>O (ND\_N<sub>2</sub>O<sub>y</sub>) is constantly monitored and obtained from the constant monitoring of the flow (Q<sub>GE</sub>) and the concentration of N<sub>2</sub>O (N<sub>2</sub>O<sub>GE</sub>) of the effluent gas:  
 $ND_{N_2O} = Q_{GE} \times N_2O_{GE}$

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

Parameter	Value	Reference
<b>PE<sub>y</sub></b>	<b>10 483 t CO<sub>2</sub> eq.</b>	Calculated
Q_N2O_by-pass <sub>y</sub>	27 576 kg	Appendix 7
Q_GE	11 214 516 Nm <sup>3</sup>	Appendix 1
N <sub>2</sub> O_GE	31 ppm	Appendix 2
ND_N <sub>2</sub> O <sub>y</sub>	683 kg N <sub>2</sub> O	Appendix 3
GWP_N <sub>2</sub> O	310 kg CO <sub>2</sub> eq./ kg N <sub>2</sub> O	Kyoto Protocol Rule. Decision 2/CP.3
Q_NG <sub>y</sub>	784 633 Nm <sup>3</sup>	Appendix 4
E_NG <sub>y</sub>	2.188 kg CO <sub>2</sub> eq./ Nm <sup>3</sup>	Appendix 5

Note: The value of E\_NG<sub>y</sub> 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 the monthly values of E\_NG shown in Appendix 5, following methodology AM0021 and the Monitoring Plan.

### 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
<b>L<sub>y</sub></b>	<b>38.6 t CO<sub>2</sub> eq.</b>	Calculated
Q_Power	25 979 kWh	Appendix 14
E_Power	0.927 kg CO <sub>2</sub> /kWh	Appendix 15
Q_Steam_c <sub>y</sub>	63 500 kg	Appendix 16
E_Steam_c <sub>y</sub>	0.228 kg CO <sub>2</sub> / kg of steam	Appendix 17

### 8.6. Calculation of emission reduction

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

$$ER_y = BE_y - PE_y - L_y$$

Or,

$$ER_y = 720\,243 \text{ t CO}_2 \text{ eq.} - 10\,483 \text{ t CO}_2 \text{ eq.} - 38.6 \text{ t CO}_2 \text{ eq.}$$

Or,

$$ER_y = 709\,721 \text{ t CO}_2 \text{ eq.}$$

The above emission reduction covers the generation of N<sub>2</sub>O during this period.



### Appendix 1

Name of item	Q_GE
Description	Volume of effluent gas leaving the stack
Value in period	11 214 516 Nm <sup>3</sup>
Method of monitoring	Annubar flow meter
Recording frequency	Monthly
Background data	Log sheet record / flowmeter

Period	Quantity of gaseous effluent Nm <sup>3</sup>
Apr. 1 <sup>st</sup> – Apr. 30 <sup>th</sup> , 2007	9 292 984
May 1 <sup>st</sup> – May 6 <sup>th</sup> , 2007	1 921 532

## Appendix 2

Name of item	N2O_GE
Description	Concentration of N <sub>2</sub> O in the effluent gas
Value in period	31 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 0-500 ppm with a detection limit of 5 ppm (1% of range). We use 5 ppm 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 <sup>3</sup>	Average concentration of N <sub>2</sub> O_GE ppm
Apr. 1 <sup>st</sup> – Apr. 30 <sup>th</sup> , 2007	646	9 292 984	35
May 1 <sup>st</sup> – May 6 <sup>th</sup> , 2007	37	1 921 532	10



### Appendix 3

Name of item	ND_N2O
Description	Quantity of non-destroyed N2O emitted by the decomposition facility
Value in period	683 kg N <sub>2</sub> 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
Apr. 1 <sup>st</sup> – Apr. 30 <sup>th</sup> , 2007	646
May 1 <sup>st</sup> – May 6 <sup>th</sup> , 2007	37





#### **Appendix 4**

Name of item	Q_NG
Description	Amount of natural gas used by the decomposition process
Value in period	784 633 Nm <sup>3</sup>
Method of monitoring	Natural gas consumption data
Recording frequency	Monthly
Background data	Log sheet record / flowmeter

Period	Q_NG Nm <sup>3</sup>
Apr. 1 <sup>st</sup> – Apr. 30 <sup>th</sup> , 2007	650 247
May 1 <sup>st</sup> – May 6 <sup>th</sup> , 2007	134 385

Note: the sum of the 2 terms above does not exactly match the total for the period due to a rounding effect.

## 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	2.188 kg CO <sub>2</sub> /Nm <sup>3</sup>
Method of monitoring	Natural Gas Composition (NGC)
Recording frequency	Monthly
Background data	Composition data received from COMGAS, the natural gas supplier
Calculation method	The average number of C in a mole of NG is calculated from the composition = $\sum (\text{number of C in each mole}) \times (\text{volume ratio})$ Following monthly data are used to calculate monthly project emissions due to the consumption of Natural Gas.

As data for the month of May are not yet available, April data have been used for this monitoring period.

The yearly value is calculated with the data available for the year prior to the beginning of the period and is used for the calculation of E\_Steam.

Component	April Natural Gas Composition	Number of C
CH <sub>4</sub> (Methane)	88.64	1
C <sub>2</sub> H <sub>6</sub> (Ethane)	6.31	2
C <sub>3</sub> H <sub>8</sub> (Propane)	1.92	3
I-C <sub>4</sub> H <sub>10</sub> (I-Butane)	0.28	4
N-C <sub>4</sub> H <sub>10</sub> (N-Butane)	0.39	4
I-C <sub>5</sub> H <sub>12</sub> (I-Pentane)	0.10	5
N <sub>2</sub> (Nitrogen)	0.74	0
CO <sub>2</sub> (Carbon dioxide)	1.47	1
Average number of C	1.119	
E_NG	2.195	

The CO<sub>2</sub> 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	98.81 %
Method of monitoring	Position of limit switch on the valve allowing to by-pass the decomposition facility
Recording frequency	Monthly
Background data	Log sheet record
Calculation method	Based upon the position of the limit switch on the valve 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:
	$\%_{\text{on-line}_y} = 1 - (Q_{\text{N2O\_by-pass}_y} / (P_{\text{AdOH}_y} \times \text{N2O\_AdOH}))$

Period	Q_N2O_by-pass <sub>y</sub> kg	P_AdOH <sub>y</sub> t	%_on-line <sub>y</sub> %
Apr. 1 <sup>st</sup> – Apr. 30 <sup>th</sup> , 2007	27 576	7 072	98.56
May 1 <sup>st</sup> – May 6 <sup>th</sup> , 2007	0	1 516	100.00

## Appendix 7

Name of item	Q_N2O_by-pass
Description	N2O by-passing the decomposition facility
Value in period	27 576 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> $\text{AdOH\_by-pass} = \text{P\_AdOH} \times (1 - \%_{\text{on-line}})$ <p>The quantity of N2O that by-pass the facility is then recorded daily.</p> $\text{N2O\_by-pass}_d = \text{P\_AdOH}_d \times \text{N2O\_}/\text{AdOH} \times (1 - \%_{\text{on-line}})$ <p>At the end of the period the quantity of N2O that by-passed the facility is :</p> $\text{N2O\_by-pass}_y = \Sigma (\text{N2O\_by-pass}_d)$

Period	N2O_by-pass <sub>y</sub> kg
Apr. 1 <sup>st</sup> – Apr. 30 <sup>th</sup> , 2007	27 576
May 1 <sup>st</sup> – May 6 <sup>th</sup> , 2007	0



## **Appendix 8**

Name of item	P_AdOH
Description	Adipic acid production
Value in period	8 588 t
Method of monitoring	Packaged production and slurry used to nylon salt production
Recording frequency	Monthly
Background data	Log sheet record 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. The quantity of adipic acid produced during this period can then be fully used as such.

Month - year	Adipic acid production t
Apr. 1 <sup>st</sup> – Apr. 30 <sup>th</sup> , 2007	7 072
May 1 <sup>st</sup> – May 6 <sup>th</sup> , 2007	1 516

## 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 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).

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 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
May 6 <sup>th</sup> , 2007	> 0.270	0.270	0.270

## Appendix 10

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

Period	Q_N <sub>2</sub> O reg kg	N <sub>2</sub> O_reg / AdOH kg	r <sub>y</sub> %
Apr. 1 <sup>st</sup> , 2007 – May 6 <sup>th</sup> , 2007	No limit	No limit	0.



## Appendix 11

Name of item

P\_N<sub>2</sub>O

Description

Market price of N<sub>2</sub>O in waste gas

Value in period

0 €/t

Method of monitoring

Market survey

Recording frequency

Yearly

Background data

No market for this low level of N<sub>2</sub>O concentration

Year	P_N <sub>2</sub> O
2007	0





## **Appendix 12**

Name of item	Q_Steam_p
Description	Amount of steam produced by the decomposition facility
Value in period	9 741 500 kg
Method of monitoring	Flowmeter
Recording frequency	Monthly
Background data	Log sheet record

Period	Q_Steam_p kg
Apr. 1 <sup>st</sup> – Apr. 30 <sup>th</sup> , 2007	8 067 600
May 1 <sup>st</sup> – May 6 <sup>th</sup> , 2007	1 673 900

### Appendix 13

Name of item	E_Steam
Description	CO <sub>2</sub> emission factor for steam produced by the facility
Value in period	0.143 kg CO <sub>2</sub> /kg of steam
Method of monitoring	Supplier data
Recording frequency	Yearly
Background data	Data supplied by the Rhodia Paulínia Industrial Platform
Calculation method	<p>The calculation is made according to the monitoring plan.</p> <p>We first calculate the amount of natural gas required to generate steam in Nm<sup>3</sup>/t of steam in a very efficient boiler</p> $QNG\_steam = \Delta H \text{ (kJ/t)} / (\text{LHV (kJ/Nm}^3\text{)} \times \eta \text{ (\%)})$ <p>The LHV data is the yearly average value for the gas supplied by COMGAS.</p> <p>E_NG<sub>y</sub> is the yearly average value for the gas supplied by COMGAS (see appendix 5).</p>
Comment	LHV data is supplied by COMGAS in kcal/m <sup>3</sup> at 20 oC. Data were converted to kJ/Nm <sup>3</sup> .

Year ending	LHV kJ/Nm <sup>3</sup>	$\Delta H$ kJ/t	$\eta$ %	QNG_tsteam Nm <sup>3</sup> /t of steam	E_NG <sub>y</sub> kg- CO <sub>2</sub> /Nm <sup>3</sup>	E_Steam kg-CO <sub>2</sub> / kg of steam
Mar. 31 <sup>st</sup> , 2007	38714	2624000	97	65.75	2.188	0.143



#### **Appendix 14**

Name of item	Q_Power
Description	Electricity consumption by the decomposition facility
Value in period	25 979 kWh
Method of monitoring	Power consumption data
Recording frequency	Monthly
Background data	Log sheet record / counter

Period	Q_Power kWh
Apr. 1 <sup>st</sup> – Apr. 30 <sup>th</sup> , 2007	21 658
May 1 <sup>st</sup> – May 6 <sup>th</sup> , 2007	4 321

## Appendix 15

Name of item	E_Power
Description	CO <sub>2</sub> intensity for electric generation
Value in period	0.927 kg CO <sub>2</sub> /kWh
Method of monitoring	Survey of data publication
Recording frequency	Yearly
Background data	Data made publicly available by the Brazilian Operador Nacional do Sistema Elétrico, ONS.
Calculation method	Calculated using the combined margin (CM) approach according to ACM0002. Conservative value used.

Date (year)	E_Power kg CO <sub>2</sub> /kWh
2007	0.927



## **Appendix 16**

Name of item	Q_Steam_c
Description	Amount of steam consumed by the decomposition facility
Value in period	<div>63 500 kg</div>
Method of monitoring	Mass flowmeter
Recording frequency	Monthly
Background data	Log sheet record

Period	Q_Steam_c kg
Apr. 1 <sup>st</sup> – Apr. 30 <sup>th</sup> , 2007	55 700
May 1 <sup>st</sup> – May 6 <sup>th</sup> , 2007	7 800



## Appendix 17

Name of item	E_Steam_c
Description	CO <sub>2</sub> intensity for steam consumed in the facility
Value in period	0.228 kg CO <sub>2</sub> /kg of steam
Method of monitoring	Calculated from steam supplier data
Recording frequency	Yearly
Background data	Data supplied by the Rhodia Paulínia Industrial Platform
Calculation method	This steam is supplied by existing boilers on site. Steam production, natural gas, fuel oil and by-products consumptions are monitored. From the monthly consumption of all fuels, the monthly value of E_NG and of the carbon content of each liquid fuel, monthly emissions of CO <sub>2</sub> for steam production are calculated and cumulated over the year. E_Steam_c is obtained from the ratio of yearly CO <sub>2</sub> emission over the yearly steam production.

Year ending	E_Steam_c_NG kg CO <sub>2</sub> /kg of steam	E_Steam_c_chem&oil kg CO <sub>2</sub> /kg of steam	E_Steam_c kg CO <sub>2</sub> / kg of steam
March 31 <sup>st</sup> , 2007	0.220	0.337	0.228