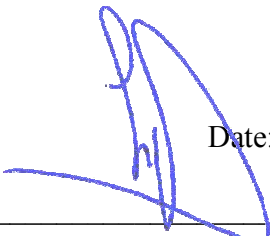




**CDM  
MONITORING REPORT #5  
of  
“N2O Emission Reduction in Paulinia,  
SP, Brazil ”  
UNFCCC 0116**

**From: May 7, 2007  
To: June 30, 2007**

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Date: July 3<sup>rd</sup>, 2007

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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 May 7<sup>th</sup>, 2007 to June 30<sup>th</sup>, 2007 as the 5<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.

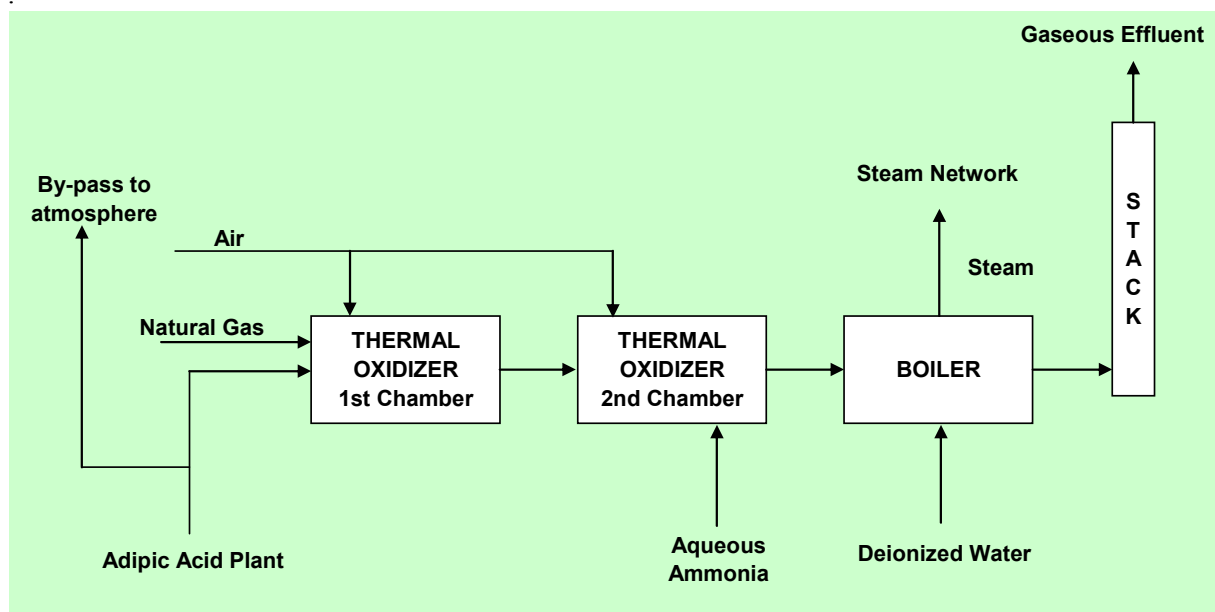
Natural gas is fed with the off gas adipic acid production containing N<sub>2</sub>O and some air in a reduction chamber, where it burns (oxidizes) to carbon dioxide CO<sub>2</sub> and water vapour. N<sub>2</sub>O is used as an oxidizer. Being oxygen deficient, the oxidation is not complete and carbon 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.

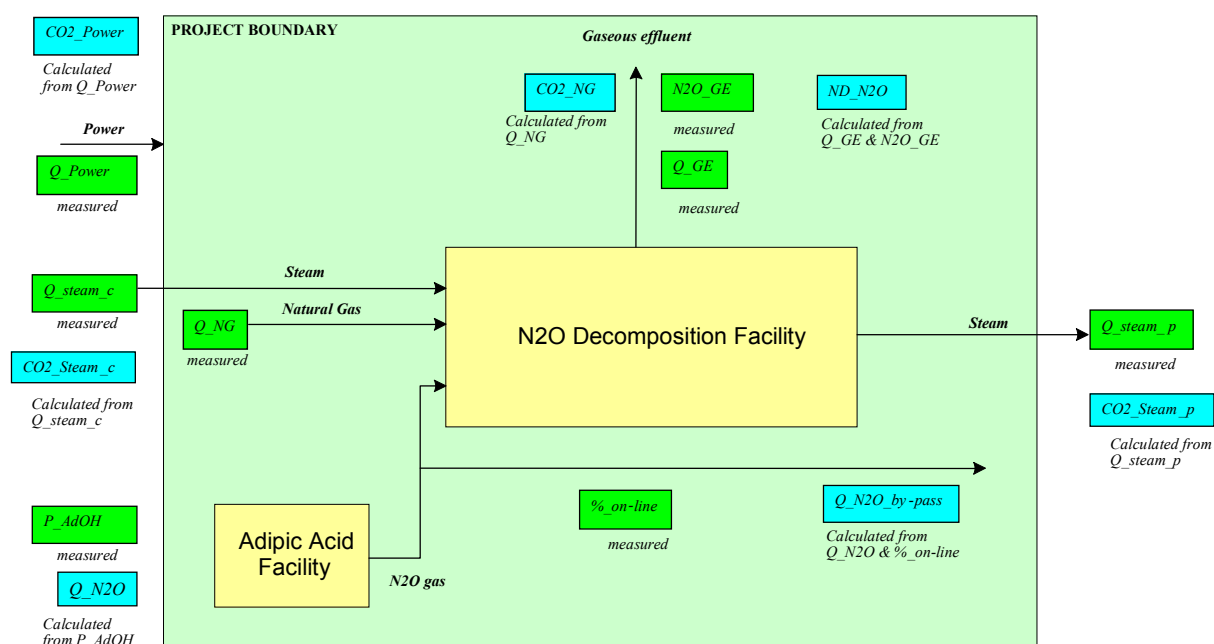


## 5. Baseline methodology

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. Applicability of the methodology

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 as:

- Thermal decomposition of the N<sub>2</sub>O 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 as 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 in the PDD were conservative, in particular the performance of the N<sub>2</sub>O abatement unit (in fact, the actual efficiency has been > 85%, and the destruction rate > 99%).

## 7. Monitored Parameters

According to the methodology AM 0021 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	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_N <sub>2</sub> O	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_N <sub>2</sub> O_by-pass	N <sub>2</sub> O by passing the decomposition facility	Calculated from Q_N <sub>2</sub> O 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	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
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



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

## 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 ISO 9001 procedures of the Paulínia 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.

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

The Paulínia 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 Chalampé 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>



### 8.3. 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.

### 8.4. 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 of Gaseous Emission for Thermal Oxidation plant

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

## 9. 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  
$$ER_y = BE_y - PE_y - L_y$$

### 9.1. 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>	3 552 741 kg	Calculated
P_AdOH	13 158 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.

## 9.2. 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

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

Parameter	Value	Reference
<b>BE<sub>y</sub></b>	<b>1 103 426 t CO<sub>2</sub> eq.</b>	Calculated
Q_N2O <sub>y</sub>	3 552 741 kg	Calculated in 9.1
GWP_N2O	310	Kyoto Protocol Rule. Decision 2/CP.3
Q_Steam_p <sub>y</sub>	14 518 200 kg of steam	Appendix 12
E_Steam <sub>y</sub>	0.143 kg-CO <sub>2</sub> /kg of steam	Appendix 13

## 9.3. 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>	79 291 kg	Appendix 7
P_AdOH	13 158 t	Appendix 8
N2O_/AdOH	0.27 kg N2O/kg AdOH	Appendix 9
%_on-line <sub>y</sub>	97.77 %	Appendix 6

#### 9.4. 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.

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

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

The non-destroyed 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:  
 $ND\_N_2O = Q_{GE} \times N_2O\_GE$

$$PE_y = (Q_{N_2O\_by-pass_y} + ND\_N_2O_y) \times GWP_{N_2O} + Q_{NG_y} \times E_{NG_y}$$

Parameter	Value	Reference
<b>PE<sub>y</sub></b>	<b>27 266 t CO<sub>2</sub> eq.</b>	Calculated
Q_N2O_by-pass <sub>y</sub>	79 291 kg	Appendix 7
Q_GE	17 303 764 Nm <sup>3</sup>	Appendix 1
N <sub>2</sub> O_GE	7 ppm	Appendix 2
ND_N <sub>2</sub> O <sub>y</sub>	233 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>	1 192 420 Nm <sup>3</sup>	Appendix 4
E_NG <sub>y</sub>	2.190 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.

### 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:

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

Parameter	value	Reference
<b>L<sub>y</sub></b>	<b>104.1 t CO<sub>2</sub> eq.</b>	Calculated
Q_Power	89 366 kWh	Appendix 14
E_Power	0.927 kg CO <sub>2</sub> /kWh	Appendix 15
Q_Steam_c <sub>y</sub>	94 200 kg	Appendix 16
E_Steam_c <sub>y</sub>	0.226 kg CO <sub>2</sub> / kg of steam	Appendix 17

### 9.6. 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,

$$ER_y = 1\,103\,426 \text{ t CO}_2 \text{ eq.} - 27\,266 \text{ t CO}_2 \text{ eq.} - 104 \text{ t CO}_2 \text{ eq.}$$

Or,

$$ER_y = 1\,076\,056 \text{ t CO}_2 \text{ eq.}$$

.

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	17 303 764 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>
May 7 <sup>th</sup> – May 31 <sup>st</sup> , 2007	7 844 728
June 1 <sup>st</sup> – June 30 <sup>th</sup> , 2007	9 459 036

## Appendix 2

Name of item	N2O_GE
Description	Concentration of N <sub>2</sub> O in the effluent gas
Value in period	7 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
May 7 <sup>th</sup> – May 31 <sup>st</sup> , 2007	123	7 844 728	8
June 1 <sup>st</sup> – June 30 <sup>th</sup> , 2007	110	9 459 036	6





### Appendix 3

Name of item	ND_N2O
Description	Quantity of non-destroyed N2O emitted by the decomposition facility
Value in period	233 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
May 7 <sup>th</sup> – May 31 <sup>st</sup> , 2007	123
June 1 <sup>st</sup> – June 30 <sup>th</sup> , 2007	110



#### **Appendix 4**

Name of item	Q_NG
Description	Amount of natural gas used by the decomposition process
Value in period	1 192 420 Nm3
Method of monitoring	Natural gas consumption data
Recording frequency	Monthly
Background data	Log sheet record / flowmeter

Period	Q_NG Nm <sup>3</sup>
May 7 <sup>th</sup> – May 31 <sup>st</sup> , 2007	539 446
June 1 <sup>st</sup> – June 30 <sup>th</sup> , 2007	652 974

## Appendix 5

Name of item	E_NGy with NGC
Description	Emissions coefficient for natural gas combustion Natural gas composition (NGC) is informed by the natural gas supplier
Value in period for E_NG	2.190 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 = $\sum$ (number of C in each mole) x (volume ratio) Following monthly data are used to calculate monthly project emissions due to the consumption of Natural Gas.  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	May Natural Gas Composition	June Natural Gas Composition	Number of C
CH <sub>4</sub> (Methane)	88.73	88.76	1
C <sub>2</sub> H <sub>6</sub> (Ethane)	6.25	6.23	2
C <sub>3</sub> H <sub>8</sub> (Propane)	1.88	1.85	3
I-C <sub>4</sub> H <sub>10</sub> (I-Butane)	0.28	0.27	4
N-C <sub>4</sub> H <sub>10</sub> (N-Butane)	0.40	0.41	4
I-C <sub>5</sub> H <sub>12</sub> (I-Pentane)	0.10	0.11	5
N <sub>2</sub> (Nitrogen)	0.75	0.75	0
CO <sub>2</sub> (Carbon dioxide)	1.46	1.47	1
Average number of C	1.117	1.117	
E_NG	<b>2.192</b>	<b>2.191</b>	

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 N<sub>2</sub>O is sent to the decomposition facility

Value in period

97.77 %

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\_ N<sub>2</sub>O\_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 <sub>2</sub> O_by-pass <sub>y</sub> kg	P_AdOH <sub>y</sub> T	%_on-line <sub>y</sub> %
May 7 <sup>th</sup> – May 31 <sup>st</sup> , 2007	39 528	5 872	97.51
June 1 <sup>st</sup> – June 30 <sup>th</sup> , 2007	39 763	7 286	97.98

## Appendix 7

Name of item	Q_N2O_by-pass
Description	N2O by-passing the decomposition facility
Value in period	79 291 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
May 7 <sup>th</sup> – May 31 <sup>st</sup> , 2007	39 528
June 1 <sup>st</sup> – June 30 <sup>th</sup> , 2007	39 763



## Appendix 8

Name of item

P\_AdOH

Description

Adipic acid production

Value in period

13 158 t
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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
May 7 <sup>th</sup> – May 31 <sup>st</sup> , 2007	5 872
June 1 <sup>st</sup> – June 30 <sup>th</sup> , 2007	7 286

## 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
June 30 <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> %
May 7 <sup>th</sup> , 2007 – June 30 <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
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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	14 518 200 kg
Method of monitoring	Flowmeter
Recording frequency	Monthly
Background data	Log sheet record

Period	Q_Steam_p kg
May 7 <sup>th</sup> – May 31 <sup>st</sup> , 2007	6 635 100
June 1 <sup>st</sup> – June 30 <sup>th</sup> , 2007	7 883 100

### 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> <p>The yearly value of E_Steam is calculated with the data available for the year prior to the beginning of the period.</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
April 30 <sup>th</sup> , 2007	38738	2624000	97	65.70	2.190	0.143



#### **Appendix 14**

Name of item	Q_Power
Description	Electricity consumption by the decomposition facility
Value in period	89 366 kWh
Method of monitoring	Power consumption data
Recording frequency	Monthly
Background data	Log sheet record / counter

Period	Q_Power kWh
May 7 <sup>th</sup> – May 31 <sup>st</sup> , 2007	39 115
June 1 <sup>st</sup> – June 30 <sup>th</sup> , 2007	50 251



### Appendix 15

Name of item	E_Power
Description	CO <sub>2</sub> intensity for electric generation
Value in period	<div>0.927 kg CO<sub>2</sub>/kWh</div>
Method of monitoring	Survey of data publication
Recording frequency	Yearly
Background data	Latest data made publicly available by the Brazilian Operador Nacional do Sistema Elétrico, ONS, are for 2005.
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>94 200 kg</div>
Method of monitoring	Mass flowmeter
Recording frequency	Monthly
Background data	Log sheet record

Period	Q_Steam_c kg
May 7 <sup>th</sup> – May 31 <sup>st</sup> , 2007	39 600
June 1 <sup>st</sup> – June 30 <sup>th</sup> , 2007	54 600



## Appendix 17

Name of item	E_Steam_c
Description	CO <sub>2</sub> intensity for steam consumed in the facility
Value in period	0.226 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. The yearly value of E_Steam_c is calculated with the data available for the year prior to the beginning of the period.

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
April 30 <sup>th</sup> , 2007	0.219	0.327	0.226