# Monitoring report form
# (Version 03.1)

## Monitoring report

| | |
|---|---|
| **Title of the project activity** | Industrial Wastewater Methane Recovery Project of Bengbu Tushan Thermoelectricity Co.,Ltd. |
| **Reference number of the project activity** | 6988 |
| **Version number of the monitoring report** | 01 |
| **Completion date of the monitoring report** | 12/09/2013 |
| **Registration date of the project activity** | 15/08/2012 |
| **Monitoring period number and duration of this monitoring period** | Period 1<br>15/08/2012-31/08/2013, about one year monitoring period |
| **Project participant(s)** | COFCO Biochemistry (Anhui) Co.,Ltd.<br>LAKEWOOD CARBON CORP. (Purchaser)<br>Umwelt-Projekt-Management GmbH(Purchaser) |
| **Host Party(ies)** | People's Republic of China |
| **Sectoral scope(s) and applied methodology(ies)** | ACM0014(Version 04.1.0): "Mitigation of greenhouse gas emissions from treatment of industrial wastewater"<br>Sectoral Scope 13: Waste handling and disposal |
| **Estimated amount of GHG emission reductions or net anthropogenic GHG removals by sinks for this monitoring period in the registered PDD** | 208,392t$CO_2$e |
| **Actual GHG emission reductions or net anthropogenic GHG removals by sinks achieved in this monitoring period** | 166,746 t$CO_2$e[1] |

[1] Actual values achieved up to 31 December 2012 is 52,083 t$CO_2$e, and actual values achieved from 1 January 2013 onwards is 114,663 t$CO_2$e

## SECTION A. Description of project activity

### A.1. Purpose and general description of project activity

>>
The Industrial Wastewater Methane Recovery Project of Bengbu Tushan Thermoelectricity Co., Ltd. (hereinafter referred to as the "Project") is to recover the biogas generated in the process of wastewater treatment as well as to create heat currently supplied by a fossil fuel. The Project is developed by the COFCO Biochemistry (Anhui) Co.,Ltd. (hereinafter referred to as the "Project Owner"), which is located at the Bengbu City, Anhui Province.

The purpose of the project is to recover biogas generated from the open lagoons while considering the CDM revenue. The main constructions would be newly-built MIC anaerobic reactors, a biogas cleaning system, a co-firing system and a retrofitting aerobic treatment facility. After the implementation of the project, the biogas generated from MIC anaerobic reactors would firstly be sent to the purification system, then the purified biogas would be transported into the retrofitted coal-fired boilers to generate steam. The sludge from the wastewater treatment would be combusted in the boilers after dewatering and drying. When the boiler is in trouble due to failure or malfunction or under maintenance, biogas collected from the MIC reactor is open flared.

### A.2. Location of project activity

>>
The Project is located in Bengbu City, Anhui Province, which is at the confluence of Jinpu line and Huaihe. The geographic coordinates are north 32° 56' 01" and east 117° 17' 11", respectively.

### A.3. Parties and project participant(s)

| Party involved<br>((host) indicates a host Party) | Private and/or public entity(ies) project participants<br>(as applicable) | Indicate if the Party involved wishes to be considered as project participant<br>(Yes/No) |
|---|---|---|
| **People's Republic of China (host)** | **COFCO Biochemistry (Anhui) Co.,Ltd.** | **No** |
| **United Kingdom of Great Britain and Northern Ireland** | **Umwelt-Projekt-Management GmbH** | **No** |
| **United Kingdom of Great Britain and Northern Ireland** | **Lakewood Carbon Corp.** | **No** |

### A.4. Reference of applied methodology

>>
The approved baseline and monitoring methodologies which are applicable to the project activity are as follows:
ACM0014: Mitigation of greenhouse gas emissions from treatment of industrial wastewater (version 04.1.0)
Sectoral Scope 13: Waste handling and disposal

The methodology also refers to the following tools:

- Tool for the demonstration and assessment of additionality (Version 06.0.0)
- Tool to determine project emissions from flaring gases containing methane;
- Tool to calculate the emission factor for an electricity system (Version 02.2.1);
- Tool to calculate baseline, project and/or leakage emissions from electricity consumption (Version 01) ;

### A.5. Crediting period of project activity

>>
The project is registered on 15/08/2012. The start date of the crediting period is 15/08/2012 and choice of crediting period is 10 years, fixed crediting period.

## SECTION B. Implementation of project activity

### B.1. Description of implemented registered project activity

>>
**Description of the installed technology, technical processes and equipments**
The Project recovers the biogas from anaerobic wastewater treatment of ethanol fuel; the purified biogas co-fired with coal is transported to the boilers to generate steam. So, the technology employed by the Project is composed of wastewater treatment technology, a biogas cleaning system and a co-fired system.
**(a) Wastewater treatment system**

**Pre-treatment:** Wastewater of ethanol fuel is cooled through cooler and then is sent into the regulation pond for quality and quantity moderation.

**Anaerobic treatment:** After pre-treatment the wastewater is sent to the $1^{st}$ stage MIC anaerobic reactor, where the wastewater is biodegraded completely (the removal rate of the COD can be up to 80%). Effluent from the first stage MIC anaerobic reactors is degassed through the degassing tower and then is sent to the second stage MIC anaerobic reactors for further organic decomposition (where the removal rate of COD is around 60%).

**Aerobic treatment:** Effluent from the $2^{nd}$ stage anaerobic reactors goes into the bio-trickling filter tower, where the wastewater on the one hand is further cooled to ensure the environment of the aerobic micro organism in the two stage aerobic reactors is suitable, and on the other hand to reduce foam generation and sludge bulking. Effluent from the bio-trickling filter tower is put into the bio-double pool for aeration treatment, and then the wastewater is pumped to the existing oxidation ditch which is used as the second stage aerobic treatment facility. The treated waste water finally drains into the efficient sedimentation devices for sedimentation. After that, the precipitation sludge at the bottom of settler is pumped back to the sludge treatment system for further treatment, while the separated fresh water from the fresh water tank meeting primary discharged standards is discharged to the wastewater treatment plant.

MIC reactor (Multi-Internal Circulation), which is the third generation anaerobic reactor based on the second. It is composed of two vertical series-connected chambers. The first is the high load chamber of which the bottom zone includes a water inlet and a back flow zone. The second reactor is low load. There is a biogas collector between the first chamber and the second chamber. The three-phase separators are installed at the upper part of them in addition to a three-phase separation cap on the top of the anaerobic reactor. The two reaction chambers and the three-phase separation cap are connected with a lift pipe and a backflow pipe.

**(b) Biogas purification and co-fired system**

There is a biogas storage cabinet used to collect the biogas produced by degradation of organic matter from the MIC anaerobic reactors. The collected biogas is transported to the gas desulfurization system[2] for purification, and then the purified biogas is transported to Tushan Thermoelectricity Company's boiler room by the booster fan through the biogas mains and distributed to eight co-fired boilers. In both sides of each boiler are installed 2 biogas burner units. The biogas pipelines to the boilers is explosion-proof and anti-tempering, automatic turn off in case of fire and so on. The surplus sludge in the Project is combusted in the boilers after dehydration and drying.
The desulfurization system consists of an alkali washing tower and a bio-reactor. The alkaline liquid in the

[2] The concentration of CH4 in the inlet of desulfurization system is 63.32%. After desulfurization, the $H_2S$ in the biogas (about 8.52g/$m^3$) is removed.

bio-reactor can be recycled.

Furthermore, when the boiler is in trouble due to failure or malfunction, biogas collected from the MIC reactor is open flared.

The specifications of the major equipment after the implementation of the Project are shown in table B.1.1.

**Table B.1.1 Main technical parameters after the implementation of the Project**

| Parameters | | | Value |
|---|---|---|---|
| Wastewater treatment system | 1st MIC reactor | Size | Φ15×22.8m |
| | | Number | 6 units |
| | | Capacity/unit | 4,000m$^3$ |
| | | HRT | 35h |
| | 2nd MIC reactor | Size | Φ15×22.8m |
| | | Number | 2 units |
| | | Capacity/unit | 4,000m$^3$ |
| | | HRT | 11.7h |
| | Bio-double pool | Size | 73×30×6.3 m |
| | Bio-trickling filter tower | Size | Φ15×16m |
| Biogas utilization system | Biogas burner | Number | 16units |
| | | Model number | FRQ-21 |
| | | Manufacturer | Xuzhou Funi Control Fired Research Institute Co.,Ltd |
| | Co-fired steam boiler I | Number | 3 |
| | | Model number | DG-260/9.81-2 |
| | | Manufacturer | Dongfang Boiler Plant |
| | | Boiler efficiency | 91% |
| | | Water temperature | 215℃ |
| | | Rated steam pressure | 9.81MPa |
| | | Rated steam temperature | 540℃ |
| | | Rated output | 260t/h |
| | | Date of manufacture | 2004.05/2004.06/2004.12 |
| | Co-fired steam boiler II | Number | 2 |
| | | Model number | CG-130/3.82-M×5 |
| | | Manufacturer | Sichuan Boiler Plant |
| | | Boiler efficiency | 90.21% |
| | | Water temperature | 150℃ |
| | | Rated steam pressure | 3.82MPa |
| | | Rated steam temperature | 450℃ |
| | | Rated output | 130t/h |
| | | Date of manufacture | 2003.03/2003.04 |
| | Co-fired steam boiler III | Number | 3 |
| | | Model number | SG-130/3.82-M247 |
| | | Manufacturer | Shanghai Boiler Plant |
| | | Boiler efficiency | 90.63% |
| | | Water temperature | 158℃ |
| | | Rated steam pressure | 3.82MPa |
| | | Rated steam temperature | 450℃ |
| | | Rated output | 130t/h |
| | | Date of manufacture | 2000.08/2000.08/2000.08 |

**Flow Diagram after the Implementation of the Project**

The figure B.1.1 in annex 1 shows general arrangement after the implementation of the project activity.

**Information on the implementation and actual operation of the project activity**

Start date of the project: 18/03/2008

Starting date of continued operation of the Project: 05/06/2012

**Actual operation of the project activity during this monitoring period**

There were no special events during the monitoring period. No equipment was exchanged or overhauled. The project participant does not submit any request for approval of changes to the registered CDM project.

**Events affecting the applicability of the methodology**

No events or situations occurred that affected the applicability of the methodology.

### B.2. Post registration changes

#### B.2.1. Temporary deviations from registered monitoring plan or applied methodology

>>
The monitoring plan is the same as described in the registered CDM-PDD. None of the monitoring plan is revised.

#### B.2.2. Corrections

>>
No correction is applied during this monitoring period.

#### B.2.3. Permanent changes from registered monitoring plan or applied methodology

>>

The monitoring of volume of biogas collected at the outlet of the anaerobic reactors is changed from one biogas flow meter into two biogas flow meters. And the methane content of the biogas at the outlet of the anaerobic reactors then was monitored at the two monitoring points as a result.

#### B.2.4. Changes to project design of registered project activity

>>
N/A

#### B.2.5. Changes to start date of crediting period

>>

As the registration date of the Project is August 15, 2012, the start date of crediting period is applied to be changed to August 15, 2012 from October 15, 2012.

#### B.2.6. Types of changes specific to afforestation or reforestation project activity

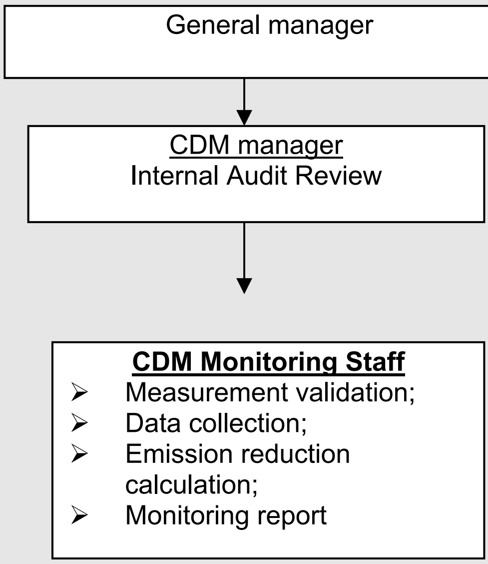
>>
N/A

## SECTION C. Description of monitoring system

>>
The Monitoring Plan for the Project is developed to ensure complete and reliable data is collected and archived in well organized manner.

**1. Monitoring Organization and Staff Training**
An organization dedicated for monitoring of CDM project activity has been set up. The president of the COFCO Biochemistry (Anhui) Co.,Ltd. appointed one CDM monitoring manager and several CDM monitoring staff. The CDM monitoring group implemented data collection, calibration of maters, recording, archiving of collected data and preparation of monitoring report, etc. The managing structure is shown below.

**Figure C.1 Managing structure of the CDM monitoring**




The CDM monitoring manager carried out instruction and training of CDM monitoring staff while receiving a necessary support from third party technical experts. The CDM monitoring manager made the CDM monitoring staff understand the importance of monitoring for the CDM project activity as well as instruct technical matters such as how to use, maintain and calibrate monitoring equipment (including on-site training), procedure for error detection, data processing for calculation of emissions reductions, data archiving system (storage media, frequency of recording and backup, etc.), preparation of internal monitoring report and data entry method.

**2. Monitoring equipment and installation**

Monitoring instrument installation position are shown in Figure B.1.1 in annex 1, monitoring instrument introduction are shown in Table C.1.

**Table C.1 Summary of monitoring equipment**

| No. | Parameter | Location | Remark |
|---|---|---|---|
| Q-101 | Wastewater flow | Inlet of anaerobic digester | |
| C-101 | Inflow COD of anaerobic reactor | Inlet of anaerobic digester | Measured periodically |
| Q-102 | Wastewater flow | outlet of anaerobic digester | |
| C-102 | Outflow COD of anaerobic reactor | outlet of anaerobic digester | Measured periodically |
| C-104 | Methane content | outlet of anaerobic digester, biogas pipe | Measured periodically |
| C-105 | Methane content | Biogas boiler entrance pipe / Torch entrance pipe | Measured periodically |
| Q-104 | Biogas flow meter | Outlet of anaerobic reactor | |
| Q-105 | Biogas flow meter | Inlet of co-fired boiler | |
| Q-103 | Biogas flow meter | Inlet of flaring system | |

| | | | |
|---|---|---|---|
| Q-106 | Wastewater flow | Outlet of aerobic reactor | |
| C-106 | Outflow COD of aerobic reactor | Outlet of aerobic reactor | |
| E | Total energy meter | Power distribution cabinet | |
| T-101 | Temperature of the flare | The open flare | |

**3. Data Collection and Archiving**

Data collection and archiving is carried out in conformity with the method stated in section B.7.2.1 of the registered PDD and the monitoring manual was prepared by the starting date of CDM monitoring implementation. Dedicated data entry sheets as well as calculation spreadsheets are prepared. When the data is not temporarily available because of breakdown and/or failure of equipment, conservatively estimated value was used alternatively in transparent and reasonable manner. At the same time, the CDM monitoring manager took actions for prompt recovery from abnormal conditions and minimization of negative impact on production according to the procedures stipulated in the CDM manual. For example, when biogas could not be combusted in the co-fired boiler due to boiler malfunction, the CDM monitoring chief soon directed a CDM monitoring staff to take measures for recovery as well as to record the time when the boiler stops and restarts, and at the same time, informed it to relevant department to adjust plant operation.

**4. Data Management**

Data monitored for CDM purposes was aggregated, summarized, calculated and recorded as an electronic file at the end of every month. Backup was saved in a digital recording media like CD and as print out. All relevant documents such as maps, drawings, applicable standards, monitoring guidance, etc. are systematically stored in order to use to check appropriateness of data and data management. The collected data and relevant documents were made available to the verifier so that the reliability of the information can be checked. All the data shall be kept until two (2) years after the end of credit period.

**5. Quality Assurance and Quality Control**

All monitoring equipment was maintained and calibrated in line with manufacturers' instruction or national standards. Calibration was implemented once a year. These activities assure that the equipment operates at the stated level of accuracy.

Data collected by CDM monitoring staff was cross-checked by the CDM monitoring chief and the CDM monitoring manager to detect and correct errors in accordance with the predetermined procedure. In order to check if daily monitoring activities are implemented in compliance with the CDM monitoring manual, and to continuously improve monitoring practice, internal audit was also implemented on once a year. In the internal audit, document survey concerning procedures of data collection, management and archiving, status of calibration, education and training, etc. and onsite audit are made. Corrective action was taken on any deviations from the manual identified though the internal audit.

**6. Monitoring Report**

COFCO Biochemistry (Anhui) Co.,Ltd. prepared a monitoring report for verification by DOE. The monitoring report included monitoring data biogas flow rate, fraction of methane in biogas, record of calibration of meters, calculations of emission reductions, etc.

## SECTION D. Data and parameters

### D.1. Data and parameters fixed ex ante or at renewal of crediting period

| **Data / Parameter:** | **$COD_{out,x}$** |
|---|---|
| Unit: | tCOD/y or m |
| Description: | COD of the effluent in the period x (a year of m) |
| Source of data: | FSR |
| Value(s) applied): | 4,830tCOD/y |
| Purpose of data: | Baseline emission calculation |

| | |
|---|---|
| Additional comment: | In the FSR, the quantity of the open lagoons effluent COD is less than 1400mg/l, the COD value is conservative. |

| **Data / Parameter:** | **$COD_{in,x}$** |
|---|---|
| Unit: | tCOD/y or m |
| Description: | COD directed to the open lagoons in the period x (a year) |
| Source of data: | FSR |
| Value(s) applied): | 120,750 tCOD/y |
| Purpose of data: | Baseline emission calculation |
| Additional comment: | In FSR, the value is monitored actually and conservative |

| **Data / Parameter:** | **Bo** |
|---|---|
| Unit: | $tCH_4/tCOD$ |
| Description: | Maximum methane producing capacity, expressing the maximum amount of $CH_4$ that can be produced from a given quantity of chemical oxygen demand (COD) |
| Source of data: | 2006 IPCC Guidelines |
| Value(s) applied): | 0.21 |
| Purpose of data: | Baseline emission and project emission calculation |
| Additional comment: | / |

| **Data / Parameter:** | **$f_d$** |
|---|---|
| Unit: | / |
| Description: | Factor expressing the influence of the depth of the lagoon or sludge pit on methane generation |
| Source of data: | ACM0014 |
| Value(s) applied): | For the baseline: 50% |
| Purpose of data: | Baseline emission and project emission calculation |
| Additional comment: | |

| **Data / Parameter:** | **D** |
|---|---|
| Unit: | m |
| Description: | Average depth of the lagoon |
| Source of data: | Specification of the baseline anaerobic lagoon |
| Value(s) applied): | 5 |
| Purpose of data: | To determine the $f_d$ |
| Additional comment: | / |

| **Data / Parameter:** | **$EF_{CO2,FF,boiler}$** |
|---|---|
| Unit: | $tCO_2/GJ$ |
| Description: | $CO_2$ emission factor of the fossil fuel type used in the boiler for heat generation in the absence of the project activity |
| Source of data: | IPCC 2006 default value for other bituminous coal |
| Value(s) applied): | 0.0946 |

| | |
|---|---|
| Purpose of data: | Baseline emission calculation |
| Additional comment: | / |

| **Data / Parameter:** | $\eta_{BL,boiler}$ |
|---|---|
| Unit: | % |
| Description: | Efficiency of the boiler that would be used for heat generation in the absence of the project activity |
| Source of data: | FSR |
| Value(s) applied): | 91 |
| Purpose of data: | Baseline emission calculation |
| Additional comment: | / |

| **Data / Parameter:** | $FL_{biogas,digest}$ |
|---|---|
| Unit: | $m^3$ biogas leaked/ $m^3$ biogas produced |
| Description: | Fraction of biogas that leak from the digester |
| Source of data: | IPCC(2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 5, Chapter 4, Page 4.4) |
| Value(s) applied): | 0.05 |
| Purpose of data: | Project emission calculation |
| Additional comment: | Applicable to the new anaerobic digester |

| **Data / Parameter:** | $GWP_{CH4}$ |
|---|---|
| Unit: | $tCO_2/tCH_4$ |
| Description: | Global warming potential for $CH_4$ |
| Source of data: | IPCC 2006 Guidelines for National Greenhouse Gas Inventories |
| Value(s) applied): | 21 before 31/12/2013 and 25 after 1/1/2013 |
| Purpose of data: | Baseline emission and project emission calculation |
| Additional comment: | / |

| **Data / Parameter:** | **A** |
|---|---|
| Unit: | Ha |
| Description: | Surface of the lagoon |
| Source of data: | Specification of the baseline anaerobic lagoon |
| Value(s) applied): | 12.5 |
| Purpose of data: | To determine the $f_d$ |
| Additional comment: | / |

| **Data / Parameter:** | $\rho_{CH4,n}$ |
|---|---|
| Unit: | $kg/m^3$ |
| Description: | Density of methane gas at normal conditions |
| Source of data: | Tool to calculate the project emissions of the methane combustion |

| | |
|---|---|
| Value(s) applied): | 0.716 |
| Purpose of data: | Project emission calculation |
| Additional comment: | / |

| **Data / Parameter:** | **$TDL_{j,y}$** |
|---|---|
| Unit: | % |
| Description: | Average technical transmission and distribution losses for providing electricity to source j |
| Source of data: | Tool to calculate baseline project and/or leakage emissions from electricity consumption |
| Value(s) applied): | 0 |
| Purpose of data: | Project emission calculation |
| Additional comment: | / |

**D.2. Data and parameters monitored**

| **Data / Parameter:** | **$F_{PJ,dig,m}$** |
|---|---|
| Unit: | $m^3$/month |
| Description: | Quantity of wastewater that is treated in the anaerobic digester in the project activity in month m |
| Measured/ Calculated / Default: | Measured |
| Source of data: | Measured by electromagnetic flow meter |
| Value(s) of monitored parameter: | See ER sheet |
| Monitoring equipment: | electromagnetic flow meter<br>Type: HHD-350K3C1E2F1T1P1D1J2<br>Serial number:HH12012902<br>Accuracy class: 0.5<br>Calibration frequency: once every two years<br>Date of the latest calibration: 18/6/2012<br>Validity:2 years |
| Measuring/ Reading/ Recording frequency: | Monitored continuously with a flow meter and recorded every day, but aggregated monthly and annually for calculation |
| Calculation method (if applicable): | / |
| QA/QC procedures: | The electromagnetic flow meter undergoes calibration in line with national standard JJG1033-2007. |
| Purpose of data: | Baseline emissions |
| Additional comment: | / |

| **Data / Parameter:** | **$w_{COD,dig,m}$** |
|---|---|

| | |
|---|---|
| Unit: | tCOD/ $m^3$ |
| Description: | Average chemical oxygen demand in the wastewater that is treated in the anaerobic digester in the project activity in month m |
| Measured/ Calculated / Default: | Measured |
| Source of data: | Measured by testing in lab |
| Value(s) of monitored parameter: | See ER sheet |
| Monitoring equipment: | Measured in lab |
| Measuring/ Reading/ Recording frequency: | Measured periodcally and recorded every day, calculated monthly and annually |
| Calculation method (if applicable): | The arithmetic mean value in month “m” is used for baseline emission calculation |
| QA/QC procedures: | Measured periodically according to the national standard of Water quality-Determination of the chemical oxygen demand-Dichromate method (GB11914-89), aggregated monthly and annually for calculation |
| Purpose of data: | Baseline emission calculation |
| Additional comment: | / |

| **Data / Parameter:** | $F_{PJ,effl,dig,m}$ |
|---|---|
| Unit: | $m^3$/month |
| Description: | Quantity of effluent from the digester in month m |
| Measured/ Calculated / Default: | Measured |
| Source of data: | Measured by electromagnetic flow meter |
| Value(s) of monitored parameter: | See ER sheet |
| Monitoring equipment: | Electromagnetic flow meter<br>Type: HHD-350K3C1E2F1T1P1D1J2<br>Serial number:HH12012903<br>Accuracy class: 0.5<br>Calibration frequency:  once every two years<br>Date of the latest calibration: 18/6/2012<br>Validity:2 years |
| Measuring/ Reading/ Recording frequency: | Monitored continuously with a flow meter and recorded every day, but aggregated monthly and annually for calculation |
| Calculation method (if applicable): | / |

| | |
|---|---|
| QA/QC procedures: | The meter will be calibrated according to national standard of Verification regulation of electromagnetic flowmeters (JJG1033-2007). According to this regulation, the meter was calibrated every two years. |
| Purpose of data: | Project emissions |
| Additional comment: | / |

| **Data / Parameter:** | $\mathbf{w_{COD,\ effl,\ dig,m}}$ |
|---|---|
| Unit: | tCOD/ $m^3$ |
| Description: | Average chemical oxygen demand in the effluent from the digester in month m |
| Measured/ Calculated / Default: | Measured |
| Source of data: | Measured by testing in lab |
| Value(s) of monitored parameter: | See ER sheet |
| Monitoring equipment: | Measured in lab |
| Measuring/ Reading/ Recording frequency: | Measured in lab and recorded everyday, calculated monthly and annually |
| Calculation method (if applicable): | The arithmetic mean value in month "m" is used for project emission calculation. |
| QA/QC procedures: | Maintain and calibrate COD according to the national standard of Water quality-Determination of the chemical oxygen demand-Dichromate method (GB11914-89), aggregated monthly and annually for calculation. |
| Purpose of data: | Project emission calculation |
| Additional comment: | / |

| **Data / Parameter:** | $\mathbf{F_{PJ,effl,lag,m}}$ |
|---|---|
| Unit: | $m^3$/month |
| Description: | Quantity of effluent from the open lagoon in which the effluent from the digester is treated in month m |
| Measured/ Calculated / Default: | Measured |
| Source of data: | Measured by electromagnetic flow meter |
| Value(s) of monitored parameter: | See ER sheet |

| | |
|---|---|
| Monitoring equipment: | Electromagnetic flow meter<br>Type: HHD-450K3C1E2F1T1P1D1J2<br>Serial number:HH12012904<br>Accuracy class: 0.5<br>Calibration frequency: once every two years<br>Date of the latest calibration: 18/6/2012<br>Validity:2 years |
| Measuring/ Reading/ Recording frequency: | Measured by flow meter, monitored continuously but aggregated annually for calculations. |
| Calculation method (if applicable): | / |
| QA/QC procedures: | The electromagnetic flow meter undergoes calibration in line with national standards JJG1033-2007. |
| Purpose of data: | For project emission calculation |
| Additional comment: | / |

| **Data / Parameter:** | $w_{COD, effl, lag,m}$ |
|---|---|
| Unit: | tCOD/ $m^3$ |
| Description: | Average chemical oxygen demand in the effluent from the open lagoon in which the effluent from the digester is treated in month m |
| Measured/ Calculated / Default: | Measured |
| Source of data: | Measured in lab |
| Value(s) of monitored parameter: | See ER sheet |
| Monitoring equipment: | Measured in lab |
| Measuring/ Reading/ Recording frequency: | Measure the COD regularly, calculate average monthly and annually values |
| Calculation method (if applicable): | The arithmetic mean value in month “m” is used for project emission calculation. |
| QA/QC procedures: | The meter undergoes maintenance and calibration in line with manufacture’s recommendation |
| Purpose of data: | For project emission calculation |
| Additional comment: | / |

| **Data / Parameter:** | $T_{2,m}$ |
|---|---|
| Unit: | K |
| Description: | Average temperature at the project site in month m |
| Measured/ Calculated / Default: | Measured |

| | |
|---|---|
| Source of data: | Weather statistic from Anhui Province Meteorological Administration |
| Value(s) of monitored parameter: | See ER sheet |
| Monitoring equipment: | Official statistic data |
| Measuring/ Reading/ Recording frequency: | Continuously, aggregated in monthly average values |
| Calculation method (if applicable): | / |
| QA/QC procedures: | / |
| Purpose of data: | To calculate baseline emission and project emission |
| Additional comment: | / |

| **Data / Parameter:** | **$HG_{PJ,y}$** |
|---|---|
| Unit: | GJ |
| Description: | Net quantity of heat generated in year y with biogas from the new anaerobic digester |
| Measured/ Calculated / Default: | Calculated |
| Source of data: | Calculated on the basis of measurements of the volume of biogas captured and used for heat generation ($F_{boiler,biogas,y}$) multiplied by the methane content of the gas ($W_{CH4,biogas,y}$), CV methane ($NCV_{CH4}$), and the efficiency of the boiler during the project (i.e. with biogas: $\eta_{PJ,boiler}$). The efficiency of the boiler during the project ( $\eta_{PJ,boiler}$) is set as 91.0% |
| Value(s) of monitored parameter: | See ER sheet |

| | |
|---|---|
| Monitoring equipment: | For measuring $F_{boiler,biogas,y}$ the biogas flow meter was used.<br>Type: YHNZ-1-1-500-121-112<br>Serial number: 120218<br>Accuracy class: 1.0<br>Calibration frequency: annually<br>Date of the latest two calibration: 19/6/2012 and 9/5/2013<br>Validity:1 year<br><br>Temperature transmitter<br>Type: KRD-SBWZ-2480-240<br>Serial number: 181201002<br>Accuracy class:0.5<br>Calibration frequency: annually<br>Date of the latest two calibration: 20/6/2012 and 13/5/2013<br><br>Industrial platinum resistance<br>Type: Pt100<br>Serial number: 181201002<br>Accuracy class: B<br>Calibration frequency: annually<br>Date of the latest two calibration: 20/6/2012 and 13/5/2013<br><br>Pressure transmitter<br>Type: T350<br>Serial number: T12160014<br>Accuracy class: 0.2<br>Calibration frequency: annually<br>Date of the latest two calibration: 20/6/2012 and 13/5/2013<br><br>Pressure transmitter<br>Type: T350<br>Serial number: C12160013<br>Accuracy class: 0.2<br>Calibration frequency: annually<br>Date of the latest two calibration: 20/6/2012 and 13/5/2013<br><br>For measuring $W_{CH4,biogas,y}$ gas analyzer was used.<br>Type: Gasboard-3200L<br>Serial number: 11302270206111000049<br>Accuracy class: 2.0<br>Calibration frequency: annually<br>Date of the latest two calibration: 6/6/2012 and 10/5/2013<br>Validity:1 year |
| Measuring/ Reading/ Recording frequency: | The volume of biogas captured and used for heat generation was measured continuously and the methane content of biogas was measured at 5, 10,15, 20, 25 and the end of every month. |
| Calculation method (if applicable): | $HG_{PJ,y} = F_{boiler,biogas,y} * W_{CH4,biogas,y} * NCV_{CH4} * \eta_{PJ,boiler}$ |
| QA/QC procedures: | The meter undergoes maintenance and calibration in line with manufacture's recommendation |
| Purpose of data: | Baseline emission |
| Additional comment: | / |

| Data / Parameter: | $F_{biogas,y}$ |
|---|---|
| Unit: | $m^3$ |
| Description: | Total amount of biogas collected in the outlet of the new digester |
| Measured/ Calculated / Default: | Measured |
| Source of data: | Biogas flow volume |
| Value(s) of monitored parameter: | 41,155,482 (23,683,314 in 2013 and 17,472,168 in 2012) |

| | |
|---|---|
| Monitoring equipment: | Gas flow meter 1<br>Type: ANB-LS<br>Serial number: ANB12010501<br>Accuracy class: 1.5<br>Calibration frequency: annually<br>Date of the latest two calibration: 19/6/2012 and 9/5/2013<br>Industrial platinum resistance<br>Type: Pt100<br>Serial number: 1201006<br>Accuracy class: B<br>Calibration frequency: annually<br>Date of the latest two calibration: 20/6/2012 and 13/5/2013<br>Pressure transmitter<br>Type: ZY-PMC<br>Serial number: ZY20120105001<br>Accuracy class: 0.2<br>Calibration frequency: annually<br>Date of the latest two calibration: 20/6/2012 and 13/5/2013<br>Type: EJA110A<br>Serial number: 91LC25311108<br>Accuracy class: 0.2<br>Calibration frequency: annually<br>Date of the latest two calibration: 20/6/2012 and 13/5/2013<br>Gas flow meter 2<br>Type: YHNZ-1-1-400-121-112<br>Serial number: 120217<br>Accuracy class: 1.0<br>Calibration frequency: annually<br>Date of the latest two calibration: 19/6/2012 and 9/5/2013<br>Temperature transmitter<br>Type: KRD-SBWZ-2480-240<br>Serial number: 181201001<br>Accuracy class: 0.5<br>Calibration frequency: annually<br>Date of the latest two calibration: 20/6/2012 and 13/5/2013<br>Industrial platinum resistance<br>Type: Pt100<br>Serial number: 181201001<br>Accuracy class: B<br>Calibration frequency: annually<br>Date of the latest two calibration: 20/6/2012 and 13/5/2013<br>Pressure transmitter<br>Type: T350<br>Serial number: T12160015<br>Accuracy class: 0.2<br>Calibration frequency: annually<br>Date of the latest two calibration: 20/6/2012 and 13/5/2013<br>Type: EJA110A<br>Serial number: 91MB07617251<br>Accuracy class: 0.2<br>Calibration frequency: annually<br>Date of the latest two calibration: 20/6/2012 and 13/5/2013 |

| | |
|---|---|
| Measuring/ Reading/ Recording frequency: | Monitored continuously and recorded daily, aggregated annually for calculation |
| Calculation method (if applicable): | Volume of biogas from anaerobic outlet 1 added that from outlet 2 |
| QA/QC procedures: | Maintain and calibrate the meter according to national standard of Verification regulation of differential pressure type flowmeter (JJG640-1994). According to this standard, this meter was calibrated annually. |
| Purpose of data: | Applied to estimate emissions associated with physical leakage from the digester. |
| Additional comment: | / |

| **Data / Parameter:** | **$FV_{RG,h}$** |
|---|---|
| Unit: | $m^3/h$ |
| Description: | Volumetric flow rate of the biogas in the hour h |
| Measured/ Calculated / Default: | Measured |
| Source of data: | Monitoring data by gas flow meter |
| Value(s) of monitored parameter: | 0 |
| Monitoring equipment: | Gas flow meter<br>Type: AVS-100/EX-30CG11DJ<br>Serial number: 12022123<br>Accuracy class: 1.0<br>Calibration frequency: annually<br>Date of the latest two calibration: 19/6/2012 and 9/5/2013<br>Validity:1 year |
| Measuring/ Reading/ Recording frequency: | Continuously, aggregated in monthly average values |
| Calculation method (if applicable): | / |
| QA/QC procedures: | / |
| Purpose of data: | To calculate project emission |
| Additional comment: | / |

| **Data / Parameter:** | **$W_{CH4,biogas,y}$/$W_{CH4,y}$** |
|---|---|
| Unit: | $kgCH_4/m^3$/% |
| Description: | Concentration of methane in the biogas |
| Measured/ Calculated / Default: | Measured |

| | |
|---|---|
| Source of data: | Monitoring data by gas analyzer |
| Value(s) of monitored parameter: | See ER sheet |
| Monitoring equipment: | Gas analyzer was used.<br>Type: Gasboard-3200L<br>Serial number: 11302270206111000049<br>Accuracy class: 2.0<br>Calibration frequency: annually<br>Date of the latest two calibration: 6/6/2012 and 10/5/2013<br>Validity:1 year |
| Measuring/ Reading/ Recording frequency: | Continuously, aggregated in monthly average values |
| Calculation method (if applicable): | / |
| QA/QC procedures: | / |
| Purpose of data: | To calculate project emission |
| Additional comment: | The methane content was measured at boiler, at outlet 1 of the anaerobic reactors and outlet 2 of the anaerobic reactors. |

| **Data / Parameter:** | **$EC_{PJ,I,y}$** |
|---|---|
| Unit: | MWh |
| Description: | Quantity of electricity consumed by the project activity |
| Measured/ Calculated / Default: | Measured |
| Source of data: | Monitoring data by electricity meter |
| Value(s) of monitored parameter: | See ER sheet |
| Monitoring equipment: | Electricity meter was used.<br>Type: DSSD566<br>Serial number: 0507970211<br>Accuracy class: 0.5<br>Calibration frequency: Every four years<br>Date of the latest calibration: 11/6/2012<br>Validity:4 years |
| Measuring/ Reading/ Recording frequency: | Continuously, aggregated in monthly average values |
| Calculation method (if applicable): | / |
| QA/QC procedures: | / |
| Purpose of data: | To calculate project emission |
| Additional comment: | / |

| Data / Parameter: | $T_{flare,y}$ |
|---|---|
| Unit: | ℃ |
| Description: | Temperature of the flare |
| Measured/ Calculated / Default: | Measured |
| Source of data: | Monitoring data by thermocouple |
| Value(s) of monitored parameter: | There is no flare in this monitoring period. |
| Monitoring equipment: | Thermocouple<br>Type: K<br>Serial number: 181201003<br>Accuracy class: II<br>Calibration frequency: annually<br>Date of the latest two calibration: 20/6/2012 and 13/5/2013<br>Validity:1 year<br><br>Temperature transmitter<br>Type: KRD-SBWR-2400-200<br>Serial number: 181201003<br>Accuracy class:0.5<br>Calibration frequency: annually<br>Date of the latest two calibration:20/6/2012 and 13/5/2013<br>Validity:1 year |
| Measuring/ Reading/ Recording frequency: | Continuously, aggregated in monthly average values |
| Calculation method (if applicable): | / |
| QA/QC procedures: | / |
| Purpose of data: | To calculate project emission |
| Additional comment: | / |

**D.3. Implementation of sampling plan**

>>

Compared with Standard for sampling and surveys for CDM project activities and programme of activities (version03.0), “DRAFT GENERAL GUIDELINES ON SAMPLING AND SURVEYS” is conservative, because it uses the lower or upper bound of 95% confidence interval, not the average. Considering the Standard for sampling and surveys for CDM project activities and programme of activities (version 03.0), the sample mean (or proportion) value shall be used for the emissions reduction calculation, not the lower or upper bound of the confidence interval (paragraph 17 of the Standard).

In this monitoring period, the parameter $\omega_{CH4,\ biogas,\ y}$ and $\omega_{CH4,y}$. is monitored fixed on date 5,10,15,20,25,and the end of each month. In order to calculate the result, the calculation method of annex1 “Sampling formulas” of “Draft General Guidelines on Sampling and Surveys” of the EB47 annex 27 is adopted. The calculation process is:

**Data analysis of $\omega_{CH4,\ biogas,\ y}$.**

1. Define the sampling population
In this monitoring period, the sampling population derives from the measurement (fixed on date 5 10 15 20 25 and the end of each month) which meets the requirement of the registered PDD's MP. The recorded datum is qualified.

Estimate the mean value of samples

$$\overline{w_{CH_4,biogas,y}} = \sum_{i=1}^{n} \frac{w_{CH_4,biogas,i}}{n}$$

Where

$w_{CH_4,biogas,i}$ denotes the value of $w_{CH_4,biogas}$ for measurement i;

$\overline{w_{CH_4,biogas,y}}$ denotes the mean value of all the sample value of $w_{CH_4,biogas,i}$;

n denotes the sample size.

Through the calculation of the recorded samples, the mean value of $w_{CH_4,biogas,i}$ is 60.0 % in 2013 and 59.7% in 2012.

.

2. Sample estimate for the population variance

$$S^2 = \frac{\sum (w_{CH_4,biogas,i} - \overline{w_{CH_4,biogas,y}})^2}{n-1}$$

Where

S denotes the standard deviation.

By calculation, the result of standard deviation of $w_{CH_4,biogas,y}$ is 2.8794 in 2013 and 3.2110 in 2012.

3. Calculation the standard deviation of mean $\overline{w_{CH_4,biogas,y}}$

$$s_{\bar{y}} = \frac{s}{\sqrt{n}} \sqrt{1 - n/N}$$

Where:

$s_{\bar{y}}$ denotes the standard deviation of mean $\overline{w_{CH_4,biogas,y}}$;

N denotes the total measurement times. Referring to the paragraph 6 of annex1 "Sampling formulas" of the EB47 annex 27, one can assume that the population (N) is large, it can ignore the term $\sqrt{1-n/N}$.

By calculation, $s_{\bar{y}}$ =0.4671 in 2013 and 0.6068 in 2012

4. Calculation 95% confidence level

$$prob\left\{\overline{w_{CH_4,y}} - \frac{ts}{\sqrt{n}}\sqrt{1-n/N} \le \overline{w_{CH_4,biogas,y}} \le \frac{ts}{\sqrt{n}}\sqrt{1-n/N}\right\} = prob(t) = 95\%$$

Where:

t denotes the normal deviate corresponding to prob(t). For sample size with 28 in 2012, the t value for the degree of freedom of 27 is 2.0518, for sample size with 38 in 2013, the t value for the degree of freedom of 37 is 2.0262 is adopted[3].

5. Use the lower or upper bound of the 95% confidence interval obtained below to ensure conservativeness

$$w_{lb,CH_4,biogas,y} = \overline{w_{CH_4,biogas,y}} - \frac{ts}{\sqrt{n}}$$

Where:

$w_{lb,CH_4,biogas,y}$ the lower bound of the 95% confidence interval of methane fraction of biogas;

As per the datum recorded, the result of $w_{lb,CH_4,biogas,y}$ is 59.0% in 2013 and 58.4% in 2012.

Estimate the mean value of samples

For the parameter of $w_{CH4,y}$ the analysis method is the same as $\omega_{CH4,, biogas, y,}$

The calculation result is as follows,

| Parameter | Average value | Standard deviation | Sample size | tn-1 | Lower /upper bound | Precision (calculated) | Precision requirement |
|---|---|---|---|---|---|---|---|
| $\omega_{CH4, biogas, y}$ 2013 | 60.0 | 2.8794 | 38 | 2.0262 | 59.0%(lower bound) | 1.58% | 10% |
| $\omega_{CH4, biogas, y}$ 2012 | 59.7 | 3.2110 | 28 | 2.0518 | 58.4%(lower bound) | 2.09% | 10% |
| $w_{CH4,y,1}$ 2013 | 60.0 | 2.8710 | 38 | 2.0262 | 61.0% (upper bound) | 1.57% | 10% |
| $w_{CH4,y,1}$ 2012 | 59.6 | 3.1881 | 28 | 2.0518 | 60.9% (upper bound) | 2.07% | 10% |
| $w_{CH4,y,2}$ 2013 | 60.0 | 2.8779 | 38 | 2.0262 | 60.9% (upper bound) | 1.58% | 10% |
| $w_{CH4,y,2}$ 2012 | 59.6 | 3.1072 | 28 | 2.0518 | 60.8% (upper bound) | 2.02% | 10% |

As demonstrated above, the confidence/precision has been met in accordance with the sampling plan. Further details can be seen from relevant electronic sheets.

## SECTION E. Calculation of emission reductions or GHG removals by sinks

### E.1. Calculation of baseline emissions or baseline net GHG removals by sinks

>>

$$BE_y = BE_{CH4,y} + BE_{EL,y} + BE_{HG,y}$$

Where:

| Parameter | Description | Data before 31/12/2012 | Data after 1/1/2013 |
|---|---|---|---|
| $BE_y$ | Baseline emissions in the monitoring period ($tCO_2e$ ). | 68,123 | 145,732 |
| $BE_{CH4,y}$ | Methane emissions from anaerobic treatment of the wastewater in open lagoons in the absence of the project activity in the monitoring period ($tCO_2e$). | 33,549 | 98,365 |
| $BE_{EL,y}$ | $CO_2$ emissions associated with electricity generation that is displaced by the project activity and/ or electricity consumption in the absence of the project activity in the monitoring period ($tCO_2$ ); | 0 | 0 |
| $BE_{HG,y}$ | $CO_2$ emissions associated with fossil fuel combustion for heating equipment that is displaced by the project in the monitoring period ($tCO_2$). | 34,574 | 47,367 |

$$BE_{CH4,y} = GWP_{CH4} \times MCF_{BL,y} \times B_o \times COD_{BL,y}$$

| Parameter | Description | Data before 31/12/2012 | Data after 1/1/2013 |
|---|---|---|---|

| | | | |
|---|---|---|---|
| $BE_{CH4,y}$ | Methane emissions from anaerobic treatment of the wastewater in open lagoons in the absence of the project activity in the monitoring period （$tCO_2e$） | 33,549 | 98,365 |
| $GWP_{CH4}$ | Global Warming Potential of methane valid for the commitment period （$tCO_2e/tCH_4$）. | 21 | 25 |
| $MCF_{BL,y}$ | Average baseline methane conversion factor (fraction) in the monitoring period, representing the fraction of ($COD_{PJ,y}$ x $B_o$) that would be degraded to $CH_4$ in the absence of the project activity. | 0.1681 | 0.3049 |
| $B_o$ | Maximum methane producing capacity, expressing the maximum amount of $CH_4$ that can be produced from a given quantity of chemical oxygen demand（$tCH_4/tCOD$）. | 0.21 | 0.21 |
| $COD_{BL,y}$ | Quantity of chemical oxygen demand that would be treated in open lagoons in the absence of the project activity in the monitoring period （tCOD）. | 45,256 | 61,450 |

$$COD_{BL,y} = AD_{BL} \times COD_{PJ,y}$$

| Paramete r | Description | Data before 31/12/2012 | Data after 1/1/2013 |
|---|---|---|---|
| $COD_{BLy}$ | Quantity of chemical oxygen demand that would be treated in open lagoons in the absence of the project activity in the monitoring period（tCOD） | 45,256 | 61,450 |
| $COD_{PJ,y}$ | Quantity of chemical oxygen demand that is treated in the anaerobic digester or under clearly aerobic conditions in the project activity in the monitoring period （tCOD）. | 47,141 | 64,011 |
| $AD_{BL}$ | Effluent adjustment factor expression the percentage of COD that is degraded in open lagoons in the absence of the project activity. | 0.96 | 0.96 |

$$AD_{BL} = 1 - \frac{COD_{out,x}}{COD_{in,x}}$$

| Parameter | Description | Data before 31/12/2012 | Data after 1/1/2013 |
|---|---|---|---|
| $AD_{BL}$ | Effluent adjustment factor expression the percentage of COD that is degraded in open lagoons in the absence of the project activity | 0.96 | 0.96 |
| $COD_{out,x}$ | Design COD outflow from the baseline anaerobic lagoon in period x (a year)（tCOD/yr） | 4,830 | 4,830 |
| $COD_{in,x}$ | Design COD inflow to the baseline anaerobic lagoon in period x (a year) （tCOD/yr） | 120,750 | 120,750 |

$$COD_{PJ,y} = \sum_{m=1}^{12} F_{PJ,dig,m} \times w_{COD,dig,m}$$

| Parameter | Description |
|---|---|

| | |
|---|---|
| $COD_{PJ,y}$ | Quantity of chemical oxygen demand that is treated in the anaerobic digester or under clearly aerobic conditions in the project activity (t COD) |
| $F_{PJ,dig,m}$ | Quantity of wastewater that is treated in the anaerobic digester in the project activity in month m （m³/month） |
| $w_{COD,dig,m}$ | Average chemical oxygen demand in the wastewater that is treated in the anaerobic digester or under clearly aerobic conditions in the project activity in month m. （tCOD/m³） |
| m | Months of year y of the crediting period |

$$MCF_{BL,y} = f_d \times f_{T,y} \times 0.89$$

| Parameter | Description | Data before 31/12/2012 | Data after 1/1/2013 |
|---|---|---|---|
| $MCF_{BL,y}$ | Average baseline methane conversion factor (fraction) in the monitoring period, representing the fraction of ($COD_{PJ,y}$ x $B_o$) that would be degraded to $CH_4$ in the absence of the project activity | 0.1681 | 0.3049 |
| $f_d$ | Factor expressing the influence of the depth of the lagoon on methane generation | 50% | 50% |
| $f_{T,y}$ | Factor expressing the influence of the temperature on the methane generation in the monitoring period | 0.3777<br>The calculation process is available in the ER sheet. | 0.6851<br>The calculation process is available in the ER sheet. |
| 0.89 | Conservativeness factor | | |

**Determination of $f_{T,y}$**

$$COD_{available,m} = COD_{BL,m} + (1 - f_{T,m}) \times COD_{available,m-1}$$ with

$$COD_{BL,m} = AD_{BL} \times COD_{PJ,m}$$

$$COD_{PJ,m} = F_{PJ,dig,m} \times w_{COD,dig,m}$$

Where:

$COD_{available,m}$ Quantity of chemical oxygen demand available for degradation in the open lagoon in month m (t COD/month)

$COD_{BL,m}$ Quantity of chemical oxygen demand that would be treated in open lagoons in the absence of the project activity in month m(t COD/month)

$COD_{PJ,m}$ Quantity of chemical oxygen demand that is treated in the anaerobic digester or under clearly aerobic conditions in the project activity in month m (t COD/month)

$AD_{BL}$ Effluent adjustment factor expressing the percentage of COD that is degraded in open lagoons in the absence of the project activity

$F_{PJ,dig,m}$ Quantity of wastewater that is treated in the anaerobic digester or under clearly aerobic conditions in the project activity in month m (m³/month)

$w_{COD,dig,m}$ Average chemical oxygen demand in the wastewater that is treated in the anaerobic digester or under clearly aerobic conditions in the project activity in month m(t COD/m³)

$f_{T,m}$ Factor expressing the influence of the temperature on the methane generation in month m

m Months of year y of the crediting period

The monthly factor to account for the influence of the temperature on methane generation is calculated based on the following van.t Hoff. Arrhenius. Approach

$f_{T,m}$= 0 if $T_{2,m}$<283K

$f_{T,m} = \exp\left(\frac{E*(T_{2,m}-T_1)}{R*T_1*T_{2,m}}\right)$ if 283K< $T_{2,m}$<303K

$f_{T,m}$ =0 if $T_{2,m}$>303K

Where:

| | |
|---|---|
| $f_{T,m}$ | Factor expressing the influence of the temperature on the methane generation in month m |
| E | Activation energy constant (15,175 cal/mol) |
| $T_{2,m}$ | Average temperature at the project site in month m (K) |
| $T_1$ | 303.16 K (273.16 K + 30 K) |
| R | Ideal gas constant (1.987 cal/K mol) |
| M | Months of year *y* of the crediting period |

Based on the monthly values $f_{T,m}$, the annual value $f_{T,y}$ is calculated as follows:

$$f_{T,y} = \frac{\sum_{m=1}^{m} f_{T,m} \times COD_{available,m}}{\sum_{m=1}^{m} COD_{BL,m}}$$

Where:

| | |
|---|---|
| $f_{T,y}$ | Factor expressing the influence of the temperature on the methane generation in year y |
| $f_{T,m}$ | Factor expressing the influence of the temperature on the methane generation in month m |
| $COD_{available,m}$ | Quantity of chemical oxygen demand available for degradation in the open lagoon in month m (t COD/month) |
| $COD_{BL,m}$ | Quantity of chemical oxygen demand that would be treated in open lagoons in the absence of the project activity in month m (t COD/month) |
| m | Months of year y of the crediting period |

$$BE_{HG,y} = \frac{HG_{PJ,y} \times EF_{CO2,FF,boiler}}{\eta_{BL,boiler}}$$

| Parameter | Description | Data before 31/12/2012 | Data after 1/1/2013 |
|---|---|---|---|
| $BE_{HG,y}$ | $CO_2$ emissions associated with fossil fuel combustion for heating equipment that is displaced by the project in the monitoring period ($tCO_2$) | 34,574 | 47,367 |
| $HG_{PJ,y}$ | Net quantity of heat generated in the monitoring period with biogas from the new anaerobic digester (GJ) | 332,586 | 455,644 |
| $EF_{CO2,FF,boiler}$ | $CO_2$ emission factor of the fossil fuel type used in the boiler for heat generation in the absence of the project activity ($tCO_2$/ TJ) | 0.0946 | 0.0946 |
| $\eta_{BL,boiler}$ | Efficiency of the boiler that would be used for heat generation in the absence of the project activity | 91% | 91% |

$$HG_{PJ,y} = F_{biogas,y} \times w_{CH4,biogas,y} \times NCV_{CH4} \times \eta_{PJ,boiler}$$

| Parameter | Description | Data before 31/12/2012 | Data after 1/1/2013 |
|---|---|---|---|
| $F_{biogas,y}$ | Amount of biogas collected at the inlet of the boiler in year y($m^3$) | 17,428,754 | 23,623,290 |
| $w_{CH4,biogas,y}$ | Concentration of methane in the biogas at the inlet of the boiler. | 58.4% | 59.0% |
| $NCV_{CH4}$ | Net calorific value of methane (GJ/$m^3$) | 0.0359 | 0.0359 |
| $\eta_{PJ,boiler}$ | Efficiency of the boiler during in the Project (i.e. with biogas). | 91% | 91% |

Based on the formula above, the baseline emissions are calculated to be

$BE_y = BE_{CH4,y} + BE_{EL,y} + BE_{HG,y}$ =68,123t$CO_2$e in 2012 and145,732 t$CO_2$e in 2013

**E.2. Calculation of project emissions or actual net GHG removals by sinks**

>>

$$PE_y = PE_{\mathbf{CH4},effluent,y} + PE_{CH4,digest,y} + PE_{flare,y} + PE_{EC,y}$$

| Parameter | Description | Data before31/12/2012 | Data after 1/1/2013 |
|---|---|---|---|
| $PE_y$ | Project emissions in the monitoring period (t$CO_2$e) | 16,040 | 31,069 |
| $PE_{CH4,effluent,y}$ | Project emissions from treatment of wastewater effluent from the anaerobic digester in the monitoring period(t$CO_2$e) | 4,531 | 13,385 |
| $PE_{CH4,digest,y}$ | Project emissions from physical leakage of methane from the anaerobic digester in the monitoring period (t$CO_2$e) | 7,996 | 12,919 |
| $PE_{flare,y}$ | Project emissions from flaring of biogas generated in the anaerobic digester in the monitoring period (t$CO_2$e) | 0 | 0 |
| $PE_{EC,y}$ | Project emissions from electricity consumption in the monitoring period (t$CO_2$e ) | 3,513 | 4,765 |

$$PE_{\mathbf{CH4},effluenty} = GWP_{CH4} \times MCF_{PJ,y} \times B_o \times (COD_{PJ,effl,dig,y} - COD_{PJ,effl,lag,y})$$

$$COD_{PJ,effl,dig,y} = \sum_{m=1}^{12} \mathbf{F}_{PJ,effl,dig,m} \times w_{COD,effl,dig,m}$$

$$COD_{PJ,effl,lag,y} = \sum_{m=1}^{12} \mathbf{F}_{PJ,effl,lag,m} \times w_{COD,effl,lag,m}$$

| Parameter | Description | Data before 31/12/2012 | Data after 1/1/2013 |
|---|---|---|---|
| $PE_{CH4,effluent,y}$ | Project emissions from treatment of wastewater effluent from the anaerobic digester in the monitoring period ( t$CO_2$e ) | 4,531 | 13,385 |
| $GWP_{CH4}$ | Global Warming Potential of methane valid for the commitment period( t$CO_2$e / t$CH_4$) | 21 | 25 |
| $MCF_{PJ,y}$ | Project methane conversion factor (fraction) in year y, representing the fraction of ($COD_{PJ,effluent,y}$ x $B_o$) that degraded to $CH_4$ | 0.2643 | 0.4795 |
| $B_o$ | Maximum methane producing capacity, expressing the maximum amount of CH4 that can be produced from a given quantity of chemical oxygen demand(t$CH_4$ / tCOD) | 0.21 | 0.21 |
| $COD_{PJ,effl,dig,y}$ | Quantity of chemical oxygen demand in the effluent from the digester in the monitoring period (tCOD) | 3,991 | 5,407 |

| | | | |
|---|---|---|---|
| $COD_{PJ,effl,lag,y}$ | Quantity of chemical oxygen demand in the effluent of the open lagoon or dewatering facility in which the effluent from the digester is treated in the monitoring period (tCOD ) | 103 | 91 |
| $F_{PJ,effl,dig,m}$ | Quantity of effluent from the digester in month m(m³ / month) | Data is available in the ER sheet | Data is available in the ER sheet |
| $w_{COD,effl,dig,m}$ | Average chemical oxygen demand in the effluent from the digester in month m (t COD / m³) | Data is available in the ER sheet | Data is available in the ER sheet |
| $F_{PJ,effl,lag,m}$ | Quantity of effluent from the open lagoon or dewatering facility in which the effluent from the digester is treated in month m | Data is available in the ER sheet | Data is available in the ER sheet |
| $w_{COD,effl,lag,m}$ | Average chemical oxygen demand in the effluent from the open lagoon or dewatering facility in which the effluent from the digester is treated in month m | Data is available in the ER sheet | Data is available in the ER sheet |

$MCF_{PJ,y}$ is calculated as follows:

$$MCF_{PJ,y} = f_d \times f_{PJ,T,y}$$

| Parameter | Description | Data before 31/12/2012 | Data after 1/1/2013 |
|---|---|---|---|
| $MCF_{PJ,y}$ | Project methane conversion factor (fraction), representing the fraction of ($COD_{PJ,effluent,y}$ x $B_o$) that degraded to $CH_4$ | 0.2643 | 0.4795 |
| $f_d$ | Factor expressing the influence of the depth of the lagoon or dewatering facility on methane generation | 70% | 70% |
| $f_{PJ,T,y}$ | Factor expression the influence of the temperature on the methane generation under the project activity in year y | 0.3775<br>The calculation process is available in the ER sheet. | 0.6850<br>The calculation process is available in the ER sheet. |

**Determination of $f_{PJ,T,y}$**

$$f_{PJ,T,y} = \frac{\sum_{m=1}^{12} f_{T,m} \times COD_{PJ,available,m}}{\sum_{m=1}^{12} (COD_{PJ,effl,dig,m} - COD_{PJ,effl,lag,m})}$$

$$COD_{PJ,available,m} = (COD_{PJ,effl,dig,m} - COD_{PJ,effl,lag,m}) + (1 - f_{T,m}) \times COD_{PJ,available,m-1}$$

$$COD_{PJ,effl,dig,m} = F_{PJ,effl,dig,m} \times w_{COD,effl,dig,m}$$

$$COD_{PJ,effl,lag,m} = F_{PJ,effl,lag,m} \times w_{COD,effl,lag,m}$$

**Where:**

| | |
|---|---|
| $COD_{PJ,available,m}$ | Quantity of chemical oxygen demand available for degradation in the open lagoon or dewatering facility under the project activity in month m (t COD/month) |
| $COD_{PJ,effl,dig,m}$ | Quantity of chemical oxygen demand in the effluent from the digester in month m (tCOD/month) |
| $COD_{PJ,effl,lag,m}$ | Quantity of chemical oxygen demand in the effluent of the open lagoon or dewatering facility in which the effluent from the digester is treated in month m (tCOD/month) |
| $F_{PJ,effl,dig,m}$ | Quantity of effluent from the digester in month m (m³/month) |
| $w_{COD,effl,dig,m}$ | Average chemical oxygen demand in the effluent from the digester in month m (t COD/m³) |

| | |
|---|---|
| $F_{PJ,effl,lag,m}$ | Quantity of effluent from the open lagoon or dewatering facility in which the effluent from the digester is treated in month m (m³/month) |
| $w_{COD,effl,lag,m}$ | Average chemical oxygen demand in the effluent from the open lagoon or dewatering facility in which the effluent from the digester is treated in month m (t COD/m³) |
| $f_{T,m}$ | Factor expressing the influence of the temperature on the methane generation in month m |
| m | Months of year y of the crediting period |

$f_{T,m}$ is calculated based on the equation provided in calculation of baseline emission above.

$$PE_{CH4,digest,y} = F_{biogas,y} \times FL_{biogas,digest} \times w_{CH4,y} \times GWP_{CH4} \times 0.001$$

| Parameter | Description | Data before 31/12/2012 | Data after 1/1/2013 |
|---|---|---|---|
| $PE_{CH4,digest,y}$ | Project emissions from physical leakage of methane from the anaerobic digester( $tCO_2e$ ) | 7,996 | 12,919 |
| $F_{biogas,y,1}$ | Amount of biogas collected in the outlet of the anaerobic outlet 1 ( $m^3$) | 14,803,475 | 20,067,020 |
| $F_{biogas,y,2}$ | Amount of biogas collected in the outlet of the anaerobic outlet 2 ( $m^3$) | 2,668,693 | 3,616,294 |
| $FL_{biogas,digest}$ | Fraction of biogas that leaks from the digester (m³ biogas leaked / m³ biogas produced) | 0.05 according to ACM0014 V04.1 | 0.05 according to ACM0014 V04.1 |
| $w_{CH4,,y,1}$ | Concentration of methane in the biogas in the outlet of the new digester 1 (kg $CH_4$ / m³). | 0.4359 | 0.4364 |
| $w_{CH4,,y,2}$ | Concentration of methane in the biogas in the outlet of the new digester 2 (kg $CH_4$ / m³). | 0.4354 | 0.4361 |
| $GWP_{CH4}$ | Global Warming Potential of methane valid for the commitment period ($tCO_2e$ / $tCH_4$) | 21 | 25 |

$$PE_{flare,y} = \sum_{h=1}^{8760} TM_{RG,h} \times (1 - \eta_{flare,h}) \times \frac{GWP_{CH4}}{1000}$$

| Parameter | Description | Data before 31/12/2012 | Data after 1/1/2013 |
|---|---|---|---|
| $PE_{flare,y}$ | Project emissions from flaring of the residual gas stream in the monitoring period ($tCO_2e$) | 0 | 0 |
| $TM_{RG,h}$ | Mass flow rate of methane in the residual gas in the hour h (kg/h) | 0 | 0 |
| $\eta_{flare,h}$ | Flare efficiency in hour h | -- | -- |
| $GWP_{CH4}$ | Global warming potential of methane valid for the commitment period ($tCO_2e/tCH_4$) | 21 | 25 |

$$TM_{RG,h} = FV_{RG,h} \times fv_{CH4,RG,h} \times \rho_{CH4,n}$$

| Parameter | Description | Data before 31/12/2012 | Data after 1/1/2013 |
|---|---|---|---|
| $FV_{RG,h}$ | Volumetric flow rate of the residual gas in dry basis at normal conditions in hour h ($m^3$/h) | 0 | 0 |
| $fv_{CH4,RG,h}$ | Volumetric fraction of methane in the residual gas on dry basis in hour h (i | -- | -- |

| | | | |
|---|---|---|---|
| | refers to methane). | | |
| $\rho_{CH4,n}$ | Density of methane at normal conditions ($kg/m^3$) | 0.716 | 0.716 |

$$PE_{EC,y} = \sum_{j} EC_{PJ,j,y} \times EF_{EL,j,y} \times (1 + TDL_{j,y})$$

| Parameter | Description | **Data before 31/12/2012** | **Data after 1/1/2013** |
|---|---|---|---|
| $PE_{EC,y}$ | Project emissions from electricity consumption in the monitoring period ($tCO_2$) | 3,513 | 4,765 |
| $EC_{PJ,j,y}$ | Quantity of electricity consumed by the project electricity consumption source j in year y (MWh) | 2,702 | 3,666 |
| $EF_{EL,j,y}$ | Emission factor for electricity generation for source j in year y ($tCO_2/MWh$) | 1.3 | 1.3 |
| $TDL_{j,y}$ | Average technical transmission and distribution losses for providing electricity to source *j* in the monitoring period | 0% | 0% |

Based on the formula above, project emissions are calculated to be

$PE_y = PE_{\mathbf{CH4},effluent,y} + PE_{CH4,digest,y} + PE_{flare,y} + PE_{EC,y}$ =16,040 $tCO_2e$ in 2012 and 31,069 $tCO_2e$ in 2013

**E.3. Calculation of leakage**

>>

$L_y = 0$

**E.4. Summary of calculation of emission reductions or net anthropogenic GHG removals by sinks**

| Item | Baseline emissions or baseline net GHG removals by sinks (t $CO_2e$) | Project emissions or actual net GHG removals by sinks (t $CO_2e$) | Leakage (t $CO_2e$) | Emission reductions or net anthropogenic GHG removals by sinks (t $CO_2e$) |
|---|---|---|---|---|
| **Total** | 213,855 | 47,109 | 0 | 166,746 |

**E.5. Comparison of actual emission reductions or net anthropogenic GHG removals by sinks with estimates in registered PDD**

In this monitoring period from 15/08/2012 to 31/08/2013, with 382 days in total, and the actual emission reduction is 166,746$tCO_2e$. The estimation of this monitoring period based on the registered PDD is 199,118*382/365=208,392$tCO_2e$.

| Item | Values estimated in ex-ante calculation of registered PDD | Actual values achieved during this monitoring period |
|---|---|---|

| | | |
|---|---|---|
| **Emission reductions or GHG removals by sinks (t $CO_2$e)** | 208,392 | 166,746 |

**E.6. Remarks on difference from estimated value in registered PDD**

>>
There is no essential difference between the actual project and the project design due to the wastewater quality and quantity that fluctuates around the designed value which influences the baseline and project emission.

No increase of actual GHG emissions from the registered PDD.

**E.7. Actual emission reductions or net anthropogenic GHG removals by sinks during the first commitment period and the period from 1 January 2013 onwards**

| Item | Actual values achieved up to 31 December 2012 | Actual values achieved from 1 January 2013 onwards |
|---|---|---|
| **Emission reductions or GHG removals by sinks (t $CO_2$e)** | 52,083 | 114,663 |

## Annex I

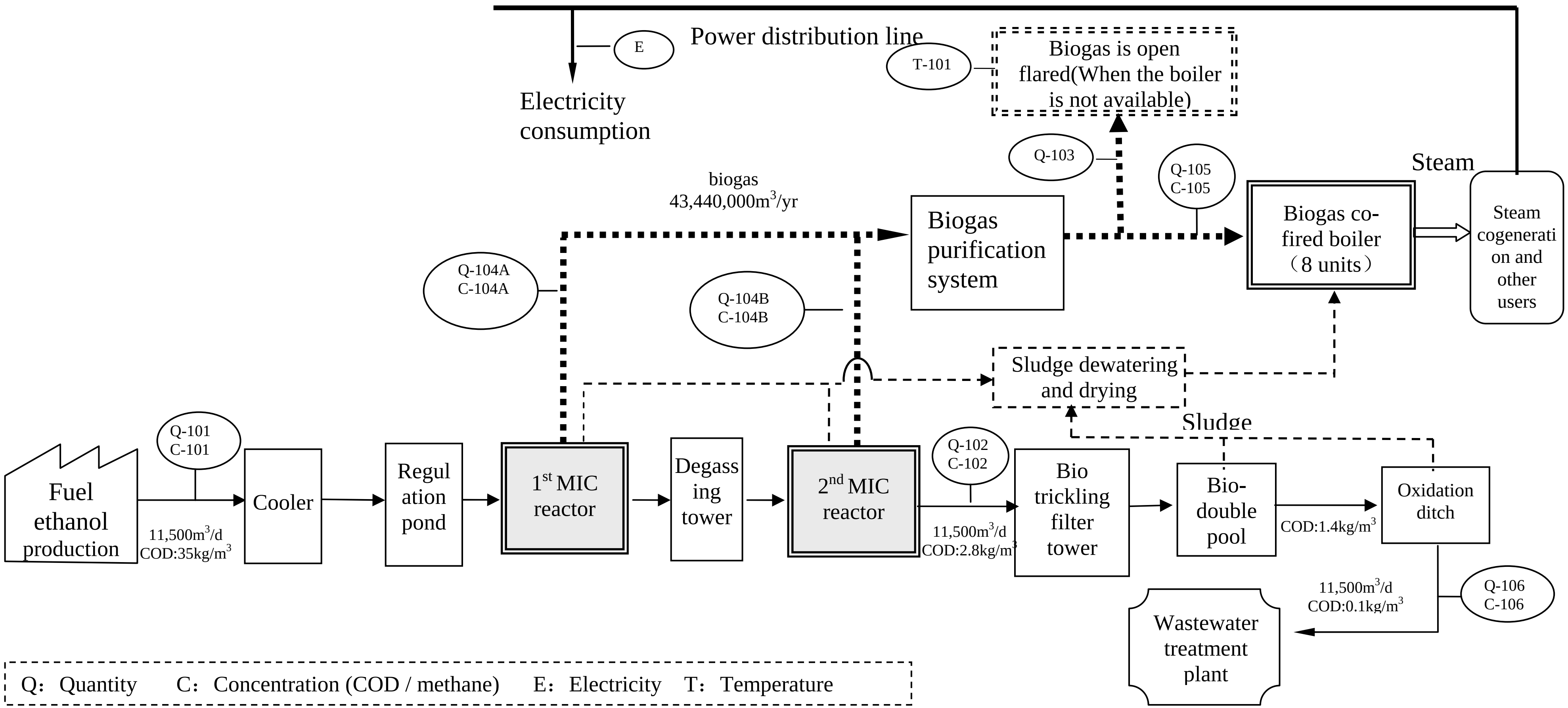



**Figure B.1.1. General arrangement drawing after the implementation of the Project**

- - - - -