Monitoring report form
(Version 03.1)

Monitoring report

Title of the project activity	Forced methane extraction from Organic wastewater at Mandya district, Karnataka by M/s. Sri Chamundeswari Sugars Ltd.
Reference number of the project activity	1088
Version number of the monitoring report	01
Completion date of the monitoring report	07/02/2012
Registration date of the project activity	27/07/2007
Monitoring period number and duration of this monitoring period	Monitoring period number : 03 01/01/2011 – 31/12/2012 (First and last days included)
Project participant(s)	1. Sri Chamundeswari Sugars Limited (SCSL) 2. Bunge Emissions Fund Limited (BEFL)
Host Party(ies)	India
Sectoral scope(s) and applied methodology(ies)	Sectoral scope: 13: Waste handling and disposal 15: Agriculture (only sectoral scope 13 is applicable for the project activity) Methodology: AMS.III.H (version 4)
Estimated amount of GHG emission reductions or net anthropogenic GHG removals by sinks for this monitoring period in the registered PDD	68,848 tCO_2e
Actual GHG emission reductions or net anthropogenic GHG removals by sinks achieved in this monitoring period	41,336 tCO_2e

SECTION A. Description of project activity

A.1. Purpose and general description of project activity

Purpose of the project activity and the measures taken to reduce greenhouse gas emissions:

The main purpose of the project activity is the installation of a closed anaerobic digestion system to extract methane rich biogas from organic wastewater generated at the distillery of Sri Chamundeswari Sugars Ltd. The biogas is collected and utilized as fuel in boilers to produce steam and the steam is utilized to produce electricity. The organic wastewater from distillery also known as spentwash is diverted from existing open anaerobic lagoon treatment system into closed anaerobic reactors to recover methane rich biogas and utilize the methane as fuel to generate steam and electricity. The emission reductions due to recovery of methane alone are considered as emission reductions of the project activity.

The project activity reduces greenhouse gas emissions in two ways:

(a) The project activity diverts the organic wastewater from existing open anaerobic lagoon treatment system to closed anaerobic treatment system thereby preventing the release of methane, a GHG, into the atmosphere.
(b) The generated methane rich biogas is utilized as fuel to generate heat and electricity, which displaces electricity consumed from grid and on site diesel fired generator (during exigency); thereby reducing the GHG emissions associated with grid electricity generation and diesel firing.

Brief description of the installed technology and equipments:

The wastewater due it high organic content when subjected to anaerobic degradation, produces biogas. Biogas mainly consists of methane and carbon dioxide and is a valuable fuel. Thus, the project activity exploit the technology of a closed anaerobic digestion system to treat the spent wash from the distillation process instead of the open lagoon system (baseline scenario), thereby avoiding the release of methane into the atmosphere.

Relevant dates for the project activity:

The Project has been completed and implemented as planned and described in the Project Design Document (PDD).The important dates related to the project activity are listed in Table 1 below.

Table 1: Relevant dates demonstrating the implementation status of the project activity

ACTIVITY	DATE
Project Start	01/06/2005
Project Commissioning for 1st Digester	04/03/2005
Project Commissioning for 2nd Digester	25//06/2005
Date of Registration at UNFCCC	27/07/2007
Crediting period	27/07/2007– 26/07/2017 (Fixed)

Total emission reductions achieved in this monitoring period:

The emission reductions as calculated are mentioned in Table 2 below.

Table 2: Emission reduction over the monitoring period

Month and Year	Total emission reductions achieved in this monitoring period in tonnes of CO_2 eq
January 2011	1670.55
February 2011	1392.23
March 2011	1543.58
April 2011	1692.55
May 2011	1579.06
June 2011	1362.97

July 2011	2315.69
August 2011	1529.35
September 2011	2214.54
October 2011	1927.54
November 2011	1578.60
December 2011	1675.27
January 2012	1562.71
February 2012	1497.11
March 2012	1936.26
April 2012	1824.01
May 2012	1762.20
June 2012	1510.87
July 2012	1686.38
August 2012	2000.01
September 2012	1688.01
October 2012	1631.19
November 2012	1943.95
December 2012	1812.21
Total	**41336.00**[1]

A.2. Location of project activity

The project activity is located within the premises of Sri Chamundeswari Sugars Ltd (SCSL) in Bharathinagara in KM Doddi village in Maddur Taluk in Mandya district of Karnataka. The biggest railhead and airport is Bengaluru which is approximately 100 kms from the project site.

(a) Host Part(ies): India
(b) Region /State/Province: Karnataka
(c) City/Town/Community: Mandya
(d) Physical/ Geographical location: 12º 23'N and 77º 01'N

Fig 1:
Map showing State of Karnataka

Karnataka State

[1] This value is roudeddown.

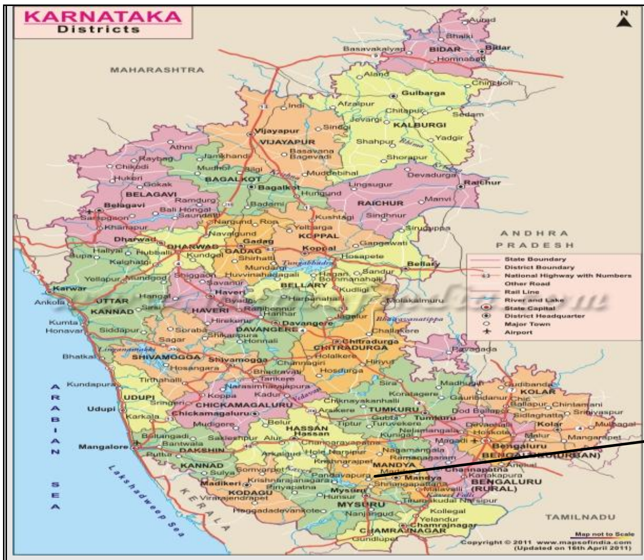


Fig 2:
Map showing Mandya district

Mandya District

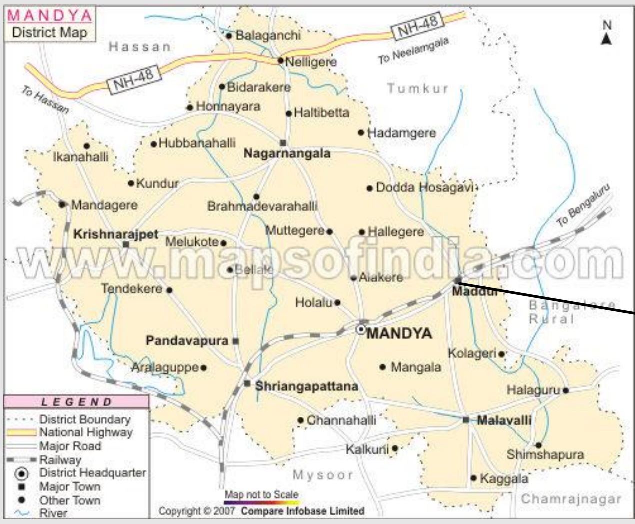


Fig 3:
Map showing Project Activity site

Location of project activity – Maddur taluk

A.3. Parties and project participant(s)

Party involved **((host) indicates a host Party)**	**Private and/or public entity(ies) project participants (as applicable)**	**Indicate if the Party involved wishes to be considered as project participant (Yes/No)**
India (host)	Sri Chamundeswari Sugars Limited (SCSL).	No
Switzerland	Bunge Emission Fund Limited.	No

A.4. Reference of applied methodology

Title, reference and version of the baseline and monitoring methodology applied to the project activity is furnished in Table 3 below.

Table 3: Methodological details

Applicable Methodology	AMS. III.H.
Project Type	Other Project Activity
Project Category	Methane recovery in wastewater treatment
Version	4
Sectoral Scope	13
Reference	http://cdm.unfccc.int/methodologies/DB/4ND00PCGC7WXR3L0LOJTS6SVZP4NSU

A.5. Crediting period of project activity

Type	:	Fixed
Crediting period	:	10 years
Start date of Crediting period	:	27 /07/2007
End date	:	26 /07/2017

SECTION B. Implementation of project activity

B.1. Description of implemented registered project activity

The first digester commissioned on 04th March 2005 whereas the second digester was commissioned on 25th June 2005. During this verification period, the distillery was shut down due to maintenance work and hence there was no biogas generation. The biodigester was shut down due to distillery maintenance during following period.

Table 4: Plant shut down details

Biodigester shut down period	No. of days of shut down
April 2011	5
August 2011	6
November 2011	9
April 2012	3
May 2012	3
September 2012	2
October 2012	1
Total	**29**

The anaerobic digestion plant is designed to handle 600 m^3/day of wastewater with a COD of 150 kg/m^3 and BOD of 50 kg/ m^3. The wastewater treatment can be broadly divided into following sections:

(a) Pre-treatment
(b) Biomethanation
(c) Utilization of biogas
(d) Post –treatment

(a) Pre-treatment

The organic wastewater discharged from the distillery is collected in a holding pit. From holding pit, it is pumped to a settling tank where settlable solids present in the wastewater settles and is removed. The overflow from settling tank flows to a buffer tank. The volume of the buffer tank is 300 m^3, sufficient to hold two-thirds of daily discharge. The pH of the wastewater is in the range of 5-5.5. Lime solution is added to raise the pH of wastewater to 6.5 for effective degradation of organics. Microbial activity is at optimum when the pH of the substrate is in the range of 6.5 - 8. Nutrients like urea, diammonium phosphate and micronutrients like ferric chloride are added in the buffer tank, if required, to supplement the nutrient requirement.

(b) Biomethanation

The wastewater is then subjected to anaerobic treatment in closed anaerobic reactors. Upflow anaerobic Sludge Blanket (UASB) type of anaerobic reactors is employed in the project activity. The wastewater from buffer tank is pumped to UASB reactors. Two UASB reactors each of 26m diameter and 9.5m height are provided for anaerobic digestion. The effective liquid height in UASB reactors is 9 meters and therefore effective liquid volume is 4780m^3 in each UASB reactor. The wastewater enters the reactors from the bottom of the reactor through a distribution pipeline grid. Holes are provided in the distribution pipeline and when wastewater is pumped in the pipeline, the effluent enters the reactors through these holes uniformly. The wastewater flows in an upward direction in the digesters through an anaerobic sludge bed where it mixes with micro organisms in the sludge bed.

The treatment of wastewater through anaerobic treatment involves following three step process:

i. Hydrolysis
ii. Acidogenesis
iii. Methanogenesis

The process of hydrolysis takes place in buffer tank, which is the preparatory step for acidogenesis and methanogenesis reactions. Acidogenesis and methanogenesis take place in digesters. Acidogenesis reactions break the complex organics in the wastewater into acids and these acids are further destroyed into basic compounds of methane (CH_4) and carbon dioxide (CO_2,) the mixture of which is known as biogas. Temperature is one of the main parameters for effective degradation of the organics. The anaerobic reactions occur when the digester temperatures are above 25°C and are at optimum at still higher temperatures in the range of 30–37°C. The temperature of the UASB contents is always between 30-37°C and thus anaerobic reactions are at optimum levels. The high ambient temperatures present in southern part of India throughout the year ensure maintenance of desired range of temperatures in UASB reactors without the need for any external heating. The resulting anaerobic degradation produces biogas. Biogas is a mixture of CH_4 and CO_2. Biogas produced rises upward through the sludge along with the wastewater. At the top of the reactor, the water phase is separated from solids and gas in a three phase separator (also known as gas –liquid -solid separators - GLSS). The three phases are gas is biogas; liquid is treated wastewater and solid is the sludge in the wastewater. Gas is collected separately, subjected to water cleaning in gas washer system and buffered in a gasholder before being used as fuel. The liquid, that is, the treated wastewater, overflows to a ‘treated wastewater collection tank’ and solids in the liquid slide down into the UASB reactor. The biogas is drawn and transferred by booster blowers to the existing cogeneration system.

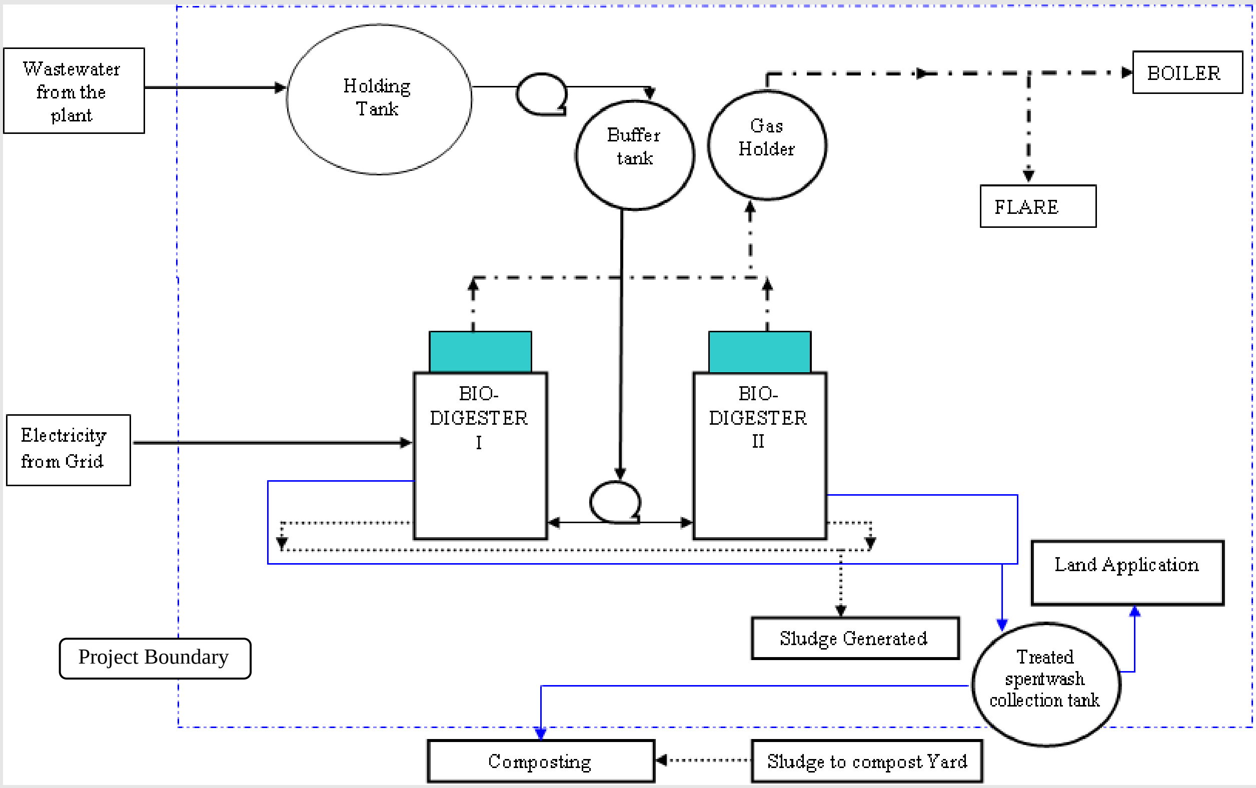
(a) Utilization of biogas

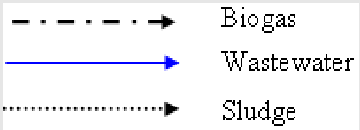
The biogas is burnt as fuel in boilers along with bagasse in existing cogeneration system to produce steam. The steam is utilized in turbines to produce electricity.

(b) Post treatment

The wastewater leaving the UASB reactors is collected in a treated wastewater collection tank from where the wastewater is transported to bio compost yard. The wastewater is unloaded into the existing open lagoons. From the lagoons, the wastewater is then mixed with pressmud and aerobically composted in windrows to produce manure. A dosing tank is fitted to the compost turning machine (compost tiller). The wastewater from the anaerobic lagoons is pumped to the dosing tank. Tilling is a process, which turns the composting material upside down. While tilling, the material at the bottom of the windrow comes to the top and top material is taken to the bottom. This process ensures maximum aeration to all the material and enhances manure quality. While tilling the windrow, the wastewater is added to the pressmud in the windrow and the tilling equipment mixes well pressmud and treated wastewater. The pressmud mixed with treated wastewater is a better enriched organic compost and sold to farmers at a nominal price. Thus no wastewater is discharged on land or into any water bodies and all wastewaters are consumed ensuring a “zero discharge”.

Fig 4: Schematic diagram of the project activity:





B.2. Post registration changes

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

No deviations from registered monitoring plan or applied methodology is applied for this monitoring period.

B.2.2. Corrections

Not applicable since no corrections to project information or parameters fixed at validation have been applied for this monitoring period.

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

The monitoring plan has been revised which was approved by UNFCCC on 21/07/2010[2]. Thus, the revised monitoring plan will be applicable for this monitoring period.

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

No changes to project design of registered project activity are applied during this monitoring period.

[2] http://cdm.unfccc.int/Projects/DB/DNV-CUK1176804855.99/view

B.2.5. Changes to start date of crediting period

No change to start date of crediting period is applied during this monitoring period

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

Not applicable as this is not an afforestation or reforestation project activity.

SECTION C. Description of monitoring system

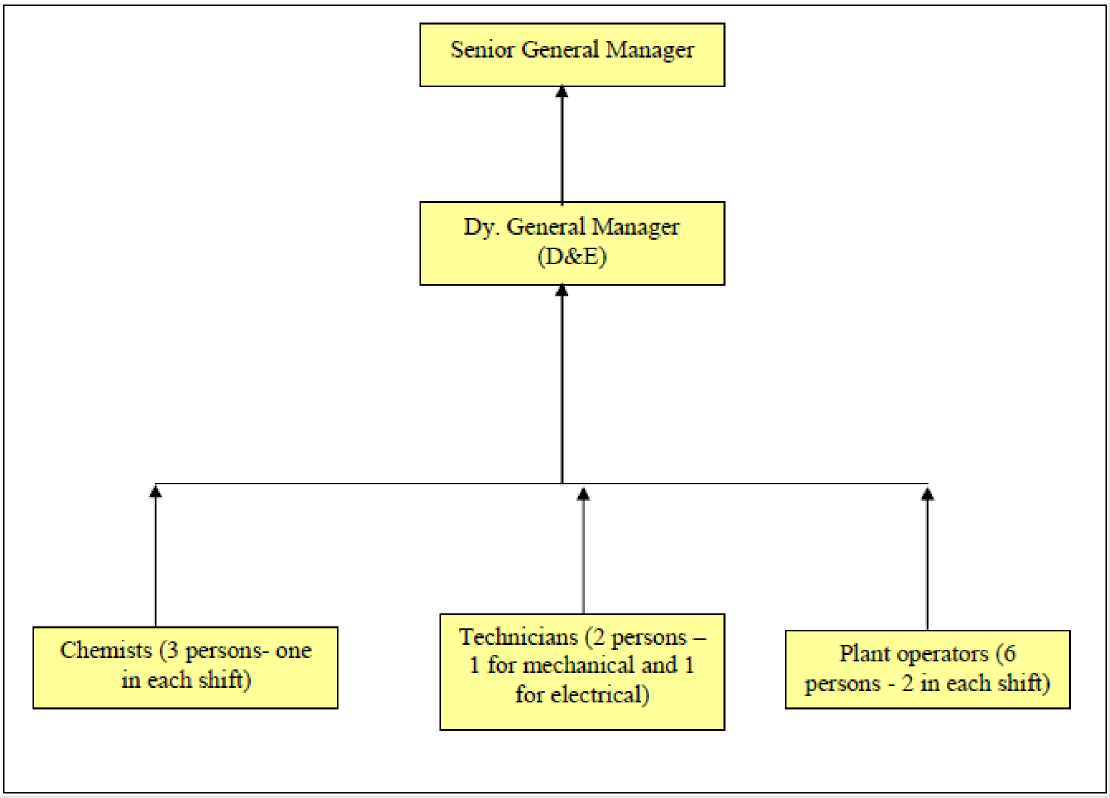
The project activity is located in the premises of sugar mill and distillery complex. Senior General Manager is the overall head of operations of the complex. The Senior General Manager is in charge of operations of the wastewater treatment plant including methane recovery system and other facilities in the wastewater treatment plant.

The plant operators run the plant on a day today basis and are assisted by two technicians for maintenance of mechanical and electrical installations in the plant. Chemists with graduate/postgraduate qualification in chemistry are available in each shift for analysis of all operating parameters like COD, biogas, etc.

The technicians are responsible for maintenance of equipment and installations in the anaerobic digestion plant. Any break down is recorded with details like type of break down, trouble shooting done, etc., and verified by the Dy. General Manager (D&E).

The organization structure illustrated below is in charge of the operation and maintenance of the wastewater treatment plant.

Fig 5: Organization Structure



QA/QC procedures

All instruments like wastewater flow meter, gas flowmeter, temperature and pressure measuring instruments, Gas analyzer are calibrated as per manufacturers' recommendations. The flowmeters are calibrated as per international/ manufacturers' recommendations or atleast once in a year.

Internal Audits

All reported results and measurements are periodically reviewed by Senior General Manager and any discrepancies are corrected with authorization from Senior General Manager. Internal audit is conducted once in every 6 months. For this monitoring period the report was generated on 8th July 2011 for reviewing period from January - June 2011 and on 5th January 2012 for reviewing period from July- December 2011.
For the period from January - June 2011 the internal audit report was generated on 9th July 2012 and for period from July- December 2012 the report was generated on 5th January 2013.
The outcome of the audit was found to be in line and as per schedule.

Emergency

The project activity does not have any operation that would result emergency emissions. Hence, there is no data monitored for emergency preparedness.

UEPL shall train the SCSL staff in all emergency requirements. The staff shall be trained in operation and maintenance of fire fighting equipments like fire extinguishers. The emergencies can be leakage of biogas from gas holders, other gas handling equipment like gas cleaning system, gas blowers. Although all the equipment, piping and instrumentation are as per explosion proof and gas tight, emergencies can happen. The staff has been trained to feel such leakages and immediately rectify the leakage areas.

The quantity of biogas that is generated, sent to boiler and flared shall be continuously measured by flow meters and recorded. From this data total biogas generated in the year “y”, is calculated, which will be $Q_{y,biogas.}$

The methane content of biogas in percentage shall be measured once in a month and average value shall be adopted and this value would be C_{CH4}.

The emission reductions ER_y would be given by the following formula:

$$ER_y = BE_y - PE_y$$

$$\underset{(tCO_2)}{BE_y} = \underset{Nm^3}{Q_{y,\ biogas,\ generated}} * \underset{\%}{C_{CH4}} * \underset{tonnes/m^3}{D_{CH4}} * \underset{tCO_2/t\ CH_4}{GWP\_CH_4}$$

The project emissions (PE_y) shall be calculated as described in the section B.6.1 of the PDD and deducted from emission reductions to calculate the emission reductions of the project activity.

While calculating the project emissions due to inefficiencies of the capture and flare, a default value of 0.5 shall be used when the biogas is combusted in the open flare. When biogas is combusted in the heating equipment, a default value of 1.0 shall be used for the reason that, in the project activity the biogas is combusted along with bagasse in the boilers where all the biogas would combust and efficiency would be 100 %. All the biogas generated in the project activity would be consumed in the heat generating equipment. However during maintenance of heat generating equipment or exigencies, there may be occasions when flare is used to combust the biogas. The number of hours of operation of flare shall be monitored as H flare and the quantity of biogas flared shall be obtained by measuring the volume of biogas flared.

Regular maintenance of the flare would be ensured as per manufacturer recommendation.

Sludge from UASB digesters

The final sludge from UASB digesters is drained periodically from the digesters. Since sludge is there inside UASB digesters for sufficiently long time, it would have completely digested and would not decay any further. This sludge could be directly used for soil application. However, to avoid any minor decay that may happen due to the sludge, this sludge is mixed with pressmud and composted aerobically. Since the sludge is aerobically composted, anaerobic decay would not happen. The quantity of sludge generated and disposed in compost yard would be monitored.

Line diagram showing all relevant monitoring points is enclosed as Annex-1 to this report.

SECTION D. Data and parameters

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

Data/Parameter	**$B_{o,ww}$**
Unit	tCH_4/ tCO_2
Description	Methane producing capacity of the wastewater
Source of data	IPCC default value and AMS-III.H. version 4
Value(s) applied	0.21
Purpose of data	This value is used for project emission calculation
Additional comment	-

Data/Parameter	**$MCF_{ww,treatment}$**
Unit	Fraction
Description	Methane correction factor
Source of data	Default values from Chapter 6 of Volume 5, Waste, IPCC 2006 guidelines and AMS-III.H. version 4
Value(s) applied	0.8
Purpose of data	This value is used for project emission calculation
Additional comment	-

Data/Parameter	**GWP_CH_4**
Unit	tCO_2 / tCH_4
Description	Global Warming Potential of methane
Source of data	IPCC default value
Value(s) applied	21
Purpose of data	This value is used for project emission calculation
Additional comment	-

Data/Parameter	**EF_y**
Unit	tCO_2/ MWh
Description	Electricity baseline emission factor of the grid
Source of data	Website of Central Electricity Authority. www.cea.nic.in
Value(s) applied	0.86
Purpose of data	This value is used for project emission calculation
Additional comment	-

Data/Parameter	**$MCF_{ww,final}$ / $MCF_{ww,treatment}$**
Unit	Fraction
Description	Methane correction factor

Source of data	Default values from Chapter 6 of Volume 5, Waste, IPCC 2006 guidelines and AMS-III.H. version 4
Value(s) applied	1.0
Purpose of data	This value is used for project emission calculation
Additional comment	-

Data/Parameter	**$MCF_{ww, final}$ / $MCF_{ww, treatment}$**
Unit	Fraction
Description	Methane correction factor
Source of data	Default values from Chapter 6 of Volume 5, Waste, IPCC 2006 guidelines and AMS-III.H. version 4
Value(s) applied	1.0
Purpose of data	This value is used for project emission calculation
Additional comment	-

Data/Parameter	**$[CH_4]_{y,ww,treated}$**
Unit	tonnes/ m^3
Description	Dissolved methane in wastewater leaving the reactors
Source of data	Default value as per AMS III.H/version 4
Value(s) applied	$10e^{-4}$
Purpose of data	This value is used for project emission calculation
Additional comment	-

Data/Parameter	**Depth**
Unit	**m**
Description	Depth of existing lagoons
Source of data	Actual measurement at site
Value(s) applied	More than 2 meters
Purpose of data	-
Additional comment	-

Data/Parameter	**D_{CH4}**
Unit	tonnes/ m^3
Description	Density of methane
Source of data	Default value as given in ACM0001“Consolidated baseline and monitoring methodology for landfill gas project activities”
Value(s) applied	0.0007168
Purpose of data	This value is used for project emission calculation
Additional comment	-

D.2. Data and parameters monitored

Data / Parameter:	$Q_{y,ww}$
Unit:	m^3
Description:	Volume of wastewater entering the wastewater treatment plant
Measured/ Calculated / Default:	Measured
Source of data:	Log books
Value(s) of monitored parameter:	2,46,167.40
Monitoring equipment:	Accuracy class : 0.25 Serial Number : 03071205 Date of Calibration: 13/03/2012, 14/03/2011, 15/03/2010 Validity: 12/03/2013, 13/03/2012, 14/03/2011 Calibration performed by Manas Microsystems
Measuring/Reading/ Recording frequency:	Measured continuously, recorded hourly, aggregate to monthly
Calculation method (if applicable):	Not Applicable
QA/QC procedures:	Meter is calibrated once in a year
Purpose of data:	This value is used for project emission calculation
Additional comment:	-

Data / Parameter:	$COD_{y,ww,untreated}$
Unit:	tonnes/m^3
Description:	Chemical Oxygen Demand of the untreated wastewater
Measured/Calculated / Default:	Measured
Source of data:	Actual measurements in the in-house lab
Value(s) of monitored parameter:	0.113873
Monitoring equipment:	Not Applicable
Measuring/Reading/ Recording frequency:	Daily
Calculation method (if applicable):	Not Applicable
QA/QC procedures:	COD of the untreated wastewater have been analyzed in external accredited laboratories once in a month.
Purpose of data:	This value is used for project emission calculation
Additional comment:	-

Data / Parameter:	$COD_{y,ww,treated}$

Unit:	$tonnes/m^3$
Description:	Chemical Oxygen Demand of the wastewater leaving the digesters/ entering lagoons
Measured/Calculated / Default:	Measured
Source of data:	Actual measurements in the in-house lab.
Value(s) of monitored parameter:	0.036223
Monitoring equipment:	Not Applicable
Measuring/Reading/ Recording frequency:	Daily. Average monthly values have been adopted for estimation of emissions.
Calculation method (if applicable):	Not Applicable
QA/QC procedures:	COD of the treated wastewater have been analysed in external accredited laboratories once in a month. In case of any major variation between the in-house and external laboratory value, the conservative among them have been considered.
Purpose of data:	This value is used for project emission calculation
Additional comment:	-

Data / Parameter:	$E_{y,consumed}$
Unit:	MWh/day
Description:	Electricity consumed per day
Measured/Calculated / Default:	Measured
Source of data:	Actual measurement
Value(s) of monitored parameter:	275.40[3]
Monitoring equipment:	Accuracy Class : 1.0 Serial Number : 1K017089 Calibration Frequency : Once in a year Date of Calibration: 17/10/2011, 18/10/2010 Validity: 16/10/2012, 17/10/2011 Calibration performed by Reltec Calibration Services
Measuring/Reading/ Recording frequency:	Measured continuously, recorded hourly, aggregated monthly
Calculation method (if applicable):	Not Applicable
QA/QC procedures:	Electricity meter is calibrated as per standard[4]
Purpose of data:	This value is used for project emission calculation

Calibration table within Monitoring equipment:

Date of Calibration	17/10/2011	18/10/2010
Validity	16/10/2012	17/10/2011

[3] Please refer the spreadsheet for monthly values
[4] IS 13779

Additional comment:	-

Data / Parameter:	$Q_{y,biogas,generated}$
Unit:	Nm^3
Description:	Volume of biogas generated
Measured/Calculated /Default:	Measured
Source of data:	Log Books
Value(s) of monitored parameter:	95,46,838
Monitoring equipment:	Accuracy class : 0.25 Serial Number : 11090459M Calibration Frequency : Once in a year Date of Calibration: 09/01/2012, 10/01/2011, 24/01/2010 Validity: 08/01/2013, 09/01/2012, 10/01/2011 Calibration performed by Manas Microsystems
Measuring/Reading/ Recording frequency:	Measured continuously, recorded hourly and aggregated monthly
Calculation method (if applicable):	Not Applicable
QA/QC procedures:	Meter is calibrated once in a year
Purpose of data:	This value is used for baseline emission calculation
Additional comment:	-

Date of Calibration	09/01/2012	10/01/2011	24/01/2010
Validity	08/01/2013	09/01/2012	10/01/2011

Data / Parameter:	$Q_{y,biogas,sent\ to\ boiler}$
Unit:	Nm^3
Description:	Volume of biogas sent to boiler
Measured/ Calculated / Default:	Measured
Source of data:	Log Books
Value(s) of monitored parameter:	92,78,848
Monitoring equipment:	Accuracy class : 0.25 Serial Number : 06040142A Calibration Frequency : Once in a year Calibration performed by Manas Microsystems

Date of Calibration	13 /03/2012	14/03/2011	15/03/2010
Validity	12/03/2013	13 /03/2012	14/03/2011

Measuring/Reading/ Recording frequency:	Measured continuously, recorded hourly and aggregated monthly
Calculation method (if applicable):	Not Applicable
QA/QC procedures:	Meter is calibrated once in a year
Purpose of data:	This value is used for baseline emission calculation
Additional comment:	-

Data / Parameter:	$Q_{y,biogas,flared}$
Unit:	Nm^3
Description:	Volume of Biogas flared
Measured/Calculated /Default:	Measured
Source of data:	Log books
Value(s) of monitored parameter:	97,269
Monitoring equipment:	Accuracy class : 0.25 Serial Number : 03071206H Calibration Frequency : Once in a year Date of Calibration: 13 /03/2012 ; 14/03/2011 ; 15/03/2010 Validity: 12/03/2013 ; 13 /03/2012 ; 14/03/2011 Calibration performed by Manas Microsystems
Measuring/Reading/ Recording frequency:	Measured continuously, recorded hourly and aggregated monthly
Calculation method (if applicable):	Not Applicable
QA/QC procedures:	Meter is calibrated once in a year
Purpose of data:	This value is used for baseline emission calculation
Additional comment:	-

Data / Parameter:	C_{CH4}
Unit:	%
Description:	Methane content in the biogas
Measured/Calculated /Default:	Measured
Source of data:	Actual measurement
Value(s) of monitored parameter:	58.60
Monitoring equipment:	Not Applicable

Measuring/Reading/ Recording frequency:	The methane content of the biogas has been measured once in a month by internationally accepted methods. Average value has been used for estimation of methane content and baseline emissions.
Calculation method (if applicable):	Not Applicable
QA/QC procedures:	Analysis by external laboratory.
Purpose of data:	This value is used for baseline emission calculation
Additional comment:	-

Data / Parameter:	**T_{flare}**
Unit:	**°C**
Description:	Temperature of the flare
Measured/Calculated /Default:	Measured
Source of data:	Actual measurement
Value(s) of monitored parameter:	253.83
Monitoring equipment:	Thermocouple Serial Number : 669 Calibration Frequency : Once in a year Date of Calibration: 13/02/2012, 16/02/2011, 22/02/2010 Validity: 12/02/2013, 17/02/2012, 23/02/2011 Calibration performed by Heatcon Sensors (P) Ltd.
Measuring/Reading/ Recording frequency:	Measured continuously, recorded every 5 minutes, averaged monthly.
Calculation method (if applicable):	All temperatures above 200°C are considered as the start of flame and temperature below 200°C as stop of the flame.
QA/QC procedures:	Calibration is conducted once in every year.
Purpose of data:	This value is used for baseline emission calculation Temperature records would detect the flame and provide an indication that flare was operational for minimum period of 20 minutes within the hour during which 50% flare efficiency would be considered. In an hour the flame is not detected for more than 20 minutes during the hour 0% flare efficiency would be considered during that hour.
Additional comment:	-

Data / Parameter:	**H_{flare}**
Unit:	Hours
Description:	Number of hours of operation of flare

Measured/Calculated /Default:	Measured
Source of data:	Log books
Value(s) of monitored parameter:	160.45
Monitoring equipment:	It is measured with the Thermocouple installed.
Measuring/Reading/ Recording frequency:	Measured every 5 minute
Calculation method (if applicable):	Not applicable
QA/QC procedures:	The thermocouple is calibrated once in a year
Purpose of data:	This value is used for baseline emission calculation Whenever the temperature shows reading above 200°C that time is recorded as start of time for flaring and temperature below 200°C is recorded as stop time for flaring.
Additional comment:	-

Data / Parameter:	**$S_{y,generated}$**
Unit:	tonnes
Description:	Quantity of final sludge from UASB reactors
Measured/Calculated /Default:	Measured
Source of data:	Log books
Value(s) of monitored parameter:	1860.53
Monitoring equipment:	Weighbridge Serial Number : EB-03w/124 Calibration Frequency : Once in a year Date of Calibration: 14/06/2011; 22/06/2010 Validity: 13/06/2012; 21/06/2011 Calibration performed by Weight and Measurement Department of Government of Karnataka
Measuring/Reading/ Recording frequency:	As when generated
Calculation method (if applicable):	Not Applicable
QA/QC procedures:	Calibration of weighbridge been conducted once in a year.
Purpose of data:	This value is used for project emission calculation
Additional comment:	-

Data / Parameter:	**$S_{y,composted}$**

Unit:	tonnes
Description:	Quantity of final sludge from UASB reactors sent to compost yard
Measured/Calculated /Default:	Measured
Source of data:	Log books
Value(s) of monitored parameter:	1860.53
Monitoring equipment:	Weighbridge Serial Number : EB-EB-05s/602 Calibration Frequency : Once in a year Date of Calibration: 14/06/2011, 22/06/2010 Validity: 13/06/2012, 21/06/2011 Calibration performed by Weight and Measurement Department of Government of Karnataka
Measuring/Reading/ Recording frequency:	As when generated and disposed
Calculation method (if applicable):	Not Applicable
QA/QC procedures:	Calibration of weighbridge been conducted once in a year.
Purpose of data:	This value is used for project emission calculation
Additional comment:	-

D.3. Implementation of sampling plan

Not applicable

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

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

The baseline emissions are calculated by using the formula given below:

$$BE_y = (Q_{y,\ biogas,sent\ to\ boiler} * \text{Combustion Efficiency}) + (Q_{y,\ biogas,\ flared} * \text{Flare Efficiency}) * C_{CH4} * D_{CH4} * GWP\_CH_4$$

Where:

BE_y	Baseline emissions in the year “y” (tCO_2)
$Q_{y,\ biogas,sent\ to\ boiler}$	Volume of biogas sent to boiler in the year “y” (Nm^3/year).
Combustion Efficiency	Default value 1.0 (Biogas is combusted in the heating equipment)
$Q_{y,\ biogas,\ flared}$	Volume of biogas flared in the year “y” (m^3/year).
Flare Efficiency	Default value 0.5 (Biogas is combusted in the open flare).
C_{CH4}	Methane content of biogas (%) which is measured once in a month and average value is adopted
D_{CH4}	Density of methane (tonnes/m^3) which is a default value as given in ACM0001 “Consolidated baseline and monitoring methodology for landfill gas project activities”
GWP_CH_4	Global Warming Potential of methane (21 tCO_2 / tCH_4)

BE_y = ((9278848*100%) + (97269*50%)*58.74*0.7168*21)/1000

= 82262.31tCO_2

Table 5: Summary of month wise baseline emissions

Month	Volume of Biogas used in Boiler (Nm^3)	Volume of Biogas flared (Nm^3)	Methane% in Biogas	Density of methane (kg/m^3)	Baseline Emissions (tCO_2)
January 2011	409115	4395	58.59	0.7168	3628.45
February 2011	348113	807	58.59	0.7168	3074.49
March 2011	387649	5034	58.59	0.7168	3441.90
April 2011	302425	691	58.59	0.7168	2670.93
May 2011	398232	6387	58.59	0.7168	3541.23
June 2011	352237	22821	58.59	0.7168	3207.97
July 2011	496851	7445	58.59	0.7168	4415.88
August 2011	339768	14221	58.59	0.7168	3060.04
September 2011	467184	7112	58.59	0.7168	4152.70
October 2011	425850	1500	58.59	0.7168	3763.31
November 2011	324081	2114	58.59	0.7168	2868.25
December 2011	408958	1884	58.59	0.7168	3615.99
January 2012	387510	2410	58.59	0.7168	3429.10
February 2012	376263	0	58.59	0.7168	3319.25
March 2012	428313	594	58.59	0.7168	3781.04
April 2012	381637	1171	58.59	0.7168	3371.83
May 2012	354026	8116	58.59	0.7168	3158.89
June 2012	368667	740	58.59	0.7168	3255.51
July 2012	397085	1628	58.59	0.7168	3510.12
August 2012	433585	5171	58.59	0.7168	3847.74
September 2012	351335	1467	58.59	0.7168	3105.82
October 2012	365233	1245	58.59	0.7168	3227.44
November 2012	382028	1	58.59	0.7168	3370.12
December 2012	392703	315	58.59	0.7168	3465.67
Total	**9278848**	**97269**	**-**	**-**	**82283.64**

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

As per AMS-III.H.Version 04, the project activity emissions **(PE_y)** consists of -

$$PE_y = PE_{y,\,power} + PE_{y,\,ww,\,treated} + PE_{y,\,s,\,final} + PE_{y,\,fugitive} + PE_{y,\,dissolved}$$

Where:

PE_y	Project activity emissions in the year “y” (tCO_2)
$PE_{y,power}$	Emissions from electricity or diesel consumption in the year “y”
$PE_{y,ww,treated}$	Emissions from degradable organic carbon in treated wastewater in year “y”
$PE_{y,s,final}$	Emissions from anaerobic decay of the final sludge produced in the year “y”.
$PE_{y,fugitive}$	Emissions from methane release in capture and flare systems in year “y”.
$PE_{y,dissolved}$	Emissions from dissolved methane in treated wastewater in year “y”

(a) CO_2 emissions related to the power used by the equipment in the project activity **($PE_{y,\,power}$)**

These are the emissions due to electricity consumed by the installations in the project activity. These emissions are obtained by multiplying the electricity consumed in the year ($E_{y,\,consumed}$) and the electricity baseline emission factor of the grid. (EF_y)

$$PE_{y,\,power} = E_{y,\,consumed} * EF_y$$

Where
$E_{y,\,consumed}$ Electricity consumed in the year "y" (MWh/year)
EF_y Electricity baseline emission factor (tCO_2/MWh)

Emission Factor:

EF_y Electricity baseline emission factor of the grid

Since the electricity baseline emission factor of the grid is applied to calculate the project activity emissions only, the higher value of table B.6.1 (0.86 t CO2/ MWh) would be adopted.

$PE_{y,\,power}$ = (320232*0.86)/1000
= 275.40 tCO_2

(b) Methane emissions through inefficiency of the wastewater treatment and presence of degradable organic carbon in treated wastewater **($PE_{y,\,ww,\,treated}$).**

The project emissions due to COD in the wastewater leaving the digesters is calculated as per the following formula given in the approved methodology AMS-III.H.Version 04;

$$PE_{y,\,ww,\,treated} = Q_{y,\,ww} * COD_{y,\,ww,\,treated} * B_{o,ww} * MCF_{ww,\,final} * GWP\_CH_4$$

Where:
$PE_{y,ww,treated}$ Project emissions due to degradable organic carbon in the wastewater leaving the wastewater treatment in tCO_2/year in the year "y"
$Q_{y,\,ww}$ Volume of wastewater treated in the year "y"
$COD_{y,ww,treated}$ Chemical oxygen demand of the treated wastewater in the year "y" in tonnes/m^3
$B_{o,ww}$ Methane generation capacity of the treated wastewater (as per AMS-III.H/ version 4, IPCC default value of 0.21t CH_4/t COD is adopted)
$MCF_{ww,treated}$ Methane conversion factor based on type of treatment and discharge pathway of the wastewater. (MCF higher value in table III.H.1. shall be adopted). The wastewater after the UASB reactors would flow to anaerobic deep lagoon (depth more than 2 meters). The MCF higher value as per Table III.H.1 for anaerobic deep lagoon is **1.0**
GWP_CH_4 Global Warming Potential for CH_4 (21 tCO_2/tCH_4)

$PE_{y,ww,treated}$ = 246167.40*0.036223*0.21*1*21
= 39296.36 tCO_2

(c) Methane emissions from the decay of the final sludge generated by the treatment systems in the year "y" **($PE_{y,s\,final}$)**

These are the emissions that arise from the anaerobic degradation of the final sludge produced by the treatment systems. In the project activity, the sludge produced by the treatment systems is very less. This sludge is basically the excess sludge in the UASB reactors which are removed from the UASB reactors periodically. In the project activity, this sludge would be mixed with pressmud and treated wastewater and subjected to aerobic composting. Since the sludge is processed through aerobic methods, the sludge would not degrade anaerobically and hence there would be no emissions. The sludge quantity generated (**$S_{y,generated}$**) and disposed **($S_{y,consumed}$)** during the verification period is detailed in the spreadsheet.

(d) Methane fugitive emissions through inefficiencies in capture and flare systems in the year "y" **($PE_{y\,fugitive}$.)**

These are the emissions that would occur when biogas is combusted in flare and heating equipment.

$$PE_{y,\,fugitive} = PE_{y,\,fugitive,\,ww} + PE_{y,\,fugitive,\,s}$$

Where:

$PE_{y,\,fugitive,\,ww}$ Fugitive emissions through capture and flare inefficiencies in the anaerobic wastewater treatment in the year, "y' (tCO_2)

$PE_{y,\,fugitive,\,s}$ Fugitive emissions through capture and flare inefficiencies in anaerobic sludge treatment in the year, "y' (tCO_2).

Since the sludge is not treated anaerobically, $PE_{y,\,fugitive,\,s}$ is not calculated

Hence, $PE_{y,\,fugitive} = PE_{y,\,fugitive,ww}$

$$PE_{y,\,fugitive,\,ww} = (1-CFE_{ww}) * MEP_{y,\,ww,\,treatment} * GWP\_CH_4$$

Where, CFE_{ww} is capture and flare efficiency of methane recovery and combustion equipment. As per the registered PDD, biogas is combusted in the heating equipment, and rest of the biogas which is not used in heating equipment is flared. A default value of 1.0 is used as combustion efficiency for heating equipment while default value of 0.5 is used as flare efficiency. This is inline with the applicable methodology, associated tools and the registered PDD for the project activity.

$MEP_{y,\,ww,\,untreated}$ Methane emission potential of the untreated wastewater in the year "y" (tonnes)

GWP_CH_4 Global Warming Potential for CH_4 (21 tCO_2/tCH_4)

$$MEP_{y,\,ww,\,treatment} = Q_{y,\,biogas} * C_{CH4} * D_{CH4}$$

Where:

$Q_{y,\,biogas}$ Volume of biogas generated from waste waster treatment plant in the year "y" (m^3/year). The quantity of biogas is continuously measured by flow meters and recorded in logbook for year "y"

C_{CH4} Methane content of biogas (%) which is measured once in a month and average value is adopted

D_{CH4} Density of methane (tonnes/m3) which is a default value as given in ACM0001"Consolidated baseline and monitoring methodology for landfill gas project activities"

$PE_{y,\,fugitive,\,ww}$ = (97269*(1-0)*58.60%*0.7168*21)/1000
= 858.1 tCO_2

(v) Methane emissions resulting from dissolved methane in the treated wastewater effluent in the year "y" **($PE_{y,\,dissolved}$)**

These are the methane emissions due to methane dissolved in the treated wastewater which are calculated by the formula as per AMS-III.H version 4:

$$PE_{y,\,dissolved} = Q_{y,\,ww} * [CH_4]_{y,\,ww,\,treated} * GWP\_CH_4$$

Where,

$Q_{y,\,ww}$ Volume of wastewater treated in the year "y" (m^3/year)

$[CH_4]_{y,\,ww,\,treated}$ Dissolved methane content in the treated wastewater. As per the methodology, default value of 10 e-4 tonnes/ m^3 would be adopted for estimation of ex-ante calculations.

$PE_{y,\,dissolved}$ = 246167.40*21*0.0001
= 516.95 tCO_2

Thus,

$$PE_y = PE_{y,\,power} + PE_{y,\,ww,,\,treated} + PE_{y,\,s\,final} + PE_{y,\,fugitive} + PE_{y,\,dissolved}$$

$$PE_y = 275.40+39296.36+0+857.8+516.95$$
$$= 40946.56\ tCO_2$$

Table 6: Summary of month wise project emissions

Month	Energy consumption (tCO_2)	DOC in treated water (tCO_2)	Fugitive Emissions (tCO_2)	Dissolved Methane (tCO_2)	Project Emissions (tCO_2)
January 2011	19.95	1874.07	38.8	25.11	1957.89
February 2011	16.26	1636.97	7.1	21.90	1682.25
March 2011	19.23	1810.72	44.4	23.97	1898.31
April 2011	17.31	943.00	6.1	11.98	978.38
May 2011	17.84	1864.16	56.3	23.82	1962.15
June 2011	16.82	1606.29	201.3	20.57	1844.95
July 2011	12.32	1997.28	65.7	24.91	2100.17
August 2011	9.44	1378.39	125.5	17.39	1530.65
September 2011	11.47	1840.73	62.7	23.23	1938.14
October 2011	10.64	1789.51	13.2	22.39	1835.76
November 2011	9.67	1245.77	18.6	15.55	1289.64
December 2011	10.73	1889.90	16.6	23.47	1940.72
January 2012	10.87	1811.31	21.3	22.95	1866.39
February 2012	10.91	1789.05	0.0	22.19	1822.15
March 2012	10.74	1805.00	5.2	23.79	1844.78
April 2012	9.96	1507.85	10.3	19.68	1547.82
May 2012	9.28	1297.80	71.6	18.02	1396.67
June 2012	9.80	1705.56	6.5	22.74	1744.63
July 2012	10.07	1775.69	14.4	23.62	1823.74
August 2012	9.52	1768.27	45.6	24.32	1847.71
September 2012	6.48	1378.41	12.9	19.98	1417.80
October 2012	4.92	1558.23	11.0	22.11	1596.25
November 2012	5.49	1401.08	0.0	19.59	1426.17
December 2012	5.68	1621.31	2.8	23.69	1653.46
Total	**275.40**	**39296.36**	**858.1**	**516.95**	**40946.56**

E.3. Calculation of leakage

As per approved methodology AMS-III.H. version 4, the leakage is to be considered if the used technology is equipment is transferred from another project activity or if the existing equipment is transferred to another activity. Since this is not case in the project activity, no leakage is considered for the project activity.

Thus, $\mathbf{Leakage_y} = 0$

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	82,283	40,946	0	41,336[5]

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

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_2e)	68,848	41,336

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

There is no **increase** in the actual emission reductions achieved during the current monitoring period.

However, there is decrease in the actual emission reduction due to following reasons:

1) The distillery unit experienced shutdowns for 29 days in 2011-12 for maintenance. Thus, there was less biogas generation which resulted into lesser emission reductions.

2) The ex-ante emission reduction is based on quantity of spentwash treated and COD of untreated spentwash whereas, ex-post emission reduction is based on actual biogas generation.

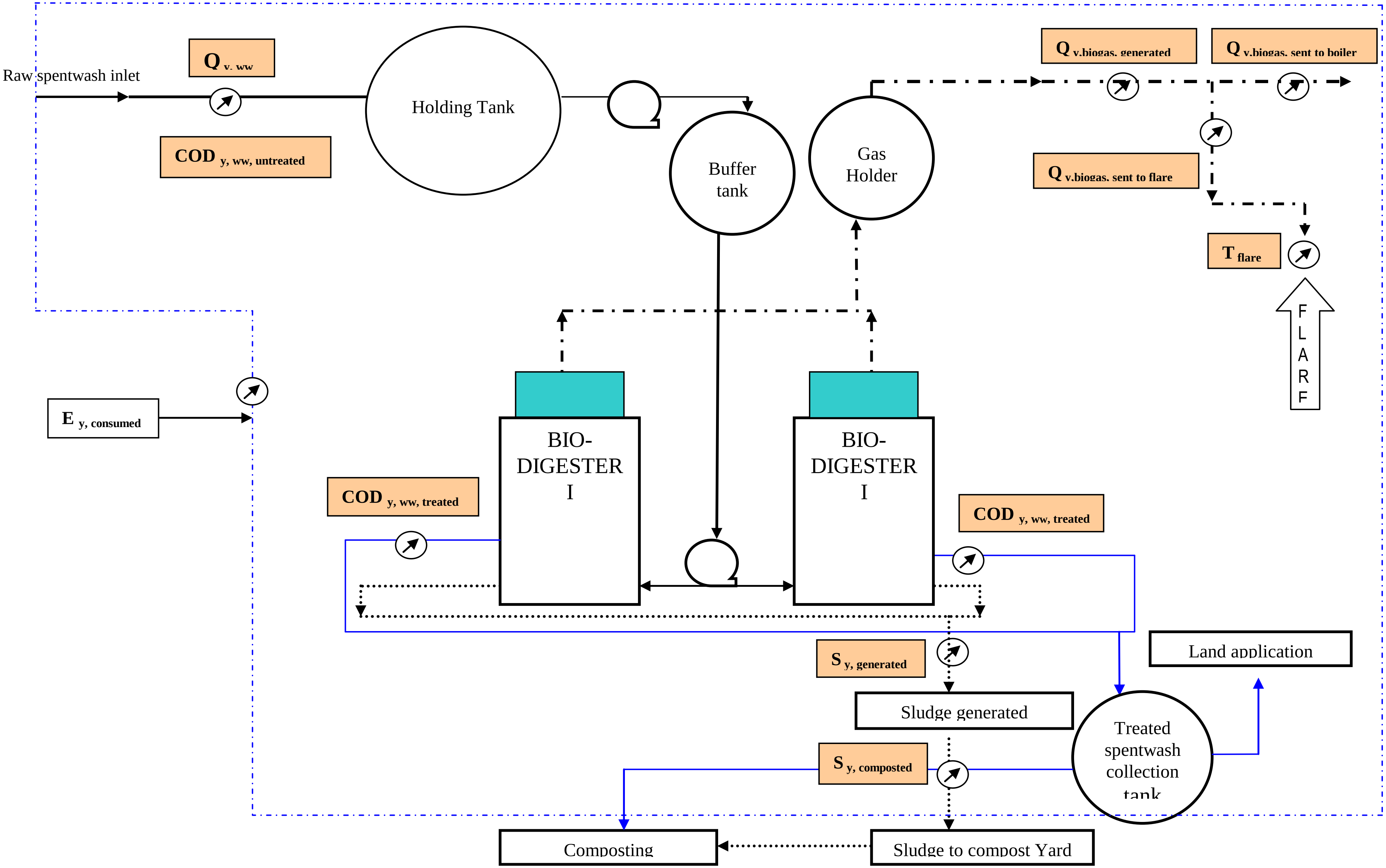
E.7. Actual emission reductions or net anthropogenic GHG removals by sinks during the first commitment period and the period from 1 January 2013 onwards

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_2e)	-	-

Not Applicable for this verification as the monitoring period ends on 31st December 2012.

[5] This value is rounded down

Annex-1: Line diagrams showing all relevant monitoring point



Meter details:

Q $_{y, ww}$	Flow meter measuring volume of wastewater entering the wastewater treatment plant
COD $_{y, ww, untreated}$	Chemical Oxygen Demand of the untreated wastewater
COD $_{y, ww, treated}$	Chemical Oxygen Demand of the treated wastewater
Q $_{y,biogas, generated}$	Flow meter measuring volume of biogas generated
Q $_{y,biogas, sent\ to\ boiler}$	Flow meter measuring volume of biogas sent to boiler
Q $_{y,biogas, sent\ to\ flare}$	Flow meter measuring volume of biogas flared
T $_{flare}$	Flare temperature sensor
E $_{y, consumed}$	Energy meter
S $_{y, generated}$	Weighbridge measuring sludge generated
S $_{y, composted}$	Weighbridge measuring sludge received at compost yard

Document information

Version	*Date*	*Description*
03.1	2 January 2013	Editorial revision to correct table in section E.5.
03.0	3 December 2012	Revision required to introduce a provision on reporting actual emission reductions or net anthropogenic GHG removals by sinks for the period up to 31 December 2012 and the period from 1 January 2013 onwards (EB70, Annex 11).
02.0	13 March 2012	Revision required to ensure consistency with the "Guidelines for completing the monitoring report form" (EB 66, Annex 20).
01	28 May 2010	EB 54, Annex 34. Initial adoption.

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