TYPE III - OTHER PROJECT ACTIVITIES

Follow the link to find General guidance / Abbreviations

III.H. Methane Recovery in Wastewater Treatment

Technology/measure

1. This project category comprises measures that recover methane from biogenic organic matter in wastewaters by means of one of the following options:

(i) Substitution of aerobic wastewater or sludge treatment systems with anaerobic systems with methane recovery and combustion.

(ii) Introduction of anaerobic sludge treatment system with methane recovery and combustion to an existing wastewater treatment plant without sludge treatment.

(iii) Introduction of methane recovery and combustion to existing anaerobic wastewater or sludge treatment systems.

(iv) Introduction of anaerobic wastewater treatment with methane recovery and combustion, with or without anaerobic sludge treatment, to an untreated wastewater stream.

2. If the recovered methane is used for heat and electricity generation the project can use a corresponding methodology under type I project activities.

Boundary

3. The project boundary is the physical, geographical site where the wastewater and sludge treatment takes place.

Project Activity Direct Emissions

4. Total annual project activity related emissions shall be less than or equal to 15 kilo tonnes of CO_2 equivalent. Project activity emissions consists of

(i) CO_2 emissions related to the power used by the project activity facilities. Emission factors for grid electricity or diesel fuel use as the case may be shall be calculated as described in category I.D

(ii) Methane emissions through inefficiency of the wastewater treatment and presence of degradable organic carbon in treated wastewater.

(iii) Methane emissions from the decay of the final sludge generated by the treatment systems.

(iv) Methane fugitive emissions through inefficiencies in capture and flare systems.

(v) Methane emissions resulting from dissolved methane in the treated wastewater effluent.

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

where:

PE_y: project activity emissions in the year “y” (tonnes of CO_2 equivalent)
$PE_{y,power}$ emissions through electricity or diesel consumption in the year “y”
$PE_{y,ww,treated}$ emissions through degradable organic carbon in treated wastewater in year “y”
$PE_{y,s,final}$ emissions through anaerobic decay of the final sludge produced in the year “y”. If the sludge is controlled combusted, disposed in a landfill with methane recovery, or used for soil application, this term can be neglected, and the destiny of the final sludge will be monitored during the crediting period.
$PE_{y,fugitive}$ emissions through methane release in capture and flare systems in year “y”.
$PE_{y,dissolved}$ emissions through dissolved methane in treated wastewater in year “y”

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

where:

$Q_{y,ww}$ volume of wastewater treated in the year “y” (m^3)
$COD_{y,ww,treated}$ chemical oxygen demand of the treated wastewater in the year “y” (tonnes/m^3)
$B_{o,ww}$ methane generation capacity of the treated wastewater (IPCC default value of 0.25 kg CH_4/kg.COD)
$MCF_{ww,treated}$ methane conversion factor for the anaerobic decay of wastewater. (default value of 0.5 is suggested)[1].
GWP_CH4 Global Warming Potential for CH4 (value of 21 is used)

$$PE_{y,s,final} = S_{y,final} * DOC_{y,s,final} * DOC_F * F * 16/12 * GWP\_CH_4$$

where:

$PE_{y,s,final}$ Methane emissions from the anaerobic decay of the final sludge generated in the wastewater system in the year “y” (tonnes of CO_2 equivalent)
$S_{y,final}$ Amount of final sludge generated by the wastewater treatment in the year y (tonnes).
$DOC_{y,s,final}$ Degradable organic content of the final sludge generated by the wastewater treatment in the year y (mass fraction). It can be measured by sampling and analysis of the sludge produced, or the IPCC default value for solid wastes of 0.3 is used.
DOC_F Fraction of DOC dissimilated to biogas (IPCC default value is 0.77).
F Fraction of CH_4 in landfill gas (IPCC default is 0.5).

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

where:

$PE_{y,fugitive,ww}$ Fugitive emissions through capture and flare inefficiencies in the anaerobic wastewater treatment in the year “y” (tonnes of CO_2 equivalent)

---

[1] IPCC default values are 1.0 for anaerobic, and zero for aerobic systems. Here it is assumed that after the discharge of the wastewater to a river, lake, sea, etc., half of the degradable organic carbon will decay anaerobically.

$PE_{y,fugitive,s}$ Fugitive emissions through capture and flare inefficiencies in the anaerobic sludge treatment in the year “y” (tonnes of CO_2 equivalent)

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

where:

CFE_{ww} capture and flare efficiency of the methane recovery and combustion equipment in the wastewater treatment (a default value of 0.9 shall be used, given no other appropriate value)

$ME_{y,ww,untreated}$ methane emission potential of the untreated wastewater in the year “y” (tonnes)

$$ME_{y,ww,untreated} = Q_{y,ww} * COD_{y,ww,untreated} * B_{o,ww} * MCF_{ww,untreated}$$

where:

$COD_{y,ww,untreated}$ Chemical oxygen demand of the wastewater entering the anaerobic treatment reactor/system with methane capture in the year “y” (tonnes/m^3)

$MCF_{ww,untreated}$ methane conversion factor for the anaerobic decay of the untreated wastewater (IPCC default value of 1.0 for anaerobic systems. If the untreated wastewater is discharged to the environment, the default value of 0.5 is suggested).

$$PE_{y,fugitive,s} = (1 - CFE_s) * ME_{y,s,untreated} * GWP\_CH_4$$

where:

CFE_s capture and flare efficiency of the methane recovery and combustion equipment in the sludge treatment (a default value of 0.9 shall be used, given no other appropriate value)

$ME_{y,s,untreated}$ methane emission potential of the untreated sludge in the year “y” (tonnes)

$$ME_{y,s,untreated} = S_{y,untreated} * DOC_{y,s,untreated} * DOC_F * F * 16/12$$

where:

$S_{y,untreated}$ amount of untreated sludge generated in the year “y” (tonnes)

$DOC_{y,s,untreated}$ Degradable organic content of the untreated sludge generated in the year y (mass fraction). It can be measured by sampling and analysis of the sludge produced, or the IPCC default value for solid wastes of 0.3 is used.

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

where:

$[CH_4]_{y,ww,treated}$ dissolved methane content in the treated wastewater (tonnes/m^3). In aerobic wastewater treatment default value is zero, in anaerobic treatment it can be measured, or a default value of 10e-4 tonnes/m^3 can be used.

Baseline

5. The baseline scenario will be one of the following situations:

(i) The existing aerobic wastewater or sludge treatment system, in the case of substitution of one or both of these systems for anaerobic ones with methane recovery and combustion.

(ii) The existing sludge disposal system, in the case of introduction of anaerobic sludge treatment system with methane recovery and combustion to an existing wastewater treatment plant.

(iii) The existing anaerobic wastewater or sludge treatment system without methane recovery and combustion, in the case of the introduction of methane recovery and combustion units to one or both of these systems.

(iv) Discharge of untreated wastewater to the environment, in the case of introducing the treatment to an untreated wastewater stream.

6. The baseline emissions scenarios will be the following:

(a) For the case of the substitution of aerobic wastewater or sludge treatment system by an anaerobic system with methane recovery and combustion, and for the case of introduction of anaerobic sludge treatment with methane recovery and combustion to an untreated sludge stream, the baseline emissions (BE_y) are due to energy consumption in the aerobic treatment plant, and for the anaerobic decay of the degradable carbon in the final wastewater and sludge streams:

$$BE_y = BE_{y,power} + BE_{y,ww,treated} + BE_{y,s,final}$$

where,

BE_y Baseline emissions in the year "y" (tonnes of CO_2 equivalent)

$BE_{y,power}$ emissions through electricity or diesel that would be consumed in the year "y" by the replaced aerobic wastewater or sludge treatment system

$BE_{y,ww,treated}$ emissions through degradable organic carbon in treated wastewater in year "y", calculated using the same formula as for the project emission ($PE_{y,ww,treated}$).

$BE_{y,s,final}$ emissions through anaerobic decay of the final sludge produced in the year "y", calculated using the formula as for the project emission ($PE_{y,s,final}$). If the sludge is controlled combusted, disposed in a landfill with methane recovery, or used for soil application, this term can be neglected, and the end-use of the final sludge will be monitored during the crediting period.

(b) For the case of introduction of methane recovery and combustion unit to an existing anaerobic wastewater or sludge treatment, the baseline emissions consists of the methane generation potential of the untreated wastewater and or sludge

$$BE_y = ME_{y,ww,untreated} + ME_{y,s,untreated}$$

(c) For the case of introduction of an anaerobic wastewater treatment unit with methane recovery and combustion to an untreated wastewater stream, the baseline emissions consists of the methane generation potential of the untreated wastewater with the methane correction factor of 0.5 (for environmental discharge

$$BE_y = ME_{y,ww,untreated}$$

For the above cases (a), (b) and (c) the methane generation capacity of the treated wastewater ($B_{o,ww}$) shall be IPCC lower value of 0.21 kg CH_4/kg .COD.

Leakage

7. If the used technology is equipment transferred from another activity or if the existing equipment is transferred to another activity, leakage effects at the site of the other activity are to be considered.

Monitoring

8. For the cases of (i) substitution of aerobic wastewater or sludge treatment by an anaerobic with methane recovery and combustion, or (ii) introduction of an anaerobic wastewater treatment unit with methane recovery and combustion to an untreated wastewater stream, the emission reduction achieved by the project activity will be measured as the difference between the baseline emission and the sum of the project emission and leakage.

$$ER_y = BE_y - (PE_y + Leakage_y)$$

The existing records of electricity consumption, COD content of treated wastewater, and quantity of sludge produced by the replaced aerobic units will be used for the baseline calculation in case (i). The project emissions will be monitored by regular measurement and recording of the flow of wastewater and/or sludge treated ($Q_{y,ww}$ and $S_{y,untreated}$), their initial and final content of degradable carbon ($COD_{y,ww,untreated}$, $COD_{y,ww,untreated}$, $DOC_{y,s,untreated}$, $DOC_{y,s,treated}$), and the dissolved methane in the wastewater just leaving the anaerobic reactor (if the default value for dissolved methane is not used).

9. For the cases of (i) introduction of anaerobic sludge treatment with methane recovery and combustion to an untreated sludge stream, or (ii) introduction of methane recovery and combustion unit to an existing anaerobic wastewater or sludge treatment system, the project activity emission reductions will be measured directly. They consist of the amount of methane recovered and fuelled or flared, which will be monitored ex-post.

10. In all cases, the amount of methane recovered and fuelled or flared shall be monitored ex-post, using continuous flow meters. The fraction of methane in the gas should be measured with a continuous analyser or, alternatively, with periodical measurements at a 95% confidence level. Temperature and pressure of the gas are required to determine the density of methane combusted.

11. Regular maintenance should ensure optimal operation of flares. The flare efficiency, defined as the fraction of time in which the gas is combusted in the flare, multiplied by the efficiency of the flaring process, shall be monitored.

12. If the methane emissions from anaerobic decay of the final sludge were to be neglected because the sludge is controlled combusted, disposed in a landfill with methane recovery, or used for soil application, then the end-use of the final sludge will be monitored during the crediting period.