Evaluation of Greenhouse Gas Emissions from Septic Systems

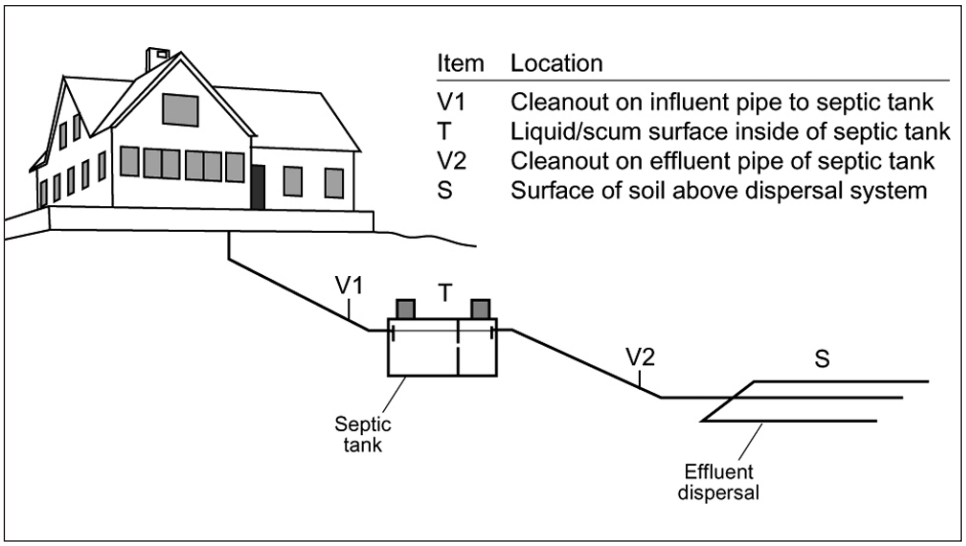
Methane is a potent greenhouse gas (GHG), with an equivalent effect 25 times that of carbon dioxide (IPCC, 2007). Based on IPCC methodology, the U.S. EPA determined that more than 80% of the methane emissions associated with wastewater originate from onsite septic systems. This is due to the large number of individual septic systems now in use and the high emission rates predicted using the IPCC method. However, the actual data currently available on the emissions of methane from septic systems are insufficient to produce an accurate greenhouse gas inventory for these systems. Thus the principal objective of this research was to obtain more accurate data on GHG emissions from septic tank systems, with a focus on methane emissions from conventional septic tanks. The research found that emission rates for methane were roughly half of current estimates.

UC-Davis graduate student, Libia Rocio Diaz Valbuena, sampling a septic tank in the snow.

University of California-Davis researchers sampled eight septic tanks using flux chambers for the production of gases from the tank contents. They also evaluated the septic system, including the dispersal field and house vent for GHG emissions.

Conclusions and Recommendations

Onsite wastewater treatment systems have received less attention compared to full-scale wastewater treatment plants when accounting for GHG releases, however, there are several studies in the literature which include measurements or estimates of the methane emission.



Definition Sketch for Mass Balance for Total Gas Emission Rate from the Septic System.

BENEFITS

- This study, which collected thousands of data points, is the largest study to date of GHG emissions from septic systems.
- Provides methods to determine the rate of GHG emission rates from venting and soil dispersal systems.
- Improves upon the estimation of GHG emission rates from septic systems.
- Provides the atmospheric emission rate value for future GHG inventory based on septic tanks in California.
- Examines the GHG emission and generation pathways in typical septic systems.
- Identifies sources of variability in the GHG emission rates that can be used as a basis for future studies.

RELATED PRODUCTS

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Methane and carbon dioxide are the primary GHGs found in emissions from the septic tank, while carbon dioxide and nitrous oxide are the primary GHGs from the soil dispersal system. Methane generation from the septic tank is the primary source of anthropogenic GHG emissions. The CO_2 equivalent GHG emission rates from septic tank systems determined using either the flux chamber or mass balance methods are relatively low compared to those for a citizen of an industrialized country (about 23.2 tonne CO_2e/capita·year; U.S. EPA, 2009). The results from this analysis indicate that septic tanks may not be a significant source of CO_2e emissions.

Implications of Findings

- Essentially no GHG emissions from the soil surface was measured, all system emissions were from the vent.
- There was considerable variability in methane fluxes from tank to tank.
- There was general agreement for methane and CO_2 rates measured by the two methods used in this study.
- COD in the tank effluent was approximately equal to the amount of carbon as CO_2 emitted from the dispersal system through the system vent.

Table 1. Estimates of Methane Emission Rates from Septic Tank Liquid Surface. (Date from Literature and this Study).

Method	Year	Methane estimate (g CH_4/capit·d)
Kinnicutt et al.	1910	10.1[a]
Winneberger	1984	14 to 18[a]
COD loading	2009	11[b]
IPCC	2007	25.5[c]
Sasse	1998	18[d]
This study	2009	11.0 (sg = 2.50)[a,e]

a Measured value.
b Calculated value assuming that 40 percent of solids are removed as septage.
c Calculated value assuming that all COD in the tank is converted into CH_4.
d Calculated value assuming 25 percent CH_4 dissolved.
e Geometric mean and standard deviation as determined using flux chamber method, this study.

Table 2. Comparison of GHG as CO_2e from the Septic Tank and Vent Average Measurements.

Compound	Geometric mean emission rate value (g/capita·d)			Carbon dioxide equivalent emissions (tonne CO_2e/capita·year)	
	Septic tank	Septic system[b]	GWP[a]	Septic tank	Septic system[b]
Methane	11.0	10.7	25	0.10	0.10
Nitrous oxide	0.005	0.20	298	0.00054	0.022
Carbon dioxide	33.3	335	1	0.012	0.12
Total GHG emissions				0.11	0.24
Total anthropogenic emissions[c]				0.10	0.12

a GWP for a 100 year horizon IPCC (2007).
b As determined from vent system sampling.
c Biogenic carbon dioxide is not included in GHG inventories (U.S. EPA, 2009).

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SEEDS

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