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METHANE EMISSIONS FROM ICELANDIC LANDFILLS – A COMPARISON BETWEEN MEASURED AND MODELLED EMISSIONS

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ABSTRACT

The total methane emissions from five Icelandic landfills were quantified using the tracer gas dispersion method in the period July-August 2017. The landfills included in this project were Álfnes, Fíflholt, Gufunes, Kirkjuferjuháleiga and Stekkjarvík landfills. Three of the landfills are still in operation (Álfnes, Fíflholt, Stekkjarvík) but two closed in 1991 and 2009 (Gufunes and Kirkjuferjuháleiga, respectively). Two or three measurement campaigns were performed at each site. The waste landfilled at four of the five sites combined (Álfnes, Fíflholt, Kirkjuferjuháleiga and Stekkjarvík) comprised approximately 78% of all traditionally landfilled waste in Iceland (considering the period of 2007-2016). No data on disposed waste amounts and compositions are available for Gufunes.

At each site, atmospheric concentrations of methane were measured to provide a qualitative assessment of the main points of methane emission, which was used to simulate the emission using a tracer gas. Also, measurements of background concentrations of methane in the surrounding area of each site were performed to evaluate possible interference of other nearby sources of methane emission. The total methane emission from each site was quantified by continuously releasing a gaseous tracer (acetylene) at a known rate while simultaneously measuring downwind atmospheric concentrations of methane and acetylene tracer gas.

The average methane emission rates measured from the five investigated landfills were 475.4 kg CH₄ h⁻¹ (Álfnes), 32.5 kg CH₄ h⁻¹ (Fíflholt), 40.8 kg CH₄ h⁻¹ (Gufunes), 9.8 kg CH₄ h⁻¹ (Kirkjuferjuháleiga) and 78.4 kg CH₄ h⁻¹ (Stekkarvík). At Álfnes, landfill gas collection was in operation during measurement operating at a collection rate of approximately 205 kg CH₄ h⁻¹, which corresponded to a methane recovery efficiency of 30% assuming that methane generation (680 kg CH₄ h⁻¹) equalled the measured methane emission (475 kg CH₄ h⁻¹) plus recorded methane collected (205 kg CH₄ h⁻¹) thus neglecting any methane oxidation in the landfill cover.

Methane emission rates were modelled using the IPCC 2006 FOD model and compared to measured emission rates. At three of the landfills (Álfnes, Fíflholt and Kirkjuferjuháleiga) the modelled emission was higher than the measured emission by a factor of 1.1 to 4.8. In the model, methane oxidation was not considered (assumed to be zero). By comparison with landfill methane oxidation rates

reported in the literature, it is likely that a part of the discrepancy between modelled and measured emission could be due to methane oxidation especially at sites with closed cells with well-established covers made of porous soils. Even though methane oxidation plays a role to some extent and thus reduces the gap between modelled and measured emissions, it is also very likely that the IPCC model overestimated the methane generation due to uncertainties related to waste amounts, compositions and categorisation, as well as input model parameters such as organic carbon contents, methane generation potentials, etc. At Stekkjarvík the modelled emission was lower than the measured (a factor of 1.9), which could be due to disposal of large amounts of mixed waste from industry and slaughterhouse waste, both likely having a higher methane potential than what was used in the model.

Combined, the emission from all five sites totalled 637.0 kg CH₄ h⁻¹, which compares relatively well with the national modelled emission of 936 kg CH₄ h⁻¹, especially when considering that the landfilled waste at four of the five investigated sites (Álfsnes, Fíflholt, Kirkjuferjuháleiga and Stekkjarvík) comprised such a large share of all landfilled waste in Iceland. Assuming that the measured emissions at the five landfills are representative of all the waste disposed in Iceland during the period from 2007 to 2016, the measured emission would be extrapolated to 817 kg CH₄ h⁻¹, which is relatively close to the modelled national emission.

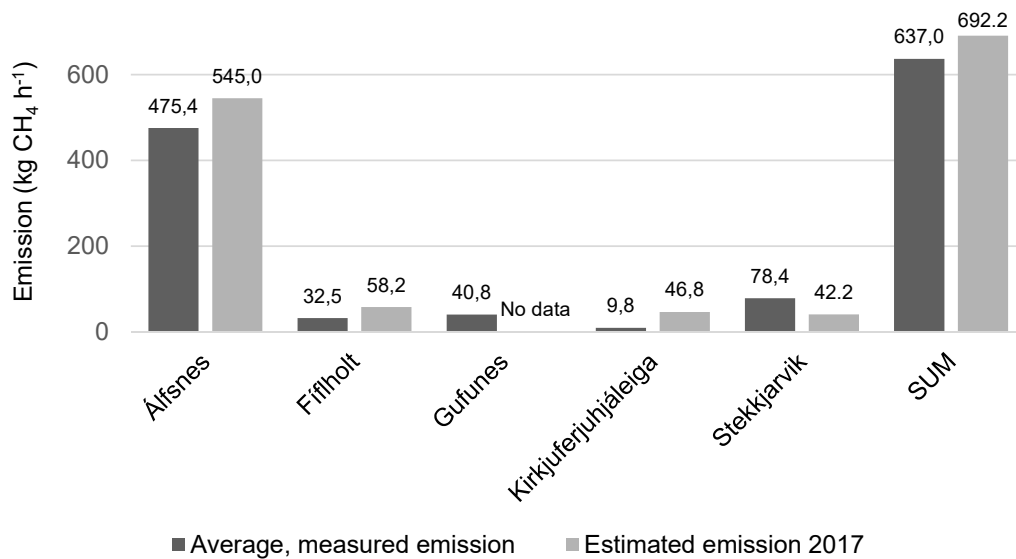


Figure 2. Comparisons of measured and estimated CH₄ emissions, using the IPCC FOD model.

The results of this study are presented in the following paper to be published in Waste Management. Please cite the original paper:

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