

Greenhouse Gas Emission Estimate
For
Status Quo Drilling Waste Handling

SCFCan Inc., August 2017

SCFCan is not aware of Greenhouse Gas (GHG) emission reporting levels by the drilling sector. This estimate has been prepared to facilitate an estimate of GHG emissions benefits associated with use of SCFCan's technology.

Status Quo Drilling Waste Handling Assumptions:

- The GHG emissions associated with the production of virgin base oil for drilling fluids is equivalent to the production of diesel fuel.
- The generated drilling waste consists of 15 wt% oil and is disposed of in landfills.
- Landfill gas collection is not practiced by the landfills used.
- Transportation of the waste to the landfills is not included.

Status Quo GHG Emissions:

Production of Virgin Base Oil:

GHG Emissions for diesel fuel is 1.19 kg_{CO2e}/kg_{Oil}.¹

Landfill GHG Emissions:

The Intergovernmental Panel on Climate Change (IPCC) recommends the use of one of two models to quantify methane emissions from landfills.² The IPCC default method (a mass balance method) has been used here.

$$\begin{aligned} \text{Methane Emissions per Waste Disposed} & \left(\frac{\text{kg}_{\text{CH}_4}}{\text{kg}_{\text{Waste}}} \right) \\ & = (MCF * DOC * DOC_F * F * \frac{16}{12} - R) * (1 - OX) \end{aligned}$$

where

¹ Natural Resources Canada, GHGenius Model 4.03a, 2013, Accessed September 2016.

² Froiland Jensen J.E. et al., CH₄ Emissions from Solid Waste Disposal, in *Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories*, www.ipcc-nggip.iges.or.jp/public/gp/bgp/5_1_CH4_Solid_Waste.pdf, p419-439

MCF is a methane correction factor (fraction; default value of 0.6; range 0.4 to 1.0 with higher values for more well maintained landfills)

DOC is the degradable organic carbon fraction of the waste ($\text{kg}_C / \text{kg}_{\text{Waste}}$; calculated from 15wt% oil in drilling waste and 86.1% C in diesel fuel)

DOC_F is the fraction of DOC dissimilated (IPCC default value of 0.77)

F is the fraction of methane in landfill gas (IPCC default value of 0.5)

R is recovered methane for landfills operating gas collection (a value of 0 has been used)

OX is an oxidation factor (IPCC default value of 0)

The result is a methane emission of 0.040 kg_{CH_4} per kg_{Waste} . Using the 15wt% oil in the waste translates into a methane emission of 0.265 kg_{CH_4} per kg_{Oil} disposed of.

Methane has a Global Warming Potential of 25 according to IPCC.³ Thus, the GHG emission associated with landfill disposal is 6.6 $\text{kg}_{\text{CO}_2\text{e}}/\text{kg}_{\text{Oil}}$.

TOTAL GHG Emission with current practice: 7.8 $\text{kg}_{\text{CO}_2\text{e}}/\text{kg}_{\text{Oil}}$ (virgin material production and end-of-life landfill emissions).

This result is an estimate only. The value will vary from one location to another, from one source of base oil to another and from one landfill to another.

³ 100 y time frame; www.ipcc.ch/publications_and_data/ar4/wg1/en/ch2s2-10-2.html#table-2-14)