

Supporting Information

On the Impact of Siloxane Impurities on the Performance of an Engine Operating on Renewable Natural Gas

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Table S1. Siloxane compounds in LFG and some of their properties, from Jalali et al.³².

Name	CAS Number	Formula	MW [g/mol]	Boiling Point [°C]	Vapor Pressure [mmHg]	Density [g/cc]
Hexamethylcyclotrisiloxane (D ₃)	541-05-9	C ₆ H ₁₈ O ₃ Si ₃	222.46	134	10	1.02
Octamethylcyclotetrasiloxane (D ₄)	556-67-2	C ₈ H ₂₄ O ₄ Si ₄	296.62	175	1.3	0.96
Decamethylcyclopentasiloxane (D ₅)	541-02-6	C ₁₀ H ₃₀ O ₅ Si ₅	370.77	210	0.4	0.96
Dodecamethylcyclohexasiloxane(D ₆)	540-97-6	C ₁₂ H ₃₆ O ₆ Si ₆	444.92	245	0.02	0.97
Hexamethyldisiloxane (L ₂)	107-46-0	C ₆ H ₁₈ OSi ₂	162.38	101	31	0.76
Octamethyltrisiloxane (L ₃)	107-51-7	C ₈ H ₂₄ O ₂ Si ₃	236.53	153	3.9	0.82
Decamethyltetrasiloxane (L ₄)	141-62-8	C ₁₀ H ₃₀ O ₃ Si ₄	310.69	194	0.55	0.85
Dodecamethylpentasiloxane (L ₅)	141-63-9	C ₁₂ H ₃₆ O ₄ Si ₅	384.84	230	0.07	0.88
Trimethylsilanol	1066-40-6	C ₃ H ₁₀ OSi	90.20	99	73.9	0.81

Table S2. Siloxanes limits in LFG and digester gas recommended by various engine manufacturers.²⁶

Engine Manufacturer	Siloxane, mg/m ³ in Landfill Gas
Waukesha	25
Jenbacher	10
Caterpillar	10
Deutz	5
Solar Turbines	0.1
IR Microturbines	0.06
Capstone Microturbines	0.03

Table S3. Oil analysis data for two used oil samples from the siloxane and non-siloxane engines.

Elements	1st oil sample		2nd oil sample	
	Non-Siloxane	Siloxane	Non-Siloxane	Siloxane
Sulfur (ppm)	2100	2200	2000	2000
Chlorine (ppm)	<50	<50	50	<50
Sodium (ppm)	<1	<1	<1	<1
Boron (ppm)	1	1	<1	<1
Silicon (ppm)	13	205	11	375
Iron (ppm)	27	24	34	25
Aluminium (ppm)	8	7	7	5
Chromium (ppm)	1	<1	<1	<1
Molybdenum (ppm)	163	149	112	110
Copper (ppm)	6	5	4	6
Lead (ppm)	<1	<1	<1	<1
Tin (ppm)	<1	<1	<1	<1
Nickel (ppm)	<1	<1	1	1
Titanium (ppm)	<1	<1	<1	<1
Silver (ppm)	<1	3	1	<1
Vanadium (ppm)	<1	<1	<1	<1
Manganese (ppm)	<1	<1	<1	<1
Phosphorous (%wt)	0.0714	0.0721	0.0725	0.0738
Zinc (%wt)	0.0932	0.0919	0.0852	0.0909
Calcium (%wt)	0.2099	0.2504	0.2044	0.2073
Magnesium (%wt)	0.0009	0.0009	0.0008	0.0008