

## Calculation Sheet 3

## Sewage Sludge Incineration - Fluidized Bed

## Polycyclic Aromatic Hydrocarbon (PAH) Emission Factors

Compound	CAS	Test Data (gram/dscm) Run 2	Test Data (gram/dscm) Run 3	Test Data (gram/dscm) Run 4	Test Data (gram/dscm) (ton/hr) Average	Emission Factor (lb/ton)
Sludge Throughput (ton/hr)		1.7	1.4	1.53		
<b>Non-Carcinogenic PAH</b>						
Acenaphthene	83-32-9	214	147	28.8	83.235	1.23E-05
Acenaphthylene	208-96-8	2280	2260	288	1047.899	1.54E-04
Anthracene	191-26-4	281	92.8	103	99.633	1.47E-05
Benzo(g,h,i)perylene	191-24-2	455	236	94	165.885	2.44E-05
Fluoranthene	206-44-0	5290	4110	1030	2240.227	3.30E-04
Fluorene	86-73-7	2010	1920	144	882.633	1.30E-04
Naphthalene	91-20-3	605000	431000	233000	272009.026	4.01E-02
Phenanthrene	85-01-8	44400	37300	8850	19514.939	2.87E-03
Pyrene	129-00-0	3540	2750	542	1466.962	2.16E-04
<b>Total Non-Carcinogenic PAH</b>						<b>4.38E-02</b>
<b>Carcinogenic PAH</b>						
Benzo(a)anthracene	56-55-3	182	441	90.7	160.447	2.36E-05
Benzo(b)fluoranthene	205-99-2	1620	1160	294	657.890	9.69E-05
Benzo(k)fluoranthene	207-08-9	1490	636	174	481.494	7.09E-05
Benzo(a)pyrene	50-32-8	147	60		64.664	9.52E-06
Chrysene	218-01-9	4690	2350	534	1595.472	2.35E-04
Dibenzo(a,h)anthracene	?-70-3	141	86	23.2	53.178	7.83E-06
Indeno(1,2,3-cd)pyrene	193-39-5	478	292	81.9	181.092	2.67E-05
<b>Carcinogenic Total</b>						<b>4.70E-04</b>

## 1) Assumptions:

- Test data from Reference a) provided in ng/dscm = nanogram per dry standard cubic meter, adjusts to 7% oxygen. Standard conditions, pressure and temperature defined as 1 atm (760 mm Hg) and 20C.
- PAH were evaluated as two groups: total non-carcinogenic (24-hour averaging period) and carcinogenic (annual averaging periods). Emission rates as Total PAH were compared as a whole to the lowest screening level for each of the two groups. This is consistent with assumptions of Reference 3c).
- Run 1 test data was invalidated by the authors of the source report and are therefore not used in this analysis.
- Benzo(a)pyrene in Run 4 was too low to be quantified and is not considered zero in the average.

## 2) Equations:

- Average Test Data (g/dscm)/(ton/hr) = {[Run 2 Test data (g/dscm) / Run 2 sludge throughput (ton/hr)] + [Run 3 Test data (g/dscm) / Run 3 sludge throughput (ton/hr)] + [Run 4 Test data (g/dscm) / Run 4 sludge throughput (ton/hr)]} / 3
- Emission Factor (lb/ton) = (Average Test Data (g/dscm)/(ton/hr)) x (1 g/1 x10<sup>9</sup> ng) x (1 lb/453.6 gram) x (1 dscm/3.283 dscf) x (11,979 dscf/min) x (60 min/hour)

## 3) References:

- Source Characterization For Sewage Sludge Incinerators, Final Emissions Report, September 2000, Table 4.1. "Summary of Data from Mill Creek WWTP Control Room Process Monitors" (sewage sludge feed rate in tons/hour)
- Source Characterization For Sewage Sludge Incinerators, Final Emissions Report, September 2000, Table 2.9. "PAH Results - Stack Gas Concentrations (ng/dscm, adjusted to 7% O<sub>2</sub>)"
- Recommendations of the Scientific Advisory Panel, Polycyclic Aromatic Hydrocarbons (PAH), July 20, 1995.