Bonsal

LFG EFD
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May 17, 1994

Refs. 18 & 19.
Data Qual.-C

To: Mike Lake

From: Dave Byrnes

Re: **LANDFILL GAS FIRED FLARE EMISSION FACTORS (4/94)**

The District has recently completed review of source test results from P/O applications for the Bonsall and Hillsborough landfills. Previous testing was completed by M&TS in 1992 at the Bell Jr. High and Arizona Street disposal sites. Emission factors for criteria pollutants from each site are provided in the following table;

Site	EMISSION FACTORS (LBS/MMBTU)				
	NOx	SOx	CO	PM10	ROG
SCAQMD Default factors	0.05	0.001	0.190	0.07	0.42
Arizona Street (Balboa Park)	0.08	0.008	<0.020	0.01	<0.06
Bell Jr. High School	0.06	0.011	<0.020	0.02	<0.06
Bonsall	0.04	0.030	0.003	0.02	0.01
Hillsborough	0.05	0.005	0.003	0.01	0.01
Proposed SDAPCD factors	0.08	0.030	0.003	0.02	0.01

The flares tested at Arizona Street (350 scfm) and Bell Jr. High (200 scfm) were manufactured by Surelite. The flares tested at Bonsall (450 scfm) and Hillsborough (175 scfm) were manufactured by Perennial. CO and ROG were not detected in the exhaust gas at Arizona Street or Bell Jr. High. ROG emissions at Bonsall and Hillsborough may be even lower than listed above due a high bias in results from the Method 25 test procedure used at these sites (speciated exhaust samples indicate much lower ROG concentrations but may be incomplete).

The SCAQMD factors are very high for CO, ROG, and PM10. This may be an indication of poor combustion occurring in the South Coast flares. Annual emission estimates using the proposed SDAPCD factors for typical facilities of different sizes are as follows;

LANDFILL FLARE EMISSION FACTORS

May 17, 1994

ESTIMATED EMISSION (LBS/DAY)

Facility Size	Est. SCFM	NOx	SOx	CO	PM10	ROG
100,000 tons	16	0.9	0.3	0.03	0.2	0.1
1,000,000 tons	163	9	4	0.4	2	1
5,000,000 tons	815	47	18	2	12	6
10,000,000 tons	1631	94	35	4	23	12
15,000,000 tons	2446	141	53	5	35	18
20,000,000 tons	3262	188	70	7	46	23

ESTIMATED EMISSION (TONS/YEAR)

Facility Size	Est. SCFM	NOx	SOx	CO	PM10	ROG
100,000 tons	16	0.2	0.1	0.01	0.04	0.02
1,000,000 tons	163	2	0.7	0.1	0.4	0.2
5,000,000 tons	815	9	3	1	2	1
10,000,000 tons	1631	17	6	2	4	2
15,000,000 tons	2446	26	10	3	6	3
20,000,000 tons	3262	34	13	4	8	4

District policy needs to be clarified regarding landfill flare testing for permitting purposes. Source test costs have been averaging $30,000 per site. Sampling and analytical charges usually account for $20,000 - $25,000 of the total cost. District staff review and witness fees average $5,000 - $10,000 per project. Since a dozen facilities are expected to install controls over the next few years, the cost / benefit of testing each system should be evaluated. Resources spent on nonessential testing could be used to accelerate the installation of controls at other sites.

District Rule 59(e)(2) states "every owner/operator of a landfill equipped with a landfill gas collection, energy recovery, gas purification, and/or disposal system shall analyze the concentrations of air contaminants including total organic compounds, toxic air contaminants and criteria pollutants except ozone emitted to the atmosphere from the system". Recent testing has repeatedly demonstrated consistent emissions from a variety of flares. Overall, flares significantly reduce existing emissions of both ROG and trace toxics released from disposal sites (average DRE is >98%).

Proposed NSR requirements will be applicable to sites with control systems that emit >10 lbs NOx/day. Flares are already considered BACT for NOx at landfills. Offset requirements in the proposed rule are not applicable unless potential NOx emissions exceed 15 tons/yr. As indicated above, aggregate gas collection systems with maximum collection rates of less than 1000 scfm are below this level.

I recommend testing of flares with incineration rates of >1000 scfm for some criteria and trace toxic emissions. The above factors should be used to analyze emissions from systems with a maximum collection rate of ≤1000 scfm.

cc: Teri Morris
Judy Lake
Tom Weeks

MEMO

April 12, 1994

To: Hillsborough File (APP 910837)

From: Dave Byrnes

Re: **HILLSBOROUGH SOURCE TEST RESULTS**

Results (Emission Factors) from the Hillsborough source testing performed in January 1994 are as follows;

NOx	0.053	lbs NOx/mmBTU
CO	0.0034	lbs CO/mmBTU
SOx	0.0045	lbs SOx/mmBTU
PM10	0.01	lbs PM10/mmBTU
TOG (inlet)	37.8	lbs TOG/mmBTU
TOG (outlet)	0.0095	lbs TOG/mmBTU
Est. TOG destruction efficiency	99.97%	
NMHC (inlet - method 25)	0.12	lbs NMHC/mmBTU
NMHC (outlet - method 25)	0.0095	lbs NMHC/mmBTU
Est. NMHC destruction efficiency	92.3%	(method 25)
NMHC (inlet - GC/MS speciated)	0.013	lbs NMHC/mmBTU
NMHC (outlet - GC/MS speciated)	0.00007	lbs NMHC/mmBTU
Est. NMHC destruction efficiency	99.4%	(GC/MS speciated)

Critical data for each emission calculation are summarized below;

EMISSION	TEST DATA		INFO SOURCE
NOx:			
- Average gas collection rate	=	144 dscfm	Table 2.1
	=	8,640 dscfh	= (144 x 60)
- Heat value	=	438 BTU/dscf	APP A pg1-3
	=	3.78 mmBTU/hr	= (8640 x 438)
- Emission rate	=	0.202 lbs NOx/hr	Table 2.1
	=	0.053 lbs NOx/mmBTU	= (0.202/3.78)
CO:			
- Average gas collection rate	=	144 dscfm	Table 2.1
	=	8,640 dscfh	= (144 x 60)
- Heat value	=	438 BTU/dscf	APP A pg1-3
	=	3.78 mmBTU/hr	= (8640 x 438)
- Emission rate	=	0.013 lbs CO/hr	Table 2.1
	=	0.0034 lbs CO/mmBTU	= (0.013/3.78)

MEMO

April 11, 1994

Ref. 19

To: Bonsall File (APP 920030) Data Qual. = C.

From: Dave Byrnes

Re: **BONSALL SOURCE TEST RESULTS**

Results (Emission Factors) from the Bonsall source testing performed in January 1994 are as follows;

NOx	0.042	lbs NOx/mmBTU
CO	0.003	lbs CO/mmBTU
SOx	0.03	lbs SOx/mmBTU
PM10	0.021	lbs PM10/mmBTU
TOG (inlet)	42.8	lbs TOG/mmBTU
TOG (outlet)	0.0085	lbs TOG/mmBTU
Est. TOG destruction efficiency	99.98%	
NMHC (inlet - method 25)	0.65	lbs NMHC/mmBTU
NMHC (outlet - method 25)	0.0085	lbs NMHC/mmBTU
Est. NMHC destruction efficiency	98.7%	(method 25)
NMHC (inlet - GC/MS speciated)	0.12	lbs NMHC/mmBTU
NMHC (outlet - GC/MS speciated)	0.0002	lbs NMHC/mmBTU
Est. NMHC destruction efficiency	99.8%	(GC/MS speciated)

Critical data for each emission calculation are summarized below;

EMISSION	TEST DATA	INFO SOURCE
NOx:		
- Average gas collection rate	= 340 dscfm	Table 2.1
	= 20,400 dscfh	= (340 x 60)
- Heat value	= 395 BTU/dscf	APP A pg1-3
	= 8.067 mmBTU/hr	= (20400 x 395)
- Emission rate	= 0.34 lbs NOx/hr	Table 2.1
	= 0.042 lbs NOx/mmBTU	= (0.34/8.067)
CO:		
- Average gas collection rate	= 340 dscfm	Table 2.1
	= 20,400 dscfh	= (340 x 60)
- Heat value	= 395 BTU/dscf	APP A pg1-3
	= 8.067 mmBTU/hr	= (20400 x 395)
- Emission rate	= 0.023 lbs CO/hr	Table 2.1
	= 0.003 lbs CO/mmBTU	= (0.23/8.067)

SOx:

- Average gas collection rate		=	340 dscfm	Table 2.1
		=	20,400 dscfh	= (340 x 60)
- Heat value		=	395 BTU/dscf	APP A pg1-3
		=	8.067 mmBTU/hr	= (20400 x 395)
- Emission rate		=	0.241 lbs SOx/hr	Table 2.1
		=	0.03 lbs SOx/mmBTU	= (0.241/8.067)

PM10:

- Average gas collection rate		=	340 dscfm	Table 2.1
		=	20,400 dscfh	= (340 x 60)
- Heat value		=	395 BTU/dscf	APP A pg1-3
		=	8.067 mmBTU/hr	= (20400 x 395)
- Emission rate		=	0.170 lbs PM10/hr	Table 2.1
		=	0.021 lbs PM10/mmBTU	= (0.17/8.067)

TOG (including methane):

- Average gas collection rate		=	340 dscfm	Table 2.1
		=	20,400 dscfh	= (340 x 60)
- Heat value		=	395 BTU/dscf	APP A pg1-3
		=	8.067 mmBTU/hr	= (20400 x 395)
- Emission rate	(inlet)	=	406,333 ppmv	pg 29 Table 6.1
	(inlet)	=	345 lbs TOG/hr	pg 29 Table 6.1
	(inlet)	=	16,912 lbs TOG/mmscf	= (345E6/20400)
	(inlet)	=	42.8 lbs TOG/mmBTU	= (345/8.067)
	(outlet)	=	6.9 ppmv TOG	APP B pg5
	(outlet)	=	0.068 lbs TOG/hr	= $\frac{(6.9)(3973)(60)(16)}{(1E6)(385)}$
	(outlet)	=	0.0085 lbs TOG/mmBTU	= (0.068/8.067)
- Est. TOG destruction efficiency		=	99.98%	= (345 - 0.068)/345

NMHC (Method 25 as methane):

- Average gas collection rate		=	340 dscfm	Table 2.1
		=	20,400 dscfh	= (340 x 60)
- Heat value		=	395 BTU/dscf	APP A pg1-3
		=	8.067 mmBTU/hr	= (20400 x 395)
- Emission rate	(inlet)	=	6,110 ppmv	APP B pg 4
	(inlet)	=	5.2 lbs NMHC/hr	= $\frac{(6110)(340)(60)(16)}{(1E6)(385)}$
	(inlet)	=	254.9 lbs NMHC/mmscf	= (5.2E6/20,400)
	(inlet)	=	0.65 lbs/mmBTU	= (254.9/395)
	(outlet)	=	6.9 ppmv	APP B pg5
	(outlet)	=	0.068 lbs NMHC/hr	= $\frac{(6.9)(3973)(60)(16)}{(1E6)(385)}$
	(outlet)	=	0.0085 lbs /mmBTU	= $\frac{(0.061E6)}{(20400)(395)}$
- Est. NMHC destruction efficiency		=	98.7%	= (5.2 - 0.068)/5.2

NMHC (GC/MS - speciated compounds):

- Average gas collection rate		=	340 dscfm	Table 2.1
		=	20,400 dscfh	= (340 x 60)
- Heat value		=	395 BTU/dscf	APP A pg1-3
		=	8.067 mmBTU/hr	= (20400 x 395)
- Emission rate	(inlet)	=	180 ppmv	APP A pgs 4-6
	(inlet)	=	0.94 lbs NMHC/hr	APP A pgs 4-6
	(inlet)	=	46.1 lbs NMHC/mmscf	= (0.94E6/20400)
	(inlet)	=	0.12 lbs/mmBTU	= (46.1/395)
	(outlet)	=	0.015 ppmv	APP A pgs 7-9
	(outlet)	=	0.0017 lbs NMHC/hr	APP A pgs 7-9
	(outlet)	=	0.0002 lbs /mmBTU	= (0.0017E6) / (20400)(395)
- Est. NMHC destruction efficiency		=	99.8%	= (0.94 - 0.0017)/0.94