Appendix A1 Calculations for Flue Gas Emissions from New Crematorium and Fugitive Dust Emissions Factors from Construction Site

Flue Gas Emissions from New Crematorium

The flue gas emission rates for 170 kg and 250 kg are 2500 $m^3$/hr (at 6.3% oxygen, 15.5% moisture, 200°C) and 4600 $m^3$/hour (at 11% oxygen, 12.7% moisture, 200°C). The diesel consumption rates for 170 kg and 250 kg cremators are 32.38 and 35.71 kg/hour respectively. There will be 4 units of 170 kg and 2 units of 250 kg cremator respectively. The emission of flue gas would be limited to the operational hours of the new crematorium, which is 9:30 and 19:30 daily.

Flue gas emission rates as adopted from Fu Shan Crematorium EIA report are as follows:

| **Cremator Capacity** | **Flue Gas Flow Rate** | **Oxygen Content** | **Moisture Content** | **Reference Temp.** |
|---|---|---|---|---|
| 170 kg | 2500 $m^3$/hour | 6.3 % | 15.5 % | 200°C |
| 250 kg | 4600 $m^3$/hour | 11 % | 12.7 % | 200°C |

Volumetric flue gas flow rates at s.t.p. (273 K, 101.325 kPa and 11% oxygen, dry condition are

(a) For 170 kg Cremator (at 11% oxygen, 273K, 101.325 kPa, dry condition)

= 2500 x (1 – 0.155) x (20.9-6.3)/(20.9-11) x 273/473
= 1798 $m^3$/hour

(b) For 250 kg Cremator (at 11% oxygen, 273K, 101.325 kPa, dry condition)

= 4600 (1-0.127) x 273/473
= 2318 $m^3$/hr

The design exit temperature of flue gas emission from the cremator after passing through air pollution control system is 120°C (393 K), the volumetric flue gas flow rate is calculated below:

(a) For 170 kg cremator (at 393 K)

= 2500 x 393/473
= 2077 $m^3$/hour

(b) For 250 kg cremator (at 393 K)

= 4600 x 393/473
= 3822 $m^3$/hour

At design efflux velocity of 15 m/s, chimney exit diameter is calculated below :

(a) For 170 kg cremator (at 393 K)

= $[(2077/(3600 \times 15) \text{ s } (4/\pi))^{0.5}$
= 0.22 m

(b) For 250 kg cremator (393 K)

= $[(3822/(3600 \times 15) \text{ s } (4/\pi))^{0.5}$
= 0.30 m

Flue gas would be discharged through high chimneys with height of 28.5 m. 6 chimneys would be divided into 2 groups and would be enclosed with concrete sheath.

Fugitive Dust Emission Factors from Construction Sites

According to AP-42 section 13.2.3.3
The emission factors for general construction activity operation is:
Emission rate = 2.69 megagrams (Mg)/hectare/Month of activity

Assume the construction activity occurs 30 days per month, 12 hours per day :
Emission rate = $2.69 \times 10^6$ gram /10000 $m^2$/(30 x 12 x 3600) sec
= $2.076 \times 10^{-4}$ gram/$m^2$/sec

According to AP-42 Table 11.9.4
The emission factor for wind erosion of open site is:
Emission rate = 0.85 Mg/hectare/year

Fugitive dust generation due to wind erosion is independent to the time of construction activity
Emission rate = $0.85 \times 10^6$ gram/10000 $m^2$/ (365 x 24 x 3600) sec
= $2.695 \times 10^{-6}$ gram/$m^2$/sec

Phase I Construction Work of the New Crematorium

Area of the construction site Phase I is 40m * 55m = 2200 $m^2$
Dust emission rates (TSP) from Phase I construction site are:

- Construction activity, 12 hours per day
  = ($2.076 \times 10^{-4} \times 2200$)
  = 0.4567 gram/sec

- Wind erosion, 24 hours per day
  = ($2.695 \times 10^{-6} \times 2200$)
  = 0.005929 gram/sec

Phase II Construction Work of the New Crematorium

Area of the construction site Phase II is 65m * 75m = 4875$m^2$
Dust emission rates (TSP) from Phase I construction site are:

- Construction activity, 12 hours per day
  = ($2.076 \times 10^{-4} \times 4875$)
  = 1.012 gram/sec

- Wind erosion, 24 hours per day
  = ($2.695 \times 10^{-6} \times 4875$)
  = 0.01314 gram/sec