

Appendix 3.2 Detailed Calculations of Emission from New Cremators at Cape Collision Crematorium

O _a :	Oxygen concentration of flue gas, dry gas
O _s :	Standard oxygen concentration, dry gas
C _{a, dry, O_a} :	Actual flue gas concentration, dry gas, O _a
C _{a, dry, O_s} :	Actual flue gas concentration, dry gas, O _s
C _{a, wet, O_a} :	Actual flue gas concentration, wet gas, O _a
C _s :	Flue gas concentration at standard conditions
V _{a, dry} :	Volume of flue gas at emission point, dry gas
V _{a, wet} :	Volume of flue gas at emission point, wet gas
V _s :	Volume of flue gas under standard condition, dry gas
M:	Mass of pollutant in flue gas
%H ₂ O:	% of moisture in flue gas
P _a :	Pressure of flue gas at emission point
P _s :	Standard pressure
T _a :	Temperature of flue gas at emission point
T _s :	Standard temperature

In accordance with Annex VI of EU Directive 200/76/EC,

$$C_{a, \text{ dry, } O_a} = C_{a, \text{ dry, } O_s} \times (20.9 - O_a) / (20.9 - O_s) \quad (\text{eqn. 1})$$

$$C_{a, \text{ dry, } O_a} = M / V_{a, \text{ dry}} \quad (\text{eqn. 2})$$

$$= M / [V_{a, \text{ wet}} \times (1 - \%H_2O)] \quad (\text{eqn. 3})$$

$$C_{a, \text{ wet, } O_a} = M / V_{a, \text{ wet}}$$

$$= C_{a, \text{ dry, } O_a} \times (1 - \%H_2O) \quad (\text{from eqn. 3})$$

$$= C_{a, \text{ dry, } O_s} \times (1 - \%H_2O) \times (20.9 - O_a) / (20.9 - O_s) \quad (\text{from eqn. 1})$$

$$C_s = M / V_s \quad (\text{eqn. 4})$$

$$C_s = M / V_s \quad (\text{eqn. 5})$$

By standard gas law,

$$P_a \times V_{a, \text{ dry}} / T_a = P_s \times V_s / T_s$$

Since $P_a = P_s$,

$$\text{Therefore, } V_{a, \text{ dry}} / T_a = V_s / T_s$$

From eqn. 2 and eqn. 5,

$$(M / C_{a, \text{ dry, } O_a}) / T_a = (M / C_s) / T_s$$

Therefore,

$$C_{a, \text{ dry, } O_a} = C_s \times T_s / T_a$$

From eqn. 4,

$$C_{a, \text{ wet, } O_a} = C_s \times (T_s / T_a) \times (1 - \%H_2O) \times (20.9 - O_a) / (20.9 - O_s)$$

Appendix 3.2 Detailed Calculations of Emission from New Cremators at Cape Collision Crematorium

For Cape Collision Cremator, for any pollutant,

For 170kg/cycle line:

O_a= 6.3%

O_s= 11%

%H₂O= 15.5%

T_a= 393K

T_s= 273K

For 250kg/cycle line:

O_a= 11%

O_s= 11%

%H₂O= 12.7%

T_a= 393K

T_s= 273K

Therefore,

For 170kg/cycle line:

$$C_a, \text{ wet, } O_a = C_s \times (273K / 393K) \times (1 - 0.155) \times (20.9 - 6.3) / (20.9 - 11) \\ = 0.866 C_s$$

For 250kg/cycle line:

$$C_a, \text{ wet, } O_a = C_s \times (273K / 393K) \times (1 - 0.127) \times (20.9 - 11) / (20.9 - 11) \\ = 0.606 C_s$$

Exit Velocity=	15 m/s
Exit Diameter for 170kg line=	0.22 m
Exit Diameter for 250kg line=	0.3 m
The actual flow rate for 170kg line, at 200°C=	2500 m ³ /hr
The actual flow rate for 250kg line, at 200°C=	4600 m ³ /hr
The discharge flow rate for 170kg line, at 120°C =	2,077 m ³ /hr
The discharge flow rate for 250kg line, at 120°C =	3,822 m ³ /hr

Air Pollutant	Target Emission Limits (mg m ⁻³)	Emission Rate (g/s)	
		170kg line	250kg line
Particulates	40	1.998E-02	2.575E-02
SO ₂	180	8.991E-02	1.159E-01
NO _x	380	1.898E-01	2.447E-01
Carbon Monoxide (CO)	100	4.995E-02	6.438E-02
Gaseous or vaporous organic substances	20	9.989E-03	1.288E-02
Hydrogen Chloride (HCl)	30	1.498E-02	1.931E-02
Mercury	0.05	2.497E-05	3.219E-05
Dioxins & Furans (ng I-TEG/m ³)	0.1	4.995E-11	6.438E-11

不來格號
 OUR REF: (33) in Ax(1) to EP2/H20/N/04
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10 April 2008

By Fax (2891 0305)

ENSR Asia (HK) Limited
(Attn. Mr. Derek LAM)

Dear Mr. Lam,

**Phased Re provisioning of Cape Collinson Crematorium
Environmental Impact Assessment Study
(EIA Study Brief No. : ESB – 177/2008)**

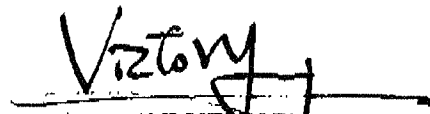
Agreement on Target Emission Levels for the New Cremators

We refer to your letter (ref. 60028568/C/dcf1803251) dated 25 March 2008 seeking our comment on the proposed Target Emission Levels for the air quality assessment for the captioned project under s.3.4.1.3 (iv)(a) of the EIA Study Brief.

We have no major comment on the proposed target emission levels of the pollutants for the new cremators and you may proceed with the quantitative assessment on operational air quality impact. Please also be reminded to state clearly the reason and basis for the proposed target emission levels, in particular for Nitrogen Oxides and Sulphur Dioxide in the EIA report.

Should you have any further queries, please feel free to contact the undersigned.

Yours faithfully,


(Victor W T YEUNG)

Senior Environmental Protection Officer
for Director of Environmental Protection

c.c. ArchSD (Attn. Mr. W K LAI) Fax: 2290 2216
FEHD (Attn. Mr. SHUM Nam-lung) Fax: 3101 0450

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By Post & Fax (2591 0558)FAXED
DATE: 25/3/08Environmental Protection Department
27/F Southorn Centre
130 Hennessy Road
Wan Chai
Hong KongAttn: Ms. Mable Chan

25 March 2008

Dear Madam,

**Phased Re-provisioning of Cape Collison Crematorium
Environmental Impact Assessment Study****Agreement on Target Emission Levels for the New Cremators**

We refer to your fax (ref. (26) in Ax(1) to EP2/H20/N/04) dated 18 February 2008 regarding the comments on the proposed Target Emission Levels for the new cremators.

In accordance with Clause 3.4.1.3 (iv) (a) of the EIA Study Brief no. ESB-177/2008, we have compared the concentration limits specified in the latest *Guidance Notes on the Best Practice Means for Incinerators (Crematoria), BPM 12/2 (06)* with other relevant overseas standards. For the purpose of this EIA, the concentration limits stipulated in the *BPM 12/2 (06)*, being the more stringent ones, would be adopted as the target emission levels. A comparison table is enclosed for your easy reference.

We would be grateful to receive your agreement on the proposed target emission levels for the new cremators on or before 1 April 2008 to enable us for commencement of the air quality assessment. Should you have any queries, please contact our Ms. Christine Tam at 3105 8568.

Yours faithfully,
For and on behalf of
ENSR Asia (HK) Ltd



Derek Lam
Senior Environmental Consultant

Encl.

cc ASD – Mr. W.K. Lai (w/encl.)

Fax: 2290 2216

Target Emission Levels for the New Cremators

Air Pollutants	Proposed Target Emission Levels of the New Cremators	Emission Limit of BPM 12/2	Overseas Emission Standards	
			Australia ⁽³⁾	UK ⁽⁴⁾
Particulates (RSP)	40 mg/m ³	40 mg/m ³	250 mg/m ³	40 mg/m ³
Gaseous and vaporous organic substances, expressed as total organic carbon	20 mg/m ³	20 mg/m ³	226 mg/m ³	20 mg/m ³
Hydrogen chloride (HCL)	30 mg/m ³	30 mg/m ³	200 mg/m ³	30 mg/m ³
Carbon monoxide (CO)	100 mg/m ³	100 mg/m ³	150 mg/m ³	200 mg/m ³
Mercury and its compounds, expressed as mercury (Hg)	0.05 mg/m ³	0.05 mg/m ³	3 mg/m ³	0.05 mg/m ³
Polychlorinated dibenzodioxins and polychlorinated dibenzofurans	0.1 ng I-TEQ/m ³	0.1 ng I-TEQ/m ³	-	0.1 ng I-TEQ/m ³
Nitrogen Oxide (expressed as NO ₂) ⁽²⁾	380 mg/m ³	-	500 mg/m ³	-
Sulphur Dioxide ⁽²⁾	180 mg/m ³	-	-	-

Note:

1. All air pollutant concentrations are expressed at reference conditions of temperature 273 K, pressure 101.3 kPa, 11% oxygen and dry gas
2. Reference to the Ministry of Public Safety & Solicitor General, British Columbia, Canada – Crematorium Operations and Emissions.
3. Reference to Crematorium Furnace, Environmental Guidelines for Crematoria and Cremators, April 2004, Australasian Cemeteries & Crematoria Association.
4. Reference to the Process Guidance Note 5/2(04) – Secretary of State's Guidance for Crematoria 2004, Cremation Society of Great Britain.