Addendum - Combustion in Boilers

This addendum coincides with the first reprint of the manual. It consists of a number of minor editorial changes. The most substantive changes relate to the use of direct measurement to estimate emissions (Section 3.1).

- **2.2.1 Emissions to Air**
  
  **Point Source Emissions**
  
  ‘These emissions are exhausted into a vent or stack…’ changed to ‘These emissions are exhausted into a vent (excluding roof vents) or stack…’

- **2.2.2 Emissions to Water**
  
  Sentence added - ‘However leakage and other emissions (including dust) from a tailings storage facility are reportable.

- **3.0 Emission Estimation Techniques**

  Paragraph inserted at end of section:

  The usage\(^a\) of each of the substances listed as Category 1 and 1a under the NPI must be estimated to determine whether the 10 tonnes (or 25 tonnes for VOCs) reporting threshold is exceeded. If the threshold is exceeded, emissions of these Category 1 and 1a substances must be reported for all operations/processes relating to the facility, even if the actual emissions of the substances are very low or zero.

  Usage is defined as meaning the handling, manufacture, import, processing, coincidental production or other uses of the substances.

- **3.1.1 Sampling Data**
  
  References to ‘dry standard’ changed to ‘dry’.

- **Equation 3**

  Paragraph preceding equation amended to read as follows:

  ‘The information from some stack tests may be reported in grams of particulate per cubic metre of exhaust gas (wet)….’

  Replaced ‘\( Q_a = \) actual cubic metres of exhaust gas per second (\( \text{m}^3/\text{s} \))’ with ‘\( Q_w = \) wet cubic metres of exhaust gas per second, \( \text{m}^3/\text{s} \)’

  \[ (1 – \text{R}/100) \] with \( (1-\text{moistR}/100) \) where \( \text{moistR} = \) moisture content

  - Use Equation 4 to calculate moisture content:

  **Equation 4**

  Moisture percentage = \( 100\% \times \frac{\text{g}_{\text{moist}}}{(1000 \times \text{V}_{\text{w,STP}})} \times \frac{\text{V}_{\text{w,STP}}}{\rho_{\text{STP}}} \)

  where

  \( \text{moistR} = \) moisture content, \%

  \( \text{g}_{\text{moist}} = \) moisture collected, g

  \( \text{V}_{\text{w,STP}} = \) metered volume of sample at STP, \( \text{m}^3 \)

  \( \rho_{\text{STP}} = \) dry density of stack gas sample, kg/m\(^3\) at STP

  {if the density is not known a default value of 1.62 kg/m\(^3\) may be used. This assumes a dry gas composition of 50% air, 50% CO\(_2\) }

- **Table 6** deleted \( Q_a \) and results for \( \text{EPM} \)

- **Example 1**

  Equation calculating \( \text{EPM} \) changed to:

  \( \text{EPM} = C_{\text{PM}} \times Q_a \times 3.6 \times [273 / (273 + T)] \)

  \[ = 0.072 \times 8.48 \times 3.6 \times [273/423 \text{ K}] \]

  \[ = 1.42 \text{ kg/hr} \]

  - Example 2 changed to:
Example 2 - Using CEMS Data

This example shows how SO₂ emissions can be calculated using Equation 5 based on the CEMS data for Time Period 1 shown in Table 7, and an exhaust gas temperature of 150°C (423 K).

\[
E_{SO₂,1} = \frac{(C \cdot MW \cdot Q \cdot 3600)}{(22.4 \cdot (T+273/273) \cdot 10^6)}
\]

\[
= \frac{(150.9 \cdot 64 \cdot 8.52 \cdot 3600)}{(22.4 \cdot (423/273) \cdot 10^6)}
\]

\[
= 296217907 / 34707692
\]

\[
= 8.53 \text{ kg/hr}
\]

For Time Period 2, also at 150°C

\[
E_{SO₂,2} = 8.11 \text{ kg/hr}
\]

For Time Period 3, also at 150°C

\[
E_{SO₂,3} = 7.23 \text{ kg/hr}
\]

Say representative operating conditions for the year are:

- Period 1 = 1500 hr
- Period 2 = 2000 hr
- Period 3 = 1800 hr

Total emissions for the year are calculated by adding the results of the three Time Periods using Equation 6:

\[
E_{kpy,SO₂} = E_{SO₂,1} \cdot \text{OpHrs} + E_{SO₂,2} \cdot \text{OpHrs} + E_{SO₂,3} \cdot \text{OpHrs}
\]

\[
= (8.53 \cdot 1500) + (8.11 \cdot 2000) + (7.23 \cdot 1800) \text{ kg}
\]

\[
= 42021 \text{ kg/yr}
\]

Emissions, in terms of kg/tonne of oil consumed when operating in the same mode as Time Period 1, can be calculated using Equation 7

\[
E_{kpt,SO₂} = \frac{E_{SO₂}}{A}
\]

\[
= \frac{8.53}{290}
\]

\[
= 2.94 \times 10^{-2} \text{ kg SO₂ emitted per tonne of oil consumed.}
\]

When the boiler is operating as in Time Periods 2 or 3, similar calculations can be undertaken for emissions per tonne.

- **Equation 7** (Equation 8 in Version 1.01 of Manual)
  ‘/100’ inserted after ‘pollutant concentration in fuel’
  ‘Concentration of pollutant in fuel expressed as weight percent, %’ added after equation.

- **Equation 8** (Equation 9 in Version 1.01 of Manual)
  ‘*’ inserted between ‘…OpHrs’ and ‘EF’

- Equation in **Example 4** changed to:

  \[
  E_{kpy,i} = A \cdot EF \cdot [1 - (CE/100)]
  \]
  \[
  E_{kpy,NOx} = 600 \text{ t/yr} \cdot 16.5 \text{ kg/t} \cdot [1 - (80/100)]
  \]
  \[
  = 9900 \cdot 0.2
  \]
  \[
  = 1980 \text{ kg/yr}
  \]

- NB: There has been some general re-formatting of Tables, Equations, Figures and Examples. Equation numbers jump 1 place after Equation 4. Eg. Equation 4 in original (February 1999) version is Equation 5 in Version 1.01.