PCDD/F in Waste Incineration


PCDD/F in Coal Combustion

- Main reasons for only little PCDD/F denovo synthesis in coal combustion are:
  - the high quality design of the combustion process with respect to controlled combustion and optimal burnout,
  - stationary conditions (except of regular load changes)
  - particulate scrubbers for fly ash separation (ESP, FF) working well below 200 °C,
  - the native chlorine contents in combination with comparatively low sulfur contents in the fired coals lead to high S/Cl mass ratios (see graphs below) - except at coal-fired CFBS with primary deaeration by limestone/mg addition into the fluidized bed.
- Addition of bromide is far more effective in mercury oxidation than that of chlorine, because the high-temperature decomposition of bromine salts provides far fewer halogenides. Vosteen 2002, 2003.
- In addition to SO2 reduction at high temperatures (Chlorine Griffin Reaction), thus inhibiting mercury chlorination.
- However, Br2 is reduced by SO2 back to HCl already at high temperatures in the APC system (Bromine Griffin Reaction), but not at high temperatures, and is therefore available to oxidize elemental mercury forming mercury bromide all over the boiler temperature range – even in presence of SO2. Kanafa 2008.

Bromide Addition to Waste or Coal

- Enhanced Mercury Oxidation is achieved by Pre-combustion Halogenide Addition to the feed fuels (Waste oiled coal) – as successfully demonstrated in commercial scale with BAYER / Currenta since 2001. Vosteen 2002.
- Addition of bromide is far more effective in mercury oxidation than that of chlorine, because the high-temperature decomposition of bromine salts provides far fewer halogenides. Vosteen 2002, 2003.
- Cl2 is reduced by SO2 back to HCl already at high temperatures (Chlorine Griffin Reaction), thus inhibiting mercury chlorination.
- However, Br2 is reduced by SO2 back to HBr only at low temperatures in the APC system (Bromine Griffin Reaction), but not at high temperatures, and is therefore available to oxidize elemental mercury forming mercury bromide all over the boiler temperature range – even in presence of SO2. Kanafa 2008.

Native Bromine in Fossil Fuels

- Chlorine and bromine are present in all fossil fuels. The Br/Ci ratio in coal is normally about only 0.01 – 0.04 (in the mean 0.02). Vassilev 2000, Vosteen 2010, Vainikka 2012, Kolker 2012.
- The S/Br mass ratio is normally >> 250 (i.e. at least two orders of magnitude greater than the S/Cl mass ratio of the fired coals).
- Modern coal-fired boilers therefore yield very low PCDD/F concentrations in the boiler raw gas respectively at the stack. Mean stack emissions at PC-fired boilers are typically well below 0.01 ng I-TEQ/Nm3 (e.g. 0.003 ng I-TEQ/Nm3). Funcke 1997, 2012, Lechner 2007.

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