Bromine based Mercury Abatement in Power Generation and Waste Combustion

Bernhard W. Vosteen, Vosteen Consulting, Harald K. Reissner, AE&E Austria

VOSTEEN Mercury Control Technology

- Invented by Professor Dr. Bernhard Vosteen et al. in 2000 - still in his time with CURRENTA GmbH & Co OHG and patented by her
- commercially applied to waste incineration plants and power plants since 2001
- A specific bromine-containing chemical Merquel™ from ICL-IP is added to the coal prior to the combustion process to enhance mercury oxidation
- AE&E (Austrian Energy & Environment) has licensed rights to the technology from Vosteen Consulting to market to the power generation and waste incineration industry in Europe and some other countries as e.g. in China or India

What makes the VOSTEEN Technology Unique?

- Pre-combustion Merquel™ addition is the most effective method to enhance mercury oxidation from coal-fired boilers and industrial processes
- Merquel™ from ICL-IP is already used by the power generation industry and the waste incineration industry; The additive is cost-effective and readily available
- The VOSTEEN Technology is simple and inexpensive to retrofit to any boiler
- The VOSTEEN Technology presents no adverse impacts on the performance of the boiler or downstream the FGD equipment when applied correctly and the FGD operation parameters are optimized according to AE&E’s MERQUER SEPARATION Optimization Skid

Strong Triangle VOSTEEN+AE&E+MERQUEL™

- Combination of Simple Technology, high efficient additive and long term experience in the installation of Air Pollution Control Systems especially in China
- AE&E Wet FGD Technology is installed for more than 120.000 MW of coal fired power plant capacity in China
- AE&E’s Air Pollution Control Technologies including DeNOx- Systems, Dry Desulphurization Systems and Wet Flue Gas Desulphurization Systems is used from more than 10 Licensees in China

Reaction Mechanism

- Oxidized Mercury can be captured very easy, elemental mercury is difficult to capture
- Merquel™ (containing Bromine) is added to the coal prior to combustion. In the flame, all Hg is elemental: Hg⁰
- Native and added Cl⁻ and Br⁻ in the coal form HCl and HBr. On cooling (starting around 1000 °C) following reactions can be found:
  4HCl + O₂ → 2H₂O + Cl₂
  4HBr + O₂ → 2H₂O + Br₂
- Elemental Hg⁰ is effectively oxidized by Br₂ to form HgBr₂

Scrubber operation and Mercury Capture

The oxidized Mercury is mainly captured in the wet scrubber of the FGD system and is found in the scrubber suspension due to complexation with halogen ions.

\[ HgCl₂ + X⁻ → HgClX₂ \]
\[ HgBr₂ + X⁻ → HgBrX₂ \]

Injection of Merquel™ in the Process

- Spraying Merquel™ solution on the coal to the conveyor belt during silo charging.
- Spraying Merquel™ solution on the coal stream from the coal feeders to the mills.
- 1000 liter Merquel™ solution container for tests at stationary FB
- Sewage Sludge Incinerator
- 10,000 liter Merquel™ solution container for long time test at coal-fired boiler (710 MW)

Process Requirement: Uniform distribution of the additive in boiler flue gas in order to provide uniform Hg oxidation of all flue gas (see Rini, Vosteen in Proceedings of MEGA Symposium 2008, Baltimore)

Large Scale Demonstration

The Technology has demonstrated its First Class Performance in the Power Generation and Waste combustion since more than 5 years.

Waste Combustion at CURRENTA GmbH & Co OHG in Germany:

- Relationship between Bromine Dosage and Mercury Separation Efficiency (see Vosteen, Kanefke, Kösar in VGB PowerTech 86 (2006), p. 70 - 75)
- Alabama Power Plant Miller (4 x 710 MW) - Demonstration Project in 2006 (Phase I) and 2008 (Phase II) (Foto: Vosteen Consulting)
- Mercury content up- and downstream wet limestone scrubber system (see Dombrowski, Berry, Vosteen et al. in Proceedings of MEGA Symposium 2008, Baltimore)