GE Power Systems

GE Power Systems' Mercury Control Through Combustion Optimization

In response to emerging multi-pollutant emissions regulations, utilities are currently considering the application of control technologies such as injection of activated carbon and other sorbents for capture of mercury emissions from coal fired utility boilers. Using these technologies to control mercury emissions from coal fired utility boilers will be challenging and potentially costly. GE Power Systems is developing a method of controlling mercury through optimization of combustion conditions and coal composition to increase mercury removal with existing particulate control devices (PCD).

Retrofitting with low-NO_x burners, overfire air injection or reburn tends to promote mercury oxidation and increase the reactivity of fly ash to mercury absorption. During this process, mercury is absorbed onto the carbon present in fly ash when the fly ash cools to temperatures below 400°F, typical of conventional PCDs. This absorption is similar to mercury removal by activated carbon injection but is absorbed on the fly ash generated in the combustion process.

GE Power Systems has been conducting coal-screening tests to assist utilities and coal suppliers in identifying optimal conditions and assessing options for mercury control. Tests are conducted in a pilot-scale, 1MMBtu/hr boiler simulator facility (BSF). The BSF is designed to simulate a coal-fired boiler consisting of a burner, vertically down-fired radiant furnace, and horizontal convective pass. The unit can be equipped with either an electrostatic precipitator (ESP) or a baghouse for particulate control.

The BSF is configured to match the gas time-temperature profile, furnace exit gas temperature, and PCD temperature of the specific coal-fired boiler. Pulverized coal is fired over a range of combustion settings and then mercury emissions are measured upstream and downstream of the unit PCD. The measurements are made using an online mercury analyzer that is capable of measuring both elemental (Hg^0) and oxidized (Hg^{+2}) mercury in the gas phase. Samples of fly ash are also collected and analyzed for carbon, loss on ignition (LOI) and mercury content.

Testing with different coals and furnace conditions has shown that mercury removal efficiency ranges from 10% to near 100%. To control mercury emissions to levels of interest to utilities requires fine control of the combustion conditions and coal properties. Testing in the BSF has demonstrated that optimization of combustion conditions to form reactive fly ash improved the efficiency of NO_x reduction and could result in close to 100% mercury removal in combustion systems equipped with a baghouse or ESP. The combustion conditions and the amount of carbon in fly ash are maintained by integrating online furnace sensors with the combustion control systems and optimization testing services. Coal blending and combustion control can optimize mercury capture even for low rank coals such as Powder River Basin and lignites.

Maintaining the proper range of optimal combustion conditions has been difficult to achieve in practice. Advances in GE Power Systems' sensor and combustion control technology provide the capability for real time combustion optimization and control, which could allow reliable mercury emissions reduction and can be expected to provide an efficient and cost-effective strategy for mercury control.

For more information contact:

Dr. Randy Seeker
GE Power Systems
randy.seeker@ps.ge.com
(949) 859-8851, Ext. 120