Balancing Fuel and Air to Improve Combustion and Boiler Efficiency when Co-firing Coal with Biomass

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When coal-fired boilers are retrofitted for co-firing with biomass, mixed fuel properties and fuel and air distribution in combustion system become critical to furnace combustion efficiency and emissions control. This paper discusses about our experience in both aspects.

When co-firing coal with biomass, due to fuel flow characteristics, the flow distribution is typically non-uniform across the splitter. Non-uniform distribution results in lower efficiency due to poor combustion. Computational Fluid Dynamics (CFD) modelling can be used for numerical investigation to modify the PF piping system. A VARB® (Variable Area Rope Breaker) and Control-Gate® system are customized and designed to control the fuel distribution between all fuel pipes within ±5% at all loads. In a case study, these systems have been applied to 500 MWe coal-fired boilers. As a result, due to better fuel distribution and hence better combustion, 4% decrease in unburnt carbon from baseline and further 1% reduction in fuel input have been achieved.

In another case study, a retrofit of co-firing biomass up to 45% by heat, as well as installing an advanced OFA (AOFA) system have been completed on a 50-MW coal-fired boiler. Biomass is delivered to site in pellets and is stored and handled at site by a complete handling and processing system. After pulverized in hammer mills, biomass is fed and transported into the furnace through biomass burners (one burner per corner) through direct injection. AOFA system has also been installed to facilitate the co-firing of biomass by improving combustion performance and biomass burnout in the upper furnace through strong turbulent mixing by AOFA system. The combined effect of biomass co-firing with AFOA resulted in a NOx emission below 200 mg/Nm3, while the loss-on-ignition (LOI) is maintained below 5%; and the CO emissions were held below 100 mg/Nm3.