P.12 Fuel Flexibility in Combustion

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Abstract

This poster presents research findings from cofiring studies of various biomass feedstocks such as pentachlorophenol (PCP) and creosote-treated wood, lumber mill and furniture waste sawdusts, pallets, feedlot biomass (cattle manure), hybrid willow, and switchgrass with several bituminous and subbituminous coals. This research includes evaluation of advanced instrumentation and the study of interrelated combustion/emissions issues, such as char burnout, impacts on SO_2, NO_x, fine particulate ($PM_{2.5}$), mercury (Hg) and other trace emissions, as well as issues impacting heat transfer, such as ash deposition slagging/fouling behavior. Biomass cofiring in large industrial and utility coal-fired boilers is a practical approach for increasing renewable energy given the wide availability, capital investment, and established performance of coal-fired boilers for providing efficient, low cost power. Although some utility biomass cofiring is successfully practiced in the U.S. and abroad, establishing long-term reliability and improving economics are still significant needs, along with research to support advanced combustion in future Vision 21 systems.

Biomass cofiring in Vision 21 systems may reduce fossil CO_2 emissions per MWe at capital and operations/maintenance cost savings relative to other technology options. Because an increasing number (currently 14) states have recently passed legislation establishing renewable portfolio standards (RPS), goals, or set-asides that will impact new power generation by 2009 and beyond, cofiring may broaden the appeal of Vision 21 systems to solve other environmental issues, including reducing landfill requirements. Legislation has been proposed to establish a federal RPS as well as extend IRS Section 29/45 tax credits (e.g., $0.005-0.010/kW-hr) for cofiring residues to supplement existing incentives, such as a $0.015/kW-hr tax credit for closed loop biomass (e.g., energy crops, such as switchgrass, hybrid willow) gasification. In addition, the coproduction/cogeneration concepts embodied in Vision 21 may also lend itself well to the type of utility/industry partnering involved in cofiring approaches.

In light of the cost limitations in shipping distance (e.g., 50-100 miles or less) from collection to end-use based on the low energy density of biomass, resource availability is a site-specific consideration. Biomass fuels also exhibit significant differences in fuel characteristics, including volatility and ash chemistry that can also influence cofiring performance.

Pilot-scale biomass cofiring tests have been conducted in the 150 kWt Combustion and Environmental Research Facility (CERF). A key aspect of the present work is to examine biomass char conversion for a range of initial particle sizes at various residence times for combustion relative to fuel processing/handling issues. In addition, a number of biomass cofiring R&D as well as full-scale utility demonstrations are providing technical insights to assist in cofiring technology commercialization. The paper will also discuss research plans, including

lignin cofiring for ethanol/power co-production, novel concepts involving animal waste utilization, advanced combustion studies, and tri-firing concepts with other fuels.