Cofiring Coal with Dairy Biomass

INTRODUCTION

Growing rates of manure produced from large confined animal feeding operations and repeated application of manure on the same parcels of land have increased concerns for the environmental quality of nearby streams and watersheds. Investigators at Texas A&M are exploring and developing small scale, onsite thermo-chemical conversion technologies for agricultural animal wastes. The ultimate goals are to minimize the required capacities of manure storage lagoons and associated land application of solids. Electrical and thermal energy for the farm is a secondary goal. Potential applications of such technologies in the Waco/Bosque River area are also being investigated.

Subtasks

- Conduct a thorough literature review of current biomass combustion systems.
- Perform parametric studies cofiring coal and dairy biomass varying fuel type, blend ratios, and equivalence ratios. Fuels are fired in a 100,000 BTU/hr boiler burner.
- Study the effect of swirl number on NOx production from cofiring.
- Studies ash fouling on heat exchanger tube to determine affect on over heat transfer coefficient.
- Study dairy biomasses ability to capture elemental and oxidized mercury released from coal during combustion.
- Present information to conference and professional journals.

RESULTS AND ANALYSIS

Fuel composition analysis has determined that dairy biomass has approximately 3x the fuel bound nitrogen of coal. When cofired with coal in a lean (excess amounts of air) environment, this nitrogen is released as nitrogen radicals; which rapidly bond with free oxygen from the excess air. Thus, more NOx is formed in lean combustion. The graph shows this. However, in a rich environment, the exact process occurs. The fuel bound nitrogen is still released as nitrogen radicals, but there is not available oxygen to bond with. The nitrogen radicals are forced to bond with themselves and form N2, or they bond with hydrogen to form NH3. NH3 naturally reduces NOx. This formation of NH3 causes the NOx that is formed to be reduced and overall NOx production is decreased. When the equivalence ratio is moved further rich, virtually all NOx is destroyed for all fuel blends.

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