Fuel Properties and energy

FUEL PROPERTIES AND ENERGY POTENTIAL IN VARIOUS FORMS

INTRODUCTION
An interdisciplinary research between College of Engineering and College of Agriculture has been undertaken to develop renewable biomass fuels. Coal/Biomass can be i) directly burnt, ii) pyrolyzed in N₂ to yield volatile matter (VM)/tar/biofuels to yield high heat values with byproducts as charcoal, iii) gasified in air to produce CO and VM, iv) gasified in O₂ to produce CO and VM, iv) gasified in pure O₂ and steam to produce CO₂ and H₂ as in FutureGen and v) digestion assuming all biomass is digested. What are the heating values (HV) of product gases and what should be firing rate per MW thermal output if various options are pursued? Investigators have developed an EXCEL program with input of ultimate analyses and proximate analyses with or without known heating values and output yields product HV (absolute and as % HV of fuel and as % of natural gas (NG) HV) and firing rates ready for use of data by industries.

MODELING
- Maintain a data bank of fuel properties (coal, animal waste based biomass)
- Determine the HV from ultimate analyses in case it is not known
- Use thermo-chemistry to determine whether gasification in air/O₂ is exothermic or endothermic
- Air Fuel ratio needed for direct combustion/gasification
- Allowable moisture and ash contents of biomass for combustion
- Heating values of product gases in various forms

RESULTS AND ANALYSIS
It is found that pure pyrolysis process under pure heating without the presence of inserts yields the highest heating value (55 % of NG), while air gasification yields lowest heating value (about 10-15 % of NG). Results could be generated for any biomass or coal fuels.

FUNDING
US Department of Energy and Texas Commission on Environmental Quality (TCEQ)
MERCURY EMISSION CONTROL

INTRODUCTION

The drive for clean air has caused an increasing concern for control of toxic metal emissions from coal combustion systems. In particular, mercury has been targeted for control. Environmental Protection Agency (EPA) has released Clean Air Mercury Rule, which announced a strict cap to reduce nationwide utility emissions of mercury from a current rate of 48 tons annually to 15 tons by the year 2018. Unlike other trace metals that are emitted in particulate form, mercury is released in vapor phase in elemental or oxidized form. As on date, there is no post combustion treatment which can effectively capture elemental mercury vapor, while oxidized form of mercury can be captured at the Flue Gas Desulfurization (FSD) unit, since oxidized mercury is soluble in water. The goal of this research is to use high chlorine content biomass and coal blend as a fuel to effectively convert elemental mercury to its oxidized form which can be captured more easily using traditional environmental devices.

FACILITY

Pilot scale experiments are conducted on a 30kW (100,000BTU/hr) Boiler Burner facility at the Coal and Biomass Energy Laboratory, Texas A&M University, which allows both reburn and co-firing kind of scenarios. The lab is equipped with ENERAC 3000E emission analyzer and Mercury Instrument VM 3000 to support our proposed aim. To provide more exhaustive results from experiments, it is required to read both elemental and oxidized mercury from the flue gas samples. Since the mercury analyzer is limited to detection of elemental mercury alone, a wet chemistry based flue gas conditioning system (modified Ontario Hydro Method for online detection) has been developed to read both elemental and oxidized forms of mercury.

FUELS

Though coal holds as the dominant fuel source, alternative fuels have made significant benchmarks, of which biomass as a renewable energy source secures a big share owing to its environmental friendly approach. Currently at the Coal and Biomass Energy Lab, animal waste is used as biomass fuel, of which primarily Feedlot Biomass (FB) and Dairy Biomass (DB) are used, which is blended with coal, both Texas Lignite and Wyoming Sub-Bituminous coal in varying proportions.

RESULTS

Mercury emission control experiments conducted on reburn facility shows the effect of using biomass as a blend with coal to oxidize elemental mercury in flue gas hence aid in mercury capture. Preliminary experiments of co-firing Wyoming Coal with Dairy Biomass has been showing promising results of effective mercury capture.