CO-FIRING BIOMASS: REGULATORY AND OPERATIONAL ISSUES

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Common Examples of Biomass

Examples

- Wood
  - Wood Chips
  - Forest Residues
- Processed Wood
  - Pelletized Wood
  - Torrefied Wood
- Agricultural Byproducts
  - Corn Stover
- Processing Byproducts
  - Bagasse
  - Rice Husks
- Purpose Grown Energy Crops
  - Miscanthus
  - Switchgrass

Biomass Example: Corn Stover

Source: farm-equipment.com

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Renewable Fuel

- Construction and Demolition (C&D) Waste
  - Often confused as a biomass fuel
  - Non-Hazardous Secondary Materials defines this as Solid Waste
  - Not clean cellulosic biomass
  - Treatment of C&D required to not be classified as Solid Waste
  - Regulation falls under the Commercial and Industrial Solid Waste Incineration Units

Major Source Determination

- 40 CFR 51.166(b)(1)(i)(a) & 52.21 (b)(1)(i)(a) outline 28 source categories (fossil units fall under these regulations)
- Facilities falling into these categories are defined as “major” if the following limitations are exceeded
  - Criteria Pollutants exceed 100 ton / yr
  - Any individual HAP exceeds 10 ton / yr
  - Combined HAP emissions exceed 25 ton / yr

IPP & Cooperative Advantage

- Biomass power plants are not one of the facilities outlined in 40 CFR 51.166(b)(1)(i)(a) or 52.21 (b)(1)(i)(a)
- Major source limitations “relaxed” for biomass power plants
  - Criteria pollutants exceed 250 ton / yr
  - Any individual HAP exceeds 10 ton / yr
  - Combined HAP emissions exceed 25 ton / yr
  - Fossil fuel heat input must be less than 250 MMBtu / hr
  - Boiler MACT
    - Major Source Biomass Heat Input >10%
    - Minor Source Biomass Heat Input >15%
- Approximate Breaking Point for Major / Minor Source Biomass Only
  - Fuel: Clean virgin wood chips
  - Steam Generator Technology: Fluid Bed Combustor
  - Net Plant Output: Approximately 25 MW

Regulated Pollutants

- Criteria Pollutants and Hazardous Air Pollutants
- Criteria Pollutants
  - Nitrogen Oxides (NO_X)
  - Volatile Organic Compounds (VOCs)
  - Sulfur Dioxide (SO_2)
  - Fine Particulate (PM)
  - Carbon Monoxide (CO)
  - Greenhouse Gasses (CO_2, CH_4, N_2O, HFCs, PFCs. SF_6) [Fall under GHG Tailoring Rule]
- Hazardous Air Pollutants (HAPs)
  - Defined by the Clean Air Act
  - List updated in 1990
  - Contains 189 chemicals classified as HAPs

Boiler MACT Minor Source Limits

- Particulate Matter *only* pollutant regulated

- Steam generators rated with a heat input greater than 30 MMBtu / hr required to limit PM emissions to 0.03 lb / MMBtu
- Steam generators rated with a heat input between 10 MMBtu / hr and 30 MMBtu / hr required to limit PM emissions to 0.07 lb / MMBtu
- Applies only to new facilities not existing ones

Major Source Proposed Limitations

- To be classified as biomass >10% heat input comes from biomass
- Affects new and existing facilities
- Limitations imposed based on combustion technology

Combustion technology	Filterable particulate matter limitation (lbm/10^6 Btu)	Total selected metals (lbm/10^6 Btu)	Carbon monoxide limitation (ppm @ 3% O_2)	Alternate carbon monoxide CEMS limitation (ppm @ 3% O_2)
Fluidized bed, existing	0.1100	0.001200	370	NA
Fluidized bed, new	0.0098	0.000042	230	180
Wet stoker, existing	0.0290	0.000057	790	410
Wet stoker, new	0.0290	0.000026	590	410
Kiln-dried stoker, existing	0.3200	0.004000	250	NA
Kiln-dried stoker, new	0.3200	0.004000	250	NA
Suspension burner, existing	0.0510	0.001100	58	1,400
Suspension burner, new	0.0510	0.001100	58	1,400
Dutch oven/pile burner, existing	0.0360	0.000240	810	440
Dutch oven/pile burner, new	0.0360	0.000041	810	440
Fuel cells, existing	0.0330	0.000049	1,500	NA
Fuel cells, new	0.0110	0.000049	210	NA
Hybrid suspension grate, existing	0.4400	0.000490	3,900	730
Hybrid suspension grate, new	0.0260	0.000490	1,500	730

Notes: CEMS = continuous emissions monitoring system, dscm = dry standard cubic meter, lbm = pound mass, ng = nanogram.

Source: EPA

Biomass Handling

- Large Space Requirements, 3 – 6 times the volumetric throughput to replace an equivalent amount of coal
- Separate Handling System Required
- Material Handling Equipment
  - Wood Chippers
  - Tub Grinders
  - Hoggers
  - Hammer Mills
  - Truck Dumpers (back-up, drive through)
  - Screens
  - Conveyors
  - Stackers
  - Reclaimers
  - Screw Feeders
  - Magnets
  - Covered Storage

Biomass Boiler Output Changes

- Virgin Wood Chips
  - High Moisture (40% - 60%)
  - Low BTU's (4,100 – 4,800 Btu / lb)
  - Decreased Combustion Efficiency
- Processed Wood (Pellets or Torrefied)
  - Lower Moisture (~10% - 20%)
  - Higher BTU's
  - Equivalent energy to sub-bituminous coal

Biomass Pollutants

- Most biomass cleaner to burn than coal
  - Low fuel bound nitrogen
  - Low sulfur content
  - Low ash content

- Not lower in all categories
  - Higher chlorine
    - Greater HAP emissions
    - Potential for superheater element corrosion
    - Increase acid dew point temperature (stack corrosion)

Biomass Ash Composition

- High Alkali Content
  - Good for capture of HCl
  - Much “sticker” than coal ash
  - Plugging of tube elements (increased soot blowing or addition of sootblowers)
  - Plugging of regenerative air heaters
  - Plugging of Selective Catalytic Reducers (if already installed)

Conclusions

- Biomass fuels vary widely and are regional
- EPA Regulations are complex and evolving
- Biomass classification benefits emission limitations
- Expensive Material Handling systems
- Combustion characteristics change
- Potential harm to boilers not designed for biomass

Questions?