Using Torrefied Wood for Electricity, Briquette & Pellet Production

By

Joe James, President
Agri-Tech Producers, LLC
Torrefaction: A Technology to Densify & Enhance Biomass

- Untreated biomass may be 50% water, it’s bulky and it’s not the most efficient or useable fuel or bio-feedstock. Torrefaction:
  - Drives off most of the water
  - Reduces the bulk
  - Makes a better co-fire feedstock to burn with coal
  - Makes superior briquettes and pellets

- Mobile torrefaction, applied at the point of harvest:
  - Reduces transportation costs of biomass, per BTU
  - Produces a more valuable biomass shipment
Torrefaction: Adding Value and Reducing Transportation Cost/BTU

- Untreated Biomass:
  - Bulky
  - Moist
  - Fibrous
  - Perishable
  - Waste
  - Expensive to transport

- Torrefied Biomass:
  - Dense, If Pelletized, Etc.
  - Dry & Water Resistant
  - Easily Crushed
  - Does Not Rot
  - Valuable Fuel
  - Energy Dense
The Process of Torrefaction

- Heating (300-400°C) wood, in a low-oxygen environment, liberates water, volatile organic compounds (VOC’s), and hemicellulose (HC) from the cellulose and lignin.
- The VOC’s and HC are combusted to generate 80% of the torrefaction process heat.
- The remaining and warm lignin acts as a binder when the torrefied wood is pelletized.
- Torrefied wood can easily replace coal in combustion or be a feedstock for further pyrolysis or gasification for combined heat and power or Fischer-Tropsch liquids.
Conceptual Schematic of Torrefaction Machine

- Burner
- VOC, CO, H₂
- Gas Collection System
- Mechanically moving biomass through torrefaction chamber
- Combustion gasses indirectly heating biomass
- Torrefied Biomass
- Cool Exhaust
- Wet Biomass
- Hot Exhaust
- Dried Biomass
- Hopper & airlock

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Making Electricity With Torrefied Wood

- Torrefied wood is a much better fuel for co-firing with coal than untreated wood.
- Torrefied wood can be ground to a particle size, similar to that of pulverized coal, with the same or less energy use.
- Untreated wood requires many times the energy use, in grinding (by a factor of 7.5 to 15), to achieve a similar particle size.
Pelletizing & Briquetting Torrefied Wood

• At torrefaction temperatures, the lignin in wood becomes plastic and can actually become a binder of individual wood particles.
• Pellets made from torrefied wood may withstand 1.5 to 2 times the crushing force of normal wood pellets.
• Torrefied pellets show little water uptake on immersion (7-20% of mass), unlike normal pellets.
• University research in the 1930’s and 1940’s details benefits of torrefied wood pellets.
Torrefied Wood’s Advantages As A Co-Fire Fuel With Coal

Assumptions used in the following chart:

- Coal is valued at $60-$80 per ton delivered price
- Torrefied wood (11,000 BTU/lb.) has a heating value nearly that of coal (12,000 BTU/lb.)
- Torrefied wood generates electricity with a similar efficiency to coal (35% fuel to electricity)
- Untreated wood has a lower efficiency of conversion (23% fuel to electricity)
- Wood can be processed into chips at a cost of about $15/green ton
- Transportation costs for chips and/or torrefied wood are about $0.23 per ton, per mile
Fuel Cost per MMBtu Electricity by Distance to Plant

- Coal ($80/ton)
- Coal ($70/ton)
- Coal ($60/ton)
- Green Wood
- Torrefied Wood

Miles

$5.00
$7.00
$9.00
$11.00
$13.00
$15.00
$17.00

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Joe James, President
Agri-Tech Producers, LLC
803 462-0153
JosephJJJames@bellsouth.net