



A Guide to Woody Biomass-to-Energy Vortex Combustion Technology

Our “Did You Know?” Series

As part of our “Did You Know” series, we are offering this detailed description of our latest Firebird V-III™ technology, for specific applications. To learn more about vortex combustion, you can read our White Paper on Vortex Combustion, or other documents in this series, available online at www.AmericanEnergyGroup.org.

General Description

The V-III™ is a grateless combustor that uses high temperatures (2,000° F and above) with high speeds (a 90 mph tornado on its side) to more efficiently burn shredded waste material, in this case, woody biomass. This material then moves through the chamber towards the back wall, where (through a patented and proprietary method) it is re-introduced back into the vortex for continuous burning.

This overall process is known as “synergistic iteration.” As the waste material burns in suspension, it becomes its own fuel, mixing with controlled amounts of air (oxygen) to achieve **complete and perfect combustion**. Current technology systems allow the waste to sit or rest on a grate while burning, which produces the harmful emissions, gases, fly ash, and smoke, because of incomplete combustion. These require expensive and complex air scrubbers to remove the contaminants prior to entering the atmosphere. The V-III™ does not produce these same harmful outputs, and therefore does not require exhaust cleaning or scrubbing.



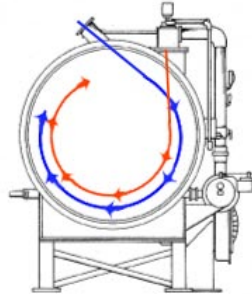
Background

Biomass is biological material derived from living, or recently living organisms. Woody biomass, for our purposes, is the material from trees, but specifically the non-marketable wood normally found in forest undergrowth, also known as the understory. This material does not have a marketable usage, and is therefore disposed of in most areas through the process of open-field burns, known as prescription burns. To prevent massive amounts of smoke choking the surrounding environment, this forest residue must dry out, or season for several months before being burned. One issue that raises concerns about the open burning is the potential for sparks and fly ash to travel through the airstream and ignite wildfires in nearby forests. Our technology will allow processing 24 hour per day, 7 days a week, and can accept very high moisture content.

Did You Know...?
... that combustion has been used as a means of waste management since the 1800's?

Details

The trees are fed into a standard chipper either onsite or at a nearby facility. The chipped wood is then inserted into a material handling manifold with the help of a fan supplying the primary air for the combustion chamber. This mixture of air and chipped wood is introduced into the chamber tangentially,



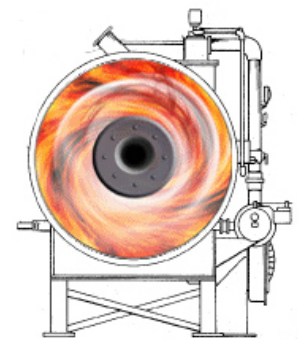
which follows the contour of the chamber, and is blended with the motion and direction of the vortex flame, as shown with the blue curved line in the image to the left. This process now creates a super-heated vortex which burns the chipped wood material while fully in suspension. To achieve complete and perfect combustion, it is necessary to control the mixture of the waste, fuel, and oxygen. Turbulence is also a critical factor, which in this case comes about with the high-speed vortex rather than a shaker-grate as some combustors use. Additionally, as the waste material is moving through the chamber, it is not only reducing in size, but becomes fuel for the process, which allows for a higher level of combustion and efficiency.

The V-III™ has been designed with state-of-the-art programmable logic controllers (PLCs) for automation processing. It is also equipped with an array of sensors which allows complete and accurate control and monitoring of numerous factors, such as vortex temperature, vortex speed, secondary air dampers, and the air quality contained in the exhaust stack. The system is equipped with EPA-approved monitoring software, with remote access capability to provide continuous transmission of the data collected and reports directly to the state environmental protection agency, and to local public works managers and supervisors.

Did You Know...?
... that in addition to being part of our breathing process, CO₂ is used for adding carbonation to sodas, and in the making of wine?

With complete and perfect combustion, the only by-products are CO₂ and H₂O. No harmful emissions, gases, fly ash, odors, or even smoke, are produced through the process of this vortex combustion, therefore no scrubber systems are needed. The exhaust that is released into the atmosphere is clean and harmless, far exceeding EPA air quality specifications and standards. Because this process doesn't allow for waste to sit or to collect, as well as not having soot or other messy residue build-up, there is very little maintenance required as opposed to current technology systems.

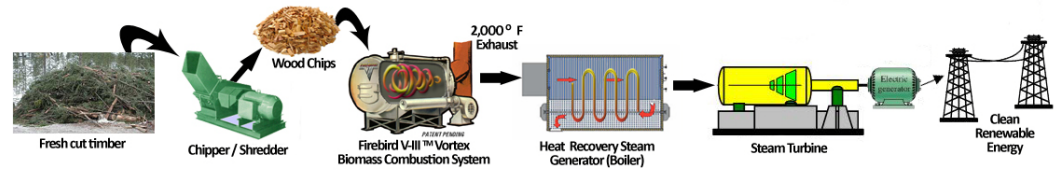
One of the most unique features of this technology is the high speed vortex. No other combustion system takes advantage of the efficiency that this offers, compared to standard combustors that use fixed or even shaker grates, or multiple chambers. With the use of a "free vortex" in combination with the high temperatures, and no need for the exhaust scrubber systems, the output temperature in the exhaust stack stays consistently around 2,000 ° F.



This system can be used as part of a waste-to-energy (WtE) system, where the super-heated exhaust can be directed to a heat recovery steam generator, or boiler, and then to a steam turbine for the production of electricity. By processing woody biomass material, which burns

at 3 times the BTU rating of standard municipal solid waste, energy is produced more efficiently than other technologies that create oils and fuels from biomass. Current methods require several steps, such as the creation of feedstock (pellets), used as fuel for various biomass-to-energy processes. The V-III™ can easily handle chipped wood at a rate of 8 to 10 tons per hour, which will obviously generate an impressive capacity of electricity.

Woody Biomass to Energy Process



This energy recapture process has been used for decades in this country, as well as all around the world. In each case, there is always a boiler and a steam turbine, but the combustion source can vary based on specific needs. Other combustion sources include jet engines, natural gas / coal fired / wood burning furnaces. Combustors are used, but because of the need with current technologies to have exhaust scrubbers that reduce output temperatures, they aren't as efficient as other sources.

Without getting into technical electricity distribution and transmission concepts, the process once the electricity is generated from the steam turbine, is handled by the electric utilities. The electrical output is purchased by the utilities, and distributed into the grid as necessary. The power that is generated at one site may not be used in the same geographic region, but could be transmitted several states away. Having a lower cost of energy production also gives the owner/operator a significant return on investment, much sooner than is currently available with other renewable and biomass-to-energy resources.

Did You Know...?
... that one V-III™ system with energy recapture can generate more electricity than 4 large wind turbines?

Summary

The V-III™ offers a high level of efficiency through the unique blending of extreme temperatures and high speeds, along with a patented process of reintroduction of particulate matter for continuous burning to achieve complete and perfect combustion. Because of this process, the system does not produce harmful emissions and gases, odors, fly ash, or smoke. With a small footprint, this system can be installed closer to populated areas, and offers a unique, modular design for rapid replacement or modification. The V-III™ can also be used as an eco-friendly solution for mobile needs, and can also be configured with smaller boiler/steam turbine combinations to produce electricity on a temporary basis.

Although the V-III™ Vortex Combustion System can be used on its own to increase productivity for forest thinning in sustainable forest management plans, it is most beneficial when combined with energy recovery systems to produce incredible capacities of clean, renewable energy. Since current technologies for biomass-to-energy are typically very large and expensive processes, our low cost, smaller footprint, and fully scalable system offers electricity generation at a fraction of the cost of available methods. But most importantly, our solution means higher productivity in forest thinning, as well as preventing commonplace wildfires, all while protecting our precious environment.