

## ***HIGH SOLIDS ANAEROBIC DIGESTION (HSAD)***

***Orbit Energy, Inc.'s High Solids Anaerobic Digestion (HSAD) technology is a microbial bioconversion process that converts solid organic waste materials into energy and a nutrient rich compost. The proprietary process design of HSAD was developed from 10 years of research at the U.S. Department of Energy's (DOE) National Renewable Energy Laboratory (NREL).***



The HSAD process can be applied to many different waste feedstocks, including restaurant and household food scraps, food processing wastes, agricultural wastes, paper and cardboard, yard or green wastes, municipal solid waste, and industrial wastewater sludges. Wastes may be treated separately or combined to achieve waste treatment flexibility and economy of scale.

A 120 to 150 tpd HSAD plant is capable of producing 3 megawatts (MW) of net electrical power with a good source separated food waste feed.

HSAD is an extension of the low-solids anaerobic digestion technology used throughout the world. The centerpiece of the HSAD process is a closed system design developed from 10 years of research at DOE/NREL, followed by 10 years of process development and optimization at Orbit Energy's facility in Clinton, NC.

HSAD is based on a horizontal, plug flow design. The process is thermophilic, using a proprietary consortium of bacterium operating at around 55°C. HSAD utilizes standardized equipment from the chemical processing industry to handle and process organic solid wastes in the HSAD bioreactor.

Thermophilic operation allows the HSAD system to process organics faster with much higher solids content than conventional technologies. The solid phase fermentation reduces the required equipment volume and associated capital and operating costs, while the bioreactor's volumetric productivity is factors higher. Conventional anaerobic digestion feedstocks typically contain 1-2% solids. In

contrast, HSAD can handle a variety of feedstocks with solids content up to 45% and can operate at organic loading rates in excess of 30 g COD/day per kg of digester content.

As a result of the high solids operation, the HSAD process does not generate any waste streams. The digested material can be dried to produce nutrient rich compost using waste heat from the electric generators sets or solar drying in greenhouses.

The HSAD process is specifically designed to process solid organic wastes. It can easily accommodate different combinations of solid and liquid, industrial or municipal wastes. Blends of rapidly degrading feedstocks, such as fat, oil and grease, and slower-degrading materials, like paper and yard waste, make superior feedstocks for the HSAD process. Blended feedstocks provide consistency of composition with improved process control and higher conversion rates.

The environmental benefits of the HSAD waste-to-energy systems are numerous. Unlike landfilling and aerobic composting, our closed-system process prevents the release of leachates, gaseous or particulate emissions, and there are no odors other than those produced by the feedstocks. As a result, the potential for greenhouse gas emissions, groundwater contamination, and nitrate runoff into lakes and streams is eliminated. The thermophilic (high temperature) system also destroys pathogens and weed seeds, creating compost and fertilizer products that are versatile and safe to use. The closed, odorless system converts up to 85% of the organic carbon in solid organic waste material into biogas, which can be used to run plant systems or generate electricity. The process reduces the volume of solid feedstock by as much as 65% depending on feedstock, and the resultant compost is a salable product rather than a disposal liability.



The biogas produced from the HSAD system can be used to generate on-site process heat, steam, or electricity, or sold as fuel gas to commercial or industrial facilities.

The HSAD process is a continuous unit operation that can be readily integrated into existing industrial plants and municipal solid waste sorting facilities. The HSAD system is almost completely automated, requiring little attention each day. Whether integrated into an existing operation or used as a stand-alone process, the HSAD anaerobic digestion technology is a renewable energy source that provides high returns of investment for its owners.



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