Livestock and Agribusiness Pollution Prevention

and Waste Utilization Research

Federal Manufacturing & Technologies

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Project Accomplishments Summary

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Introduction

Acres and acres of mounting wood waste, increasing pollution from animal confinement lagoons, and landfill closings as a result of a failure to divert recoverable waste to useful products are examples of waste materials that are disposed of in ways that are inefficient at best. The value of any beneficial energy resource is typically disregarded, if not totally ignored. The waste/resource stream of the business and agricultural sectors is commonly seen as just a cost of doing business. This cost is also magnified by the fact that disposal options and current methods are insufficient; environment impacts such as air, water, and soil quality issues often accompany the waste stream; and process energy requirements are intense and expensive. As a result of these costs and the changing farm and natural resource policy at the federal and state level, innovative concepts were explored through research to find solutions and advance practical applications in order to address current and emerging problems and develop new opportunities for the benefit of Missouri, rural America, and the nation.

Thousands of dollars currently leave northwest Missouri to purchase energy. Also, thousands of dollars are spent disposing of selected non-hazardous organic waste generated by livestock, agribusiness, and industrial entities. If these wastes could be economically converted to energy in an environmentally sound process, the potential exists to afford northwest Missouri communities the opportunity to be less dependent upon purchased energy and to be more self-sustaining and environmentally friendly.

Northwest Missouri State University recognized these facts as early as the late 1970s and began an initiative to convert to the use of sustainable energy sources for the campus heating and cooling needs. The commitment to biomass resources, typically viewed as waste resources, and its start-up of the woodchip boiler in 1980 launched Northwest to the forefront of biomass utilization in the region and country.

Background

Northwest Missouri State University is a leader in the use of non-fossil fuels to provide energy for heating and cooling. Currently, the use of wood chips and non-recyclable paper accounts for approximately 80 percent of the campus' thermal energy requirements. An ongoing goal at Northwest is to explore other wastes/resources for potential energy sources in northwest Missouri and eliminate the potential for air, land, and water contamination by directing it from traditional disposal methods (lagoons, landfills, etc.) to a system that will produce energy.

Bioenergy technologies currently exist that can turn potential problems or hazards into opportunities by converting biomass wastes into renewable resources of usable energy. These technologies include gasification of solid components of the waste stream and methane recovery through anaerobic digestion processes. Additionally, industrial and other agribusiness feedstocks can be used in the production of energy as solid, liquid, or gaseous fuels. Biomass consists of renewable organic materials and includes feedstocks such as forestry and agricultural crops and residues (e.g., livestock wastes and energy crops such as switchgrass, other native grasses, and fast-growing trees), wood and food processing wastes (e.g., sawdust), and municipal solid wastes. For the purposes of this project, a systems approach to examine the most effective bioenergy technologies, or combinations thereof, was employed and developed to reconfigure existing technologies for site-specific variables depending on the waste stream source and volume.

The project involved the identification, testing, assessment of availability, and energy potential calculation for common non-hazardous fuel feedstock in the region. The project was also to determine if sufficient feedstocks exist in northwest Missouri to allow Northwest Missouri State University or other entities in the area to be more energy self-sustaining with minimum dependence on fossil fuels and public utilities.

The project team for the project consisted of AlliedSignal Federal Manufacturing & Technologies, operating the U.S. Department of Energy's Kansas City Plant, and personnel from Northwest Missouri State University's Departments of Environmental Services and Agriculture. AlliedSignal team members applied their systems management, analytical capabilities, and modeling expertise with Northwest's knowledge of waste-to-energy conversion experience. The goal of this partnership was to explore an innovative concept to find one possible solution through applied research.

Scope of Work

A systems integration approach was undertaken to determine the available quantity of livestock,

agribusiness, and industrial feedstock, its value as an energy source, and then develop a system that will permit its conversion to useable energy with minimal risk of pollution to the environment. From this data, a decision model was created to outline a systems approach for the utilization of waste, in an environmentally responsible manner, for energy and other alternative uses to allow Northwest and local communities to move toward more energy and environmental sustainability.

Our approach was structured to demonstrate a project that was focused more toward application rather than a purely scientific study. The technical analyses that were completed helped to identify areas worthy of additional, more concentrated study. Northwest's experience in applied research has provided timely, practical results to pressing issues, and in this instance, one possible solution to complex issues of concern in the region, state, and nation.

Description

The primary focus of this project was to explore an innovative concept that would develop one possible solution to multi-faceted yet connected issues that faced the region. A systems integration approach was undertaken to determine the available quantity of number of renewable organic materials, or biomass, in the area, determine its feasibility and value as an energy source, and then develop a system utilizing existing bioenergy technologies that will permit its conversion to useable energy with minimal risk of pollution to the environment.

After surveying potential biomass sources, we found a notable amount of available and useable waste materials. When combined with the amount of recoverable waste from the local livestock industry, a significant amount of potential energy resources was being generated in the region. The biomass feedstocks proved to have a reasonable BTU value that was in line with other biomass feedstocks already in use at the University.

As a result of the feedstock material usually being agriculture-related, the exploration of existing bioenergy technologies for our system led us to equipment common in agriculture-related fields. We found that drying the feedstock would be a costly step in any process in terms of the capital expense for the equipment as well as the energy-intensive nature of the application. Blending of materials, typically one with high moisture content with a drier feedstock produced the desired effect to nearly the same degree. In addition, liquid/solid separation in the early stages of particular waste streams also helped to decrease the amount of moisture in certain feedstocks.

For the combustion portion of our system, we focused on gasification due to current national interest and attention to biomass gasification as an effective method to efficiently utilize biomass waste materials. A small gasifier was already part of the University's alternative energy program and, after some visits to gasifier manufacturers and end-users, University personnel achieved a level of operational expertise with this unit.

The testing and analysis of gasification emissions primarily centered on biomass feedstocks that were blended and contained some percentages of livestock waste. This was as a result of the large amount of available livestock waste available in the area as reflected in the survey. The