A rural municipal waste-to-energy system and method converting waste to fuel gas through anaerobic digestion (AD) and pyrolysis/gasification. Fuel gases derived during the processes are combined and used to generate electricity. The amount of MSW normally collected by a municipality may be inadequate in volume to produce enough fuel gas with which to generate electricity sufficient to serve the entire community. It may be necessary, therefore, for additional wastes from the surrounding area to be included. The municipality must have its own public electric utility to be able to charge rates necessary for profitability.
RURAL MUNICIPAL WASTE-TO-ENERGY SYSTEM AND METHODS

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims the benefit of U.S. Provisional Patent Application No. 60,920,422 filed Mar. 28, 2007, the disclosure of which is incorporated herein in its entirety.

STATEMENT REGARDING FEDERALLY SPONSORED RESEARCH OR DEVELOPMENT

[0002] Not applicable.

BACKGROUND OF THE INVENTION

[0003] The present invention relates to a system and methods for converting rural municipal, industrial, commercial or agricultural waste to energy, and in particular, to a system that is operated as a municipal electricity generating utility.

BRIEF SUMMARY OF THE INVENTION

[0004] The present invention does not dispose of garbage and trash through incineration, as many waste-to-energy systems do that have the difficult challenge of meeting EPA emission requirements. This system, instead, involves the conversion of waste to fuel gas through anaerobic digestion (AD) and pyrolysis/gasification. Fuel gases derived during the treatment process are used to generate electricity by various means, including without limitation, internal combustion engines with generators, fuel cells and/or mini-turbines.

[0005] The present invention would enable small municipalities to take advantage of existing and potential revenue sources from waste management, provide cost competitive waste management services to the public, and develop its own independent power supply. This would be accomplished within a pollution-reduced environment, substantially reduced landfill use which prolongs landfill life, and the generation of alternative energy which contributes to the reduction of "greenhouse gases", burning of fossil fuels, and the country's dependence on foreign oil.

[0006] The present invention has considerable environmental benefits. The treatment process is essentially particulate "emission-free"; most by-products are used as compost and fertilizer, and landfill use and development is greatly reduced. Alternative energy is produced which reduces greenhouse emissions and slows "global warming" problems. Further landfill development would not be necessary in many instances. In cases where area geology complicates landfill development because of the threat of ground water contamination, this system provides an environmentally acceptable alternative for waste management. Additionally, the security a community has owning its own power source is an asset. Being independent of the "grid" for its power supply relieves the municipality from potential outages that may come from large-scale grid failures that originate in other areas from various causes outside the control of the municipality. A municipality's ability to obtain electric utility status is an important factor in the economic and development feasibility of the invention.

[0007] Development of the processing plants of the present invention will be a great asset to the economic development of small cities across the country, primarily in rural areas where large amounts of additional wastes are available to supplement the community's MSW. For a city of around 15,000 population, it is anticipated that a plants development cost could approximate $20,000,000 and employ around 50 people. This represents a significant investment for a city of that size and can provide the economic development boost needed for many rural areas around the country.

[0008] The present invention could change the way wastes are managed, provide a boost to the economic development of rural areas of the country, and provide lucrative investments. The growth of landfills in height and area would begin to slow down from decreased use, and the expansion and development of new areas could stop completely in some cases. Certainly, a different alternative for waste management and disposal would be available to areas where geology complicates the economic development of a landfill.

[0009] These and other features, objects and advantages of the present invention will become better understood from a consideration of the following detailed description of the preferred embodiments and appended claim in conjunction with the drawings as described following.

BRIEF DESCRIPTION OF THE DRAWING

[0010] FIG. 1 is a flow chart of the system and process of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

[0011] A flow chart of the invention is shown in FIG. 1 that illustrates the process. Shaded boxes represent points of potential revenue. A description of the process follows:

[0012] I. Municipal Solid Waste (MSW) 10 is collected and brought to the material recovery facility (MRF) 11 where a tipping fee 12 may be collected. A fee for pickup of MSW or garbage is also collected.

[0013] II. Materials are separated at the MRF 11 for recycling and to be sold.

[0014] III. Metals and glass 13 are sold for recycling.

[0015] IV. Separated inert wastes 14 may be reused in construction materials 15, land development 16, or simply landfilled 17.

[0016] V. Plastics 18 are separated for use in the pyrolysis/gasification process 20.

[0017] VI. Biomass waste 19 is separated for use in the gasification process 20, wet biomass for the AD process 21 and dry biomass such as wood for pyrolysis/gasification.

[0018] VII. In addition to plastics 18 and dry biomass 19 from the MRF 11, tires 22, and forest (wood) wastes 23 bypassing the MRF 11 are deposited into the pyrolysis/gasification process 20 directly. A tipping fee 24 for the tires 22 and wood waste 23 is collected and residues of the process such as char and oils 25 may be marketed.

[0019] VIII. Wet biomass 19 from MSW is deposited into the AD process 21 along with plant and animal wastes 26 and sewage sludge 27 that are deposited directly, bypassing the MRF 11. A tipping fee 28 is collected, and the residue from the AD process 21 may be marketed as a compost and/or fertilizer 30. Other residue 19 may be diverted and processed through the pyrolysis/gasification process 20.

[0020] IX. A syngas product 31 is generated from the pyrolysis/gasification process 20 and biogas 32 is produced from the AD process 21. Syngas 31 consists mainly of hydrogen and carbon monoxide, and biogas 32 consists mainly of methane. Both gases are fuel sources and may go through a
cleaning process 33 before being marketed as a gas byproduct 34 or used to generate electricity 35.

Electricity generation 35 may be achieved by using the gases 31, 32 as fuel in an internal combustion engine with a generator or directly in a mini-turbine. Fuel cells also have attractive characteristics, however, they are not believed to be cost-competitive at present. Recovered heat 36 generated from electricity production 35 will be diverted to the pyrolysis/gasification process 20. Water and heat 37 will be recovered and diverted to the AD process 21.

Potential direct sources of revenue include garbage pick-up; tipping; and sale of metals and glass, compost, fertilizer, char, oils, fuel gas, and electricity. Prolonging the landfill life and use of inert waste in construction materials and land development are also economic benefits, however, the benefits are longer-term.

The amount of MSW normally collected by a municipality may be inadequate in volume to produce enough fuel gas with which to generate electricity sufficient to serve the entire community. It may be necessary, therefore, for additional wastes from the surrounding area to be included, such as forest wastes, agricultural wastes, industrial wastes, tires, etc. It will be necessary to perform a feasibility study to determine if enough additional wastes are available in and around the community before a municipality can be determined a proper candidate for this system. Wastes may be obtained outside the general vicinity of the municipality and either transported to the other location for processing in the AD or pyrolysis/gasification facility or processed at the source location to produce fuel gas which may be transported to the electrical generating facility.

It is necessary for the municipality to have its own public electric utility to be able to charge rates necessary for profitability. Otherwise, revenues from the sale of electricity are dependent on an adequate “avoided cost” rate negotiated with the power company having jurisdiction. Being a municipally owned utility also enhances capabilities for grants and subsidized loans which may not be as available to private enterprise. Tax credits and “greenhouse emission” carbon credits are also available because of the environmental and alternative energy production benefits. Ownership may be held exclusively by the municipality or in a public/private partnership with investor(s).

Preliminary cost studies indicate that the economics of the present invention would be competitive, however, in many cases will not be as economical as simply disposing of the waste in a landfill. In such a case, the decision of the municipality to use this system may be based also on the attractive environmental factors and the security of independent power production. Obviously, the system will not fit every municipality’s requirements for waste disposal, especially those looking only at the bottom line costs for disposing of their wastes in an existing landfill that may have only minimal problems and none of major significance anticipated in the future.

There are existing municipalities that have landfill problems, however, and will want to “make a difference” and contribute to the solution of environmental and energy problems plaguing the country. This system provides a choice for them in the evaluation of their alternatives on how to handle their waste management problems in a competitive manner.

The present invention business plan would be to not only participate in the ownership of the waste management-to-energy facilities, but to also provide the engineering, planning and feasibility analysis, development consulting, operation and maintenance of the facilities. The processing system is unique and although made up of existing technology, it is also innovative and will require specialized expertise. For this reason, it will be necessary to develop a highly trained team of professionals and technicians that are able to take a project from conception to feasibility, development, and operation in an efficient, dependable, and profitable manner. The utilization of these skilled resources will be mandatory for the success of such highly technical and innovative facilities. Most of the economic benefits of the business plan will be derived from the revenues received for the professional services and ownership participation.

The present invention has been described with reference to certain preferred and alternative embodiments that are intended to be exemplary only and not limiting to the full scope of the present invention.

What is claimed is:

1. A method for a rural municipality to convert solid waste to energy, comprising the steps of:
   a. selecting a rural municipality having an area surrounding the municipality capable of supplying a quantity of solid waste or having other capabilities to supply solid waste sufficient to produce fuel gas to generate a quantity of electricity sufficient to serve the electrical energy needs of all of the residents of the municipality;
   b. establishing a public electric utility to serve the rural municipality;
   c. providing a facility for the conversion of the solid waste to fuel gas through anaerobic digestion and pyrolysis/gasification;
   d. providing a facility for the conversion of the fuel gas to electricity; and
   e. selling the electricity at retail rates to the residents of the municipality.

2. The method of claim 1, further comprising the steps of:
   a. providing a material recovery facility and separating the solid waste into a wet stream comprising wet biomass, animal wastes and sewage sludge and a dry stream comprising dry biomass, tires, plastic and wood waste, converting the wet stream into fuel gas by anaerobic digestion and converting the dry stream into fuel gas by pyrolysis/gasification.

3. The method of claim 2, further comprising the step of recovering recyclable materials from the solid waste for sale.

4. The method of claim 2, further comprising the step of collecting a tipping fee for solid waste brought to the material recovery facility.

5. The method of claim 2, further comprising the step of selling residues from pyrolysis/gasification of the dry stream.

6. The method of claim 2, further comprising the step of selling residues from the anaerobic digestion of the solid waste.

7. The method of claim 2, further comprising the step of pyrolysis/gasification of residues from the anaerobic digestion of the solid waste.

8. The method of claim 2, further comprising the step of combining the fuel gas produced from anaerobic digestion and the fuel gas produced by pyrolysis/gasification.

9. The method of claim 8, further comprising the step of selling the combined fuel gas.

10. The method of claim 8, further comprising the step of generating electricity from the combined fuel gas.

11. The method of claim 10, wherein the electricity is generated in at least one of an internal combustion engine with a generator, a mini-turbine and a fuel cell.

12. The method of claim 10, further comprising the step of recovering heat generated from electricity production and used in the anaerobic digestion and pyrolysis/gasification of the solid waste.

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