# Compost to Heat Generator

Jerry Faulring

You MAY recall from your life in 2009, business was bad. I needed a distraction and a project to deflect the day-today-day issues facing all of us so I started researching this concept. In previous years I wondered how we could convert heat produced from composting horse manure into something useful in our operation. Our compost windrows produce enormous amounts of heat from a minimum of 120 degrees F to 165F and sustained temperatures in the range of 145F.

I spent many hours on the internet researching. I schemed through several different compost containment vessels and heat transfer systems that would efficiently reduce energy bills. It appeared that one simple need could possibly be met in generating hot water for propagation bottom heat during the winter months. Our propagation scale is tiny compared to most but consumes about 1,000 gallons of propane each winter. In a tough economy, nothing could achieve more satisfaction than messing with the propane supplier. Further we are already processing about 10,000 cubic yards of horse manure per year, had the raw materials, equipment, and a basic understanding of compost heat production.

There is an enormous amount of data available surrounding the issue of how many BTUs of heat are produced from a cubic yard of compost from which one can engineer a system. The huge challenge is to convert the heat efficiently to another use.

## Composting BTU Production

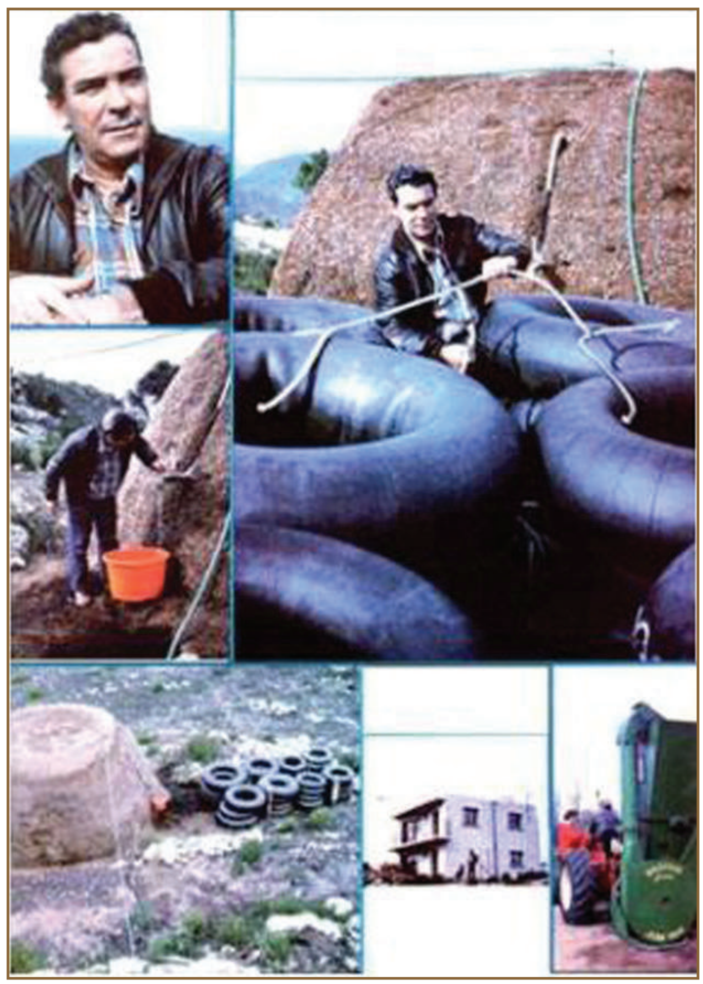
Source BioCycle Magazine-Lew Naylor, Black & Veatch, Gaithersburg, MD

- One pound (wet weight) of compost can yield 10,000 BTUs,
- One ton of compost can yield 20,000,000 BTUs, another source says 16,000,000 BTUs,
- One gallon of propane yields 91,000 BTUs,
- One gallon of heating oil yields 140,000 BTUs,
- Therefore, one ton of compost could be equal to 219 gallons of propane or 140 gallons of oil if maximum heat extraction occurred.

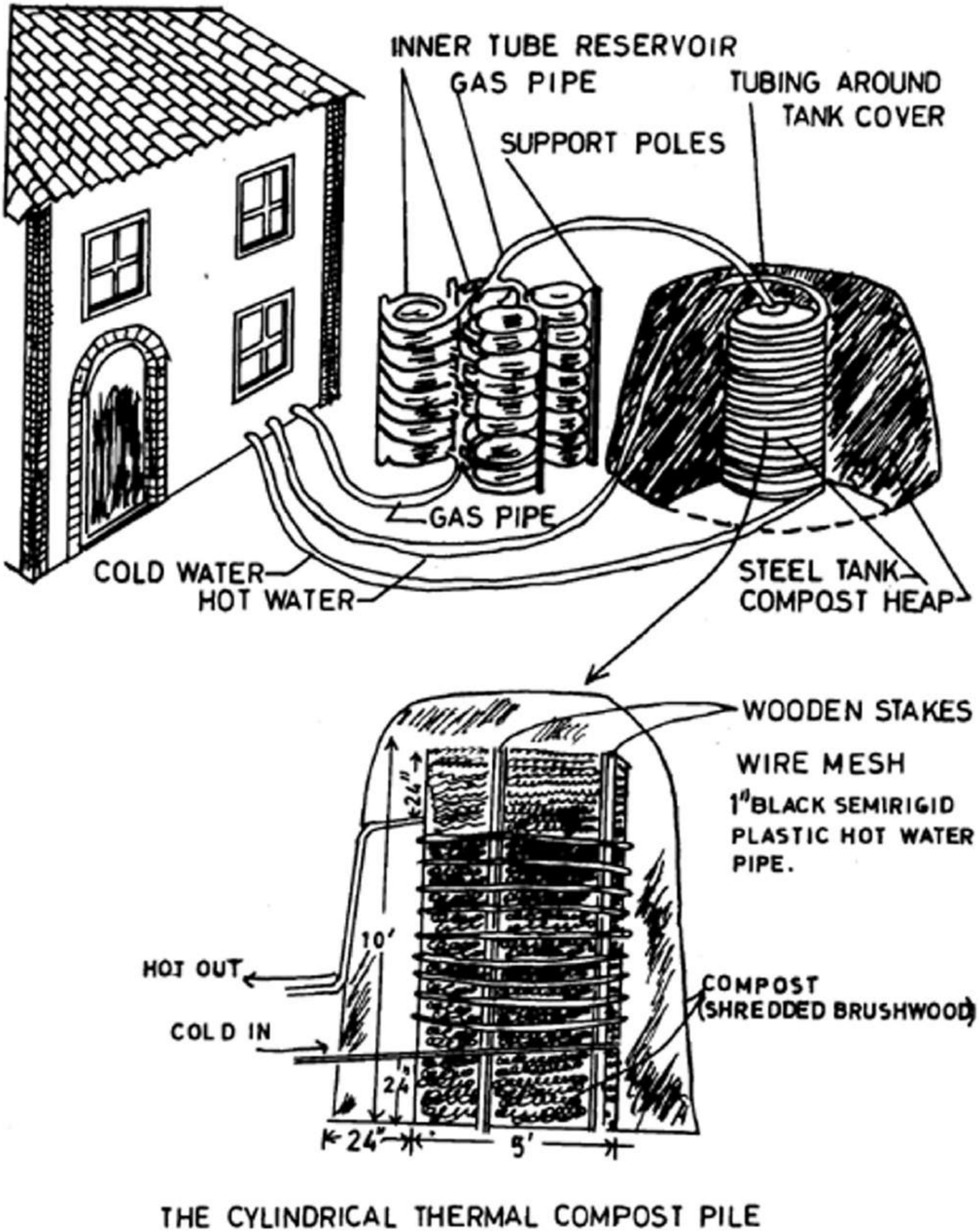
The history of producing hot water from composting organic matter goes way back. In recent history, a farmer in southern France, during the 1960s, developed a simple system that produced all his domestic hot water and enough methane to run his tractors and trucks. He also used methane for cooking. His name was Jean Pain and became somewhat of a legend in the world of alternative energy.

The genius of Pain's system was low capital investment resulting in exceptional return on investment. (Diagram on page 19)

The concept has been researched and demonstrated in several recent implementations; two I describe below.

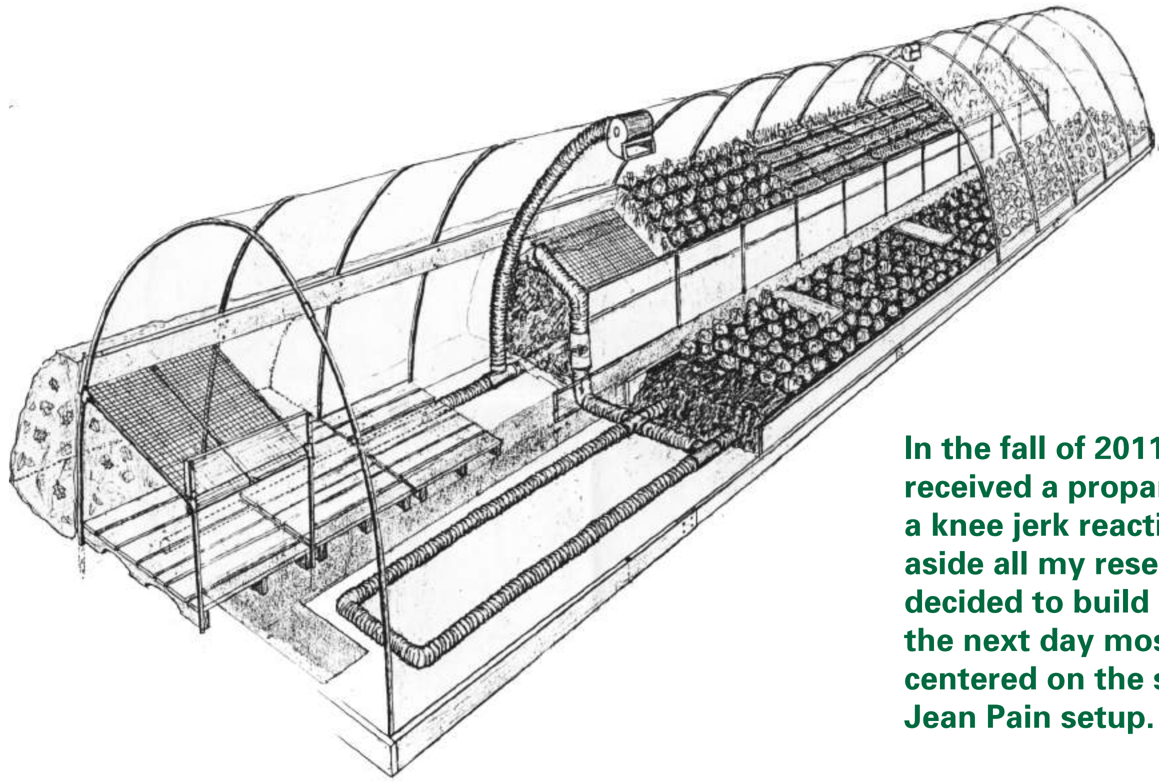


Jean Pain compost to heat collage




**The diagram depicts Mr. Pain's system.**

*(continued on page 20)*



**In the fall of 2011 I received a propane bill. In a knee jerk reaction, I set aside all my research and decided to build a system the next day mostly centered on the simple Jean Pain setup.**

*(…"A livestock farm in a remote Vermont town has the world's first commercial-size composting facility that converts excess heat from the compost piles into energy for the farm. Diamond Hill Custom Heifers, located in Sheldon, Vermont, is using the heat transfer system of a Canadian company, Agrilab Technologies, Inc., to capture water vapor from compost to heat flooring in a calf barn and heat water to warm calves' milk.*

*Diamond Hill's owners, Terry and Joanne Magnan, raise approximately 2,000 milk calves and heifers for custom boarding and sale to the dairy industry. The Magnans had good reasons for starting a compost system. They were facing much higher energy costs and restrictions on manure spreading. Magnan applied for state and federal funding to install the Agrilab system. The Magnan's contributed more than $120,000 in cash, labor and materials and received $247,000 in state and federal funds. The USDA Natural Resources Conservation Service (NRCS) awarded the Magnans a $197,000 Conservation Innovation Grant, one of 42 awarded in the U.S. in 2004. The Vermont Agency of Agriculture Food and Markets (VTAAFM) also provided $50,000 in Best Management Practice (BMP) funds. Agrilab Technologies contributed in-kind engineering, patent license use, and monitoring and operating equipment"*….Copyright 2006, The JG Press, Inc.)

The system works but if you add it up they spent over $400,000. The article does not say how much energy is produced in dollars, BTUs or KWH but one would have to guess the return on investment…………..such is research.

Another example includes a project titled THE COMPOSTING GREENHOUSE AT THE ALCHEMY INSTITUTE at the institute's facility on Cape Cod. This involved growing vegetable liners in a greenhouse with trays positioned on top of bins filled with composting material. The project was mostly successful…. except they did not have a backup heat source and all the plants died during an extreme cold period.

The photo, top page 21, shows our tiny 'Propagation Hut', as I call it, with the Compost to Heat Generator under construction during the fall of 2012. Note the piping going from the lower left side of the pile into the 'Hut'. Photo, center page 21.

The bottom heat system is typical with hot water produced by a regular propane hot water tank. We have plumbed the system so that water returning from the tables flows into the compost pile, returns through the hot water tank and then back to the tables. The hot water tank is then available to add additional heat to the water if the compost source can not maintain the needed temperature.

Our system utilizes 500 feet of thin wall one inch

Our tiny 'Propagation Hut', with the Compost to Heat Generator

Piping going from the lower left side of the pile into the 'Hut'

polyethylene pipe. In 2011 I installed an aeration tube at the bottom of the pile. I did not think it was needed and deleted it in 2012 which I think was a mistake. I'll know when the propane bill arrives.

The total investment for labor, additional plumbing fittings and equipment use was $300 the first year. We spent an additional similar amount in 2012 for some upgrades. For the 2011-2012 winter heating season we saved about $2400 over the 2010-2011 heating season or about 75% of normal usage.

During the bottom heat season we stick 6400 cuttings on two tables with near 100% success, photo bottom right. In that first year, I was surprised to realize the energy cost to produce one rooted cutting, in our operation, exceeds $.50 each. I believe this system could be scaled to any size to replace any amount of energy consumed for a bottom heat system. There is continuing research and trials going on each year around the country. I am sure significant heat transfer engineering improvements could make our trial more productive. However, one must be careful to minimize capital investment costs to earn the highest possible return on investment. ❦

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Cuttings on two tables, inside the 'Hut'