faq-frequently-asked-questions-waste-heat-to-energy-turbines

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This webpage QR code

Infinity Turbine LLC

Frequently Asked Questions by Infinity Turbine LLC

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Company Name: Infinity Turbine LLC
Product: Waste Heat to Energy Systems and Technology

PDF Version of the webpage (first pages)

History

Infinity Turbine was started in 2008, but its roots go back further into the 1980's when I was buying and selling legacy steam engines into the forest products Scope: Infinity has experimented with just about every type of expander, focussing on those below 500 kW in output size, and more on the smaller end of the spectrum (less cost to experiment and develop).

What We've Learned:

If your expander has more than one moving part, it will break. This is a lesson learned, and capitalized on by Capstone Turbine. Beyond that, even having one moving part, will break. That is why we have ultimately focussed on tribo-effect, and a solid-state turbine.

4/15/2024

Market:

We have on focussed on low-grade heat (at or below 100C), and the small commercial market. While the residential market it huge, entrants into that market have failed quickly (huge support needed, and lack of payback).

Working Fluid:

Our original development was with Honeywell Genetron R245fa and R134a. The costs of those proprietary refrigerants is expensive, and will soon be rendered unmarketable in most countries with active CFC programs. We have looked at, and are focussing on liquid CO_2 and supercritical CO_2 (30 C or 89 F).

Business Model:

Our current business model is to sell plans that we have already developed and documented (blueprints). We have build a large number of expanders, and put some into systems (IT10, IT50, and IT250).

Our specialty is in the small end of prime movers, and to that end, we are focussing on selling plans for rotating turbomachinery, and developing a solid state turbine. One of our new products is a APU for drones, using a air-breather gas turbine, but then evolving into a electrostatic turbine.

4/15/2024

Additive 3D Printing:

We have come to the conclusion that a 3D metal (or ceramic) printed turbine generator, with one moving part, may be able to provide a cost effective solution when mass produced. This applies only to turbines or parts less than 6 inches in length or diameter. The nature of furnace heating during the final stage of metal printing shrinks metal, and erases any tolerances. A better method is using a 2D waterjet or laser and stacking parts to build a 3D assembly. It's faster and less expensive.

4/15/2024

Residential Market:

There are significant challenges, which include:

- ORC is a waste heat energy solution, and if you have to pay for the fuel, or to harvest it, it does not have a payback (i.e. solar energy).

- ORC is designed for 24/7 heat supply. Any fractional time heat supply sources have no payback.

- Most residential waste heat sources are time limited (i.e. hot water heaters only operate a small amount of time, solar energy is only part of the day, etc.).

- Most residential applications for CHP have no payback, and required significant amounts of support.

All result in no profit to the equipment supplier. A good example is the recent attempt of the residential Sterling engine by Dean Kaman.

http://www.forbes.com/sites/christopherhelman/2014/07/02/dean-kamen-thinks-his-new-stirling-engine-could-power-the-world/#120f6b71589d

Waste Heat:

Generally, any heat source that can be converted to a liquid (water, glycol, oil, etc.) and is free, is a good source for a ORC system.

If you have to pay to harvest the heat (like solar), then it does not make economic sense, unless your grid based power is very expensive.

ORC and Phase Change Dynamics:

A big part of the equation for a waste-heat-to-energy recovery operation is the necessity for cooling flow, to condense the gas to a liquid. This is often overlooked by developers, and can be a big power draw, rendering a installation commercially infeasible (i.e. no payback).
Commercial ORC Builds: For all models of the turbine with induction AC generator, you will need a grid-tie interconnection device.

The grid-tie integrates the AC Induction motor/generator into the grid, whether it be a local (in-house) or public grid connection.

ORC and Supercritical CO2 Performance Charts

Buy Via PayPal $100 USDNote - when purchase is complete, download will automatically begin to your computer.

When purchase is complete, Click on RETURN TO INFINITY TURBINE LLC and your download will begin. Otherwise, we will email you a download link.

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Heat Rate and Efficiency:

If you have to pay for your heat or fuel, the ORC process doesnot make any financial sense to install. ORC is a bottoming cycle, and designed for waste heat (free heat).

As for supercritical CO_2 Brayton Cycle, it is about the same or lower efficiency as ORC at or below 200 C. Above 500 C The S CO_2 cycle will start to have efficiencies from 40+ percent. This process needs large amounts of funding to be fully developed.

4/15/2024

R245fa:

Our standard developed turbine generator system uses R 245fa (Honeywell Genetron) system which operates between 80-110 C within our parameters. This represents 4-8 percent efficiency. R245fa has proven to be the most efficient refrigerant in this heat range. The cats meow however is CO_2. If you are developing any waste heat to energy systems, you should go directly to CO_2 which will never be phased out as a refrigerant.

Condenser:

The standard systems use a water cooled condenser.

Expect a temperature increase of 5-10 C from the input and exit water flow. There are a few novel condenser designs which will allow a greater cooling rate, and lower water flow rate.

Some novel designs include ejector cooling, Zeolite pellet condenser design, and using our new counterflow turbopump, which uses the turbine power to spin a turbopump that cools the exiting gas from the turbine as a pre-heater. There are also nano-fluid additives which may increase heat transfer efficiency in working fluids.

Also consider Calmac, ground source geothermal, and ambient temperature cooling coils if you have an application in temperate zones with cold winters. Or deep sea cooling for island applications.

Organic Rankine Cycle ORC Simplified:

(a) Your heat is provided in the form of thermal liquid (water, glycolor oil). If you already have heat exchanger equipment, then you can just use water, glycol, or a better alternative is thermal oil. If you don't have a heat exchanger to capture your waste heat, then we recommend a hot air to thermal oil exchanger (they are available everywhere).

The source of the heat can be geothermal, engine waste heat, gas turbine heat, solar collector, industrial waste heat, steam,etc.

Your heat source in the form of a liquid then goes through the evaporator heat exchanger. This is where the working fluid for the ORC turbine gets vaporized and pressurized. The heat source should beat least 80 deg C. Once it passes through the evaporator, it comes out at about 10-15 deg C cooler. This can then be used for additional process heat (CHP hot water or chiller).

(b) The working fluid for the ORC closed system is pressurized by the evaporator, then is expanded by our turbogenerator. This produces the shaft horsepower to turn the generator and produce electricity. Of course, you can have the turbine power a generator, pump, or whatever you require.(c) The expanded working fluid then goes through a condenser to return the vapor to a liquid state.

The condenser requires some method of cooling fluid, typically water which is provided from a cooling tower, or ground based geothermal (the ground has a constant temperature of 15 deg C or less temperature). The liquid is then pumped back into the evaporator unit to complete the cycle. Only environmentally friendly working fluid is used in the system. So, the basic system has a evaporator, turbogenerator unit and condenser.

The temperature difference between the evaporator and condenser heat and cooling flows must be at least 125 deg F, or about 65 deg C (difference).

Our Industry Niche:

Our specialty is distributed energy and developing power systems for business that have unique power opportunities by utilizing waste heat.