The Heat Transformers

gTET Hot Wire

Q2, 2020

News & Updates from Green Thermal Energy Technologies

gTET remains open for business during COVID19

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Turn-key solutions to transform waste into useful energy, delivering economic and climate change benefits

gTET specialises in innovative solutions at industrial scale for thermal energy management, in particular redeploying waste or renewable streams to reduce opex and carbon footprint.

gTET's revolutionary ORC generators enable thermal energy to be effectively converted into electrical power where this is the most efficient and effective use of the energy.

As we like to say here " *WASTE* is the new *OIL*"

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1. Projects:

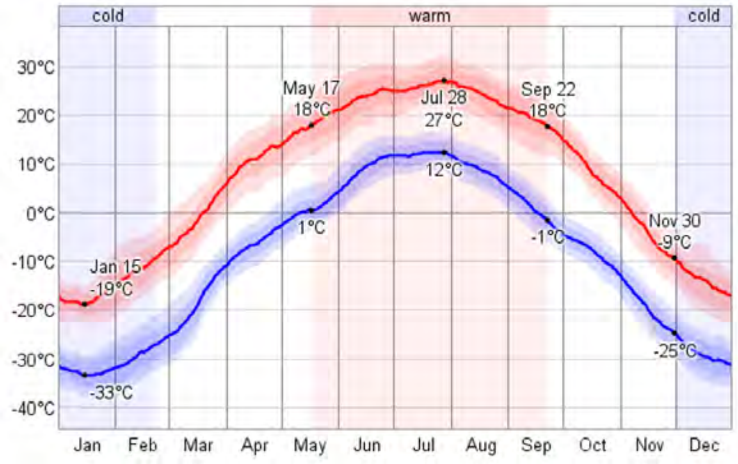
Oyu Tolgoi Shaft 1,2 & 3 Mine Air Heater Skids

The Oyu Tolgoi mine is a combined open pit and underground mining project in Mongolia's South Gobi Desert approximately 550km's south of the Capital , Ulaanbaatar and 80km's north of the Mongolian – China border. The mine primarily produces copper but also small amounts of gold, silver and other metals.

Oyu Tolgoi mine is jointly owned by the Mongolian Government (34%) and Turquoise Hills Resources(66%). Rio Tinto, which has a 51% stake in Turquoise Hill Resources, has been operating and managing the development of the Oyo Tolgoi mine since 2010.

Worley is responsible for providing EPCM (Engineering, Procurement, Construction management) services for the current underground mine expansions underway. Howden Australia has been engaged on the expansion project to develop the mine ventilation system for the underground work.

Conditions in the South Gobi Dessert can be harsh with temperatures in winter months dropping to as low as -30°C.



Oyu Tolgoi Average annual Temperatures

Mine Air Heaters

In Jan 2016 gTET was approached by Howden Australia to provide a turnkey water to glycol heat transfer system enabling Howdens mine air heating system to take outside air from temperatures as low as -30°C and delivering them to the mine shaft ventilation system at a constant 2°C. The underground mine requires air temperatures to remain above 0°C to prevent services in the downcast shaft from freezing and to maintain a comfortable work environment. Mine Air Heater houses are designed to draw air in through glycol to air radiator banks mounted in the walls. At the heart of the heater house are 2 heat transfer stations that circulate glycol through these radiators and warm the glycol to the required temperature to maintain constant 2°C downcast temperature of air to the mine. Each heater house is capable of providing 658m3/s of fresh air to the mine. Energy used to heat the glycol in gTET's heat transfer system is provided by hot water from a central heating plant (CHP) located near to the mine site.

Each heat transfer station is provided with an integrated control panel designed, developed and manufactured by gTET. The heat transfer stations function is monitored and controlled by a PLC in the control panel, which communicates with the main ventilation e-room via the ethernet. Each heat transfer station is fitted with an array of temperature, pressure & flow transmitters which monitor key performance attributes allowing the system to react to changes in outside temperature using electric control valves and pump speed.

Air Temperature in the shaft is monitored signalling demand to adjust the air temperature, the gTET control system then adjusts flow through the heat exchanger to increase or decrease temperature of the glycol circulating though the heater house radiators accordingly.

Each heater house has 2 heat transfer stations, one operates as a backup, if a fault is detected the backup station takes over the heating process automatically, leaving the other station available for maintenance.

To date gTET has supplied six heat transfer stations, two supporting shaft 1 (commissioned in 2017), four supporting shaft 2 (commissioned in 2019). Production of an additional four heat transfer modules was completed in February 2020, to support shaft 3. These will be transported and stored onsite at the mine ready for installation and commissioning in October 2020. Heat transfer stations designed and developed by gTET are produced in China under supervision of gTET’s technical team. gTET provides the contract manufacturer with all input materials required to produce the heat transfer stations including the completed control panels manufactured in gTET's Melbourne facility. Heat transfer station production is independently audited and certified to ASME standards.

gTET provides on-site technical support during the commissioning phases of each mine air heater house, ensuring the heat transfer stations are installed correctly and function to design parameters.

Shaft 2 Mine Air Heater Houses commissioned October 2019, to support up to 200km's of underground tunnels (1.3km's below the surface)

Shaft 1 Mine air heater house

Heat transfer stations inside shaft 2 heater house

2. Technical Brief:

Organic Rankine Cycle

Many people's eyes glaze over when the discussion on Organic Rankine Cycles machines start. The name is long, and gives little information as to what is actually being talked about. However, this technology is older than many realise and well suited to business applications.

To break down the name first we need to build it up. The full name of the system is an Organic Rankine Cycle Heat Engine.

Working from the back to the front, a Heat Engine is a term used by thermodynamics to convert Heat into Work. Everything from a coal fired power station through to an air craft Jet is, or at least a substantial part of it is, a heat engine. The key feature is that some form of heat has to be brought to the engine. The "Internal Combustion" Engine makes that heat inside the engine by "Combusting" fuel "Internally". Many take the heat from external sources, such as a coal fired power station that takes it's heat as hot steam from a boiler.

The next term in the name is the "Rankine Cycle". This is named after its inventor Dr William Rankine, a Scottish professor from the University of Edinburgh, born in 1820. The cycle is most familiar to people as the steam engine. Where water is boiled at pressure and converted to steam. That steam is passed through some sort of expander (e.g. a piston, or a turbine) and then condensed back to water at the lower pressure to be pumped back into the boiler and go around again. This is probably the most commonly used form of power generation around the world with the heat coming from combustion sources such as coal, biomass, nuclear, or solar thermal (heliostats). To be efficient these systems generate steam that is of very high pressure and temperature (e.g. 50 bar, and 500°C). However, there is one further change to this cycle to make it a little more specific.

The final, or perhaps first term, is 'Organic' this refers to the fluid that is being used in the Rankine Cycle Heat Engine. In the general public's mind Organic has to do with farming practices, but to a chemist it refers to the branch of Chemistry that contains hydro carbons, or molecules consisting largely of Hydrogen and Carbon atoms. By changing the fluid from water to other materials allows us to shift the boiling points lower and hence make power from much lower temperatures. This is often desirable as it takes quite a bit of effort to heat steam to 500°C or have a fuel capable of combustion in milliseconds in a piston.

So now there is some understanding of what it is, the next question is how does it work in reality. Figure 1 shows a concept of the ORC system. As above it is the same thermodynamic cycle as a steam plant, but with an Organic fluid. Although it is a cycle the logical place to start is with a low-pressure liquid. This is point 1. In a steam plant this could be water at atmospheric pressure, in an ORC it is a hydrocarbon at slightly above atmospheric pressure. This low-pressure liquid is pumped to high pressure, and fed into a heat exchanger (Point 2). On a steam system this heat exchanger is often a boiler, but in an ORC system the heat source is just heat, so it may be geothermal water, or process heat. The high-pressure liquid is boiled to become a high-pressure vapour at Point 3. The gas now has a considerable amount of energy and can then be expanded through a turbine and generate power. Exiting the turbine, it becomes a low-pressure gas. The low-pressure gas is then cooled and condenses back to a liquid (Point 1) to undergo the cycle again.

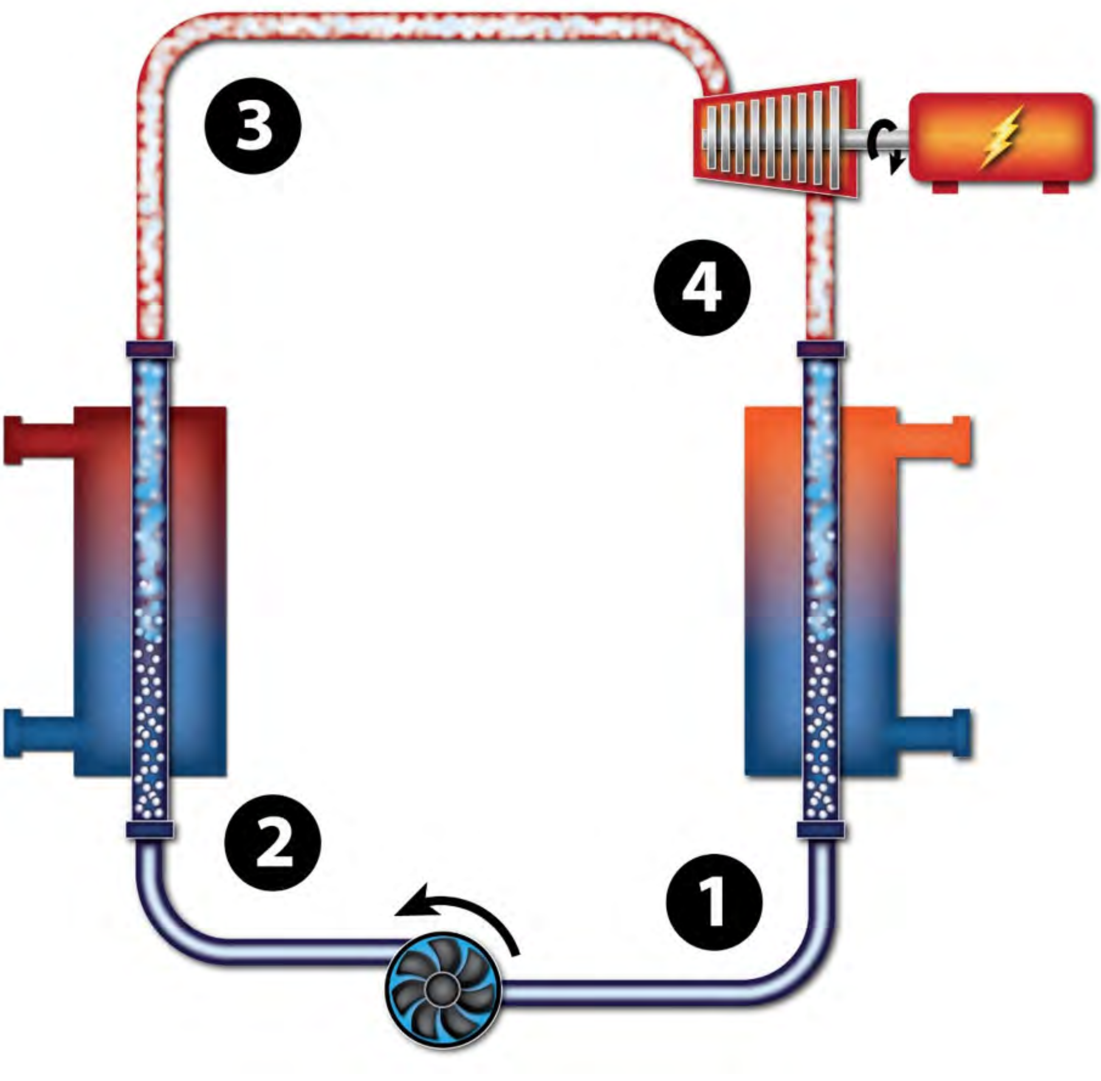


Figure 1 : ORC schematic

As mentioned earlier the Organic fluid allows lower quality heat sources to generate real power. A fluid such as R245fa which has a boiling point of around 15°C at atmospheric pressure, or 13 atmospheres of pressure at 100°C, more than enough to spin a turbine and make power.

There are a range of fluids that can be used to match the heat source available, the R245fa might be used in a 200°C excess biomass produced saturated steam system, or a low temperature source like an artesian basin bore might have water at 86°C and may use a more traditional, but low Global Warming Potential refrigerant such as R152a.

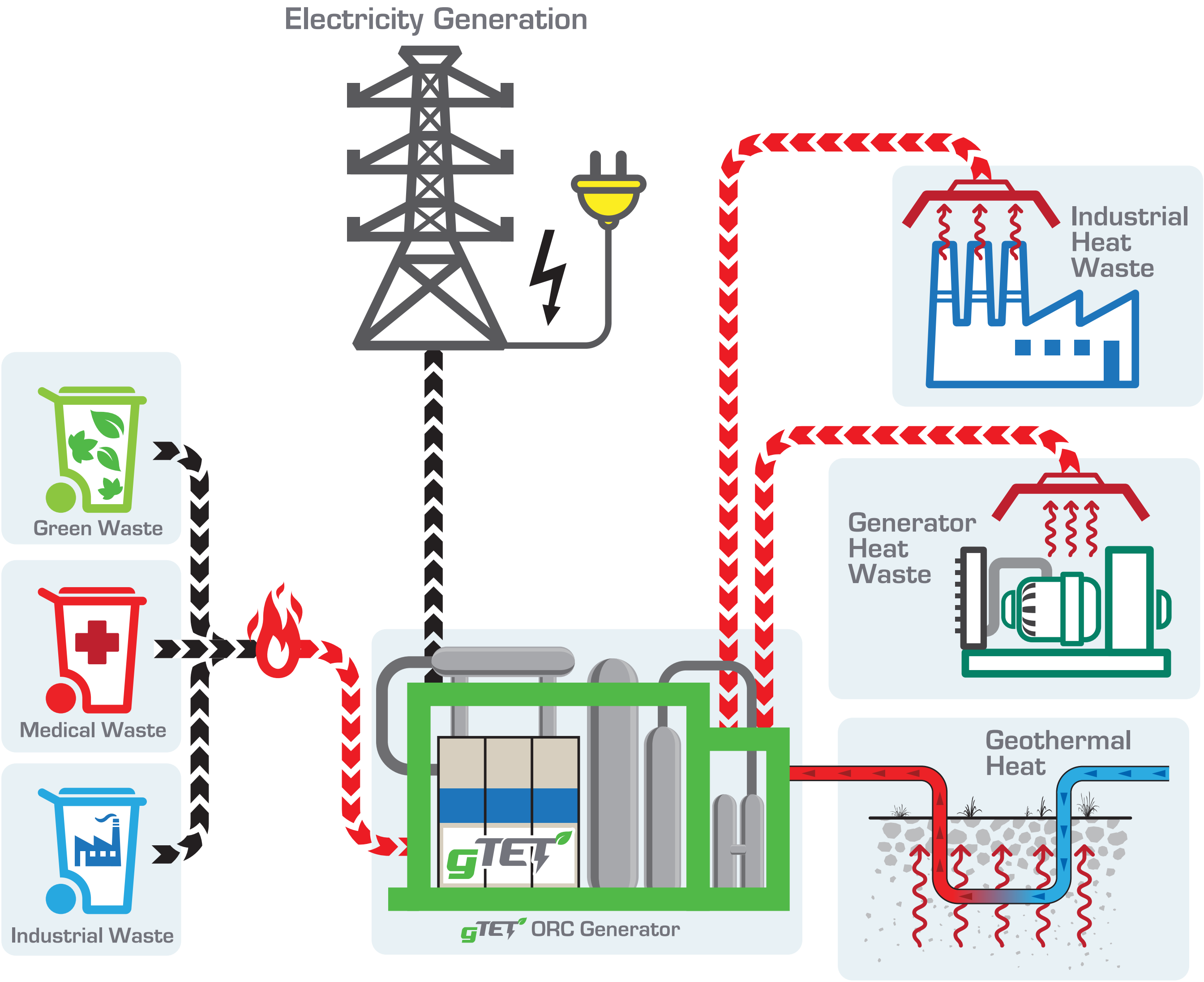
There is a general principal that the thermal efficiency of a heat engine is related to the difference between the 'Source' and the 'Sink', more often than not, the 'Sink' is the natural environment. This has led the steam turbine systems to get hotter and higher pressure in order to get the best efficiency. But in todays world there is a different type of efficiency that is important and that is financial efficiency. That is how much money does it cost you to produce a kilowatt of electricity, or $/kW. In many cases, chasing higher thermal efficiencies is required because of the cost, and emissions of the fuel. However, if the fuel is free then it is often best to sacrifice some thermal efficiency to massively reduce the plant cost. This fits within the commonly cited 80/20 rule of thumb. It takes 80% of the cost to get the last 20% of the efficiency. ORC systems using a stream that either needs to be cooled by the process, or is available for free can generate extremely cost effective power.

Typical applications of ORC is where companies are using biomass to generate steam for their plant needs, they often have too much fuel, but struggle with the slow reaction of their boilers. The ORC can help to flatten out these peaks and troughs generating needed power, and consuming their waste biomass. Other applications include industrial exhaust, waste incineration, or geothermal applications. Basically, anywhere there is a substantial amount of lower grade heat or fuel makes ORC a cost-effective electricity generation solution.

ORC heat engines are starting to appear in a variety of applications to the point that some companies are finding that they can get off the grid as the energy production is timed with their plants production alleviating the need for large storage systems. It is a viable product available in the market today with a long history and track record.

To reduce your business operating costs, and reduce your reliance on a continually degrading national grid, then a clean energy off-grid Power Purchase Agreement (PPA) may be the solution you need...

gTET provides Waste to Energy (W2E) solutions with zero capital investment



gTET The Heat Transformers