THERMINOL
Heat Transfer Fluids by Eastman

TLC Total Lifecycle Care® and Therminol® fluids support ORC clean energy projects.

Alternative energy projects and specifically those based on ORC (organic rankine cycle) technology are widely successful across the western Canadian provinces of Alberta, British Columbia, and Saskatchewan. The success of the ORC process is the creation of "clean energy" that reduces GHG (greenhouse gas) emissions.

Evidence of the support for these projects in western Canada is in the funding programs that are available to the industry. Although the ORC process finds its fuel source from either WHR (waste heat recovery) or biomass (organic waste), many of the elements of the HTF (heat transfer fluid) system are different from project to project. These different factors include the process and flow rate, temperature and pressure, and equipment and components. In addition, there have been numerous stakeholders involved in the various projects.

However there is one element that most of these projects share in common. That common element is that Therminol and Eastman Chemical Company are the brand and supplier of choice for heat transfer fluid requirements. Another common element is that Genalta Power of Calgary, Alberta, has emerged as a leader in the waste to power business.

In this case study, we will discuss the ORC technology, a few of the success stories, incentive programs, and why Eastman and Genalta have emerged as key stakeholders in current and future clean energy projects.

ORC, how it works

With ever-increasing energy costs and a drive to reduce carbon footprints, the timing is right for North American industries to utilize heat recovery applications. ORC technology is now widely available and is considered to be the best solution to turn low-grade waste heat or biomass fuel into clean energy (Diagram 1). A **heat source** from waste heat or from a furnace that burns biomass waste as fuel is used to heat a HTF in a primary loop. As precise temperature control combined with excellent thermal stability and heat transfer coefficients are key for reliable operation in the primary loop, Therminol® heat transfer fluids are widely used for ORC systems.

In a **secondary heat exchanger,** the Therminol fluid in the primary loop is used to heat a fluid such as a refrigerant in the secondary loop that becomes the "working fluid." The low boiling point working fluid is vaporized in the heat exchanger and then travels to an **expander (turbine)** which drives an **electrical generator** thus producing power that can be transmitted to the grid. After the energy is extracted from the working fluid, it is condensed to a liquid state in a **condenser** (usually air cooled) then pressurized by a **pump** to once again enter the **heat exchanger** containing Therminol heat transfer fluid and continue the cycle.

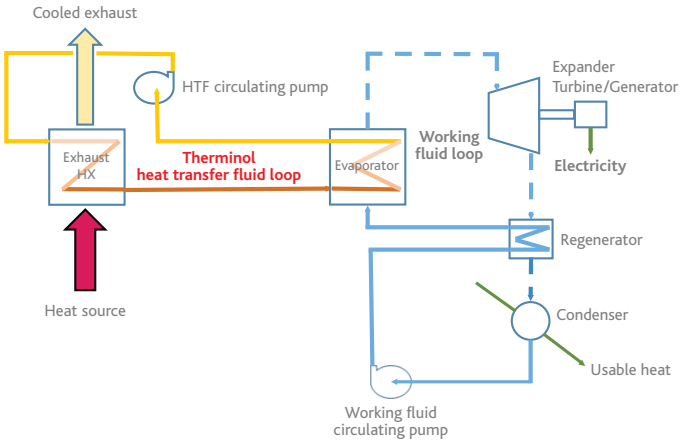

Diagram 1. Organic Rankine Cycle

ORC systems are widely used in Europe for the production of electricity from biomass combustion such as municipal waste or wood products or the safe recovery of thermal energy from exhaust gases from industrial processes such as cement, glass, or metal processing plants. This expanding "green" technology is helping reduce the global energy footprint. ORC is a process designed to use high- or medium-temperature Therminol fluids with lower operating pressures and higher partial load efficiency than steam-driven conventional power plant turbines. ORC hybrid applications, such as combined CSP (concentrated solar power) and ORC, are also finding Therminol products as excellent heat transfer media.

EASTMAN

Transgas, 1 MW ORC WHR
Rosetown, SK

Spectra Energy, 5 MW each ORC WHR
Savona & 100 Mile House, BC

There have been previous articles written on the use of Therminol heat transfer fluid as the product of choice for ORC projects in Western Canada. With this article, testimonials are now available for the use of Therminol fluid in ORC projects in Alberta, British Columbia, and Saskatchewan. The British Columbia and Saskatchewan articles are testimonials on converting waste heat from gas compressor stations to energy. In both cases, the compressor stations capture heat normally vented to the atmosphere through the compressor engines' exhaust and convert it to electricity via an ORC process. The Saskatchewan project is the $5.7 million 2011 Transgas 1 megawatt (MW) ORC system near Rosetown, Saskatchewan. The British Columbia testimonial covers the 2008 startup of the 5 MW ORC systems at Savona as well as 150 Mile House, British Columbia. The two British Columbia projects produce a combined 10 MW of clean energy and offset 25,000 MT of GHG annually. The key to selecting Therminol heat transfer fluid for the demanding requirements of the primary loop for these projects was the proven experience, technical support, and after sales service offered by Eastman to ensure success for these emerging technologies.

Genalta Power and the Judy Creek, Alberta ORC project

Similarly, Genalta Power Inc. chose to work with the Therminol team when they were required to select a heat transfer fluid to be used for an ORC breakthrough application in secondary oil recovery. Genalta Power is a privately held Canadian corporation in the business of developing, owning, and operating independent power plants that produce and sell environmentally friendly electricity from waste energy sources. Genalta Power pursues a mix of waste heat recovery, waste fuel gas, and waste pressure projects. Genalta Power is developing projects in strategic regions of North America with an emphasis on the oil and gas industry.

Genalta completed the 2 MW energy deal with Pengrowth Energy for a waste heat to power project to capture waste heat from two existing turbines at Pengrowth's Judy Creek facility. "Pengrowth and Genalta had been working together to bring this opportunity to fruition," said Drew Shaw, CEO of Genalta. "This project is a great example of bringing sound economics to an environmentally friendly solution to produce green energy for the oil and gas sector."

Genalta Power installed and operates the power plant in exchange for a long-term power purchase agreement for onsite power use. Pengrowth participates in the project as a minority stakeholder and purchases all the energy produced by the project. In addition to generating sustainable power from a wasted heat source, the project generates greenhouse gas offset credits, proves the commercial viability of power installations of less than 5 MW in size, provides much needed power in an area of instability, and reduces the overall operating costs of the facility.

The Judy Creek WHP facility is at Pengrowth's Judy Creek Water Complex located 52 km north of Whitecourt, Alberta. The Judy Creek Water Complex receives roughly 36,000 m^3/day of an oil-water emulsion at 60˚C which is processed to separate the fluids. The mixture is made up of 98% water, and once separated, the water is eventually reinjected into a reservoir. The process of water injections involves two Solar Centaur gas turbines driving water pumps. The excess waste heat produced by the gas turbines is captured and used to generate power using an ORC unit.

The generated power is delivered to a facility motor control center (MCC) and used on site at the Judy Creek Water Complex by two electric drive pumps P-1110 (using 2200 to 3000 kW), and P-1105 (500 to 1400 kW). Any excess power produced by the ORC is fed into the grid. The waste heat to power unit produces power in the range of 1–2 MW with 2013 production averaging 1.2 MW. The waste heat generated by the turbines is diverted to the ORC by an exhaust handling system.

Pengrowth, 2 MW ORC WHR
Judy Creek, AB

The energy produced from this site is eligible to generate carbon credits for sale in the Alberta carbon offset market. Prior to the development of the Judy Creek WHP, the gas turbines at the Judy Creek Water Complex were releasing all of the generated waste heat through an exhaust stack. The two electric drive pumps that now run on the WHP unit were powered by grid electricity. Prior to the Judy Creek WHP subproject, no GHG emissions were being produced as a result of the waste heat, which was released into the atmosphere through an exhaust stack. However, in the project condition, the waste heat is recovered and used to generate electricity. As a result, there is a reduction in the use of grid electricity by the facility. Since most of the grid electricity generated in Alberta is from the combustion of nonrenewable fossil fuel sources, any reduction in grid electricity usage results in emissions reductions.

In addition to the Judy Creek project, Genalta also worked with Pengrowth at two other Pengrowth plant locations in Alberta to divert waste gas from flaring to energy production. Blue Source Canada presenting as an exclusive agency for Genalta Power indicated in a December 2013 report that these aggregate facilities will reduce carbon emissions by 31,000 MT/year.

CCEMC (Climate Change and Emissions Management Corporation)

The benefit of these emission reductions is supported by grants from the CCEMC. "CCEMC's funding is a crucial component in these initiatives and provides the foundation in proving the commercial viability of energy efficiency based projects in Alberta," said Drew Shaw, CEO of Genalta. "Investing in clean energy projects that reduce emissions over the long term while proving the economic viability will provide economic returns for years to come."

Funding for CCEMC projects comes from the Alberta government which collects it from industry. Since 2007, Alberta companies that produce more than 100,000 tons of greenhouse gases are required to reduce their emissions intensity by 12%. To do so, companies can improve the efficiency of their operations, buy carbon credits in the Alberta-based offset system, or pay $15 into the climate change and emissions management fund for every ton over the reduction limit. As of 2014, the fund has generated about $122 million dedicated to climate change and emissions management.

TLC offered by Eastman

Brad McCann, Sales Manager at Solutia Canada, a subsidiary of Eastman Chemical Company, states, "It is no surprise that Eastman and Therminol fluids were a natural fit for these clean energy projects. Eastman is committed to protecting the environment through the continuous improvement of our energy performance. To foster that commitment, Eastman was named an ENERGY STAR® Partner in 2008 and began following the ENERGY STAR® Guidelines for Energy Management."

ENERGY STAR® was introduced by the U.S. Environmental Protection Agency in 1992 as a voluntary market-based partnership to reduce greenhouse gas emissions through increased energy efficiency. ENERGY STAR® offers businesses and consumers energy-efficient solutions to save energy and money and help protect the environment for future generations.

McCann adds, "Eastman was honored once again to be named by the U.S. Environmental Protection Agency as a 2014 ENERGY STAR® Partner of the Year. Eastman is the only chemical company to have the distinction of being named ENERGY STAR® Partner of the Year more than once. This recognition confirms Eastman's efforts in achieving energy efficiencies in their operations which is a key part of Eastman's commitment to being a sustainable chemical company."

Conrad Gamble, Senior Associate for Technical Services at Eastman says, "In addition to Eastman's commitment to energy efficiency, the Eastman Therminol product line offers a TLC Total Lifecycle Care® program that also supports the intentions of clean energy projects. The TLC program includes assistance with system design, start-up assistance, technical support hotline, operational training, and a fluid trade-in program. The technical support minimizes the volume of fluid required for an initial fill as well as the quantity of fluid used during maintenance and operation and extends the life of the fluid. Then, at the end of the life of the fluid, Eastman offers the trade-in program that responsibly manages the used fluid while creating value for the customer."

The fluid trade-in program (available in North America) may permit customers to return used heat transfer fluids to Eastman for potential credit towards the purchase of new Therminol heat transfer fluid. Gamble further states, "Most Therminol heat transfer fluids after use will meet the criteria for nonpetroleum used oil under the U.S. EPA Standards for Management of Used Oil (40 CFR 279), which govern recycling and disposal of used oil. By using the fluid trade-in program, customers minimize the hassle and disposal costs associated with used heat transfer fluids and can be confident that the used fluids will be handled in an environmentally responsible manner."

McCann concludes, "The more than 50 years of experience for the Therminol brand is a significant benefit that reduces risk for stakeholders in these emerging clean energy projects. Furthermore, the comprehensive TLC program and the Eastman commitment to energy efficiency are additional reasons for Therminol fluids and Eastman to be the product and supplier of choice for the heat transfer fluid requirements for clean energy projects."

ORC and clean energy, what's next

Eastman has already expanded the use of Therminol heat transfer fluids from WHR applications to several biomass projects in Western Canada. Considering that over 20,000 MW could potentially be generated from waste heat in North America alone, there has been a relatively small amount of development of this potential resource in addition to the opportunities for biomass. One area of potential growth is to duplicate current successes from one facility to another. For example, the technology for capturing waste heat from the secondary oil recovery process at Judy Creek and converting that WHR to energy is an excellent testimonial for duplicating this technology at many other operations worldwide.

On the other hand, there is a wide range of potential industry sources of waste heat and biomass available to be harnessed and converted to electricity. The following industries are suitable for applying ORC technology to capture waste heat:

- Natural gas compressor stations
- Cement
- Pulp and paper
- Mining
- Glass
- Steel
- Nonferrous furnaces
- Refineries
- Landfill gas and biomass power production

McCann states, "For the immediate future, Eastman looks forward to working with Genalta on pending ORC projects to create Therminol heat transfer fluid systems that are well designed, maintained, and managed. The benefits to the Clean Energy market are HTF systems that run safer, have faster startup, deliver better on-stream performance, and require less fluid and energy."

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