

Da Vinci Co.'s Rotary Heat Engine



Description
Wankel-based Rotary Combustion Engine driven by Rankine cycle. RHE is patented, proprietary technology developed internally.

Design Sizes
Flexible. Current 500 (W) model available. Design size varies from 200W up to 50 kW.



Objectives
RHE enables us to convert waste heat into electricity. Applications exist for waste heat recovery systems at factories, incinerators, geothermal facilities, co-generation systems, etc.

Environmental Approach
Reducing carbon emissions deters environmental pollution. Using waste thermal resources efficiently reduces consumption of fossil fuels.

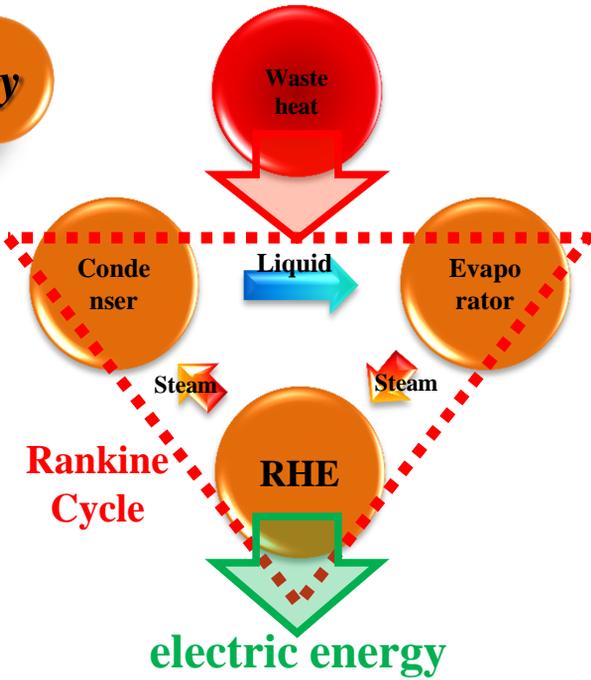


Rotary Heat Engine

Patented Rotary Heat Engine is capable of converting waste heat to electric energy at less than 150 °C !!

Waste Heat Converts to Electric Energy

Da Vinci Co.'s Rotary Heat Engine (RHE) is a waste heat recovery type generator which offers the ability to convert waste heat into electric energy. Regenerating electric power from waste heat leads to lower energy bills and reduced carbon emissions. In this system, the working fluid at liquid phase in the evaporator is vaporized from waste heat. The rotor in RHE turns by the action of the pressure of the vaporized fluid. Steam is emitted from the RHE's port, where it turns back into liquid with cold condensation. It then returns to the evaporator to begin the cycle anew. This type of cycle is referred to as Rankine cycle.

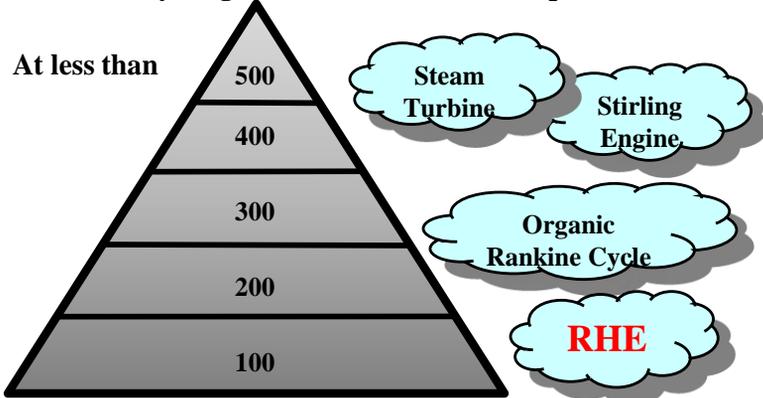


Research and Development is carried out in partnership with the University of Tokyo and The Kansai Electric Power Co., INC.

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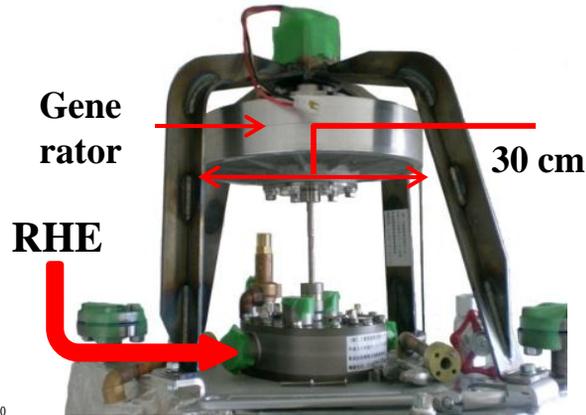
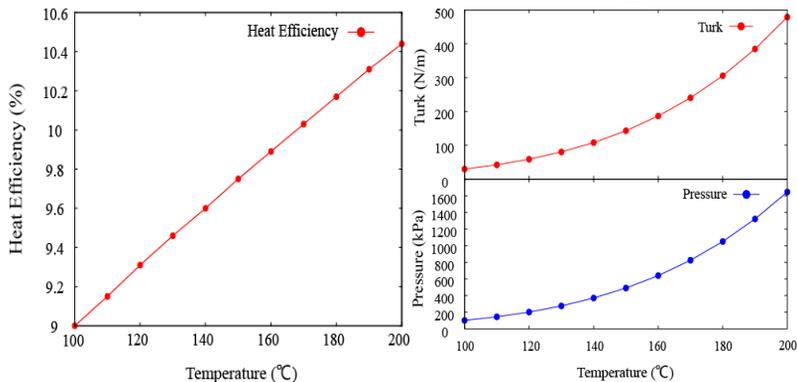


Heat Recycling Devices at Different Temperatures (°C)



Temperature Distribution of Thermal Devices

The pyramid at left shows the temperature of available waste heat, with applicable devices indicated on the right. Steam Turbines utilize waste heat at over 400 °C; Stirling Engines over 300 °C, and Organic Rankine Cycle over 200 °C. Da Vinci Co's RHE targets waste heat at less than 200 °C.



Comparison of Theoretical Performance of Engines

The upper-left graph shows the heat efficiency (on the Y-axis) under various steam temperatures (on the X-axis), and upper-right graph shows the gas pressure at the outlet (blue line), and the turk (red line). The RHE's heat efficiency is calculated from the experimental data obtained when our generator is implemented (regarded working efficiency as 100 %). Therefore, heat efficiency is predicted to fluctuate because of the performance of generator.

Compared with the cycle where is used only gas phase such as Carnot Cycle, Rankine Cycle where is used two phases gas and liquid has a high ability to transfer heat. As a result, RHE shows the high heat efficiency with small temperature difference at low temperature. RHE is proper for heat recovery at low temperature.

Also, if ammonia is used as working fluid, RHE can convert waste heat into electricity with around 50 °C temperature differences.

Specifications :

Electric Power (net) : 500W
 Own Consumption : 20 W (mainly used for condenser pump)
 Heat losses from RHE surface : around 5W^a
 Engine Efficiency (net) : 14% (at the outlet shaft of RHE/ input temperature)

Outside dimensions for RHE (mm) :
 500W : 230 (width) x 164 (depth) x 94 (height)
 Evaporator (for 1kW) : 370 (w) x 620 (d) x 420 (h)
 Condenser (for 1kW) : 500 (w) x 400 (d) x 200 (h)

Working gas : Water^b
 Gas pressure of RHE : 500 kPa (at the inlet), 40kPa (at the outlet)^c
 Engine speed : 300-600 rpm

- Note : These data relate to current prototype (500W), which is continually updated and optimized, generating new data continuously.
- a RHE is covered with glass to maintain its temperature. This value is calculated using 30 C glass surface temp and 20 C room temp.
 - b Other types of gas such as ammonia or organic solvent can be used.
 - c Provided that there is 50 C temp. difference and that ethanol is used as a working fluid.

Promoting Technologies which Contribute to Society

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