waste-heat-to-energy-organic-rankine-cycle-expanders-and-electrostatics

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Waste Heat to Energy Organic Rankine Cycle

This webpage QR code

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Company Name: Infinity Turbine LLC
Product: Waste Heat to Energy Systems and Technology
Working Fluid: Refrigerants, water, and CO_2
Machine: ORC and ROT Radial Outflow Turbine System
Industry: Energy
Applications: Waste heat to power, utilities, server farms, bitcoin mining, hot geothermal
High Technology Uses: Converting waste heat starting at 30C.
Machine Features: One moving part and solid state turbine technology.
Other Technology: Tribo effect power, hydrodynamic cavitation hot water power and extraction. Modular block technology. Gas leverage turbine for production of fuels from liquid CO_2.

PDF Version of the webpage (first pages)

https://infinityturbine.com/waste-heat-to-energy-organic-rankine-cycle-expanders-and-electrostatics.html

Publications for Waste Heat to Energy:

List of selected waste heat to energy publications.

Waste Heat to Energy is a renewable energy field which deploys technology to utilize industrial, commercial, and home based heat which would otherwise be unused, to make power. Since much of the quality of this heat is low, efficiency to capture and convert to power is also low. This makes the most sense (payback) where utility (grid-based) power rates are at or above $.15 per kwh.

Keywords: wood pellets, silo, smoldering fire, explosion, carbon dioxide, static electricity, steam, electrostatic charge, supercritical CO2, subcritical CO2, liquid CO2, lithium ion battery electrolytes, lithium ion battery, recycling, radial turbine design, waste heat recovery, Wasteheat,heatrecovery,thermoelectricgenerator,electricitygeneration, tribo effect, TENG, Triboelectricity, triboelectric materials, thickness layer,contact surface area, Organic Rankine Cycle, Power Generation, Energy System, Design, Build, Capstone Turbine, Microturbine, Binary Power Plant, Organic Rankine Cycle, Matching and Optimization, Two-phase Geothermal Resources, High Enthalpy, Recuperator, Geothermal Comb

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Carbon dioxide not suitable for extinguishment of smouldering silo fires:

[CO_2 develops a large static charge which may result in a corona discharge, when used in Fire Extinguishers. May be a alternative (static DC) energy source when used in a ORC phase change system.]

Carbon dioxide is generally available as a liquid under high pressure. When discharged, small particles of dry ice are formed. The rapid flow of particles can generate considerable amounts of static electricity, which can act as a source of ignition if ignitable pyrolysis gasses are present. This article discusses a serious wood pellet smouldering fire and silo explosion in Norway in 2010, which took place when firefighters discharged portable CO_2 fire extinguishers into the headspace. The attempt to suppress the fire may have ignited pyrolysis gasses. The article examines selected guidelines, standards, popular wood pellet handbooks and other literature and argues that the electrostatic hazard is widely under-appreciated. In the past, major explosions have been attributed to electrostatic ignition of flammable vapours during the release of CO_2 for fire prevention purposes. There is evidence to suggest that those early lessons learned have at least partly passed out of sight.

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Electrostatic Effects of Charged Steam Jets:

[May be a significant source of static DC.]

Wet steam during expansion develops a electrostatic charge which interacts with the environment. Drop evaporation produces a discharging drift current. The result is an electrostatic ignition hazard.

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The Role of Sub- and Supercritical CO_2 as Processing Solvent for the Recycling and Sample Preparation of Lithium Ion Battery Electrolytes:

[Supercritical CO_2 can be used to recycle Lithium batteries.]

Quantitative electrolyte extraction from lithium ion batteries (LIB) is of great interest for recycling processes. extraction is a necessary tool for LIB electrolyte aging analysis as well as for post-mortem investigations in general, because a qualitative overview can already be achieved after a few minutes of extraction for well-aged, apparently dry LIB cells, where the electrolyte is deeply penetrated or even gellified in the solid battery materials.

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Thermodynamic Study of a Combined Power and Refrigeration System for Low-Grade Heat Energy Source:

This study focuses on the thermal performance analysis of an organic Rankine cycle powered vapor compression refrigeration cycle for a set of working fluids for each cycle, also known as a dual fluid system.

Further, a combination of R123 in the refrigeration cycle with propane in the Rankine cycle was scrutinized for their highest efficiency value of 16.48% with the corresponding highest coefficient of performance value of 2.85 at 40 C.

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Analytical and Experimental Study of Thermoelectric Generator (TEG) System for Automotive Exhaust Waste Heat Recovery:

Nearly 70 percent of the energy produced from automotive engines is released to the atmosphere in the form of waste energy. The recovery of this energy represents a vital challenge to engine designers primarily when a thermoelectric generator (TEG) is used, where the availability of a continuous, steady-state temperature and heat flow is essential.

The potential of semi-truck engines presents an attractive application as many coaches and trucks are roaming motorways at steady-state conditions most of the time. This study presents an analytical thermal design and an experimental validation of the TEG system for waste heat recovery from the exhaust of semi-truck engines.

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Generation of 3D Turbine Blades for Automotive Organic Rankine Cycles: Mathematical and Computational Perspectives:

Organic Rankine cycle technology is gaining increasing interest as one of potent future waste heat recovery potential from internal combustion engines. The turbine is the component where power production takes place. Therefore, careful attention to the turbine design through mathematical and numerical simulations is required.

As the rotor is the main component of the turbine, the generation of the 3D shape of the rotor blades and stator vanes is of great importance. Despite the strong vortices, the mathematical model proved to be an effective and fast tool for the generation of the 3D shapes of turbine blades and vanes.

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Overview of the Development and Application of the Twin Screw Expander:

The development of renewable energy and recovery of low-grade waste heat in industry is the key to solve the problem. As a type of volumetric expander with full flow expansion, the screw expander is extensively applied in the industrial waste heat recovery and geothermal energy generation industry because of its effective utilization of low enthalpy energy.

Improving the performance of the screw expander as the core, the paper concludes and summarizes the research status of the leakage, rotor geometry, sealing and lubrication, processing and manufacturing, which can affect the performance of the screw expander.

Experimental Performance Analysis of a Small Thermoelectric System Applicable to Real-Time PCR Devices:

The efficient use of energy from waste heat from the ISS away from the Earth is very important to the efficient operation of the ISS.

To develop a thermoelectric module that can be used for real-time polymerase chain reaction (PCR) machinery used in biological and medical research, we simulated and evaluated the thermoelectric waste heat recovery system.

Triglycerides as Novel Phase-Change Materials:

A Review and Assessment of Their Thermal Properties: Latent Heat Storage (LHS) with Phase-Change Materials (PCMs) represents a high energy density storage technology which could be applied in a variety of applications such as waste heat recovery and integration of renewable energy technologies in energy systems.

To increase the sustainability of these storage solutions, PCMs have to be developed with particular regard to bio-origin and biodegradability. Triglycerides represent an interesting class of esters as the main constituents of animal and vegetable fats, with attractive thermal properties.

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Supercritical Carbon Dioxide(s CO2) Power Cycle for Waste Heat Recovery A Review from Thermodynamic Perspective:

Supercritical CO2 p ower cycles have been deeply investigated in recent years. However, their potential in waste heat recovery is still largely unexplored. This paper presents a critical review of engineering background, technical challenges, and current advances of the sCO2 cycle for waste heat recovery.

Firstly, common barriers for the further promotion of waste heat recovery technology are discussed. Afterwards, the technical advantages of the sCO2 cycle in solving the abovementioned problems are outlined by comparing several state-of-the-art thermodynamic cycles.

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Nanogenerators as a Sustainable Power Source: State of Art, Applications, and Challenges:

A sustainable power source to meet the needs of energy requirement is very much essential in modern society as the conventional sources are depleting. Bioenergy, hydropower, solar, and wind are some of the well-established renewable energy sources that help to attain the need for energy at mega to gigawatts power scale.

Nanogenerators based on nano energy are the growing technology that facilitate self-powered systems, sensors, and flexible and portable electronics in the booming era of IoT (Internet of Things). The invention of nanogenerators is a breakthrough in the field of ambient energy-harvesting techniques as they are lightweight, easily fabricated, sustainable, and care-free systems.

Parametric Assessment on the Advanced Exergy Performance of a CO2 Energy Storage Based Trigeneration System:

The turbine efficiency produces a higher impact on overall exergy destruction than compressor efficiency. The pinch temperature in cold storage causes the highest effect on exergy destruction amongst all the heat exchangers. There exists an optimum value in the compressor inlet pressure and ambient temperature.

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Carbon Dioxide Mixtures as Working Fluid for High-Temperature Heat Recovery: A Thermodynamic Comparison with Transcritical Organic Rankine Cycles:

This study aims to provide a thermodynamic comparison between supercritical CO_2 cycles and ORC cycles utilizing flue gases as waste heat source. Moreover, the possibility of using CO_2 mixtures as working fluids in transcritical cycles to enhance the performance of the thermodynamic cycle is explored. ORCs operating with pure working fluids show higher cyclic thermal and total efficiencies compared to supercritical CO_2 cycles; thus, they represent a better option for high-temperature waste heat recovery provided that the thermal stability at a higher temperature has been assessed.

The results show that a total efficiency of 0.1476 is obtained for the CO_2-R134a mixture (0.3 mole fraction of R134a) at a maximum cycle pressure of 200 bars, which is 15.86 percent higher than the supercritical carbon dioxide cycle efficiency of 0.1274, obtained at the comparatively high maximum pressure of 300 bars.

Steam cycles, owing to their larger number of required turbine stages and lower power output, did not prove to be a suitable option in this application.

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Investigation of a Radial Turbine Design for a Utility-Scale Supercritical CO2 Power Cycle:

Mechanical stress calculations show that the current blade design flow path of the rotor experiences tolerable stress values, however a more detailed re-visitation of disc design is necessitated to ensure an adequate safety margin for given materials.

A discussion of the enabling technologies needed for the adoption of a mid-size radial turbine is given based on current advancements in seals, bearings, and materials for supercritical CO2 cycles.

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Waste Heat Recovery Technologies and Applications:

Industrial waste heat is the energy that is generated in industrial processes which is not put into any practical use and is lost, wasted and dumped into the environment. Recovering the waste heat can be conducted through various waste heat recovery technologies to provide valuable energy sources and reduce the overall energy consumption.

Techniques are considered such as direct contact condensation recovery, indirect contact condensation recovery, transport membrane condensation and the use of units such as heat pumps, heat recovery steam generators (HRSGs), heat pipe systems, Organic Rankine cycles, including the Kalina cycle, that recover and exchange waste heat with potential energy content.

Furthermore, the uses of new emerging technologies for direct heat to power conversion such as thermoelectric, piezoelectric, thermionic, and thermo photo voltaic (TPV) power generation techniques are also explored and reviewed. In this regard, the functionality of all technologies and usage of each technique with respect to their advantages and disadvantages is evaluated and described.

Energy Harvesting from the Waste Heat of an Electrical Oven via Thermoelectric Generator:

This paper presents an attempt to generate the electricity by recovering the waste heat of an electrical oven. An experimental work has been done to investigate the electricity production by using a thermoelectric generator (TEG).

This power could be used for charging a cell phone or light emitting diodes LEDs during cooking.

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Fundamental theories and basic principles of triboelectric effect:

Long-term observation of the triboelectric effect has not only proved the feasibility of many novel and useful tribo-devices (e.g., triboelectric nanogenerators), but also constantly motivated the exploration of its mysterious nature.

In the pursuit of a comprehensive understanding of how the triboelectric process works, a more accurate description of the triboelectric effect and its related parameters and factors is urgently required.

Triboelectric effect in energy harvesting:

The triboelectric effect converts mechanical energy into electrical energy based on the coupling effect of triboelectrification and electrostatic induction and is utilized as the basis for triboelectric generators (TEG). TEG's are promising for energy harvesting due their high output power and efficiency in conjunction with simple and economical production.

Due to the wide availability of materials and ease of integration, in order to produce the triboelectric effect such functional materials are effective for wearable energy harvesting systems.

Shining Light on Triboelectric Phenomena:

These electrical machines, where the mechanical energy is converted to electricity by rubbing together two surfaces, would later be called triboelectric generators.

Recently, there has been a resurgent interest in triboelectric generators for niche situations. In the modern world, very small and localized electrical power is sometimes needed for example, to power a sensor or small LED.