ENERGETICAL, TECHNICAL AND ECONOMICAL CONSIDERATIONS BY CHOOSING BETWEEN A STEAM AND AN ORGANIC RANKINE CYCLE FOR SMALL SCALE POWER GENERATION

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ABSTRACT

To generate electricity from biomass combustion heat, geothermal wells, recovered waste heat from internal combustion engines, gas turbines or industrial processes, both the steam cycle and the Organic Rankine Cycle (ORC) are widely in use. Both technologies are well established and can be found on comparable applications.

This paper presents a thermodynamic analysis and a comparative study of the cycle efficiency for a simplified steam cycle versus an ORC. The most commonly used organic fluids have been considered : R245fa, Toluene, (cyclo)-pentane, Solkatherm and 2 silicone-oils (MM and MDM). Working fluid selection and its application area is being discussed based on fluid characteristics.

The thermal efficiency is mainly determined by the temperature level of the heat source and the condenser conditions. The influence of several process parameters such as turbine inlet and condenser temperature, turbine isentropic efficiency, vapour quality and pressure, use of a regenerator (ORC), is derived from numerous computer simulations. The temperature profile of the heat source is the main restricting factor for the evaporation temperature and pressure.

Finally, some general and economic considerations related to the choice between a steam vs. ORC are discussed.

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