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COMPARISON BETWEEN THE USE OF PURE FLUIDS AND MIXTURES FOR THE EXPLOITATION OF VARIABLE TEMPERATURE HEAT SOURCES.

Marco Astolfi, Silvia Lasala, Carlo De Servi, Ennio Macchi

ABSTRACT

Nowadays, the Organic Rankine Cycles technology is well known and widely used in small solar thermal power plants, for the exploitation of hot geothermal brines and for waste heat recovery from industrial processes like steel and iron furnaces. In Europe, biomass combustion is another field where ORCs are commonly used [5]. To promote the installation of Organic Rankine several counties in Europe are reducing ORCs' LCOE by applying feed-in-tariff mechanisms, but where these incentives are not present biomass fuelled ORCs show considerably higher LCOE The main limits in LCOE reduction are strictly related to the biomass furnace cost and to the efficiency of Organic Rankine Cycles. Nowadays, as regards biomass applications, ORCs commonly use pure working fluids (i.e. siloxanes or long chain alkanes) in a saturated recuperative configuration. In particular, the selected evaporation temperature is the result of the cycle efficiency optimization through the evaluation of the trade-off between the maximization of both the power production and the heat recovery from the synthetic oil used as Heat Transfer Fluid (HTF) in the biomass burner. The performance of the ORC can be improved by the adoption of multicomponents blends as working fluids[6]. However complex analytical tools are needed to design such ORC units and, in particular, the selection of a mixture characterized by a proper temperature glide is not trivial because requires the evaluation of the miscibility of mixture components, its thermal stability and the study of the heat transfer coefficients in phase transition. In this paper the design of a saturated recuperative ORC coupled with a small capacity biomass fired boiler is investigated using different working fluids. Pure toluene and toluene/ethanol mixtures are considered and both thermodynamic and techno-economic aspects will be here analyzed.