

### Evaluation of the suitable working fluid for additional power generation

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#### Abstract

Waste heat emissions derived from cooling systems of the thermal power plant often discharged in rivers, lakes and seas, have been the direct cause of environmental problems to marine life. To control those wastewater discharge in the receptor water body, governmental standards have been created to act as limiting factors for the additional power generation of these plants. The problem can be solved with an organic Rankine cycle (ORC), which is considered a promising technology in electric generation and an alternative to avoid the thermal pollution of the aquatic ecosystems. The present work discusses the use of ORC system aiming to increase both thermal and overall efficiency of traditional systems already established without causing an additional thermal impact on marine species. This evaluation was based on the first and second laws of thermodynamics, applied to seven organic fluids (toluene, methanol, benzene, R11, R12, R113, R134a) and equations that linked the power plant overall efficiency with parameters of life quality in rivers. Results showed that among the organic fluids chosen benzene produced the highest thermal efficiency for the ORC. Besides, an application of the proposed modelling in a thermal power plant localized near to Tubarão river, SC – Brazil was presented. Results demonstrated that by using R113 as working fluid, is possible to generate up to 1365.02  $kW_{elec}$  of additional electric energy and to increase both thermal and overall efficiency of a thermal power plant up to 22.33% and 11.01%, respectively, without causing thermal impact in the aquatic ecosystem. The best energy use was reached by the recuperative cycle configuration of the ORC. The Dissolved Oxygen Concentration (DOC) was decreased up to 6.14 %  $day^{-1}$ , which is consistent with the Brazilian government regulations regarding the effluents released in lagoons, rivers and seas.

**Keywords:** Organic rankine cycle, thermal pollution, aquatic ecosystem, thermal power plant, organic fluids.

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