**Title:** Energetic and exergetic analysis of waste heat recovery systems in the cement industry

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From the abstract: “A parametric study proved that the water steam technology is more efficient than ORC in exhaust gases temperature [sic] higher than 310oC”

This study compared a traditional water-steam Rankine cycle to an ORC in which the working fluid was isopentane. Later in the paper, it is stated that four different organic fluids were examined in order to choose the most appropriate for this application. It turned out that in this case, isopentane was the most efficient working fluid. Price and the energy required to produce the working fluid were not considered in the choice of the working fluid, so says the paper explicitly.

The fact that the heat should be transferred to the ORC via a heat exchanger rather than through direct interaction of the working fluid with the heat source is explained as a fire safety measure. This consideration only applies to hydro-carbons, and in my opinion is an upside to the use of refrigerants as working fluids. This is the case even if a heat-exchanger is used because the possibility of working fluid leaks is always present.

Because this process uses the waste heat from a cement production process, which technically produces both electricity and cement, this application is considered a co-generation process.

“The heat transfer fluid should remain in liquid state and thus pressurized water at 30 bar is ideal for this use. It is important not to have steam, because steam is not able to transfer the heat to the organic fluid as effectively as water.”