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### **PROSPECTS FOR THE APPLICATION OF INSTALLATIONS WITH LOW-BOILING WORKING FLUIDS**

This article discusses the problem of recycling the heat of flue gases using an installation with a low-boiling working fluid (LWF) operating on an organic Rankine cycle (ORC). Due to the low boiling point of organic liquids, ORC is an effective way to improve the efficiency of low-temperature waste heat recovery.

In the modern world, the development of technology and industry requires a constant search for new solutions to improve existing processes and introduce new technologies. One of the promising directions in this area is the use of low-boiling working fluids [1]. In this article we will consider the main advantages and prospects for the use of such working bodies in various industries.

Increasing the thermodynamic efficiency of energy generation of various types must be considered as one of the possible ways to solve this problem [2]. ORC is well suited for these applications, mainly due to the possibility of low-temperature heat recovery and the possibility of implementing decentralized power plants with lower capacity.

Gas turbine units can be used to recover heat [3]. LWF installations consist of three main elements: an expander (turbine), a pump and a heat exchanger. These elements form the basis for the effective operation and implementation of ORC thermal circuit processes. In these elements, a change in the properties of the working fluid occurs, where the efficiency of the cycle can be determined by the known temperature of the heat supplied from the source and the heat removed from the cycle. And yet, the efficiency of the cycle depends on the properties of the working fluid [4].

The temperature of industrial waste heat sources is in the range of 150–300 °C. Higher leaving hot water temperature is found to increase condenser exergy but reduce evaporator power output. Conversely, low outlet temperature provides high power output but low cooling flow exergy and therefore low potential for heating buildings or meeting other industrial thermal energy needs [5].

It should be noted that, in general, waste heat supply profiles and low temperature heat requirements will not be matched. In particular, industrial waste heat is strictly associated with specific production processes; the thermal demand profiles of buildings are highly influenced by daily and seasonal variations. This means that without suitable thermal storage systems, cogeneration heat from ORC

systems may be removed for significant periods of the year [6]. The best working fluid resulting from the optimization procedure may not be optimal if the heat demand is subject to high time variations and does not match the power profile of the HCE plant.

There are pure working fluids and their mixtures. Clean liquids exhibit non-isothermal evaporation, which in some cases can be used to increase the average temperature of the heat input, hence the temperature profile of the heat source can be matched to the working fluid, reducing evaporator losses. Likewise, the heat rejection process is non-isothermal for mixtures, which can increase the average heat rejection temperature. This is expected to have a negative impact on cycle efficiency. However, given that the condenser is used to provide useful heating, the temperature profile of the condenser can be better matched using a working fluid mixture, which can improve the overall exergy performance of the system [5].

Optimal working fluids are usually mixtures of hydrocarbons, usually mixtures of pentane or hexane with other alkanes. Another key characteristic of these fluids is that they predominantly contain a high concentration of pentane or hexane. This is partly due to the fact that pentane and hexane are the two most efficient pure working fluids, but also because their mixtures are better suited to heat source and heat sink streams.

The use of low-boiling working fluids opens up broad prospects for the development of technologies in various industries. Thanks to their unique properties, they make it possible to create more efficient and economical cooling systems, increase equipment performance and reduce the harmful impact on the environment.

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