

## CO<sub>2</sub> expander development for CO<sub>2</sub> transcritical cycle

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### Abstract

Developing CO<sub>2</sub> expander to replace the throttling valve in CO<sub>2</sub> transcritical cycle is a good way to improve the efficiency of the cycle. In this paper, the reciprocating expander, the scroll expander, the screw expander, the rotary vane expander, the rolling piston expander, the swing rolling piston expander and the turbine expander were compared according to the properties of the CO<sub>2</sub> expanding process. The rolling piston expander was chosen to be developed due to its suitable capacity, low cost, simple construction and relatively high efficiency in this paper.

According to our CO<sub>2</sub> transcritical cycle water to water heat pump experimental system and the design system operation condition, the construction parameters of the rolling piston expander prototype were determined. According to the characteristic of the rolling piston expander, the inlet fluid should be controlled to make sure the designing expanding process. The two types of inlet control systems---mechanical controlling system and electromagnetism controlling system were analyzed and compared. The mechanical controlling system was chosen in the rolling piston expander due to its reliability and simplify. The capacity regulation methods of the expander at different operation conditions was also analyzed.

Basing on the dynamics analysis of the rolling piston expander, some unique construction designs were put forward to decrease the friction force and decrease the leakage losses. The friction losses were calculated and the leakage losses were analyzed according to the leakage models. The irreversibility factors were analyzed and the isentropic efficiency of the rolling piston expander prototype were estimated.