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A high temperature cascade heat pump (HTCHP) using a near-zeotropic mixture named BY-3 as the working fluid in the low-stage refrigerant cycle and R245fa as working fluid in the high-stage refrigerant cycle was proposed in this study. Several experiments were carried out to investigate the performance of the HTCHP at the evaporating temperature from 40 °C to 60 °C and the water outlet temperature on the condensing unit of the high-stage cycle can reach 142 °C with the coefficient of performance (COP) of 1.72. The results showed that BY-3 was feasible to be used in the low-stage cycle. A numerical model of the HTCHP was proposed and validated in this study to evaluate its performance. The comparison between the experimental results and the simulated results showed that the HTCHP system using BY-3 and R245fa can product hot water at 142 °C with good performance and the temperature lift of the HTCHP can reach 100 °C.

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