Development and Field Test of High Temperature Water Circulation Type Heat Pump for Industries

Hiroshi NAKAYAMA
Research Engineer, Energy Applications R&D center, Chubu Electric Power co., Inc
Nagoya, Japan
Yoichi MIYAOKA
Manager, Energy Applications R&D center, Chubu Electric Power co., Inc
Nagoya, Japan
Tsukasa TAKAYAMA
Research Engineer, Core Technology center, Toshiba Carrier Corporation,
Shizuoka, Japan

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Abstract

The consideration to the global warming and energy saving is rising every year, and the heat pumps have been expected as one of the most effective among the technologies for the energy problems and carbon dioxide reduction. However, in industrial heating processes and equipment, heat pumps have not fully used, many boilers as the heat sources are mainly used. Boilers have issues on heat dissipation loss since they are often centralized and transport vapor to destinations by long pipe arrangement. Therefore, in industrial heat source fields, high energy efficient and high output water temperature heat-pump equipments are expected to replace existing centralized boilers, as a means of energy saving, carbon dioxide reduction and cost reduction.

In these backgrounds, we have developed an air-source circulation type heat-pump for high temperature water as shown in Fig.1, which is high energy efficient and enables decentralization of heat-source. By using the cascade refrigerating system, we have achieved a maximum output water temperature of 90^{o}C, and an energy efficient operation and reduction in energy consumption of 60% in contrast with gas boiler. In addition, each unit of the system is compactly designed, considering installation at limited places. The field test of the developed heat pump was conducted at food production processes, and seasonal energy efficiency of the heat pump was evaluated. On the basis of the results, the energy consumption and the energy cost of the heat pump is estimated to be 41% and 47% lower than that of the heavy oil boiler, respectively.

Moreover, for industrial washing use of mechanical parts, we have improved the heat pump by using SUS as the liquid touching part material. Therefore, this heat pump can directly heat washing liquid with solubility. System efficiency of direct heating system using the heat pump is estimated to be 13.7% higher than that of indirect heating system with an indirect heat exchanger and a pump. The field test of the heat pump was also conducted at washing process of metal parts. The test result shows that stable and efficient heat supply is possible by washing internal heat exchanger periodically.

Figure 1 Developed heat pump