Commercial Heat Pump Water Heater

**Features**

- Heat pump water heater is highly efficient system that heats water by using heating energy, which may not be very hot but has energy abundantly available, such as ambient heat, underground heat or waste heat with the usage of heat pump technologies.
  - A new hot water system to replace the conventional boilers.
  - Only 1/3 (this may fluctuate depending on the heat source temperature and other various conditions) of the energy required to produce the same amount of water.
  - Some models can store hot water at 90˚C, even from a heat source with an external air temperature of -25˚C.

- Wide range of variations
  - The introduction of the commercial Eco-Cute, which uses natural refrigerant CO₂, is increasing.
  - A wide range of products are available from compact models, used for households, to larger models, used for pools and spas.
  - Hybrid hot water supply systems that combine combustion type boilers are also possible.

- Reduction of the energy consumption and CO₂ is possible and the electric power load leveling is also possible.
  - Due to the high energy efficiency the energy consumption is low. Compared to fossil fuel combustion system it is very energy conservation system which also can significantly reduce CO₂ emissions.
  - The use of hot water stored in the hot water storage tank makes it possible to suspend heat source operations in electric power peak periods during the day or hot water storage operations using discounted night time electric power to level the electric power loads and reduce running costs.

**Basic Concept or Summary**

- Refer to pages, such as R-03 (Heat Pump [General purpose]) and R-04 (Air/Heat Pump Water Heater with Natural-Refrigerant), regarding the operating principles of the heat pump water heater.

- Types and characteristics of refrigerants for heat pump water heater
  1. Natural refrigerant CO₂
     - Environmentally considerate refrigerants that have an Ozone Depletion Potential (ODP) of 0 and a Global Warming Potential (GWP) of 1.
     - Hot water storage tanks can be made smaller, since a maximum hot water output temperature of 90˚C is possible. Furthermore, applications that require high temperature hot water, such as dish washers in kitchens, can also be provided.
     - Many models adopt a single pass temperature rise system that increases the temperature of the feed-water up to high degree in one rush. (Some models support circulated heating also)
  2. HFC refrigerant
     - There are two types of heating systems, one raises the temperature while circulating water with a constant temperature difference (about 5˚C), whereas the other comprises a single pass temperature raising system.
     - Although technically it is possible to dispense hot water at a high temperature of 90˚C, using the HFC refrigerant, but doing so significantly reduces the efficiency and for this reason the characteristics of the refrigerant are generally utilized with many models set to 70˚C, the maximum temperature for highly efficient operations.
     - Since many parts are in common with other heat pump equipment, such as air conditioners, the products can be delivered with a high degree of reliability at a relatively low cost.

- Types and characteristics of hot water storage tanks
  1. Sealed tanks
     - These tanks are made of SUS. Hot water can be supplied using service water pressure, since it is possible to connect the tank to the service water system. Since the application of a load can potentially cause damage, hot water supplies to lower floors are restricted.
  2. Open tanks
     - Many of these are panel tanks built on site, using SUS or FRP. The internal pressure of a tank is atmospheric and a pump for supplying the hot water is required separately, however, it supports an instantaneous supply of large quantities of hot water or the supply of hot water to the lower floors with piping over a long distance.
Effects or Remarks

- Medium term transition of COP for heat pump water heater (current models)
  - With the improved efficiency enabled by the technology development of domestic manufacturers, COP 5.1 or more, or annual heating efficiency of 4.2 or more has been achieved.

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\text{COP} = \frac{\text{Available thermal energy (kW)}}{\text{Input energy (kW)}}
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- Introduction to implemented case examples
  - Location: Shizuoka Prefecture
  - Business category: Dormitory
  - Scale: 200 to 250 persons (fluctuates according to season)
  - Summary of hot water supply facility: Heat pump water heater (heating capacity 14kW x 6 units) and hot water storage tank (18 tons)

(Implementation effects)
The performances (annual) of the renovated hot water supply system of the building shown above, with a hot water supply system comprised of the combination of a heavy oil boiler and a city gas firing hot water supply unit, compared with a heat pump hot water supply unit, depicted in the graphs below, reveal results that indicate carbon dioxide emissions were reduced by 60% and running costs were reduced by about 61%.

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\text{Annual Heating Efficiency} = \frac{\text{Annual Heating Amount}}{\text{(Annual Standard Reserved Hot Water Thermal Dose)}}
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\text{Annual Heating Efficiency} = \frac{\text{Annual Electricity Consumption Amount}}{\text{(Annual Power Consumption for Standard Reserved Hot Water Heating)}}
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- With the improved efficiency enabled by the technology development of domestic manufacturers, COP 5.1 or more, or annual heating efficiency of 4.2 or more has been achieved.

65 tons per year \(\rightarrow\) 26 tons per year (approx. 60% reduction)

* Carbon dioxide emissions unit consumption: 0.332kg - CO2/kWh (TEPCO, 2008)

3.14 million per year \(\rightarrow\) 1.21 million per year (approx. 61% reduction)

* Running costs: Calculated based on the electric power unit price of TEPCO serviced areas for 2008.

Source: Toshiba Carrier Corporation.

Contact: Heat Pump & Thermal Storage Technology Center of Japan, International Department & Technical Research Department
Tel: 03-5643-2404  Fax: +81-3-5641-4501
URL: http://www.hptcj.or.jp