

Overview



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The Kyoto Protocol, which came into effect in 2005, requires all industrialized nations to reduce global greenhouse gas emissions by 5% from 1990 levels during the period from 2008 to 2012. Accordingly, countries have worked hard to develop and introduce technologies for reducing such emissions and meeting their respective targets, for example, -6% for Japan. Heat pump technologies applied to air-conditioning equipment, refrigerators, and water heaters feature high energy efficiencies and effectively reduce greenhouse gas emissions. In particular, the coefficient of ozone destruction of carbon dioxide gas (CO₂), which abounds in nature, is zero and the gas is neither inflammable nor toxic. By using this environment-friendly carbon dioxide as a refrigerant gas for heat pumps, we can create environment-friendly systems.

In order to use carbon dioxide as a refrigerant, the operating pressure needs to be three to five times that of the conventional refrigerant, which is equivalent to approx. 100 atmospheres. Carbon dioxide under such high pressure exhibits a supercritical state in which carbon dioxide has both gaseous characteristics (diffusivity) and liquid characteristics (solubility). In a supercritical state, the density typically fluctuates largely. Therefore, it is important to carefully consider ways to reduce leakage loss and friction loss in the compressor, a pressure-proof design and the path-pattern design of the refrigerant heat exchanger in order to use carbon dioxide in heat pump equipment. In addition, heat pump equipment using carbon dioxide refrigerant can supply hot water at 90°C, which is difficult with the conventional refrigerant. The technology thus has a wide range of applications. Conventional heat pump systems used to have the weakness that their performance decreased in cold conditions. However, recently developed systems with high energy efficiencies can maintain high performance even in cold conditions, with the result that heat pump equipment is increasingly being used in cold regions.

This issue introduces the latest heat pump systems using carbon dioxide natural refrigerant and development of the elements of heat pump systems, such as compressors and refrigerant heat exchangers. Mitsubishi is committed to continuing to develop high-performance energy-saving systems to help curb global warming.