

SANYO Develops Japans first CO2 Refrigerant Direct Expansion Type Refrigeration System

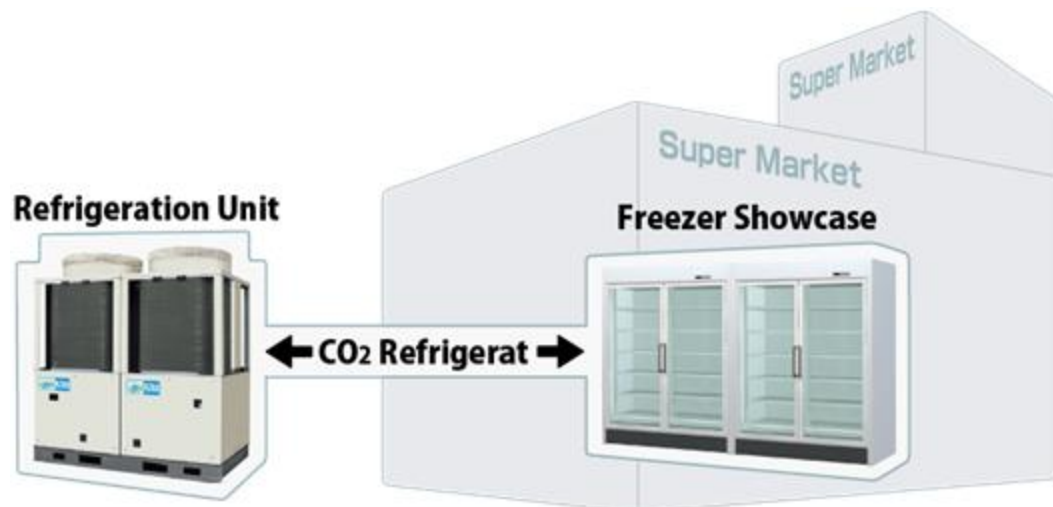
By [admin](#) on October 5, 2009

SANYO Electric Co., Ltd. (SANYO) is pleased to announce the development a CO2 Refrigerant Direct Expansion Type Refrigeration System using a natural refrigerant (CO2), the first of its kind in Japan, for use as a refrigeration system for supermarket freezer showcases. In the past, the Alternative Fluorocarbo, R404A, was mainly used as the refrigerant in refrigeration systems for freezer showcases. However, the natural refrigerant CO2 has a very low global warming potential compared to an alternative fluorocarbon (about one four-thousandth), and can therefore greatly contribute to the prevention of global warming.



SANYO has been pursuing R&D for the new system, based on its adoption as a FY 2008 Non-fluorocarbon Energy-saving Refrigeration/Air-conditioning System Project by the New Energy and Industrial Technology Development Organization (NEDO). In August 2009, test installation of the system was begun at 'Maxvalu Express Rokugodote Ekimae' a supermarket by AEON Retail Co., Ltd. (Shohei Murai, President; headquartered in Chiba City, Chiba), a subsidiary of AEON Co., Ltd. (Motoya Okada, President; headquartered in Chiba City, Chiba).

SANYO will continue to help realize comfortable store environments while preventing further global warming, by accelerating the development and application of CO2 compressor technology, in order to promote a low-carbon society.



Development Background and Aims

Since the adoption of an international treaty in 1987, the Montreal Protocol, companies have been obligated to reduce the production and use of Chlorofluorocarbons (CFCs) in stages. Certain fluorocarbons, including CFCs used in refrigeration machines and air conditioners, cause damage to the earth's ozone layer, and may be contributing to global warming and harming ecosystems. Currently, Hydrofluorocarbons (HFCs) are used as an Alternative Fluorocarbon*3 refrigerant that does not damage the ozone layer, in refrigeration machines and air conditioners. However, even Alternative Fluorocarbons have global warming potentials (GWP) of 1,430 to 3,920, compared to a GWP of just 1 for CO₂. There has been concern that Alternative Fluorocarbons contribute to global warming, and emissions of these gases are regulated as a greenhouse gas under the Kyoto Protocol. Japan's 2007 emissions of HFC refrigerants, when converted to an equivalent amount of CO₂, were 13.2 million tons of CO₂*4, making up almost 1% of the country's total CO₂ emissions, and the amount is expected to increase substantially in the future. Consequently, there is an urgent need to accelerate the development and application of devices and systems that use natural refrigerants, while promoting conversion to natural refrigerants with low GWP and zero ozone depletion potentials, in order to protect the planet's environment.

Aside from CO₂, other natural refrigerants include Hydrocarbons (HCs) and ammonia, but these natural refrigerants have posed problems of efficiency deterioration, toxicity, flammability and high pressure requirements. Although CO₂ refrigerant is not toxic or flammable, it must be used at a much higher pressure than HFC refrigerants. However, SANYO has now developed Japan's first*1 CO₂ Refrigerant Direct Expansion Type*2 Refrigeration System using CO₂ refrigerant, after succeeding in the creation of a safe design for handling high-pressure CO₂.

Features of the CO₂ Refrigerant Direct Expansion Type Refrigeration System

1. Reduces energy consumption by up to 10% and realizes high Coefficient Of Performance (COP) *6 refrigeration cycles using a larger version of SANYO's proprietary rotary two-stage CO₂ compressor, and a newly developed split cycle

HFC refrigerants can provide considerable cooling effects by condensing refrigerant in an outdoor condensing unit. With CO₂ refrigerant however, in an hot operating environment of

30°C or higher, such as during the summer, it becomes difficult to create good efficient cycles using condensation latent heat, as the refrigerant does not condense due to the fact that the pressure of the refrigerant inside the gas cooler rises above the critical pressure. Consequently, SANYO developed a split-cycle CO₂-refrigeration circuit that can handle high pressure. With the split cycle technology (see Diagram 1) part of the high-pressure refrigerant cooled by the gas cooler is diverted to make a bypass. By lowering the pressure of the bypassed refrigerant to the intermediate level using an expansion valve, the cooling effect is triggered, which enhances the cooling effect of the main refrigerant flow by the heat exchange inside the internal heat exchanger which is peculiar to the split cycle. It is possible to reduce the necessary compression power by returning the bypassed refrigerant after the conveyance of cooling effect to a suitable intermediate-pressure level in the compression process. Through this reduction of necessary compression power and the expansion of cooling effect, the COP has been greatly improved.

In order to create a flow that returns refrigerant from the split heat exchanger to a suitable intermediate-pressure level, it is necessary to have an injection port, since a single-stage compressor is used for the HFC refrigerant circuit. With the new system however, a split cycle structure has been realized without special structural changes, that efficiently returns the refrigerant to the second-stage injection port, since it uses a larger-capacity version of SANYO's proprietary two-stage CO₂ compressor.

Thanks to the split cycle and the rotary two-stage CO₂ compressor, the energy consumption has been reduced by about 10% during refrigeration operation, compared to previous HFC refrigeration systems

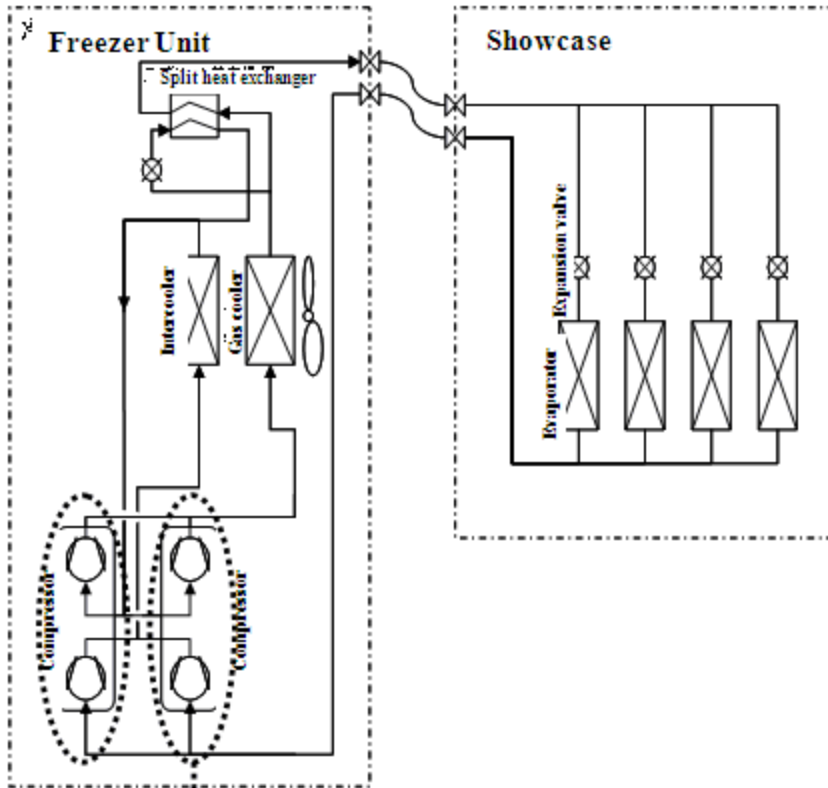


Diagram 1. Split Cycle System

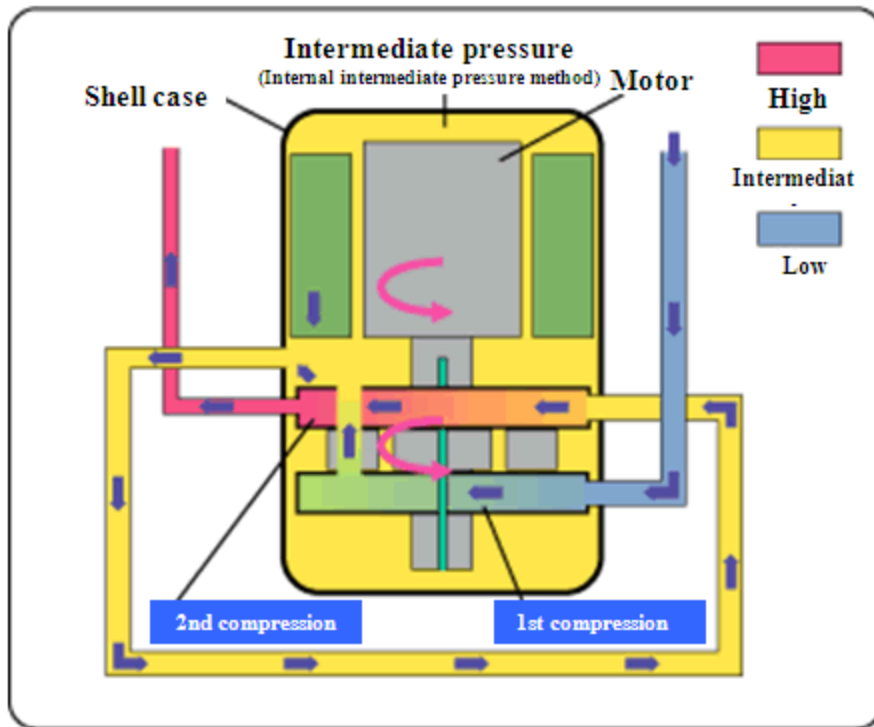


Diagram 2. CO₂ Rotary Two-stage Compressor

2. Enables installation and a unit size the same as previous models through the adoption of the direct expansion method

Some refrigeration machines use an HC or ammonia as a natural refrigerant, but these substances are toxic and flammable, and they cannot be used for indoor showcases. Moreover, it is complicated to convert to CO₂ refrigerant by creating a dual refrigeration cycle.

With SANYO's new system however, a direct expansion method has been adopted where the refrigerant flows directly between the refrigeration machine and the showcase to be cooled. This means that it is the same format as HFC refrigeration systems already being used. Accordingly, the pipe laying and installation can be carried out using the same framework as for older systems, making it easy to install or to update existing equipment. Since the new refrigeration machine and the refrigerant piping framework are almost the same structure and layout as for HFC refrigeration machines already being used, SANYO was able to make the casing for the new refrigeration machine the same size or less as existing machines.

3. Helps to protect the environment by reducing piping material by about 37% through the adoption of CO₂ refrigerant

CO₂ refrigerant is a thermodynamic substance with high saturation pressure compared to HFC refrigerant. Therefore, the piping needs to be 25% thicker for a CO₂ refrigeration system than for an HFC system in order to withstand the higher pressure. With CO₂ refrigerant, the heat delivery capability is higher and pipes can be narrower when compared to mainstream R404A in refrigeration systems for freezer showcases. Consequently, the weight of the necessary copper piping can be reduced by about 37%, thereby contributing to the saving of resources.

CO₂ Emissions Reduction Effect

The recently started test installation of the new system at the 'Maxvalu Express Rokugodote Ekimae' in Tokyo involved the replacement of about one third of the existing freezer showcases in the store. The CO₂ emissions reduction including the energy-saving effect is expected to be about 12% for all the showcases in the store, when taking into consideration the emissions reduction effect*7 for greenhouse effect gas by using refrigerant with low GWP. If all the freezer and refrigerator showcases in the store were converted to CO₂ refrigeration system, the CO₂ emissions reduction effect would be about 50%.

