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## MAYEKAWA MFG. CO., LTD.

- Strategic Development of Energy Conservation Technology Project - Development of a Dehumidification-type High-performance Air-based Freezing System that Uses Polymer Adsorbent (FY2003-2005) and other projects

# Ultra-low-temperature Freezing System that Achieves $-60^{\circ}\text{C}$ Using Air as the Refrigerant



Among "refrigerating warehouses" used to store foods in the frozen state, those used to store large high-value fishes such as tuna and skipjack at a temperature below  $-50^{\circ}\text{C}$  are called "ultra-low-temperature refrigerating warehouses." There are about 400 such refrigerating warehouses throughout Japan (in fishery bases for tuna fishing boats, fish-consuming large cities and other places), and they are supporting the physical distribution of fish to restaurants, our homes, etc. However, it is not well known that the use of these ultra-low-temperature refrigerating warehouses had been on the verge of being discontinued up until quite recently.

That is, the use of chlorofluorocarbon type refrigerants, which had been traditional main refrigerants in the refrigerating warehouse industry, was going to be no longer possible after the year 2020, because international rules including the Montreal Protocol for stopping the depletion of the ozone layer and the Kyoto Protocol for stopping global warming had strongly demanded that those chlorofluorocarbon type refrigerants with high environmental impact be replaced with ones with lower environmental impact. Companies in the ultra-low-temperature refrigerating warehouse industry had feared that they would be forced to abolish ultra-low-temperature refrigerating warehouses because there would be no refrigerant to use for them.

Against this background, MAYEKAWA MFG. CO., LTD., which is an industrial freezer manufacturer, tackled the task of developing an innovative system that uses the very familiar "air" as the refrigerant rather than traditional chlorofluorocarbon type refrigerants. What motivated MAYEKAWA MFG. CO., LTD. to pursue this technological development was the three years of development work the company conducted under the "Project for Strategic Development of Technologies for Achieving More Efficient Utilization of Energy" of NEDO.

After completion of the project, MAYEKAWA MFG. CO., LTD. conducted a two-year field test using an ultra-low-temperature refrigerating warehouse for tuna in actual operation to ensure the viability of the introduction of the developed technology into the market, and established, in cooperation with refrigerating warehouse operators, who were target users, a system for practical operation of the new technology that utilizes air, which is a safe and novel refrigerant, and is capable of achieving a reduction in the annual power consumption of up to 50% (that is, dramatic energy saving).

In December 2008 (which was five and half years after the start of the development), MAYEKAWA MFG. CO., LTD. started selling "PascalAir," an air refrigerant-based freezing system for ultra-low-temperature refrigerating warehouses. A total of about 25 units of PascalAir were introduced at facilities in Japan in five years after the start of sale. It is expected that PascalAir will become more popular in the future as the demand for PascalAir will increase in conjunction with renovation of old ultra-low-temperature refrigerating warehouses.



The "heart" of PascalAir - the compressor with integral turboexpander



The PascalAir unit installed in a facility of Fukazawa Reizo K.K.

### **Q. Why did this project start?**

In the early 1990s, CO<sub>2</sub> concentration increases caused by the burning of fossil fuels and the resultant acceleration of global warming started to be discussed as an international environmental problem. Japan established its "New National Energy Strategy" in 2006 to achieve the international commitments it had made at international conferences including the Conference of the Parties to the United Nations Framework Convention on Climate Change. In line with the Strategy, for the Ministry of Economy, Trade and Industry and NEDO decided to advertise a wide range of companies and organizations including companies and organizations in the manufacturing sector, in which the implementation of reduction measures had already been started, and companies and organizations in the (household and business use) consumer products production sector and transportation sector to propose ideas for research and development in the area of energy-saving technologies without limiting the range of research themes, they strategically promote research and development including that in the domains of basic research, development for putting developed technologies into practical use and demonstration studies.

### **Q. What was the aim of the project?**

This project was designed and implemented as a project which propose a wide range of ideas and contribute wisdom for research and development from universities, companies, etc., rather than a project in which NEDO specifies detailed specific technological tasks in advance. This made it possible for the project to provide system which support multi-layered development that covers energy-saving technology development at various development stages including pioneering technological development with a potential for achieving significant energy saving in the future, development for putting technologies with a potential for bringing about energy-saving effects at an early stage into practical use and demonstration studies.

MAYEKAWA MFG. CO., LTD., which is a leading manufacturer of large freezing and refrigerating equipment, participated in this project and developed a novel energy-saving type ultra-low-temperature refrigerating system for large fishes such as tuna which uses air as the refrigerant to save energy and help alleviate global warming. The market for the system itself is not large, but the system is indispensable equipment for Japan's fishery industry and the supply of fish in Japan, and the ripple effects of the system are unfathomable.

### **Q. What is the role of NEDO?**

The Ministry of Economy, Trade and Industry set the goal of improving the energy consumption efficiency by at least 30% by the year 2030 in the "Energy Saving Front Runner Plan" incorporated in the "New National Energy Strategy." The specific strategy for achieving this goal was established jointly by NEDO and the Ministry of Economy, Trade and Industry in the form of the "Strategy for Energy-Saving Technologies." This NEDO project was conducted in accordance with the Strategy.

NEDO endeavored to appropriately manage the research and development activities conducted under the themes adopted, by (1) organizing a technical committee comprised of outside experts which was charged with the task of reviewing the progress statuses of each research and development activities, if necessary, making discussions for addressing encountered problems and challenges to expedite the activities identified by the Technical Committee as behind schedule activities and detect problems in advance so that they can be solved at an early stage and the research and development activities produce the intended results.

NEDO estimates that energy saving of 13.585 million kl and 29.367 million kl (crude oil equivalent) will be achieved by 2020 and 2030, respectively, by the research and development activities conducted under the adopted themes and their ripple effects.