

Trends of Refrigerant and Compressor in Air-Conditioning and Refrigeration Industry

Knowing that emissions of certain gases account for adverse climate and environmental impacts, the Montreal Protocol, dedicated to restoring ozone layer by phasing out CFCs and HCFCs, and the Kyoto Protocol, aimed at fighting global warming, were consecutively signed by most global countries and entered into force in late 20th and early 21st century. As the phase-out of CFCs and HCFCs proceeds, various Hydrofluorocarbons (HFCs) with zero ODP (Ozone Depletion Potential) have emerged or are emerging as the preferred refrigerants in air-conditioning and refrigeration industry. HFCs not only retain the desirable safety characteristics - low toxicity and non-flammability - that originally led to the widespread use of CFCs and HCFCs as refrigerants, but also provide an even more cost-effective performance in many applications. Many HFCs such as R-134a, R-410A, R-407C, R-404A and R-507, have been used extensively so far in the industry as CFCs' and HCFCs' substitutes.

However, HFCs still hurt the environment with high Global Warming Potential (GWP) and are considered as "transitional substances" to more environmental-friendly ones. In the Kyoto Protocol, HFCs were included in the comprehensive greenhouse gases along with carbon dioxide, methane, nitrous oxide, PFCs and SF₆. The protocol requires 37 industrialized countries to first eliminate any growth in their greenhouse gas emissions that took place over the two decades (since 1990) and collectively to further reduce their emissions about 5% below 1990 level on average over the 2008 to 2012 time period. In other words, the widely-adopted HFCs nowadays will still be restricted in future applications. Next-generation refrigerants after HFCs shall be more climate-friendly, and those that are popularly recognized so far are the natural refrigerants such as: ammonia, hydrocarbons, carbon dioxide, etc. Natural refrigerants have no or very low GWP and zero ODP and thus meet the prerequisites of the Montreal Protocol and fulfill the aims of the Kyoto Protocol in terms of reduction of CO₂-equivalent emissions.

1. Ammonia (ODP=0; GWP= 0)

Ammonia has been used widely in industrial refrigeration field over a century and is attractive with its high-efficiency and low cost. It is the backbone of the food industry for freezing and storage of both frozen and unfrozen foods. Many worldwide institutes have announced to encourage more use of ammonia in air-conditioning and refrigeration industry as it is now. Hanbell RG series open-type screw compressor can be applied to HCFCs, most HFCs and especially ammonia with its open-type structure. Its references for industrial refrigeration have been widespread all over the world.

2. Hydrocarbons (ODP=0; GWP <3)

Application of hydrocarbons like propane, butane, and isobutane as refrigerants has been popular. For instance, isobutane has been used successfully in domestic refrigerators

and freezers. In the meanwhile, propane is gaining in popularity as a replacement for HCFC-22 and HFCs in commercial air-conditioning and refrigeration. Hanbell screw compressors can be applied to propane with additional explosion-proof enclosure of electrical devices due to propane's flammability.

3. **Carbon dioxide** (ODP=0; GWP= 1)

Carbon dioxide (CO₂) can be applied in most heating and cooling systems such as mobile air-conditioning (MAC), vending machines, coolers, commercial cabinets for supermarkets, containers and climate control systems for residences. CO₂ technology in commercial air-conditioning has also advanced forward with the launch of new rotary and reciprocating compressors available in the market.

Environmental-friendly concept has also influenced overwhelmingly the development of compressor in air-conditioning and refrigeration industry especially after the Kyoto Protocol. Energy-efficiency has been the essential feature in new compressors in order to achieve a lower indirect CO₂ emissions to atmosphere with less electrical power consumption, and the users also get reward from energy-savings afterwards. The international standards for evaluation of energy-efficiency are usually IPLV and ESEER. Operating a screw compressor with an inverter can better improve efficiency of the system especially in part load.

Hanbell RV series VFD screw compressor can be applied to most HFC refrigerants. Together with an inverter, its capacity modulation can be done via change of its rotation speed. Due to its higher volumetric efficiency at higher rotation speeds (max. 80-120 Hz per model selection), lower pressure drop and always compatible Vi, it excels in COP (IPLV or ESEER values) than equivalent screw compressors in the market.

Confronted by calls for reduction in greenhouse gases emission and increasing energy costs, applications of natural refrigerants and innovations for high-efficiency systems/compressors will continue to proceed and lead new developments in the future. Hanbell offers customers more choices of advanced compressors to keep pace with this trend.