Special Feature 1 Next-Generation Fluorocarbon Products – Hydrofluoroolefins (HFOs)

Next-Generation Environmentally Friendly Blowing Agents and Solvents

History of Chlorofluorocarbon Regulation

Chlorofluorocarbon Regulation and Central Glass's Business

Chlorofluorocarbons (CFCs) were developed in the 1920s as coolants for refrigerators and similar devices. Demand for CFCs increased from the 1960s onward.

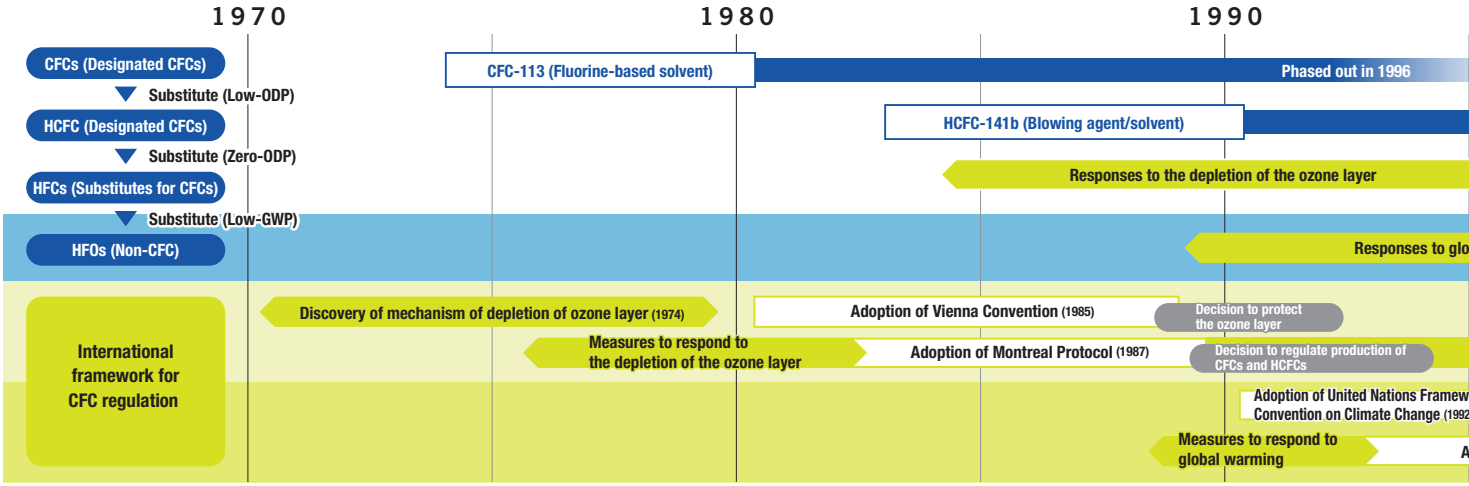
However, the effect of CFCs in depleting the ozone layer and contributing to global warming became known with the discovery of the mechanism of ozone depletion in 1974, creating a need for the development of alternative substances.

Against this backdrop, Central Glass developed the fluorine-based blowing agent HFO-1233zd(E), used mainly in rigid urethane foams, and the fluorine-based solvent HFO-1233zd(Z), used mainly to clean metals and electronic components. These are non-CFC products that can replace CFCs.

Major Events in Relation to CFC Regulation

1974	Discovery of mechanism of depletion of ozone layer
1985	Adoption of Vienna Convention → Decision to protect the ozone layer
1987	Adoption of Montreal Protocol → Decision to regulate production of designated CFCs
1992	Adoption of United Nations Framework Convention on Climate Change → Agreement to combat global warming
1997	Adoption of Kyoto Protocol → Decision to regulate emissions of greenhouse gases (including HFCs)
2015	Adoption of Paris Agreement → Decision to make efforts to combat global warming by all signatory nations
2016	Revision of Montreal Protocol (Kigali Revision) → Decision to regulate production of HFCs

Changes in the Environment surrounding CFCs and Central Glass's Fluorocarbon Business



Next-Generation Non-CFC Products

Next-generation blowing agent HFO-1233zd(E)

HFO-1233zd(E) is a low-GWP product with a GWP*1 approximately one thousandth that of existing products (GWP=1). Its performance is either equal or superior to the currently used HFC-245fa, but it does not contribute to ozone depletion.

Hydrofluorocarbons (HFCs) that do not damage the ozone layer are currently used as fluorine-based blowing agents. Central Glass is the only company producing HFC-245fa in Japan, and also sells the product. However, HFCs were targeted for reduction in the Kyoto Protocol as greenhouse gases that absorb heat released from the surface of the earth.

Central Glass therefore worked to develop technologies for a next-generation blowing agent with a low GWP and environmental burden.

*1 Global warming potential (GWP): An index that expresses the degree to which a greenhouse gas contributes to global warming, compared to the benchmark of carbon dioxide
*2 Ozone depletion potential (ODP): A relative value that indicates the potential of a substance to destroy the ozone layer, compared to CFC-11 as a benchmark

Our Ube UF-1 Plant, where HFO-1233zd(E) is manufactured

Next-generation solvent HFO-1233zd(Z)

HFO-1233zd(Z), developed by Central Glass, is a fluorine-based solvent that satisfies all of the requirements of environmental performance, cleaning performance, safety, and easy handling.

Although substances such as chlorine-based methylene chloride and bromine-based 1-bromopropane were previously used in fields requiring cleaning performance, the toxicity of these substances and especially their effects on health have become issues in recent years.

In the area of fluorine-based solvents and cleaning agents, HCFC-225 and HFC- and HFE-based substances have been used since the complete phase-out of HCFC-141b. However, HCFC-225 has a high ODP*2, and will be phased out in 2020. Many efforts are underway to reduce HFCs and HFEs, which have high GWPs. Under such conditions, there is demand for the development of environmentally friendly products with zero ODP and low GWP.

Packaging of HFO-1233zd(Z) (Left: 20L pail; Right: 200L drum)

Expansion of the Ube Plant and Future Plans

Formerly, we only manufactured fluorocarbon products at our Kawasaki Plant. As we predict increased demand for our next-generation blowing agent, a promising material in efforts to address global warming, we began operating a new facility that manufactures HFO-1233zd(E) at our Ube Plant in fiscal 2016.

Central Glass will continue to respond to social demands, contributing to a better global environment through R&D and global supply.