



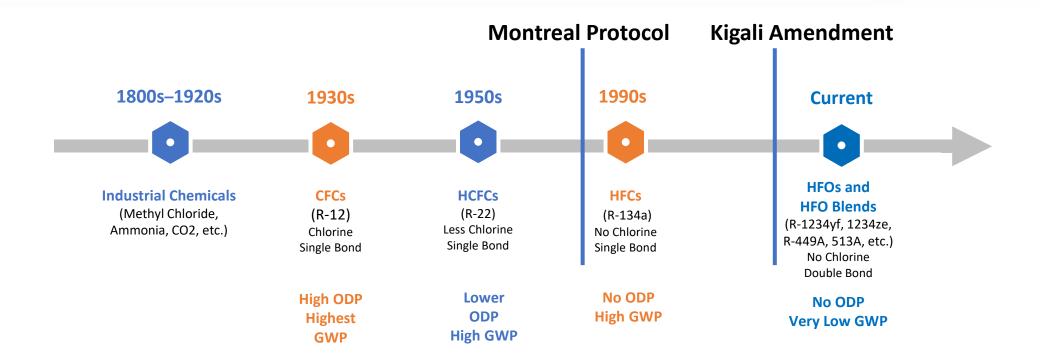
Refrigerant Selection Considerations in Industrial Process Refrigeration

Industrial Processes Emissions Reduction (IPER) Technology Workshop April 5-6, 2022

Dave Snyder *Chemours R&D Senior Staff Engineer*

302-773-6669 david.snyder@chemours.com

Evolution of Refrigerants



Regulations Drive Industry Transitions





Regulatory Landscape



Montreal Protocol

Phaseouts, like R-22

Kigali Amendment

Phasedowns, like R-410A



US State Level

CARB

Climate Alliance



US Federal Level

AIM Act

EPA SNAP



The international community has been operating under Kigali

In the absence of Federal activity, the states began regulating

New Federal regulations should re-align the industry





The Chemours Story



1930 DuPont co-invents fluorine-based refrigerants (CFCs)



2011

DuPont commercializes Low GWP Hydroflouro-olefin (HFOs)



2016

Chemours breaks ground on world's largest HFO manufacturing facility



2018

Announced investment in new World-Class Innovation Center for R&D



~1990

Commercial Sales of Hydrofluorocarbons (HFCs) begin



2015

DuPont spins off its Performance Chemicals business, creating Chemours (NYSE: CC)



2017

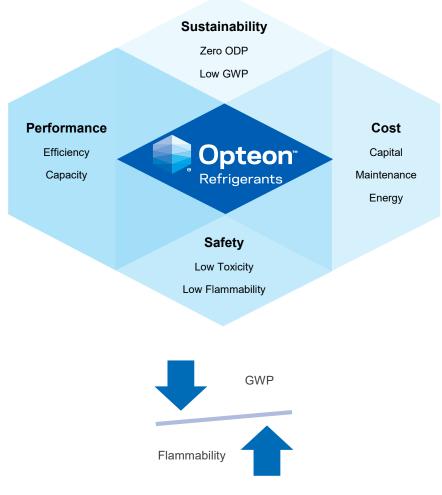
Chemours named a 2017 Fortune 500 Company







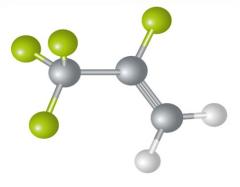
Balancing Performance with Sustainability



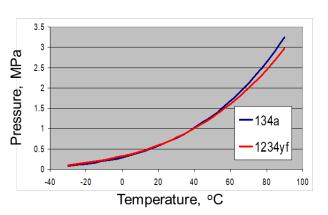


HFC Hydrofluorocarbon

	<u>R-134a</u>	HFO-1234yf
Formula	CH ₂ FCF ₃	CF ₃ CF=CH ₂
Molecular Weight	102	114
ODP	0	0
GWP _{100 (AR5)}	1300	< 1
T Critical Point	102 ºC	95ºC
Boiling Point	-26ºC	-29ºC



HFO Hydrofluoroolefin







ASHRAE Standard 34 Refrigerant Safety Group Classifications

Higher Flammability	A3	B 3
Flammable	A2	B2
Lower Flammability	A2L	B2L
No Flame Propagation	A 1	B1
	Lower Toxicity	Higher Toxicity

Class 3 Requirements

Exhibit flame propagation @ 60°C & 101.3 kPa
LFL ≤ 0.10 kg/m³ or HOC ≥ 19,000 kJ/kg

Class 2 Requirements

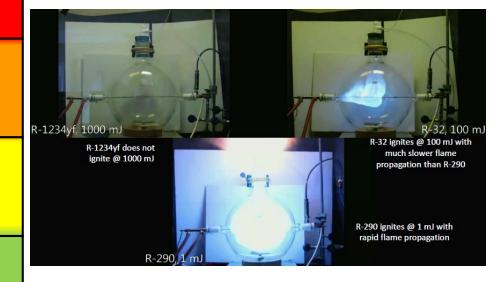
- 1. Exhibit flame propagation @ 60°C & 101.3 kPa
 - 2. LFL > 0.10 kg/m^3
 - 3. HOC < 19,000 kJ/kg

Class 2L Requirements

- 1. Exhibit flame propagation @ 60°C & 101.3 kPa
 - 2. LFL > 0.10 kg/m^3
 - 3. HOC < 19,000 kJ/kg
 - 4. S_{.,.} ≤ 10 cm/s

Class 1 Requirements

1. No flame propagation @ 60°C & 101.3 kPa

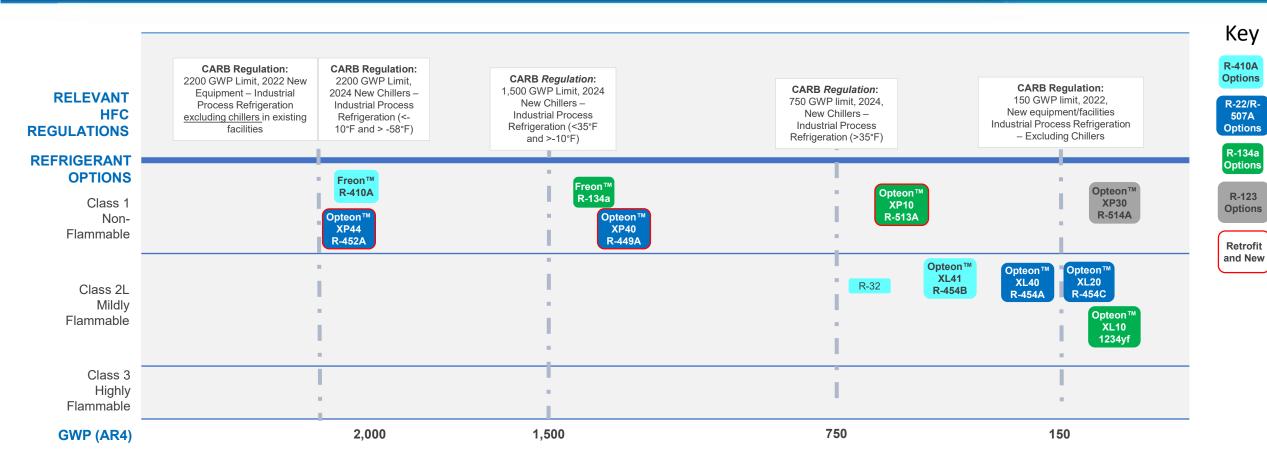








Refrigeration Options







Options for Existing R-22 Flooded Systems

1. **Do Nothing**

- Continue to operate/service with R-22
- Supply and pricing uncertainty
- Ozone depletion potential (ODP)

2. Complete System Replacement

- \$\$\$
- + Efficient & Sustainable Systems

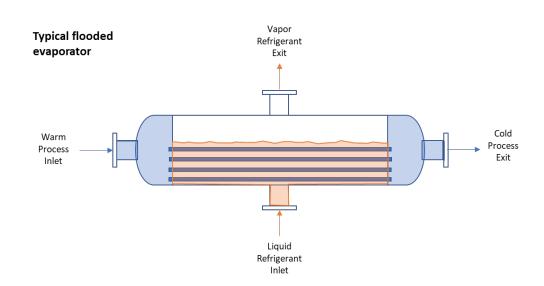
3. Partial System Replacement (Evaporator only)

- \$\$, custom solution
- + Demonstrated success w/ Opteon™

4. Refrigerant Only Conversion to Opteon™*

- + Lowest cost to non-ODP, low global warming potential (GWP)
- + Several successful customer projects







^{*}This is an engineered solution. Chemours can assist in viability assessments.

Resources

Product Information

- Product information bulletin
- PUSH Bulletin

Engineering Properties

- PH Diagrams
- PT Data
- Thermodynamic Properties
- Transport Properties

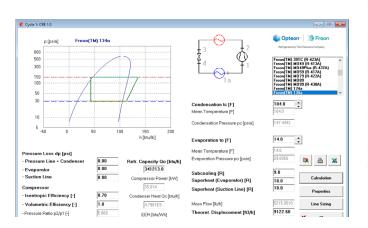
Applications

- Retrofit Guidelines
- Case Studies



Additional Resources

- Refrigeration Replacement Guide
- Line Sizing Tables
- Chemours Refrigeration Expert
- PT Calc mobile app
- Tech service direct contact





https://www.opteon.com/en/support/understanding-a2l-refrigerants

https://www.opteon.com/en





Thank You