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FUTURE TRENDS OF NATURAL REFRIGERANTS: SELECTION, PREPARATION AND EVALUATION

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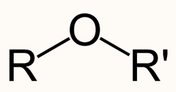
INTRODUCTION

HISTORY

1805



Ethers are used as refrigerant

1834

Ether (Jacob Perkins' refrigeration machine).

1830-1930

Ether, HCs, CHCs, $HCOOCH_3$, SO_2, H_2O, CO_2, NH_3 were used.

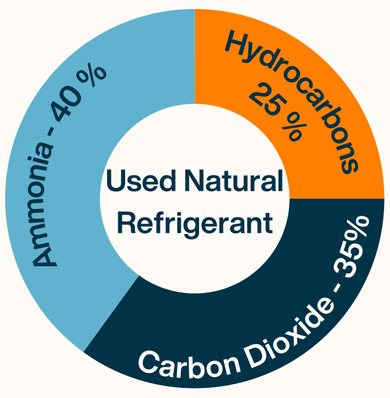
1930s

Shift to synthetic refrigerants (CFCs, HFCs)

1900s to Present

Natural Alternatives are being tested due to Global Warming

Natural Refrigerants have **Low ODP and GWP** values compared to **CFCs and HFCs**.



SELECTION OF NATURAL REFRIGERANTS

COMPARISON OF THE REFRIGERANTS

	Ammonia	Carbon Dioxide	Hydrocarbons	Air
GWP	Low	Low	Very Low	None
ODP	None	None	None	None
COP	High	High	High	Low
Toxicity	High	Low	Low	None
Flammable	No	No	Yes	No
Efficiency	High	High	High	Low
Cost	High	Medium	Medium	Low

COMMON APPLICATIONS

AMMONIA
- Industrial Refrigeration
- Food Processing

CARBON DIOXIDE
- Cold Storage
- Food Preparation

HYDROCARBONS
- Automotive Air Conditioning
- Domestic Refrigeration

AIR
- General Cooling
- Engineers Air Cooling

EVALUATION OF NATURAL REFRIGERANTS

EFFICIENCY

Natural refrigerants are still a good substitute because their COP values are still **on par** with those of conventional refrigerants.

- **HC600a**: 32.2% higher COP than HFC134a (46g vs. 70g)
- **R290**: Comparable COP to R22, 2.3% lower COP compared to R134a.
- **Ammonia**: 10% higher COP than R134a, Lower COP than R22
- **R600a**: Lower COP than R22
- **R1270**: 1.9% lower COP compared to R134a.

COP EFFIENCY

TRADITIONAL ≈ NATURAL

ENVIRONMENTAL IMPACTS

Natural refrigerants have low to zero ODP and GWP values, in contrast to traditional refrigerants that have high values.

OZONE DEPLETION POTENTIAL VALUES
- Traditional Refrigerants (CFCs/HCFCs): 0.33 - 1
- Natural Refrigerants: 0

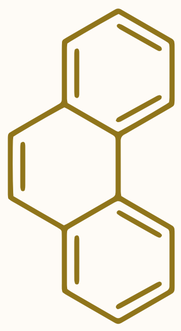
GLOBAL WARMING POTENTIAL VALUES
- Traditional Refrigerants (CFCs/HCFCs): 1700-11700
- Natural Refrigerants: 0-20

PREPARATION OF NATURAL REFRIGERANTS

GASES that contain no chlorine and fluorine

The preparation of natural refrigerants involves finding environmentally friendly alternatives to halogenated refrigerants

HYDROCARBON REFRIGERANT



- Ammonia are natural and have properties that make them suitable for use in refrigeration systems.
- Preparation involves determining the **OPTIMAL** mass ratio of the hydrocarbons
- The optimal charged mass is 40% of that of R134a.

WATER REFRIGERANT

- Simplified component models addressed crucial issues specific to water-based refrigeration cycles, such as compression ratio and refrigerant-side pressure drop.
- It's important to develop **LOW-COST** and high-capacity compressors to make water vapor refrigeration systems economically attractive.

AMMONIA REFRIGERANT

- Safety and regulations are designed to ensure the safe handling and usage of ammonia.
- In preparation, its toxicity and **FLAMMABILITY** requires strict adherence to safety protocols and guidelines.

FUTURE PERSPECTIVES

Global refrigerant demand **expected to rise sharply**.

CHALLENGES

NATURAL REFRIGERANTS

HYDROFLUORO-OLEFIN (HFO) REFRIGERANTS

Limited availability, requires new technology.

RESEARCH GAPS

- Natural refrigerants are environmentally sustainable but **require extensive and comprehensive literature**.
- The rise of new substances of refrigerant in smaller systems is evidence for this study. However, this remains unclear, which tells that **design considerations and economic feasibility are needed**.
- The lack of testaments of the **long-term effects** for utilization of natural refrigerants must be introduced to society.