

Progress of Alternative Refrigerants in Transport Refrigeration Sector

运输制冷行业制冷剂替代的进展



A pair of hands is shown from the right side of the frame, gently cupping a small, realistic-looking globe of the Earth. The globe is positioned in the lower right quadrant, showing the African continent and surrounding regions. The background is a soft-focus field of green grass. A white semi-transparent banner is overlaid on the left side of the image, containing the title text. A red curved shape is visible in the top left corner.

Selecting Refrigerants For The Future 为未来甄选制冷剂

Primary Issues With Low GWP Transition

过度到低GWP的主要问题

- Safety 安全性
 - Many flammable refrigerant will likely be used
很多易燃制冷剂都可能会被采用
 - The total refrigerant lifecycle needs to be evaluated by product and application to understand impacts.
产品及应用需要考虑制冷剂全生命周期的评价
- Efficiency 效率
 - Must be able to meet or exceed today's performance
必须达到或超越现今的性能表现
 - Must be able to perform at high ambient conditions
必须能够在高温环境操作

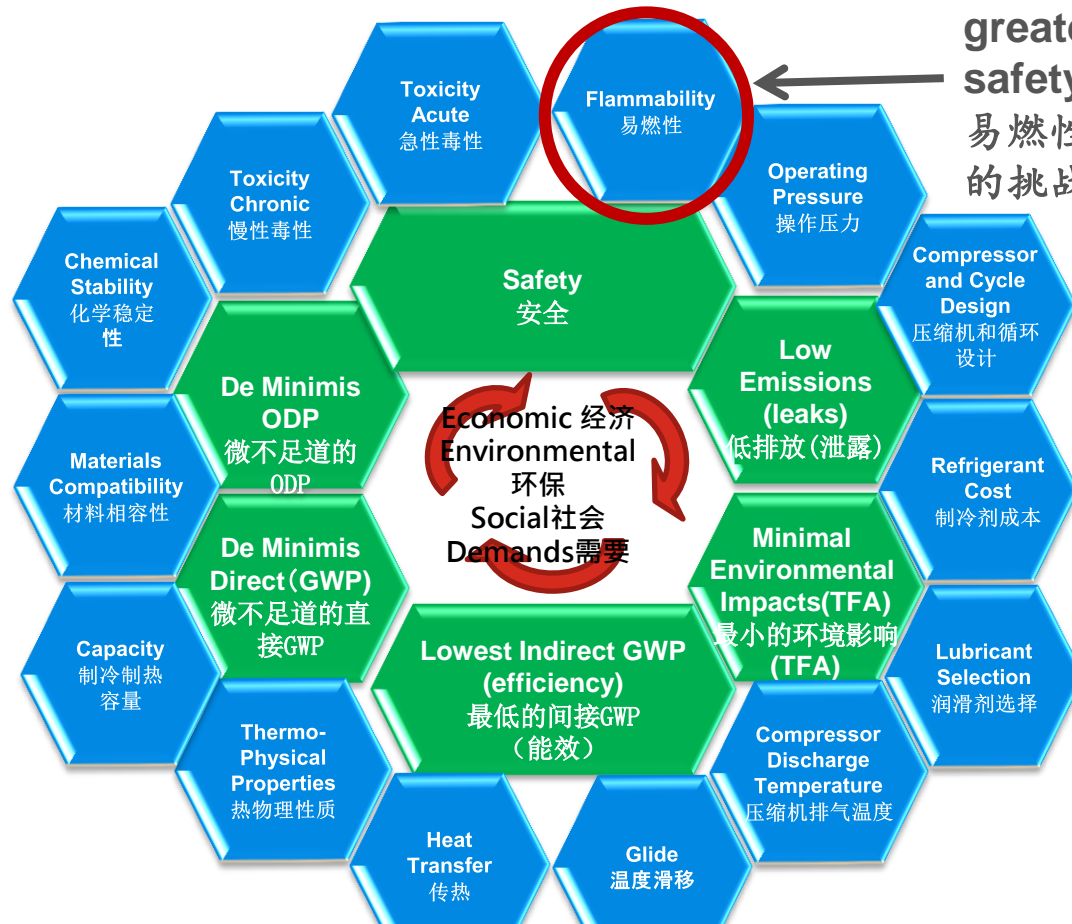
Primary Issues With Low GWP Transition

过度到低GWP的主要问题

- Cost 成本
 - Cost of safety, equipment and refrigerant
设备与制冷剂的安全成本
 - IP barriers
知识产权的障碍
- Technical Transition 技术转移
 - Cost and time to change technology
技术转移所需的时间与成本
 - Changes should be as “future-proof” as possible
改变尽可能不过时

Technical Issues with Low GWP Refrigerant Selection

低GWP替代制冷剂选择的技术问题



Flammability is the greatest technical and safety challenge
易燃性是技术与安全最大的挑战

Refrigerant selection is a complex process that involves the balancing of safety, environmental, efficiency, reliability and economic impacts
制冷剂的选择是一个复杂的过程，必须平衡安全、环保、效率、与经济影响等因素

Alternatives in Transport Refrigeration

运输制冷剂的替代物



Transport Air Conditioning 运输用空调

(Bus, Truck & Rail 巴士、卡车和列车) :

Current Offering 现有产品

- Mostly R-134a, some R-407C for expanded capacity
以R134a为主, 部分大容量: R407C
- Non Flammable 不可燃
- Very high GWP to high GWP's
高至非常高GWP
- Safety is a priority 安全第一
- Large capacity AC units, 7-12+ tons
大冷量空调器, 7至12冷吨以上



Next Generation 下一代产品

- Refrigerant blends 混合制冷剂
- Non flammable, moderate GWP
不可燃、中等GWP
- R-134a → non flammable solutions GWP ~600 near term available
R-134a → 不可燃的替代品短期内有, GWP约600
- R-407C → non flammable solutions GWP ~1000 under development
R-407C → 不可燃的替代品还在研究中, GWP在1000左右
- Lower GWP (~ <150 GWP) R-134a and (~ <675 GWP) R-407C options available longer term but 2L flammable.
更低GWP的R134a与R407C替代品长远可有, 但可燃性都是2L级

Transport Refrigeration 运输用制冷

(Both low/moderate temp refrigeration 中级低温制冷)

Current Offering 现有产品

- R-404A & R-410A (low temp 低温),
- R-134a (fresh 新采用)
- Non Flammable 不可燃
- Very high GWP (R-404A) and high GWP (R-134a) 很高和高GWP
- Safe to use 使用安全
- Transport refrigeration is a very challenging application (high ambient and low temp, with design space constraints)

运输制冷的应用具挑战性(高温环境、低温制冷、空间小)



Next Generation 下一代产品

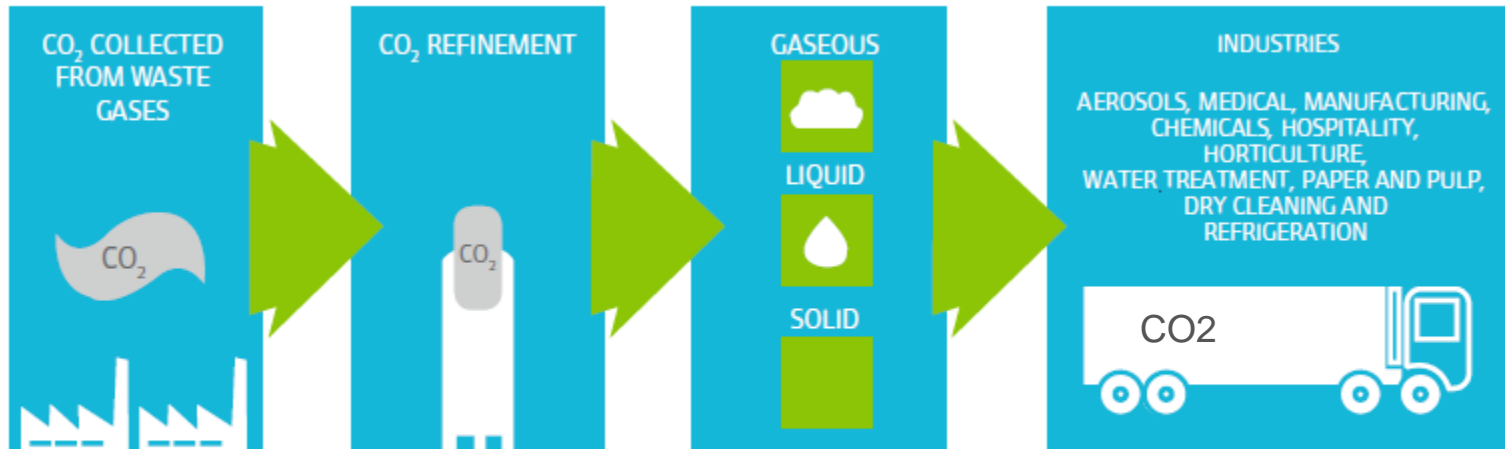
- Refrigerant blends 混合制冷剂
- R-404A and R-134a: **Non flammable options near term developing with greatly reduced, but still higher GWP (<2000)**
R-404A and R-134a: 不可燃替代品短期可实现, 但GWP仍然很高 (<2000)
- R-404A Lower GWP (~<675) options: **available longer term but 2L flammable.**
R-404A 低GWP (~<675) 替代品: 长远可实现, 但可燃性是2L级
- Use of flammable refrigerants may pose safety risk in cargo boxes, but lower flammability options clearly possible
使用易燃制冷剂为货柜安全带来风险, 可燃性较低的选择显然是可能的

Cryo Tech
CO₂运输制冷系统



CryoTech Systems CO₂ 运输制冷系统

- No cumulative global warming effect
没有累计的温室效应
- Second use of cryogen
制冷剂使用回收气体
- Minimal greenhouse gases created during liquefaction of R-744
R-744 制冷剂液化中产生的温室气体非常有限



The total carbon footprint for the use of a CryoTech system is 75% less than a conventional diesel system and 68% less than a nitrogen cryogenic system.

CryoTech Systems CO₂运输制冷系统

Some Learning's经验分享

- Highly rely on Gas Supply Availability
气体供应非常关键
- Not economically viable in high ambient operation
在高环境温度下运行没有经济效益低
 - Diesel cost vs. CO₂ consumption/cost
- Noise legislation is driving interest (PIEK)
在欧洲噪声法规是一个驱动因素之一
- Significant impact of Applications + loading practices on consumption
应用和装载都需要改变
 - Door openings + Curtains 门控开关+门帘
 - Lanes vs. Compartments 箱体分隔
 - Product pre-cooling 预冷

Thank you
谢谢