SPECIALISTS IN Industrial Refrigeration

CO_2 vs NH_3

Typical applications for refrigeration:

1. Domestic & Residential
   Airconditioning split systems, household fridges etc.

2. Commercial
   Retail and groceries, hospitality etc.

3. Industrial
   Petro-chemical, food processing, brewing, large scale fruit storage etc.

4. Healthcare & Pharmaceuticals
   Medical storage, cryogenic freezing etc.

5. Transport & Logistics
   Cold chain shipping/trucking etc.

Types of refrigerants:

Synthetic Refrigerants

- As the name suggests it is not naturally occurring
- Also known as “freons”
- High GWP (Global Warming Potential)
- Typically found in supermarkets, home fridge and your car’s AC
- Not well regulated within the industry with very adherence by installers to SANS guidelines for safe and responsible usage and construction

Types of refrigerants:

Natural Refrigerants

- Naturally occurring
- Carbon Dioxide (R-744) and Ammonia (R-717)
- Ammonia has no GWP and no ODP (Ozone Depletion Potential)
- Carbon Dioxide has a GWP of 1 and no ODP
- NH_3 is typically found in large scale industrial applications
- CO_2 is typically found in small to large scale applications from commercial to industrial
- NH_3 is very well regulated and guided by local and international standards
- CO_2 is not very well regulated and treated the same as freons

When to use what?

We need to base our decision on the following factors:

- Cost (Capital outlay and life cycle costs such as maintenance, efficiency etc.)
- Safety and the environment
- Location and footprint constraints

When to use what?

Synthetic Refrigerants

- Cost
  - Relatively cheap, mass produced and catalogue based
  - Fair COP (Coefficient Of Performance) but not the best
  - Can be expensive to maintain (components are typically replaced and not repaired)
- Safety and the environment
  - Not very environmentally friendly and toxic to humans (undetectable to the nose and kills by depriving oxygen)
- Location and footprint constraints
  - Ideal for small applications (commercial etc.)

When to use what?

Natural Refrigerants

- Cost
  - Not off the shelf and custom built so typically only viable on systems larger than 100kW
  - The best COP depending on application (It can be horrible if not done right)
  - NH_3 is per kWR relatively affordable to maintain as components are over engineered and can be repaired in most instances.
  - CO_2 is designed and constructed to freon standards and can be expensive to maintain (components are typically replaced and not repaired)

- Safety and the environment
  - Both safe for environment and both are harmful to humans (NH_3 can at least be smelled. CO_2 is a silent killer)

- Location and footprint constraints
  - Ideal for medium to large applications (commercial to industrial etc.)

When to use what?

- CO_2 has a very high volumetric cooling capacity allowing for smaller pipes and components compared to NH_3
  - NH_3 is most often more expensive in initial cost due to larger scale components required
- CO_2 has a very low critical point (31°C) meaning it becomes very inefficient operating at temperatures above that. Critical point for NH_3 is 132°C.
  - South Africa's avg summer temp typically between 25°C and 32°C
  - Northern & Central Europe avg summer temp typically 18°C and 23°C
- NH_3 systems typically operate at a maximum of 1200kPa whereas CO_2 can operate up to 6 times this.
  - NH_3 is regulated under strict standards such as ASME, PER and SANS. Over engineered.
  - CO_2 is constructed and treated the same as typical freon systems. Scary.

What is the right choice for South Africa?

Cost

Plant Load (LT / MT in kWR)	R-744 TC DX (COP)	R-717 2-stage (COP)
300 / 900	2.51	3.64
900 / 2700	2.50	3.69

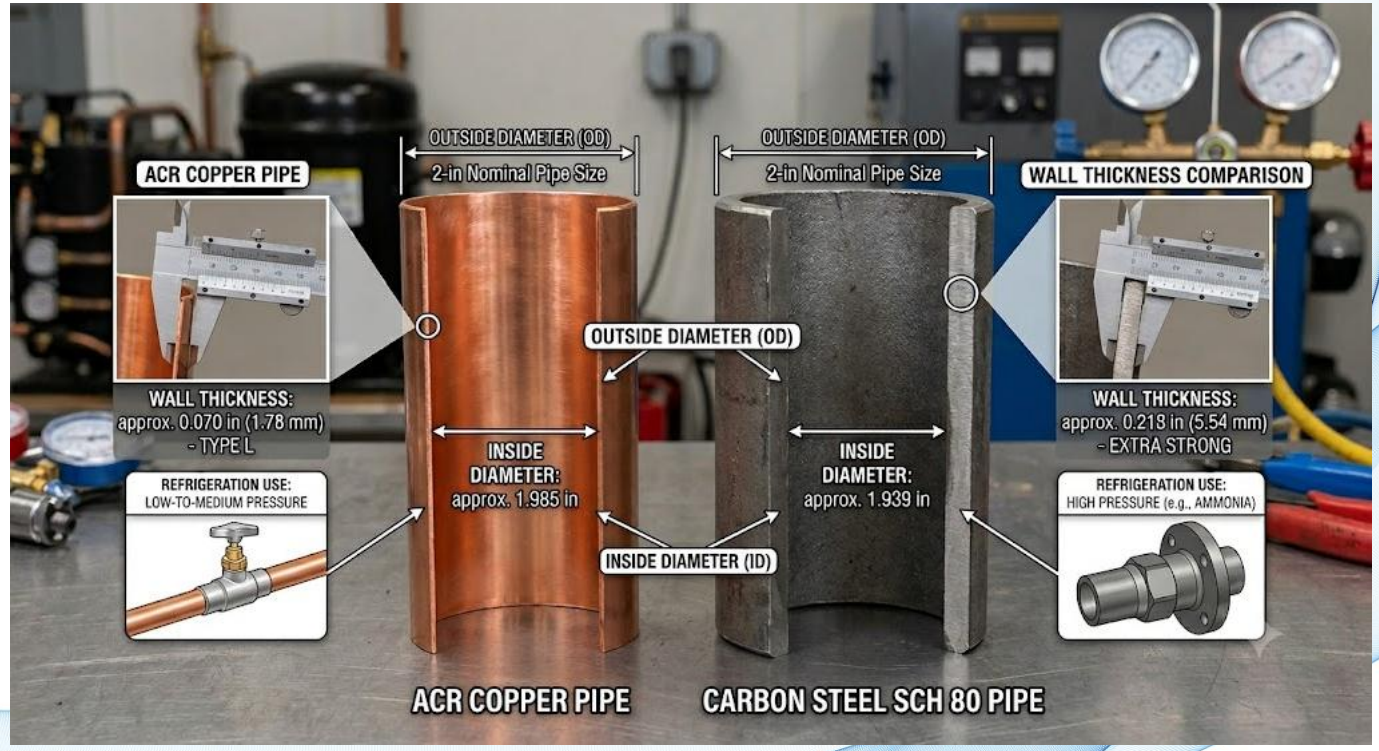
Plant Load (LT/MT in kWR)	R-744 TC DX	R-717 2-stage
300 / 900	3578 MWh	2778 MWh
At a tariff rate of R1.70 / kWh	**R6 082 600.00**	**R4 722 600.00**

The above is for warmer ambient climates such as South Africa. These number would look completely different for the Northen Europe type climates.

What is the right choice for South Africa?

Safety and Environment

- GWP and ODP
- Construction standards



What is the right choice for South Africa?

Location and footprint constraints

- If you have space available, then there is no need to compromise. How much space?

12-off CA Stores with Grape Holding Rooms

Conclusion

- Refrigeration systems are long term investments
  - Maintenance and running costs (reliability, durability, efficiency)
  - Life cycle costs are crucial and electricity a premium in SA

- We operate in warmer ambient temps compared to Northern Europe so NH_3 is much more efficient for South African temperatures.

- For product temperatures up to -25°C use NH_3 if you can. Only if we go below this then CO_2 becomes worth investigating.

- For fruit processing and storage requiring minimal electricity and lowest possible life cycle costs then use NH_3

- CO_2 requires superheat which means lower suction pressures resulting in higher risk of fruit moisture loss meaning less weight per fruit. NH_3 requires no superheat so we can run higher suction temperatures mitigating the risk of moisture loss in fruit completely.

Thank you!

Questions?