Experience and applications within secondary systems allowing lower refrigerant charge

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refrigerants delivered by mother nature

Indirect refrigeration systems vs. DX

Restrictions and limitation of refrigerant range, indirect refrigeration systems are still in focus.

Pros

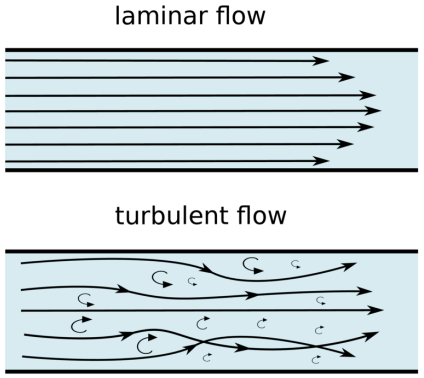
- Allowing lower refrigerant charge
- Refrigerant kept in machine room
- “Regular" pipes and low pressure levels
- Plastic pipes can be used (diffusion tight)
- Do not require certified welders
- Not directly sensitive to water (as refrig.)
- Cheaper installation - cost efficient
- Broad range of installation components

Cons

- Need for special materials for some HTF
- High pressure drop
- High pump power
- Larger pipe dimensions
- One “extra” heat exchanger

Heat transfer fluids – how to choose HTF

- Choose a HTF suitable for the actual application and plant
- All HTF have pros and cons
  - Health and Environment Hazards
  - Energy efficiency – Thermophysical properties
    - Pressure drop
    - Heat transfer coefficient
    - Pumping energy demand
  - Corrosivity – electrical conductivity mS/cm
  - Corrosion protection
  - Installation – restriction on materials
  - Lifespan
  - Cost or rather life cycle cost
- Consider HTF criteria priority



Secondary systems – a selection of applications

- Food applications
  - Different kinds of food production
    - Slaughter houses/meat production
    - Cheese production
    - Ice cream production
    - Etc.
  - Distribution centers – e.g. supermarkets
  - Bakeries
- Sport facilities
- Climate test chambers
- Hydrogen tank stations for cars
- And many more…






Project in Grece – logistic center

Country: Greece
Customer: Marinopoulos sa (purchased by Sklavenitis @2017)
Project: Logistics Center 17 000 m^2
Engineering Consultants: ecoRef
Project Year: 2013-2014

Existing System

- 3 x R134a (aircooled) Chillers producing 3x700kW of refrigeration Power at conditions -5,0°C
- Heat transfer fluid MEG, mono ethylene glycol 30% konc. – 60 000L
- Yearly Consumption in Electricity @2012: €1.100.000 (1,1 million)

Scope of Project

- An energy efficient plant using natural refrigerants and replacing the harmful for products ethylene Glycol

Solution Adopted

- 2 x NH_3 (Ammonia) water cooled Chillers producing 2x900KW of refrigeration Power at conditions (-6,-2) ° C
- Heat transfer fluid (Temper-15 – 90.000lt)
- Yearly Consumption in Electricity @2016: €526.000 (526 thousand)

Conclusion

NH_3 water cooled with Evaporative Condensers

Temper-15 as food approved heat transfer fluid

Energy savings **53%** - Investment pay off Period: **2,1 years**
(compared with the old R134a system)

Project in Greece – feta cheese production and packaging

Country: Greece
Customer: La farm sa
Project: Feta Cheese production 14 000 m^2
Engineering Consultants: ecoRef
Project Year: 2018-2019

Scope of Project

- Design an energy efficient production/logistics center for cheese using natural refrigerants

Solution Adopted

- Low charge NH_3 (Ammonia) system water cooled, with NH_3 as primary refrigerant, Temper-15 as heat transfer fluid
  - System capacity 1.600kW
  - Low charge Ammonia system with U-turn Evaporators
  - Secondary system conditions (supply, Return)= (-6,-2)°C
    - Heat transfer fluid Temper-15, quantity 45.000L
      - HTF buffert tank with 20m^3

Conclusion

Energy efficient system using natural refrigerants:

NH_3 low charge water cooled with use of Temper-15 as food approved heat transfer fluid

Project Greece

Place: Greece
Customer: Stergiou SA
Project: Refurbishment of Existing Installation
Engineering Consultants: ecoRef

Project Year: 2015

Scope of Project

- Replacement of R404a system for Blast chillers and cold stores of Stergiou Factory which is bakery/production of bread, puff pastries, yeasts and others

Solution Adopted

- Cascade NH_3 (Ammonia) – CO_2 system, and Temper-20 as heat transfer fluid for coldstorage
  - Ammonia system NH_3 operating @(evaporating,condensing) = (-10,+35)°C
  - CO_2 system operating @(evaporating,condensing) = (-40,-10)°C
  - Secondary system conditions (supply, return) = (-7,-3)°C
    - Heat transfer fluid, Temper-20, quantity 15.000L

Conclusion

System adapted: NH_3-CO_2 cascade system for blast chiller + NH_3-Temper-20 system replaced DX system

Energy savings **46%**

Investment pay off Period: **3,6 years**

(compared with the old R404a system)

Applications – HTF & ammonia

GRUPO JORGE

Slaughter house in Spain

Processed meat/charcuterie in Spain

ELPOZO

Contigo de principio a fin

Large meat production in Sweden

scan

Applications – HTF & ammonia

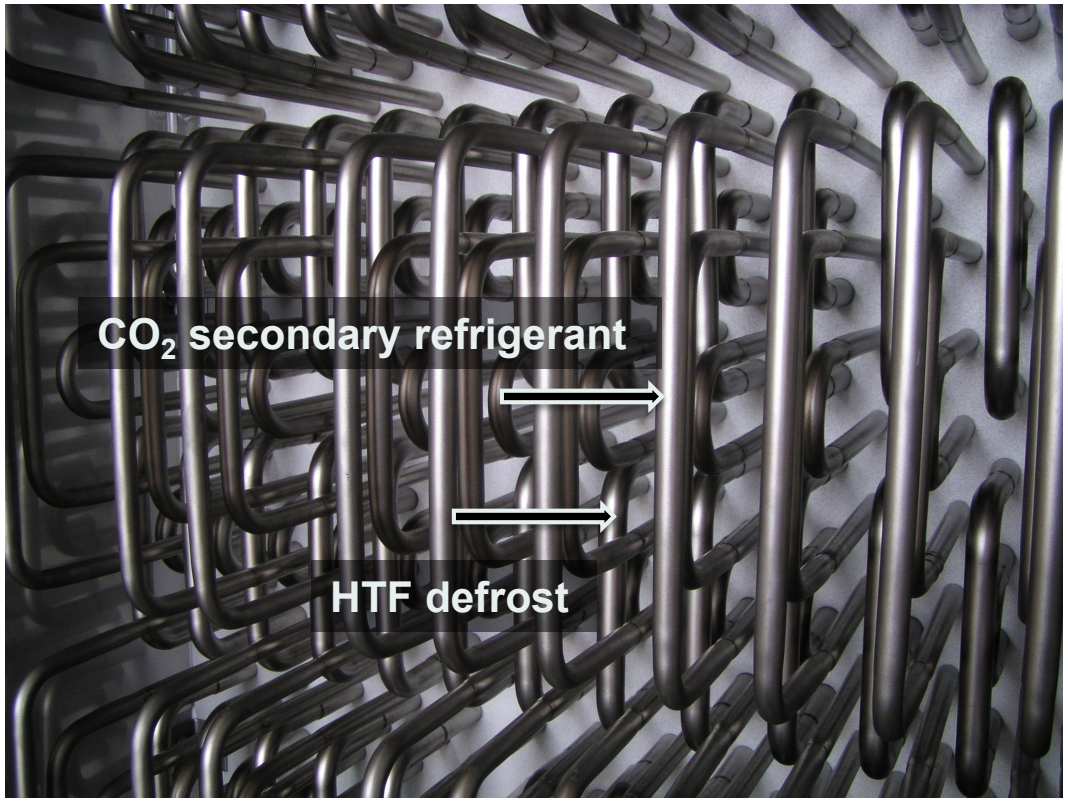
Sport facilities

Distribution centers

Ice cream production

Defrosting with HTF

- A lot of electricity is needed for electric defrosting
- HTF may be used as waste heat defrost in CO_2 plants by double piping
- Waste heat defrost – the heat is "free" and only the pump operation is operating cost

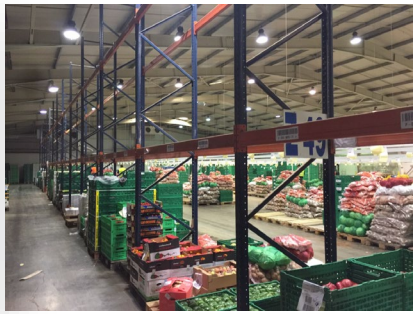


Summary

- Secondary systems used in a wide range of applications
- Choose right HTF for your application
- You are able to achieve
  - Lower refrigerant charge
    - Refrigerant kept in machine room
  - Energy efficient system
  - Long term solution
  - Safe solution
  - Perfect for food applications
- Waste heat defrost possible






Thank you for your attention!

Questions?

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