New Low Global Warming Potential(GWP) Synthetic Refrigerants

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Master of Science Thesis

Why Low GWP Refrigerants?!

- In refrigeration and air conditioning systems choose an appropriate working fluid (refrigerant) is an important step.
- HCFCs, CFCs and HFCs have been applied as refrigerants

But :

- CFCs and HCFCs have harmful impact on ozone layer
- HFCs have high global warming potentials (GWP)

Environmental friendly and safe alternatives in a way the energy efficiency also is improved, are required!

HFO-1234yf and **HFO-1234ze** have low GWP and acceptable potential to replace the common refrigerants (like R-134a).

More experiments in different type of cycles and conditions are necessary in order to utilize these new refrigerants.

Low GWP refrigerants

1. Literature survey:

- Obtained thermodynamic and transport properties of new refrigerants (**HFO-1234yf** and **HFO-1234ze**) by RefProp version 7.01
- Studied safety and environmental aspects.

2. Theoretical cycle performance:

- Calculated basic cycle data of **HFO-1234yf** and **HFO-1234ze** for most commonly used condensing and evaporating temperatures:
  - **HFO-1234yf** and **HFO-1234ze** have comparable COP (coefficient of performance of cycle) and volumetric cooling capacity with R-134a for an isentropic compression.
  - Pressure ratio : **HFO-1234ze** (3%) > R-134a
    HFO-1234yf (9%) < R-134a

⇒ Compressing energy consumption : **HFO-1234ze** > R-134a > **HFO-1234yf**

Low GWP refrigerants

3. Drop-in experiment:

Test carried out in a refrigeration cycle consists of two plate heat exchangers and one electrical heater placed in the brine loop. Experimentation was operated first by R-134a and continued by **HFO-1234yf** with 10 different brine heat loads at two condensing temperatures of 30°C and 40°C.

- **Cycle performance**
  - **COP:**

    R-134a (2-9.2 %) > **HFO-1234yf** @ condensing temperature 30°C

    R-134a (4.4-15 %) > **HFO-1234yf** @ condensing temperature 40°C
  - **Volumetric cooling capacity:**

    R-134a (0-3 %) > **HFO-1234yf** @ condensing temperature 30°C

    R-134a (0-3.8 %) > **HFO-1234yf** @ condensing temperature 40°C
- **Heat transfer**
  - **Evaporator:** R-134a has higher heat transfer coefficients than **HFO-1234yf** by 4-12 % and 9-36 % at condenser temperatures of 30ºC and 40ºC respectively.
  - **Condenser**: **HFO-1234yf** has 22-29 % and 22-33 % lower overall heat transfer coefficients than R-134a respectively at condenser temperatures of 30ºC and 40ºC.