Safe handling of natural refrigerants - Tackling safety concerns in installation and maintenance

Edgar Timm, HEAT GmbH, commissioned by GIZ
Stellenbosch, South Africa, 20 / 06 / 2019
Safe handling of natural refrigerants - Tackling concerns in installation and maintenance

• This is not a safety training!

• Why Natural refrigerants
  ➡️ “New” relevant properties

• Barriers / Concerns in Lifecycle of RAC systems
  ➡️ Focus Safe Handling
  ➡️ Specific concerns for South Africa

• Overcome the hurdles
  ➡️ Existing support
  ➡️ Additional demands
Why natural refrigerants? The Relevance of RAC for the Climate

Overall Emissions

RAC-Application
→ **Direct Emissions**
  - CO₂- Equivalent
→ **Type of refrigerant**

Electricity Production
→ **Indirect Emissions**
  - CO₂
→ **Efficiency**
Why natural refrigerants?
The Relevance of RAC for the Climate

Overall Emissions

RAC-Application

- Direct Emissions
- CO₂ Equivalent
- Type of refrigerant

Break away session

Electricity Production

- Indirect Emissions
- CO₂
- Efficiency

Plenary session

16.06.2019
E. Timm, Heat GmbH
The ideal candidate? **Environmental friendly AND ?**

![Vapour pressure curves](https://efficient-energy.com/kaeltemaschine-schillertemperatur-als-kaeltemittel/)
## Safety vs. “Environmental” classification

<table>
<thead>
<tr>
<th></th>
<th>Lower Chronic Toxicity</th>
<th>Higher Chronic Toxicity</th>
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<tbody>
<tr>
<td><strong>Flammability</strong></td>
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<tr>
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<td>A1</td>
<td>B1</td>
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<table>
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<th>GWP</th>
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<td>Lowest / GDP</td>
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### Safety vs. Environmental classification

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<td>Higher Flammibility</td>
<td>A3</td>
<td>B3</td>
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</table>

**Technical Tackle Feasible**: Only Technical Tackle is AVOIDANCE of USE

- **Highest GWP**: A1
- **High GWP**: A2, A2L
- **Lower GWP**: A2L
- **Lowest / GDP**: A3, B2L, R744

*Consultancy services provided by HEAT GmbH*

Alternative Refrigerants

GWP

R410A
R452A
R452B
R466A
R454B
R455A
R454A
R454C
R718
R290
R744

R507A
R404A
R407F
R407C
R448A
R449A
R1234ze/yf
R600a
R717

HP/LP: High,- Low-Pressure Reigerants
A/B>1: Refrigerants class A2L, B2L, A2, A3
AC: Air Conditioning, Com.: Commercial
HP: Heat Pumps

SOURCE: ETSuS UG

Consultancy services
provided by HEAT GmbH
## Alternative Refrigerants (selection)

<table>
<thead>
<tr>
<th>Refrigerant</th>
<th>ODP</th>
<th>GWP (AR4/AR5)</th>
<th>NBP/NDP</th>
<th>Critical Temp.</th>
<th>Critical Pressure</th>
<th>Class</th>
<th>CLP classification</th>
<th>LFL Kg/m³</th>
<th>LFL Vol%</th>
<th>Su(^*) burning velocity</th>
<th>H(_v) Verbrenn.-wärme</th>
<th>ATEL / ODL / kg / m³</th>
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<tbody>
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* ISO 817 Nominal Formulation or WCF
Flammability

Flammability Triangle

Fuel

O₂

Ignition - Source

Consultancy services provided by HEAT GmbH
Refrigerants – past and present!

1974

2018

Low-GWP refrigerants will be flammable for many applications.

...do we have an issue here?
Korean AC and Cooking Hydrocarbon Phenomenon

… but hard to chill!

/Charly Huber/

Propane: It's easy to grill, …

Source: with friendly support of Prof. M. Kauffeld, “Technologies needed to cope with HFC Phase Down and Climate Change”, eurammon symposium Schaffhausen CH, 26.06.2018
Most low GWP alternatives have characteristics that require extra training

- Technicians doing installation, maintenance and end-of-life decommissioning
- Engineers doing design of systems and components

<table>
<thead>
<tr>
<th></th>
<th>Ammonia</th>
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<th>CO₂</th>
<th>HFOs</th>
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<td>Toxicity</td>
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<td>High pressure</td>
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</table>
Life cycle of RAC systems

**Stakeholder**
- Planner Manufac.
- Manufac. Installer
- Installer Owner (Operator)
- Installer Owner (Operator)
- Installer Owner Disposall firm

**Design**
- Materials
- Components
- Layout

**Production**
- Procurement
- Assembly
- Charging
- Testing

**Installation**
- Installation
- (Charging)
- Commissioning
- Instruction of Operators

**Service**
- Planned
- Repair
- Refrigerant removal
- Charging
- ...

**End of Life**
- Refrigerant removal
- End of life treatment

**Concerns**
- Availability
- Costs
- Safety
- Qualific. Safety
- Time Safety
- Qualific. Safety
- Coste Safety

**Barriers**
Important to understand the barriers
Specific barriers and challenges

Anticipated barriers

- "No standards"
- "Peer group are against"
- No trained technicians"
- "No parts available"
- "No market demand"
- "Too dangerous"
- "Not currently in use"
- "Too much trouble"

Depends on several aspects:

Country, region, size and type of equipment, type of refrigerant, perception of person making the statement, etc

How to overcome?
Safe Handling: Specific Concern – Tackle them! Barriers 15 min brainstorming

- For Example:
- What is your experience with natural refrigerants?
- What is the expected or required level of expertise?
- What is already in place – what is missing?
- Are there show stoppers?
- ....
Overcoming barriers and challenges

- Awareness-raising
- Training
- Guidance
- Demo projects
Overcoming barriers and challenges (Former findings)

- Market development... stimulate industry involvement with low-GWP alternatives; encourage local manufacturing, product directories, etc

Financial incentives... subsidies for using low-GWP, tax incentives for low-GWP / tax disincentives for high-GWP

Regulatory infrastructure... better control of industry to work safely, modify regulations that inhibit low-GWP alternatives, ensure safety standards are constructive
GIZ products

Download all Proklima publications under: https://mia.giz.de/esearcha/browse.tt.html / browse for “Proklima”
Thank you for your kind attention!

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Bayerisches Landesamt für Umwelt (LfU)

On behalf of

Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

Federal Ministry for the Environment, Nature Conservation and Nuclear Safety

of the Federal Republic of Germany