
VDV Report Nr. 1509: Strategy on environmentally friendly refrigerants

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Recently partially fluorinated hydrocarbon refrigerants received a strong focus because of their high global warming potential (GWP). Actually, the GWP of the widely-used R134a yields 1430, compared to the GWP of carbon dioxide (CO₂), which is 1. With respect only to air-conditioning systems used in the German railway sector the annual leakage is estimated 22 tons, which equals a carbon dioxide equivalent of about 31,460 tons. Furthermore, the decomposition products of partially or totally fluorinated hydrocarbon refrigerants are persistent and hazardous to all creatures, especially to those living in water.

In the beginning of refrigeration engineering natural refrigerants were used. Besides ammonia and carbon dioxide also flammable gases like Propane or Propene are included into this group. Practically, every up-to-date refrigerator or freezer works with Propane, a hermetic system ensures a maintenance-free operation that guarantees no leakage over the life time. Thus, flammability plays no eminent role on safe use. Since the beginning fixed installations (food industry, building technology, ice rinks etc.) use ammonia as refrigerant. Apart from its acute toxicity it offers a high volumetric cooling capacity and has no global warming potential. In mobile system it is rarely used. At the same time also CO₂ was utilised. While having the highest cooling capacity of all refrigerant, it works at very high pressures in a supercritical process. Systems based on air are implemented successfully for many years on planes and recently even on railway vehicles.

Newly provided air-conditioning equipment should be featured with natural refrigerants, with the following recommendations:

- Air (R729) at sufficient mounting space and tolerable peak power consumption
- Carbon dioxide (R744) with respect to technical and economical parameters
- Propane (R290) after a successfully completed fire-safety analysis
- Propene (R1270) after a successfully completed fire-safety analysis

If the installation should offer a heat pump functionality (possibly important on battery-operated vehicles like electric busses), the choice mentioned above narrows to just propane and carbon dioxide.

For an environmentally-friendly operation not only the GWP value shall be taken into account but also further biological or chemical aspects must be considered.

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