



Cooling systems account for an ever higher proportion of energy consumption around the world.

Refrigerant-free cooling equipment based on magnetocaloric materials could provide the basis for greener cooling systems in the future.

MAGNETOCALORICS REFRIGERANT-FREE COOLING SYSTEMS

Growth market for cooling technology – rising energy demand

Cooling technology is one of the fastest growth areas for additional energy demand. Every year, over 50 million air-conditioning systems are installed and the trend is rising. Over 72,000 GWh of electrical power p.a. is consumed for technical cooling in Germany which is a relatively cool country, a figure which corresponds to around 14 percent of total power consumption in Germany.

State of cooling technology

Technical cooling today almost exclusively uses compressor-based systems. But there are often drawbacks with these systems, in that they require a great deal of space, generate noise, are subject to wear and need to be serviced at great expense. Soo-

ner or later, as the cooling circuit's leakage rates increase, the refrigerants escape and need to be replaced. In addition, all conventional refrigerants have a global warming potential to a greater or lesser extent which, as we know, can damage the environment. Some refrigerants, such as ammonia, are even harmful to health.

Cooling without refrigerants

New refrigerant-free cooling systems have managed to demonstrate their benefits in the cooling technology market. They are based on what are called magnetocaloric (MC) materials. MC materials are magnetizable materials which heat up by a temperature of ΔT when exposed to a magnetic field and cool down again by ΔT when the field is removed. This is how it is possible to implement a cooling cycle.

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Advantages of magnetocalorics

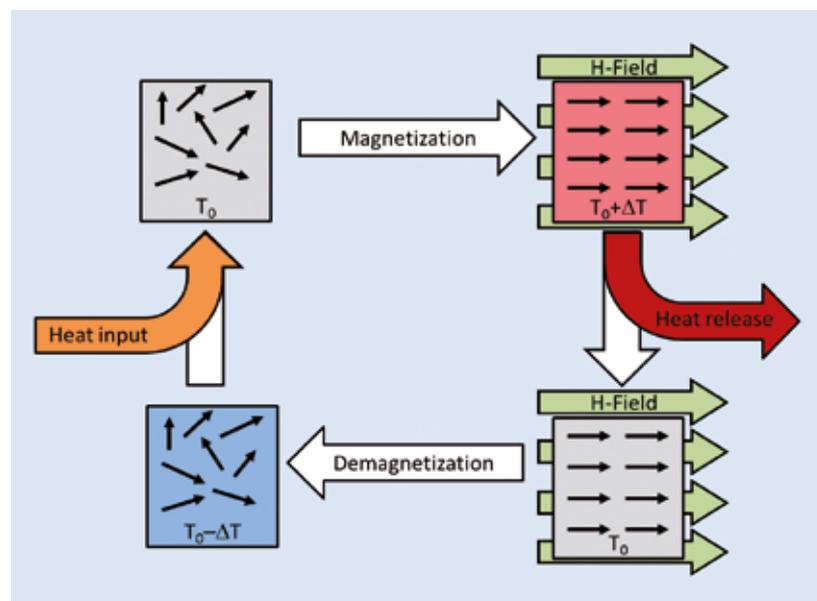
Overall, MC materials have a number of inherent benefits compared to conventional compressor technology:

- **Efficient** – an increase in efficiency of 20–30 percent is possible compared to conventional systems
- **Green** – no refrigerants
- **Low maintenance** – no wear parts
- **Silent** – can be used anywhere
- **Small and lightweight** – perfect for mobile use

Innovative custom-made cooling technology

Magnetocaloric cooling technology opens up a whole new world of innovative opportunities for particularly efficient, green cooling systems. Fraunhofer IPM is the perfect partner for creating smart innovations to meet new requirements relating to cooling technology. We can help you to develop bespoke solutions for refrigerant-free cooling equipment.

The principle of magnetocaloric cooling



Magnetization: Magnetocaloric (MC) material is exposed to a magnetic field and heats up due to the generated magnetic order from temperature T_0 to $T_0 + \Delta T$.

Heat release: The magnetocaloric (MC) material is connected to a heat sink, the heat produced can be dissipated, the MC material cools down again to temperature T_0 .

Demagnetization: If the magnetic field is removed, the MC material cools down and is at a lower temperature $T_0 - \Delta T$ than it is at the start of the cycle.

Heat input: The MC material is now connected to the system to be cooled and can absorb heat, until it reaches temperature T_0 again.