DDMC 2011

Commercializing Magnetic Refrigeration

Alessandro Pastore, Camfridge ltd

Oct. 24-25, 2011
Aula Congress Centre TU Delft, Mekelweg 2, Delft

www.camfridge.com
Magnetic refrigeration commercialization: where are we?

- Magnetic cooling technology is sufficiently well understood
- Evaluation basis of future performances extrapolated by current performance and benchmarked with current specs
- R&D roadmaps of 3-5 year timeframe can be drafted

Source: “Magnetic Cooling: From Fundamentals to High Efficiency Refrigeration” O.Gutfleisch, K.G.Sandeman, editors, John Wiley & Sons Ltd, soon to be published
Early commercial: market applicability

- Domestic Refrigeration
- Commercial Refrigeration
- Air Exchanger/Heat Pump
- Vehicle Air Conditioning
Early commercial: Domestic Refrigeration

Reference specs (for temperate class)

- T span: 34K (fridge)/ 54 K (freezer)
- Tcold: 274 K (fridge) / 254 K (freezer)
- Thot: 308 K
- Cooling power: 30W – 180W
- Cooling engine weight: max 10 Kg
- Efficiency appliance: EEI < 22
- Life cycle: 10-15 years
- Noise appliance: <40 dB
- Gas compressor nominal cost benchmark: 300 – 600 €/kW
Early commercial: Commercial Refrigeration

Reference specs

T span: 34 K

T product temperature: 276 K

Thot: 308 K

Gas compressor cooling capacity: 180W

Gas compressor weight: 8kg

Electricity bill with gas compressor: about 100 euro/year

Life cycle: 10 years

Noise appliance: < 40dB

Gas compressor nominal cost benchmark: 160 €/kW
Early commercial: Vehicle Air Conditioning

Reference specs

- T span: 50 K
- Tcold: 278 K
- Thot: 328 K
- Cooling power (cars): 3 - 6 kW
- Cooling system weight: max 20 Kg
- Efficiency target: COP > 2
- Life cycle: about 300000 Km
- Noise: lower than 45 dB
- Cost benchmark: industry proprietary
Early commercial: Air Exchanger/Heat Pump

Reference specs (Air-to-Air, Water-to-Air)

**Typical Cooling Mode span:**
- Air-Air Exchanger 8K
- Air-Air Heat Pump 16K
- Water-Air Heat Pump 10K

**Typical Heating Mode span:**
- Air-Air Exchanger 8K
- Air-Air Heat Pump 25K
- Water-Air Heat Pump 10K

**Cooling power:** 2 - 5 kW

**Exergy Efficiency for magnetic cooling engine:** +50%

**Whole unit weight:** 13 - 28 Kg/kW

**Life cycle:** 10 - 15 years

**Noise:** < 40 dB

**Gas compressor nominal cost benchmark:** 12-20 €/kW
Construction holistic approach is required
Collaboration and partnering are essential to making magnetic refrigeration successful
Cambridge already works with Whirlpool, Arcelik, Clivet, VAC, + others under confidentiality terms
Magnetic System Development

Magnetic solution now same size and similar weight to gas compressor!

Typical gas compressor  1.15T field  5 Hz rotary magnetic system

Operating conditions in 4 material regenerator

- Span ~35°C

Designed to integrate with domestic fridge (left) and air-air exchangers (right).
Thanks for listening
Acknowledgements

This work has been supported under the FP7 Grant NMP3-SL-2008-214864.

See: http://www.sseec.eu/

This work has been supported under the FP7 Grant European Community’s Seventh Framework Programme (FP7/2007-2013) under grant agreement n° 245288.

See: http://www.frisbee-project.eu/