Numerical routine for magnetic heat pump cascading

Filonenko, Konstantin; Lei, Tian; Engelbrecht, Kurt; Bahl, Christian; Veje, Christian

Publication date:
2017

Document Version
Publisher's PDF, also known as Version of record

Link back to DTU Orbit

Citation (APA):

General rights
Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the URL identifying the publication in the public portal

If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.
Motivation

The possibility of magnetic heat pumps (HPs) industrialization depends on their ability to provide sufficient heating power with competitive COP. Conventional HPs provide from few to tens of kW. To make it achievable with magnetic HPs, we proposed cascading [1], which also may reduce losses, Fig. 1. Here the more practical cascading design is studied: we develop a general numerical routine to model cascading and apply it to a three-heat pump cascade, Fig. 2.

Design

1. The total HP system (Fig. 1): 12 Active Magnetic Regenerator beds (AMRs) on a platform inside a rotating magnet.
2. No cascading: AMRs are connected in parallel to the same pump
3. Cascading: 6 pumps are now connected to each other
4. Transfer from no cascading to cascading is shown in figures

Three-HP cascading system performance

1. Temperature difference at the HP hot outlet increases approx. 3 times compared to the case with no cascading
2. COP is slightly less than without cascading
3. Heating and cooling powers slightly degrade

Conclusion

Calculated increase in temperature difference (3-4 K) is an argument in favor of a magnetic heat pump cascades as possible residential heating systems. Developed numerical routine can be useful in modelling magnetic HPs operation inside target buildings.

Acknowledgments

We are grateful for financial support provided by the ENOVHEAT project funded by Innovation Fund Denmark (contract no 12-132673).

References