Integration of a magnetocaloric heat pump in a low-energy residential building

The EnovHeat project aims at developing an innovative heat pump system based on the magnetocaloric effect and active magnetic regenerator technology to provide for the heating needs of a single family house in Denmark. Unlike vapor-compression devices, magnetocaloric heat pumps use the reversible magnetocaloric effect of a solid refrigerant to build a cooling/heating cycle. It has the potential for high coefficient of performance, more silent operation and efficient part-load control. After presenting the operation principles of the magnetocaloric device and the different models used in the current numerical study, this article demonstrates for the first time the possibility to utilize this novel heat pump in a building. This device can be integrated in a single hydronic loop including a ground source heat exchanger and a radiant under-floor heating system. At maximum capacity, this magnetocaloric heat pump can deliver 2600 W of heating power with an appreciable average seasonal system COP of 3.93. On variable part-load operation with a simple fluid flow controller, it can heat up an entire house with an average seasonal system COP of 1.84.