Title: Thermochemical energy storage with manganese-iron oxides in a moving bed reactor

Nicole Neumann[1], Marc Linder[1], Henrik Leion[2]

[1]Institute of thermodynamic engineering, DLR
[2]University of Chalmers

Nicole.neumann@dlr.de

Thermochemical materials have a higher energy density for heat storage applications compared to latent or sensible storage materials. The reversible gas-solid redox reaction of metal oxides offers the advantage that oxygen from ambient air can be used as reactive gas, thus there is no need for a separate storage of the gaseous reaction partner. Depending on the selected reaction system of metal oxide, the equilibrium temperature under atmospheric pressure is in the range from around 700 °C to over 1300 °C. Therefore solar thermal power plants with receiver temperatures up to 1000°C represent one promising application for metal oxides as thermal energy storage material since it allows a dispatchable renewable power generation. Manganese-Iron oxides present a promising candidate due to adequate reaction stability, low cost of raw materials and convenient equilibrium temperature of around 900 - 1350 °C in air depending on the manganese-to-iron ratio. By using the concept of a continuously operated reactor for metal oxides as storage material and heat transfer medium, the storage capacity and thermal power output of the storage can be defined separately. A moving bed reactor enables a continuous discharging and heat extraction of manganese-iron oxides. Sensible and chemical heat can be transferred to a direct counter-current moving air stream to increase overall efficiency. The reactor concept is adapted to low particle stability, due to reported particle attrition, agglomeration and sintering effects in a fixed bed reactor.