CFD Simulation of Airflow in a New Receiver Concept for Solar Tower

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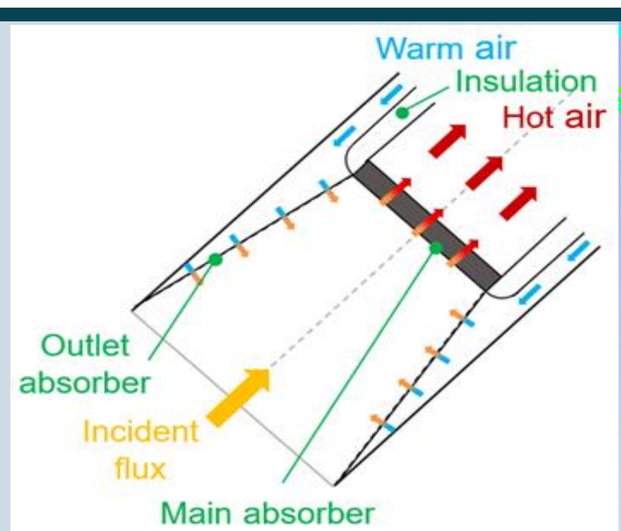
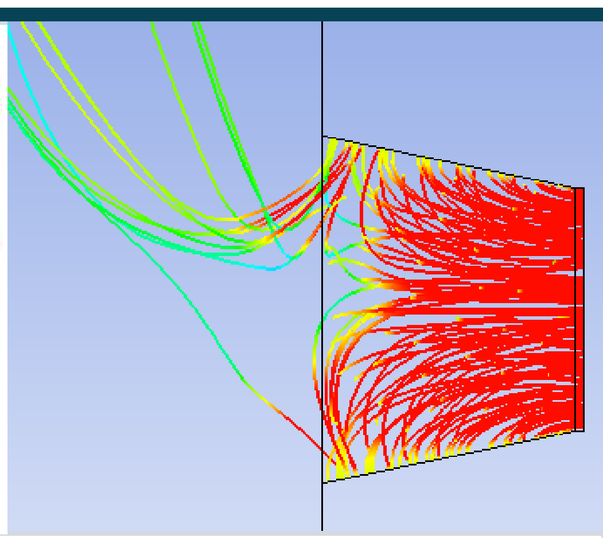
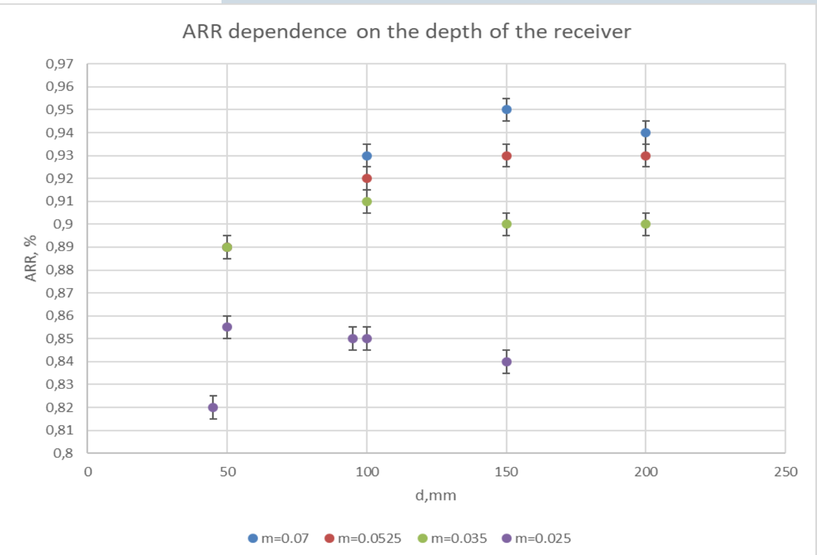
The new solar receiver design has the potential to achieve convective efficiencies of 95%.

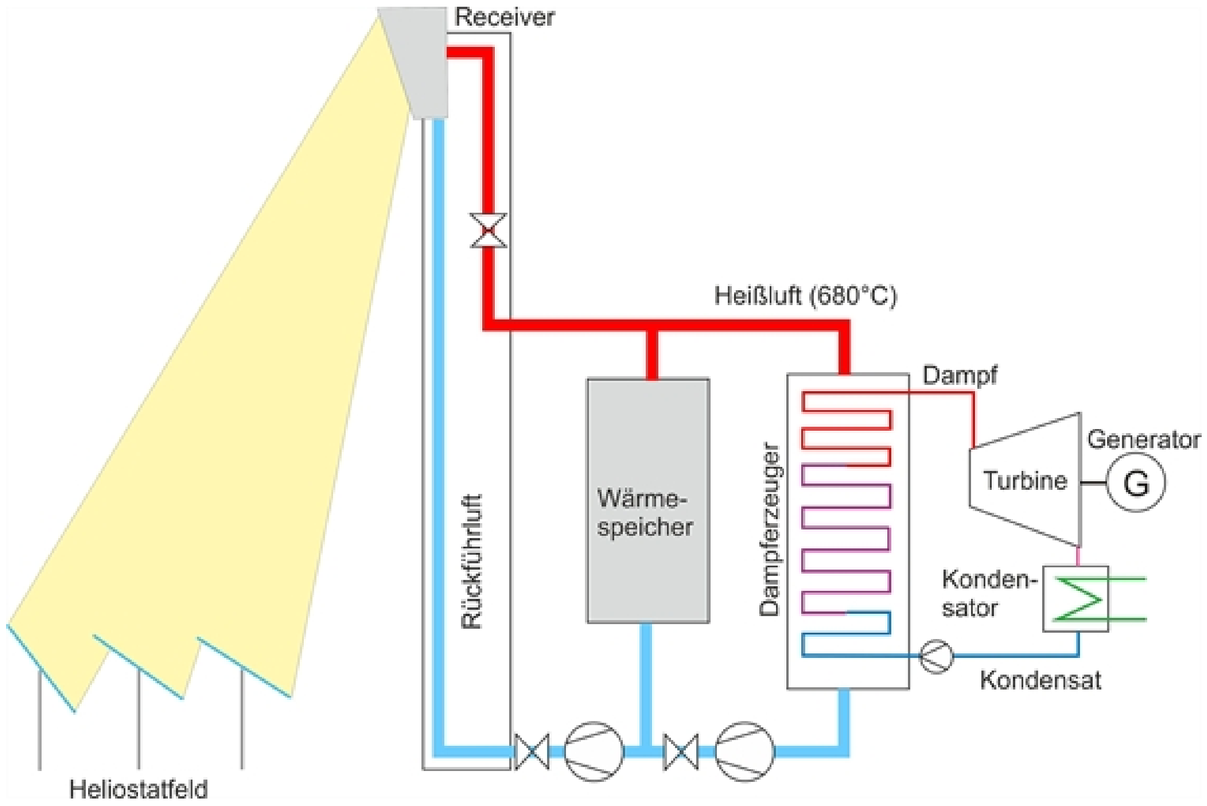






- Carefully selected geometric design improves efficiency (8%)
- Gradual adjustment of mass flow gradient results in higher ARR up to 1.4% increase near the main absorber
- Rugged design maintains effectiveness at all load levels
- Minimal effect of temperature gradients on ARR with the load variations used.

Introduction



Energy lost to the environment

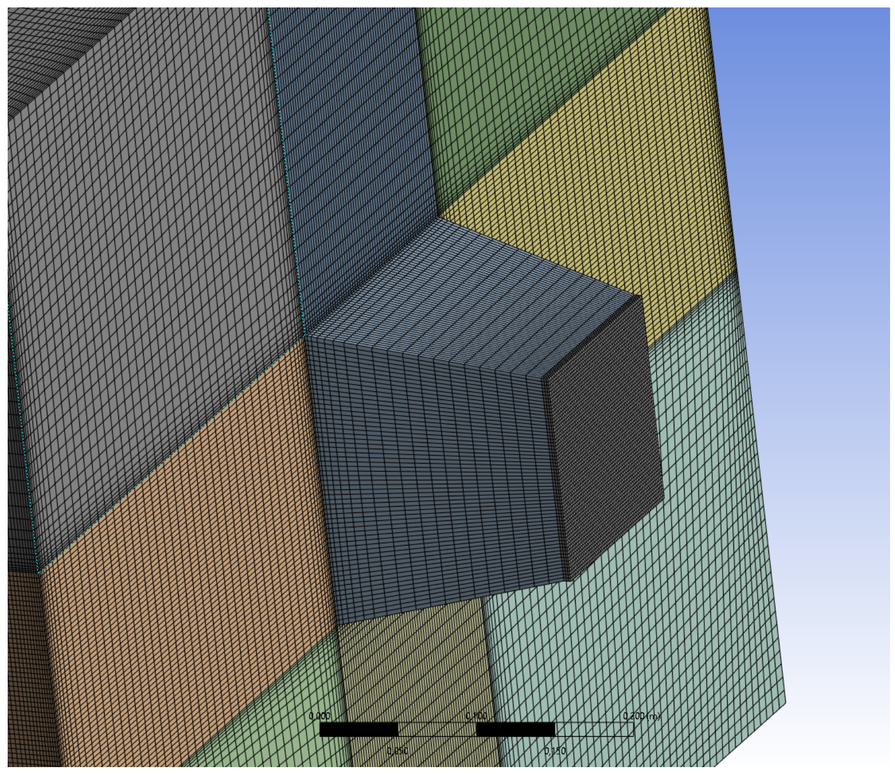
$$Q_{loss}^{air} = \left(H_{loss}^{air} - H_{amb}^{air}\right) \cdot (1 - ARR),$$

where H_{loss}^{air} – enthalpy carried with air, kJ/s;
H_{amb}^{air} – enthalpy brought in with ambient air, kJ/s;
ARR – air return ratio;

$$ARR = \frac{\dot{m}_{\text{ReturnedInletAir}}}{\dot{m}_{Full}}$$

ARR is a dimensionless measure of the amount of heated air returned to the energy system and a quantitative indicator of the convective component of the solar receiver's energy efficiency.

Workflow



Visual conclusion