Modeling of a fluidized-bed heat exchanger for integration in a solar power plant

Master's internship - 2024

Objective

The aim of the internship is to contribute to the development of a fluidized-bed heat exchanger model in which the fluid to be heated circulates inside bundles of immersed tubes. This is an intermediate-scale model between a particulate approach in which the movement of each particle is simulated, and a global approach which describes the transfer solely on the basis of a parietal exchange coefficient.

Context

In order to raise the operating temperature of concentrating solar power (CSP) plants above 600°C (ideally 700-750°C), several projects in the USA, Australia and Europe are developing the concept of particle solar power plants. In this concept, particles are used as a heat transfer fluid and thermal storage material. The particles are heated in a receiver exposed to concentrated solar radiation and stored. The solar energy thus captured is then transferred to a working fluid (which powers a turbine) via a heat exchanger. The latter is therefore a key component of the concept, which differs from conventional liquid/liquid or liquid/gas heat exchangers used in conventional thermal power plants. This is because the heat transfer mechanisms between the particles and the immersed tubes are very different. As part of the European Horizon Europe "Powder2Power" (P2P) project coordinated by the PROMES laboratory, we are developing a fluidized-bed heat exchanger. The internship takes place in this context.

A thesis on the subject is due to start at the PROMES laboratory by the end of 2024. Funding has already been secured as part of the P2P project.

Work to be carried out

- Literature review on parietal heat transfer modeling in a fluidized bed
- Simulations of fluidized-bed dynamics and thermals in a heat exchanger compartment using an Euler-Euler approach
- Parametric study of heat exchanger geometry and operating conditions
- Exchanger design

Terms and conditions

Location : Perpignan

Gratuity : ~670€/month (legal rate in force)

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