Master's Thesis project proposal

CFD based optimisation of the flue gas flow of the electrostatic precipitator in a waste to energy plant

Background

In plant engineering and construction more stringent emission limits and increasing requirements in terms of efficiency, availability and safety are the driving forces for development and optimisation of products and processes. One prerequisite for product and process optimisation is a detailed knowledge of flow coupled transport phenomena within plant components and ducts. The method for investigation of these processes is "Computational Fluid Dynamics" (CFD): a computational method for the simulation and analysis of coupled momentum, heat and mass transfer in single- and multiphase reactive fluid systems. CFD is used to homogenise the flow-through and incoming flow of plants and system components, minimise pressure loss, optimise particle and droplet distributions and obtain the desired distributions for temperatures and species concentrations.

Aim

The aim of this project is to provide data about particles behaviour inside the electrostatic precipitator (ESP) in a waste to energy plant. This can be achieved by performing rigorous CFD analysis. The investigation should allow to discover which of the technical parameters have the highest influence on the correct performance of electrostatic and formulate conclusions to improve the collection efficiency of the instrument. Thus, the main project tasks are:

- Build an ESP geometry model with detailed gas distribution system and high quality meshing of the flow domain to ensure the simulation results will be mesh size independent
- Perform CFD simulation of the ESP to investigate the flow distribution by variation of the gas distribution screens
- Describe and optimise the homogenisation of the flow inside the ESP and possible reduction of the pressure loss

Additional information

The project should be preferably carried out by two students. The work corresponds to 30 ECTS credits (approximately 20 weeks). If the project results provide an analysis of high quality with interesting findings, students can be awarded by one month paid summer job in the Lillesjöverket waste-to-energy power plant to get the engineering experience in the real process system.

Prerequisites

The students are expected to have a background in chemical, process or energy engineering (e.g., from, but not limited to, master programs Sustainable Energy Systems or Innovative and Sustainable Chemical Engineering). The students should have knowledge in theory and practice in CFD modelling. Advance ability to use ANSYS Fluent or similar software is preferable.

Supervisors and Contact information

The main project supervisor will be Pawel Kak in Lillesjöverket waste-to-energy power plant.
Associate Professor Stavros Papadokonstantakis will be a co-supervisor and examiner.
If you are interested, please contact:

Email: pawel.kak@uddevallaenergi.se
Email: stavros.papadokonstantakis@chalmers.se
Phone: +46(0)31 772 8533
Division of Energy Technology, fourth floor of Hörsalsvägen 7B