LABORATORY FOR CHEMICAL TECHNOLOGY
Technology 125, 9052 Gent, Belgium

Machine Learning to Predict Segregation Indices in Magnetically Fluidized Beds

Coach	Supervisor(s)	Funding
Balamurugan Deivendran Zhiheng Fan	Geraldine Heynderickx Vladimir Galvita Hilde Poelman	FWO-MACBED

Aim

The aim of this master thesis is to develop machine learning (ML) models to predict the segregation index in magnetically assisted fluidized beds (MFBs) as a function of time, considering various magnetic field modes (first and last mode) and magnetic gradients fields. Leveraging existing in-house codes for computing segregation indices, the project will focus on enhancing prediction accuracy under different magnetic mode conditions. Segregation index describes how well the two particle types are segregated.

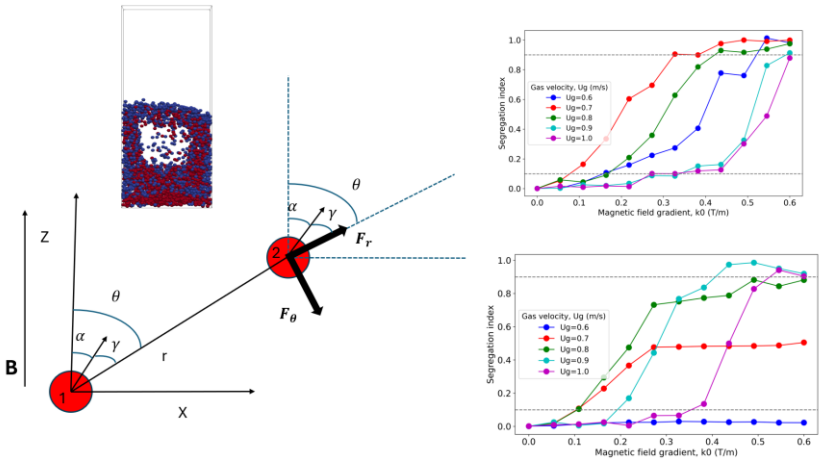

Figure 1: Simulation of MFB of magnetic (blue) and non-magnetic (red) particles. Segregation indices in magnetic last mode of operation of MFB.

Justification

Understanding segregation dynamics in a (M)FB is crucial for improving the performance of fluidized beds, especially in processes involving mixtures of particles with different physical properties, such as density and size. In MFBs, external magnetic fields influence the behaviour of magnetic and non-magnetic particles in a different way, leading to either enhanced mixing or enhanced segregation, depending on the magnetic field intensity and gradient. Magnetically induced segregation presents both challenges and opportunities for optimizing industrial processes such as CO_2 capture, particle mixing, or energy-efficient chemical looping by using MFBs. The accurate prediction of segregation dynamics over time is essential for optimizing operational parameters in MFBs. This project will leverage existing datasets and in-house developed segregation index computational codes to train ML models that can predict segregation behaviour under varying conditions. Such models can improve the design of MFBs and their operation, making processes more efficient and environmentally sustainable.

Program

- **Review of literature** on machine learning applications for segregation prediction in fluidized systems.
- **Analyse existing data** to understand the segregation index behaviour under various magnetic modes and gradients.
- **Develop and train machine learning models** to predict the segregation index over time for different magnetic conditions.
- **Evaluate model performance** by comparing predictions against results from in-house codes and existing data.
- **Generate operational guidelines** for optimal magnetic conditions to control segregation in MFBs.

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