OTTO VON GUERICKE UNIVERSITÄT MAGDEBURG

WORKGROUP FOR MULTIPHAS FLOWS

Influence of the agglomeration and breakage of particles on the performance of cyclone separators

Grant number

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Project title

Influence of the agglomeration and breakage of particles on the performance of cyclone separators

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Short description of the Project

Cyclones are stationary mechanical devices that uses centrifugal force to separate solid particles from a carrier gas. They are widely used in the industry due to its wide range of operational conditions and simplicity of construction, leading to low investmer and maintenance costs. The design of a cyclone involves a compromise between the main performance parameters: collection efficiency and pressure drop. The collection efficiency has a great sensibility with the particle size, thereby, the bigger particles a collected more easily than the smaller ones, because they are more inertial and have higher relative velocity. In the case of stick particles, it is necessary to consider other phenomena for a better determination of the collection efficiency.

The agglomeration phenomena may lead to bigger particles (agglomerate), which would be easier to collect, improving the collection efficiency for smaller particles (under 3 µm). This phenomenon leads to a great improvement, once the greatest cyclor limitation is that unless the cyclone is very small, its collection efficiency is very low for particles smaller than 5 µm. However, the resulting agglomerates may break and generate small particles in areas that could not be reached by those size classes under normal conditions, resulting in a decrease of the collection efficiency.

For those reasons, a CFD model is being developed and implemented in OpenFOAM®, based on Eulerian/Lagrangian approach considering the following models:

- Particle-wall collisions considering the effect of wall roughness;
- Stochastic particle-particle collision and agglomeration model;
- Agglomerate breakage model.

In order to validate the proposed model, it will be conducted several laboratory experiments to get the performance parameters and velocity profiles in cyclones for different operational conditions.