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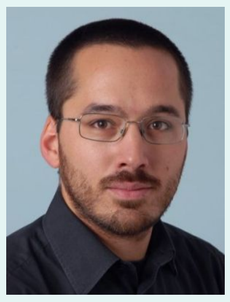
StAggloP - Steering Agglomeration Processes during spray drying

Reducing energy use and material loss by better control of agglomeration during spray drying



Project number DR-50-15

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Partners Corbion - Danone - DSM - FrieslandCampina - ISPT - U Hohenheim - WUR

Budget € 1.000.000,00

Duration 2020-2024

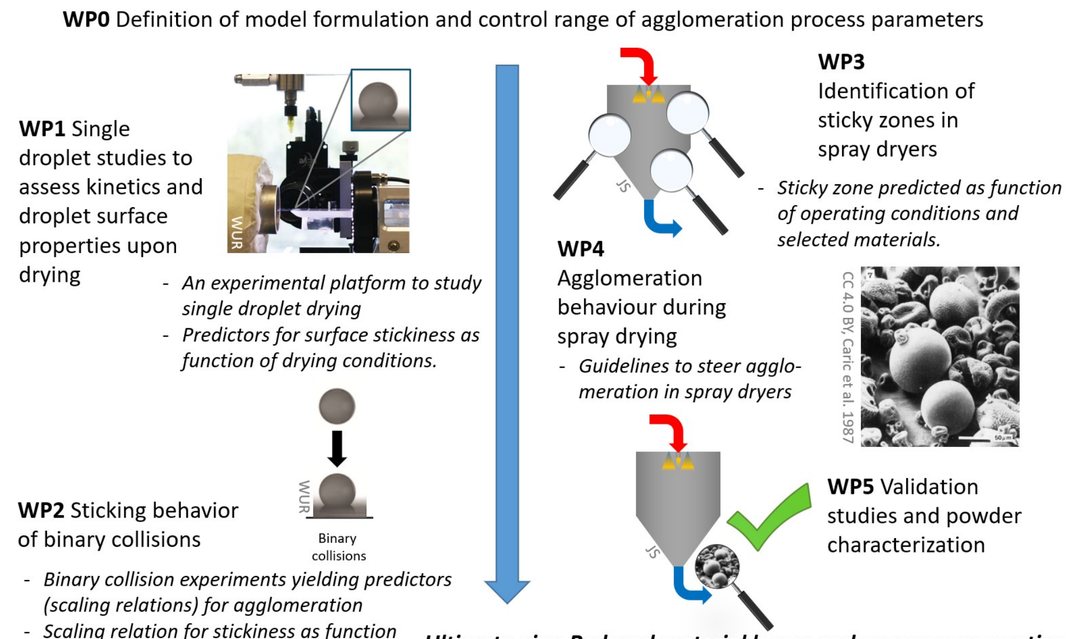
Context of project scope

A large fraction of powdered formulations a. o. in food industry are produced by spray drying. Key reason to use spray drying is usually the potential to achieve good powder properties such as desired bulk density, improved flowability and reduced dustiness but also consumer specific properties such as improved reconstitution. Spray drying can achieve this at a good balance between energy consumption & costs and powder properties.

Agglomeration has major influence on the above mentioned powder properties in spray drying. It occurs when a partially dried droplet collides with another partially dried droplet or with a fully dried (agglomerated) particle. There is a complex relationship between drying of droplets and agglomeration dynamics. The period, which starts with generation and exposure of a droplet to high inlet air temperature (resulting in extreme drying rates) and ends with the collision, is crucial for steering the agglomeration process. In industrial practice, agglomeration is optimized by adapting the position and/or angle of nozzles, position and amount of returned fines and the air flow pattern to obtain agglomerated powder of desired quality. This approach is trial-and-error based and needs to be continuously repeated for different spray drying systems and products.

Motivation and environmental benefit

Lack of agglomeration control negatively impacts operation efficiency of spray dryers (e.g. due to fouling and lower production capacities) and leads to significant material losses (in the form of off-spec product) during large scale production. It is estimated that, for the Netherlands, annually 0.9-1.5 PJ energy or 200-300 kton CO_2 equivalent emission may be reduced by improving agglomeration control in spray dryers. Moreover, improved agglomeration control will contribute to reduction of fine dust emission from dryers, for which increasingly strict regulations are reinforced by the government.



Overview of work packages (WP) - WP1 and WP2 linked to micro-scale studies, WP3 to WP5 linked to pilot scale investigations

Approach

This project therefore aims at developing scaling-relations to steer sticky behavior and agglomeration in spray drying. We develop these by 1) studying on micro-scale drying kinetics, evolution of sticky surface properties and binary particle collisions at the single droplet scale and 2) investigating on pilot-scale sticky zones and agglomeration behavior in well-defined spray drying systems to move away from current empirical approaches. Translation of critical parameters obtained in single droplet drying studies will lead to recommendations for process conditions in spray drying, e. g. nozzle positions and angles, air flow and temperature.

Both PhD's started in September resp. October 2020 with their research activities.

Institute for Sustainable Process Technology

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