



IFPRI Project Abstract

EFFECT OF FEED PROPERTIES AND LOCAL DRYING KINETIC ON PARTICLE MORPHOLOGY IN SPRAY DRYING

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Project Objective:

The main objective of the project was to investigate the influence of the rheological properties of the solutions sprayed during the spray-drying process on the final properties of the product. The developed mathematical relationships are also to take into account the kinetics of drying the particles inside the drying chamber.

Approach:

The goals of the project will be achieved through the following steps:

- detailed rheological tests of water solutions of the selected substance will be performed in a wide range of concentrations and temperatures;
 - tests of the co-current spray drying process of the tested solutions (for selected process conditions) will be carried out in order to obtain powders for morphological tests;
 - the drop drying kinetics will be carried out in a specially designed and constructed column, in which the monodisperse chain of drops will be dried by the free fall method;
 - relationships between rheological properties of solutions, drying kinetics and process parameters, and particle morphology will be determined using neural networks.
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Recent Results:

In the past year, the focus has been on analyzing the morphology of powder samples obtained in experiments performed earlier on a semi-industrial spray dryer. The following properties of the powders were determined: diameter distribution, bulk density and averaged particle density, moisture content, flowability, porosity, and the correlation of these values with the viscosity and surface tension of the spray solution, which changed during the experiments. Details of the analyses are presented in the annual report.

A large part of the work focused on the construction of a test rig to investigate drying kinetics during free-fall of droplets. The method of using IR cameras to indirectly measure the temperature of the falling droplet was demonstrated. We decided to apply for a EU patent for the aforementioned method. Thus, we developed an IR measurement of the temperature of moving objects with unknown emissivity and named it IRTUC (InfraRed

Temperature for Unknown Coefficients). The reviewers from the patent office required us to carry out additional proof-of-concept work and changes to the original design concept. We have designed a new measuring chamber, whose background is thermostated using Peltier cells that allow rapid changes in temperature (cooling and heating). A test to confirm the accuracy of the temperature reading was the determination of the wet bulb temperature of suspended on a thermocouple water droplet. The experiment was performed at room temperature and in a hot air stream. In both cases, the error was approximately 5%. In parallel, we had to design a new droplet generator. The existing design developed by TNO (the Netherlands) did not allow continuous operation with maltodextrin solutions of more than 25%. The low operating temperature of the nozzle caused clogging of the outlet. A series of unsuccessful trials and experiments forced us to design a new generator. To this end, we partnered with the German company FMP Technology. We succeeded in developing a droplet generator that can be thermostated and can work with liquids at temperatures up to 90°C. The design itself can operate at temperatures of up to 120°C. However, the new nozzle required the purchase of a new pump system (higher pressures) and a power supply and signal modulator. We have spent the last few months mainly fine-tuning the electronic and optical controls and fixing the rather frequent errors and faults. Unfortunately, due to the current geopolitical situation, lead times have been extended several times, causing delays in construction.

Next Steps:

In the near future, we want to focus on

- construction of a column to study drying kinetics by IR.
 - conducting studies to determine drying curves for DE12 maltodextrin solutions with different initial concentrations and droplet diameters.
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