IFPRI Project Abstract

Model Assisted Design of Granular Products: Linking Process and Product Models for Wet Granulation

Rachel Smith
The University of Sheffield
Project Start Date: 1st October, 2019
Abstract Date: 22nd May, 2023

Project Objective:

The objective of this project is to develop multi-dimensional process models of binder agglomeration that have as their output the appropriate particle properties (likely distributed) that are linked to associated product models to predict product performance. The project scope is constrained to high-shear and/or fluid bed granulation, however the choice of formulation(s) and modeling approach(es) are open.

Approach:

The aim of this research project is to develop a modeling framework for product performance driven process design which is deployable to industry, and demonstrate the potential of this strategy. This will involve the development and linking of population balance models for wet granulation with a mechanistically-based product model.

Recent Results:

To validate the previously developed single granule disintegration model, a novel experimental method was developed using a specially designed flow cell combined with optical microscopy. The model was tested using granules composed of Microcrystalline cellulose, Sodium starch glycolate, and Hydroxypropyl methyl cellulose. The model showed good agreement with experimental data in three out of four cases, with the exception of 2% SSG concentration granule swelling was slower than predicted. A novel method using Focused Beam Reflectance Measurement (FBRM) was chosen to measure the particle distribution of granules and released primary particles during disintegration. The results from FBRM showed a shift in the particle size distribution towards lower sizes, centered around 100 μm, corresponding to the size of MCC particles. Increasing SSG concentration resulted in a wider distribution, indicating the impact of SSG on the disintegration process and earlier release of primary particles. Good progress has been made on the implementation of the granule disintegration model into gPROMS.

Next Steps:

Focus will be on completion of the validation of the granule disintegration PBM, and end-to end validation of the coupled Process and Product models. There remains a lot of exciting and impactful work to be done in this area (see renewal project proposal), especially in the area of inverse problem solving and multi-performance model optimization.