IFPRI Project Abstract

Scale-up Rules for Mixing Mechanisms in Rotating Drum Flows

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Project Objectives:

1. Develop a continuum model of rotating flows that spans rolling-to-cascading flows.
2. Validate the model using PEPT.
3. Identify the energy proxies for discriminating between the dominant mixing mechanisms.
4. Extract dimensionless number that facilitates scale-up of the mixing mechanism.

Approach:

To evaluate mixing rules in rotating drum mixers using:

1. in-situ measurements via Positron Emission Particle Tracking (PEPT)
2. numerical simulation via DEM.
3. Continuum modelling with PEPT and DEM data as inputs to the continuum equations.

In the present work (phase 3) we formulate a continuum model for rotating drum flows and extract a suitable dimensionless number that facilitates scale-up of the dominant mixing mechanisms.

Recent Results:

A continuum model of rotating drum flows was formulated using the linearised form of the $\mu(I)$-rheology. The model velocity field and flow geometry were successfully validated against PEPT measurements. Energy proxies describing shear and advective mixing were identified from the differential energy balance of the model. The Entrainment number was shown to successfully scale-up the relative combinations of advection-to-shear mixing from bench scale to larger configurations consistent with industrial scale. The scale-up rule via the Entrainment number was shown to be valid across the rolling-to-fully-cascading flow regimes.

Next Steps: Test the scale-up rule beyond bi-disperse systems. A full tensorial analysis is currently being developed for the purpose of calculating the energy proxies directly from PEPT data. The extension to wet rheologies is also being pursued.