



IFPRI BRIEF TEMPLATE

Check One: **Project** **Review** **Collaboration**
 Workshop **Other**

Descriptive Title	Creation and Break up of Film Formations, Viscous Fronts, & Fish Eyes During Reconstitution of Powders
Working Title¹	Particle Bed Behavior & Transformations During Reconstitution
Technical Area²	W
Date	06/22/21
Short Description	Incorporation of liquid into powder beds with a purpose to reconstitute the solids into solution involves a transition of a high solids fraction system to a system which is much more dilute. The particle bed imbibition process has been previously investigated in single drop penetration studies for understanding granulation nucleation events. There seems to be an opportunity to apply the current understanding of drop penetration times to the wetting of particle beds and film formations. In industrial practice, it is often observed that wetting of powder beds can lead to the development of films, viscous fronts or fish eyes where further liquid imbibition is halted, or unsaturated powder remains after the incorporation of liquid into a particle bed.
Objectives	For liquid incorporation into powder beds, the goals of this project are: <ol style="list-style-type: none"> 1) Investigate the change of particle/granule physical structure (shape, size, porosity, etc...) and the resulting interactions between neighboring particles in the particle bed (film formation, granule or particle swelling, viscosity changes), during the imbibition and particle bed wetting process. 2) Develop an understanding of the particle bed restructuring during the reconstitution process (imbibition, swelling, dispersion, and dissolution) as a function of both the particle bed hydrodynamics and material properties. 3) Explore various hydrodynamic shear rates (from minimal shear to high shear) to either prevent the formation of or to facilitate the breakup (erosion/fragmentation) of films, viscous fronts and fish eyes.

¹ Title used in meeting agendas and file archives

² One or more from the following list: W = wet systems; D = dry systems; F = particle formation; SR = size reduction; M = modeling; SE = systems engineering

Scope	Materials such as gums, surfactants, starches, proteins, food powders are model systems of interest. Materials can be requested and supplied by IFPRI members.
References	<p>Fitzpatrick, J. J., Salmon, J., Ji, J., & Miao, S. (2017). Characterisation of the wetting behaviour of poor wetting food powders and the influence of temperature and film formation. <i>KONA Powder and Particle Journal</i>, 34, 282-289.</p> <p>Mitchell, W. R., Forny, L., Althaus, T., Niederreiter, G., Palzer, S., Hounslow, M. J., & Salman, A. D. (2019). Surface tension-driven effects in the reconstitution of food powders. <i>Chemical Engineering Research and Design</i>, 146, 464-469.</p> <p>Mundozah, A. L., Cartwright, J. J., Tridon, C. C., Hounslow, M. J., & Salman, A. D. (2018). Hydrophobic/hydrophilic static powder beds: Competing horizontal spreading and vertical imbibition mechanisms of a single droplet. <i>Powder Technology</i>, 330, 275-283.</p> <p>Nguyen, T., Shen, W., & Hapgood, K. (2009). Drop penetration time in heterogeneous powder beds. <i>Chemical Engineering Science</i>, 64(24), 5210-5221.</p>

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