



## IFPRI BRIEF TEMPLATE

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

<b>Descriptive Title</b>	Characterising how the method of drying (presence of shear, mode of heat supply, presence of solutes, etc) affects the state of agglomeration of the dried product, and its ability to be redispersed.
<b>Working Title<sup>1</sup></b>	<b>Effect of drying on particle-particle bonds / Drying wet particulates with shear to prevent agglomerate formation</b>
<b>Technical Area<sup>2</sup></b>	W/D overlap, also has SR aspect (drying under shear is done in mills)
<b>Date</b>	2021-06-22
<b>Short Description</b>	<p>IFPRI has supported strong work on spray drying in recent years which has provided insight into the mechanisms of atomisation (affects granule PSD) as well as the dewatering modes of the droplets (drying outside-in vs inside out) and how they affect the granule strength and porosity.</p> <p>However, industrially, drying is diverse, with tray and belt dryers at low/no shear, fluid bed and rotary dryers at medium shear, and flash and agitated dryers at high shear - with diverse mechanisms of heat exchange.</p> <p>The choice of the right dryer for a given situation is multifactorial - it can be driven by cost (capex/energy efficiency), by the delicacy of the material, or by the resulting bulk density, flowability or dustiness of the product.</p> <p>The state of agglomeration, and the ability to redisperse the powder later is also important and not always ideal.</p> <p>For many fine materials, drying results in unavoidable agglomeration, sometimes this is beneficial, sometimes it presents problems. The degree and nature of this agglomeration is influenced by the particle's surface chemistry and morphology (size and shape) but is also strongly influenced by the type of dryer used, as well as the presence or absence of solutes in the water.</p>

<sup>1</sup> Title used in meeting agendas and file archives

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

	<p>A study that could map out the key parameters that promote or block particle agglomeration would be valued, with particular focus on the presence of shear during the final stages of water removal which is expected to be important.</p> <p>This project could choose to focus on subtopics such as “drying under shear” or really focus on a few particles losing their last water (with high speed cameras or perhaps via simulation).</p> <p>Additional comments for the potential investigator:</p> <ol style="list-style-type: none"> <li>1. Drying under shear could be contrasted with drying and then separately shearing/milling to get a fine powder. Experience in industry (especially with submicron materials) has shown that these are not equivalent. It may be that agglomerates, once formed (especially in the fines) are very robust and hard to mill. It can also be that static drying processes allow “concentration” effects, such as fine particles segregating, that a high shear environment would disrupt. Concentration effects may occur for example when capillaries carrying water to the surface of an agglomerate carry ultrafines which are then deposited as the water evaporates.</li> <li>2. How do we characterise an “unagglomerated” powder? Dry particle size analysis is notoriously difficult (dry laser suffers from electrostatic agglomeration effects). A first suggestion would be to immediately redisperse the powder in water and compare the PSD to that before drying, using for example sedigraph, laser-light scattering or similar.</li> </ol>
<b>Objectives</b>	Provide a map of how key drying parameters affect the particle-particle bonds in the dried powder/agglomerate.
<b>Scope</b>	<p>The scope would be the drying of typical fine particulates, probably inorganic, probably hydrophilic, and fairly robust, perhaps calcium carbonate and alumina to match up with the Kwade project on grind aids.</p> <p>This would be applicable across the mining and materials sectors.</p>

<b>Recommended Contractors (2 or 3)</b>		
<b>Name</b>	<b>Institution</b>	<b>Email Address</b>
Rajesh Davé	New Jersey Center for Engineered Particulates, NJIT	<a href="mailto:dave@adm.njit.edu">dave@adm.njit.edu</a>
Alban Sauret	<a href="#">UCSB - Sauret Lab</a>	<a href="mailto:asauret@ucsb.edu">asauret@ucsb.edu</a>
Heather Emady	<a href="#">ASU - Emady Research Lab</a>	<a href="mailto:Heather.Emady@asu.edu">Heather.Emady@asu.edu</a>

<b>Submitted By:</b>	
<b>Name</b>	<b>Organization</b>
J. Hart	Imerys
D, Swanson	EnviroDiamond
M. Louge	Cornell
maybe more to come!	