



## IFPRI BRIEF TEMPLATE

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

<b>Descriptive Title</b>	Predicting flow from flexible-walled containers
<b>Working Title<sup>1</sup></b>	Predicting flow from flexible-walled containers
<b>Technical Area<sup>2</sup></b>	Dry systems
<b>Date</b>	15 June 2022
<b>Short Description</b>	<p>There are existing models for flow from hard-walled silos that are regularly used to design such systems but similar models do not exist for soft-walled, flexible containers. This project seeks to develop such models.</p> <p>Experimental work, including the recent IFPRI-funded project by Karen Daniels, has demonstrated the importance of boundary conditions on the quantitative prediction of models. Mechanical wall aids such as massagers, elongators, and rams are often needed to produce reliable flow from compliant-walled systems, making the boundary conditions dynamic. Misuse of mechanical aids can also impede flow. Understanding the effects of these changing conditions, both qualitatively as well as quantitatively, is important for predicting bulk flow.</p> <p>Using bulk powder properties and industrially-relevant wall materials, a qualitative regime map showing when there is a need for specific flow promoters. Quantitative models should be developed to scale from laboratory testing predicting flow profiles at large scale ranging up to ton quantities. Models can be determined experimentally or in combination with computational methods; as an example, an update of Jenike’s Bulletin 123 for flexible-walled containers would be welcomed.</p> <p>Variation of particle shape, size, solvent content, and level of cohesivity are all in scope to explore understanding of the effect of mechanical flow aids, but addition of chemical flow aids is out of scope.</p>
<b>Objectives</b>	<ol style="list-style-type: none"> <li>1. Lab-scale experiments to understand causes of flow obstruction and rate problems and effectiveness of flow promoters on flow from flexible walled containers</li> </ol>

<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

	<ol style="list-style-type: none"> <li>2. Regime map for flow aid requirements for compliant wall containers (particle properties, wall fabric properties, geometry) based on experimental data acquired in (1)</li> <li>3. Develop quantitative model of emptying flow rate, flow profile, obstruction (e.g., arching, stable rathole) prevention based on experimental data acquired in (1)</li> <li>4. Validate conclusions of (2,3) at plant scale</li> </ol>
<b>Scope</b>	<p>In Scope:</p> <ul style="list-style-type: none"> <li>• Polydisperse systems tested across a wide size range of industrially relevant materials (<math>15\mu\text{m} &lt; D_{50} &lt; 5\text{mm}</math>)</li> <li>• Free flowing and cohesive materials</li> <li>• Consideration if some flow promoters cause consolidation</li> <li>• Bag sizes from <math>0.5 \text{ m}^3</math> to bag height 3 m</li> <li>• A range of solvent/moisture content, but not including saturation</li> </ul> <p>Out of Scope:</p> <ul style="list-style-type: none"> <li>• Addition of chemical additive flow aids as a solution to improve flow</li> </ul> <p>Welcome extensions:</p> <ul style="list-style-type: none"> <li>• Any additional insights into novel segregation behavior in flexible containers</li> </ul>

<b>Recommended Contractors (2 or 3)</b>		
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