



IFPRI Project Abstract

Predicting Powder Flow from Containers with Flexible Walls

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Project Objective:

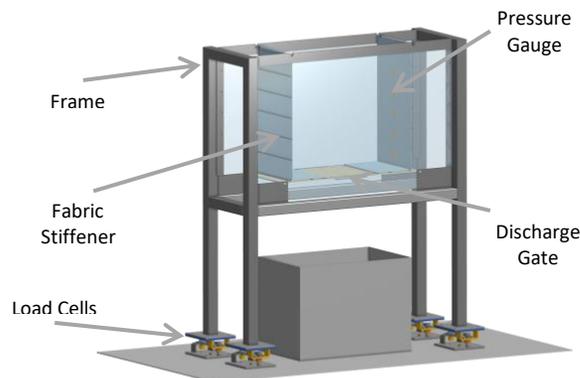
This project seeks to improve the prediction of powder discharge from Flexible Intermediate Bulk Containers (FIBCs), or 'Big Bags'. FIBCs have a crucial role to play in the transportation of food-grade materials, volatile chemicals, pharmaceutical powders, agrochemicals and more. Despite their common use, issues such as arching and sensitivity to storage conditions persist and are not well understood. This research aims to enhance understanding of FIBC flow characteristics to refine predictive models.

Approach:

Our approach integrates experimental, theoretical, and numerical methods to predict discharge from Flexible Intermediate Bulk Containers (FIBCs). We aim to apply recent advancements in bulk solid mechanics, including the hoop stress theory and numerical modelling tools, to develop flow models for containers with flexible walls. This methodology will be supported by experimental testing to analyse discharge patterns from FIBCs, focusing on specific powder bulk materials and characterising them through our flow properties lab.

Recent Results:

- Extensive literature review conducted on powder flow prediction, surrounding granular mechanic behaviour, flow theories, characterization methods, and recent research. Concurrent review of Australian standard (AS 3774) and Eurocode equivalent, exploring basic calculations and examples.
- Survey distributed within the IFPRI community, gathering insights on challenges and trends in FIBC usage, material types, and bag construction. Responses confirmed common issues like consolidation, arching, and ratholing.
- Early experimental trials underway, focusing on full-scale bag discharge to benchmark behaviour across different bulk material types, informing subsequent scale-model and flow properties investigations.
- Design finalized for Phase-1 experimental rig, soon to be commissioned within workshop facilities. 2D concept design illustrations available.
- Numerical approaches explored, with emphasis on Discrete Element Method (DEM) for modelling flexible walls as particle 'shells' or 'pfacets'. Calibration based on particle interactions and material properties.



Next Steps:

- Material characterization of selected samples for key characteristics determination.
 - Conducting simulations (DEM, FEA) to investigate FIBC flow patterns.
 - Commissioning of discussed Experimental Apparatus.
 - Commencing experimental analysis to measure and model discharge behavior.
 - Reviewing flow theory for flexible walled containers, including stress distribution prediction focus.
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