



# IFPRI Project Abstract

---

## Predicting Powder Flow from Containers with Flexible Walls

Mitchell Boots, Mark Jones, Peter Robinson, Craig Wheeler, Alan Roberts

University of Newcastle, Australia

Project Start Date: 05<sup>th</sup> February 2024

Abstract Date: 16<sup>th</sup> May 2025

---

### *Project Objective:*

This project aims to improve the prediction of powder discharge from flexible intermediate bulk containers (FIBCs), commonly known as ‘Bulk Bags’. FIBCs play a crucial role in the transportation of various bulk materials, from pharmaceutical powders to landscaping supplies. Despite their common use, challenges such as arching and irregular flow patterns persist and are not well understood. This research aims to advance the understanding of FIBC flow behavior and to adapt predictive models.

---

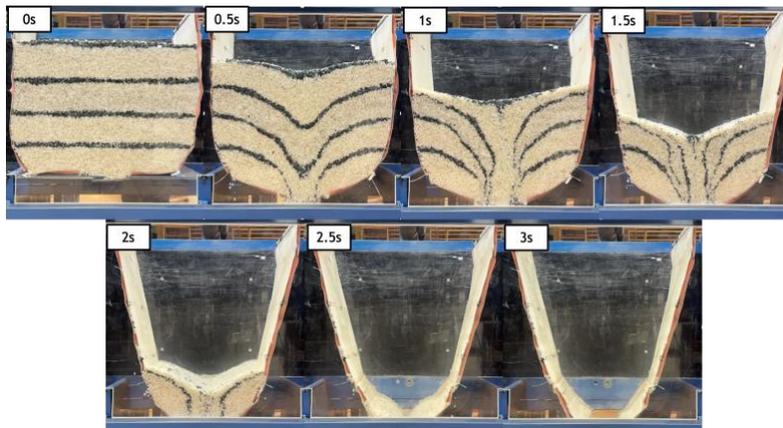
### *Approach:*

Our approach integrates experimental, theoretical, and numerical methods to help us improve our understanding of discharge from flexible intermediate bulk containers (FIBCs). We aim to develop a framework to better predict flow for containers with flexible walls by leveraging recent advancements in bulk solid material handling, including flow theories and numerical modelling tools. This methodology will be complemented with experimental testing to analyse discharge patterns from FIBCs, focusing on specific bulk materials and characterising them through our flow properties lab.

---

### *Recent Results:*

- Commissioning and Testing of a Scaled ‘2D’ Rig:
  - Plastic beads – Used as a baseline, representing a basic cohesionless material for visualisation before extending to more complex cohesive materials.
  - Sand – Tested with varying moisture content to modify material properties and induce various cohesive effects.
  - Early results were summarised in the Year 1 annual report.
- Material Flow Property Data:
  - A full suite of flow property tests was conducted on the packing sand at various moisture contents
  - A Comprehensive flow property report for the sand was provided in the appendix of the year 1 annual report.
- DEM Modelling:
  - Continued simulations have yielded promising results.
  - Simulation focus has been on ‘2D’ Rig, and replicating the behaviour seen in the workshop.
  - The calibrated cohesionless simulation closely replicates real-life behaviour, demonstrating the potential of DEM for predicting and visualising flow.
- Exploration of Flow/No-Flow Criteria:
  - Focus on consolidation stresses within the bin and their impact on flow behaviour.
- 3D Rig Design:
  - Development is underway, with manufacturing scheduled to commence later in the year.
  - Final Designs are currently being worked through.



---

### *Next Steps:*

- Expand 2D DEM Simulations: Further calibration and discharge simulations for cohesive materials to replicate arching behavior observed.
  - Commissioning of Full-Scale Rig: Development of a full-scale rig to simulate and visualize discharge regimes under realistic conditions. Testing various off-the-shelf FIBCs, materials, and discharge aids.
  - Exploration of Consolidation Stress in Bags: Continued investigation into consolidation stresses within FIBCs to apply Jenike's methodologies for flow prediction. Vital for flow/no flow predictions.
-