**Check One: x Project ☐Review ☐Collaboration**

**☐Workshop ☐Other**

| **Descriptive Title** | Developing a mechanistic understanding of caking/aggregation in amorphous & crystalline powder systems during storage and transport |
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| **Working Title[[1]](#footnote-0)** | Understanding Caking & Aggregation in Heterogenous Powders |
| **Technical Area[[2]](#footnote-1)** | Dry systems/Particle Formation |
| **Date** | 16/6/2025 |
| **Short Description** | Caking and aggregation in powders during storage and transport are persistent challenges across a wide range of industries. While the mechanisms underlying caking in purely crystalline or amorphous systems are relatively well-established, most industrial powders exist as complex blends of both phases. The interactions at the amorphous–crystalline interface, and their contribution to time-dependent caking behaviour, remain poorly understood.  This project aims to develop a mechanistic and time-resolved understanding of caking and aggregation phenomena in hybrid amorphous–crystalline systems. By elucidating the physicochemical interactions that govern moisture uptake, thermal effects, inter-particle bonding, and structural consolidation across phase interfaces, we will expand the current domain of knowledge beyond idealised systems.  This work builds on the conclusions of Jamie Clever’s 2008 IFPRI review on powder caking, which emphasised that formulations of ductile and brittle materials—representing amorphous and crystalline phases—remain poorly understood. We aim to extend this foundational work by providing new insights into the coupled behaviour of these mixed-phase systems and enabling more robust powder product design and control. |
| **Objectives** | * **Characterise the time-resolved caking and aggregation behaviour** of mixed amorphous–crystalline powder systems under controlled storage and transport conditions, particularly under varying moisture and temperature conditions. * **Identify and model the mechanistic interactions** at the interface of amorphous and crystalline phases that drive moisture-induced bonding and consolidation. * **Develop predictive tools and design guidelines** to mitigate caking in hybrid powder formulations, enabling improved handling, flowability, and product stability. |
| **Scope** | * This project will investigate a model system comprising representative crystalline and amorphous powders to systematically study caking and aggregation behavior. * The scope includes controlled variation of the crystalline-to-amorphous ratio to identify critical thresholds where caking mechanisms shift or intensify. * Emphasis will be placed on isolating the moisture, thermal and chemical interactions at the phase interfaces, with the goal of understanding how increasing crystallinity or amorphicity impacts time-resolved consolidation under realistic storage and transport conditions. |

| **Recommended Contractors (2 or 3)** | | |
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| **Name** | **Institution** | **Email Address** |
| **Prof. Lisa Mauer** | Purdue University | [mauerl@purdue.edu](mailto:mauerl@purdue.edu) |
| Mojtaba Ghadiri/ | University of Leeds | M.Ghadiri@leeds.ac.uk |
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| **Submitted By:** | |
| --- | --- |
| **Name** | **Organization** |
| Nabhan Ahmed | Keurig Dr Pepper |
| Martijn Van De Hoeven | Danone |
| Isabelle Deleris | Cargill |
| Vincent Meunier | Nestle |
| Sarah David | Novovartis |
| Alexander Findeisen | Novonesis |
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1. Title used in meeting agendas and file archives [↑](#footnote-ref-0)
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 [↑](#footnote-ref-1)