



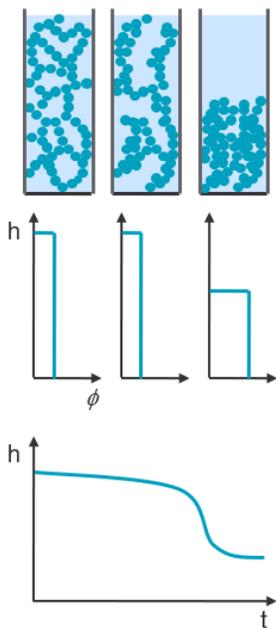
## Research Project Brief

### Syneresis of Colloidal Dispersions

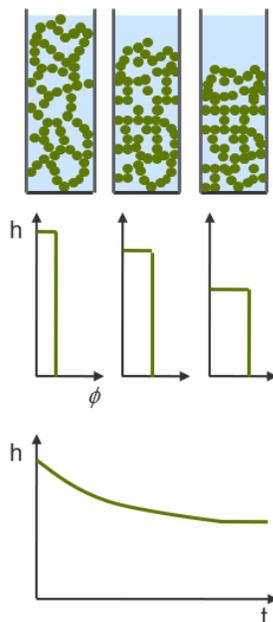
Many particulate products are formulated as colloidal dispersions. A key quality attribute of such formulations is that they are stable to particle flocculation and settling over the “shelf life” of the product, which is typically measured in months or years. To achieve this, the dispersions are formulated as gels, which rely on the yield strength of the fluid matrix to retard the motion of the particles and thereby arrest their settling.

These formulations typically don’t have infinite shelf life, and they can fail by (at least) three modes: delayed gel collapse; syneresis; and gel consolidation. In our understanding, these are described in the following diagram:

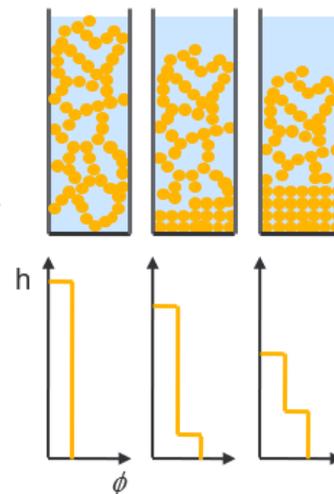
#### Delayed Collapse



#### Shrinkage



#### Consolidation



In delayed gel collapse, the gel structure is lost, creating a dense particle phase coexisting with a dilute phase. In syneresis, the gel densifies but retains its structure, expelling a small volume fraction of a dilute particle phase. In gel consolidation (Buscall-White behavior), the bottom of the gel consolidates under the weight of the gel above it, and this forms a dense particle layer on the bottom, a gel with the initial volume fraction above it, and a dilute phase above that.

The objective of this project is to understand the fundamental physics and chemistry of syneresis. What are the controlling variables, and how can they be manipulated to control both the extent and rate of gel shrinkage? How is syneresis related to the other modes of gel instability?

Water and oil-based systems are in-scope as well as multi-phase systems such as suspension emulsions. Solids in suspension may be either organic or inorganic. All rheology modifiers are in-scope, such as cellulose, gums, clays, polymers, silicas and salts. Solids volume fractions will be 5 to 50%. Given the fundamental focus of the project, model formulations are in-scope (and are encouraged). The project should be experimental, supported by theoretical and/or computational work.

IFPRI has and continues to fund extensive work in colloidal gels, including past projects by Mike Solomon (U. Michigan), Eric Furst (U. Delaware), and Wilson Poon (U. Edinburgh) and current projects by Jan Vermant (ETH Zurich) and Lilian Hsiao (NCSU), and this new project is an important addition and extension to this.