Design and characterization of gel networks in consumer products

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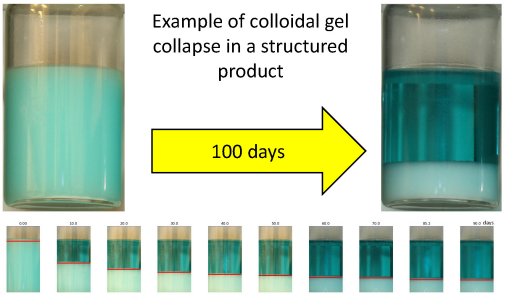

FIG. 1. The gel network initially distributed homogeneously along the vertical direction is modified by the constant gravitational stress applied on it. Mechanical failure mechanism happening over long time scale need to be avoided or at least well controlled via proper design of the colloidal scale microstructure.

In the last 20 years many consumer products evolved from simple solutions to multiphase complex fluids in which surfactants, polymers, solid particles, encapsulated materials and emulsion droplets coexist in a delicate equilibrium. Such evolution enabled the addition and fine-tuning of multiple functions but also increased the complexity of the liquid microstructure and required the development of fluid structuring strategies that are closely related to gel networks. The product formulation effort changed significantly from independent selection of ingredients and subsequent optimization of production processes, to a much more interdependent selection of formulation and processing strategies. The motivation for such changes is not only to deliver active chemical ingredients but to also design the physical colloidal scale microstructure that makes delivery possible and efficient. Many of todays liquid detergents, for example, rely on colloidal gel or glass microstructures to provide physical stability of suspended colloidal particles to deliver benefits beyond just cleaning. The mechanical stability of the colloidal microstructure over long timescale, example provided in in Fig. 1, is an interesting problem associated with structured fluids and can be interpreted within the theoretical framework developed in the colloidal gel literature [1],[2]. In this talk, we will review some of the challenges we face in characterizing and designing the mechanical properties of liquid formulated products, with emphasis on the open questions that would certainly benefit from a strong partnership with the soft matter community.

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[2] Landrum, Benjamin J., William B. Russel, and Roseanna N. Zia. "Delayed yield in colloidal gels: Creep, flow, and re-entrant solid regimes." Journal of Rheology 60.4 (2016): 783-807.