

## EFFECT OF CENTRIFUGATION ON SAMPLE HOMOGENEITY

H. Dihang<sup>1</sup>, P. Bru<sup>1</sup>, G. Meunier<sup>1</sup>, B. Pouligny<sup>2</sup>, P. Snabre<sup>2</sup>

<sup>1</sup> Formulation, 10 impasse Borde Basse, 31240 L'Union, France

<sup>2</sup> Centre de Recherche Paul Pascal, avenue Albert Schweitzer, 33600 Pessac, France

---

### Abstract

Centrifugation is a common method used in many industries to reduce the time for stability studies, as the acceleration field leads to a quicker destabilization of the system. However, correlation with real shelf life of a colloidal system can prove to be complex, as the stress applied to the sample is far from natural forces, which can be encountered in the normal "life" of a product. This paper presents some data proving the detrimental effects of centrifugation on the destabilization process, as important segregation between small and large particles is observed after centrifugation of the dispersion and not when the sample is left at rest.

Keywords: stability, centrifugation, suspension, dispersion, shelf life, Turbiscan®.

---

### Introduction

Many industrial products available in the market are in the form of emulsion or suspension. These products are often complex due to the large number of components in the formulation and their physical stability is a critical parameter, which has to be controlled thoroughly. Different techniques are available to monitor the stability of such colloidal systems and most of them offer the possibility to accelerate the destabilization phenomena in order to obtain results more quickly. Two methods are commonly used to accelerate the destabilization process: temperature and centrifugation. The scientific community is regularly debating whether these methods are realistic and can be correlated to real shelf life of a product.

In this paper, experiments show evidences that centrifugation causes segregation among polydispersed particles, which is not observed when the sample is left still for the stability analysis. This effect is highlighted using simple fluorescence imaging experiments. The mechanism involved in this process involves the jamming properties of the percolation network, which can be applied to most of the gel-like structures, corresponding to many industrial products (cosmetic creams, toothpaste, yogurt, cheese, paint, etc.).

Gel structures are between liquid and solid states. The gel transition, or so-called sol-gel transition involves a percolation threshold and

jamming transition, whereby a continuous path between particles starts to form (as in Figure 1 for weakly interacting PMMA particles). The jamming transition can be caused either by an increase in particle density (concentrated emulsion or suspension) or physico-chemical interactions between particles leading to a restriction of particle motion in the dispersion.

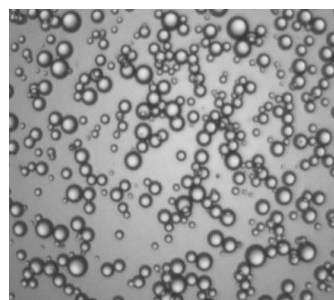


Figure 1. Microscopy image of 10µm – 40µm PMMA beads in a viscous fluid.

The gelation network greatly influences the rheology of the dispersion and leads to the existence of a yield stress. The dispersion remains static for low mechanical stress, but flows when the stress exceeds the yield stress. This is the typical example of toothpaste, which remains in the tube as long as one does not press on it, the yield stress corresponding to the stress necessary for the toothpaste to flow out of the tube.