Biopolymers: determination of the optimal gelling agent concentration

Introduction

Gels are widely used in formulations as their unique properties allow stabilization and texturization of products. Very often, biopolymers are used for this gel formation. Typical questions for formulators are:

A) What is the minimum concentration of gelling agent needed to form a gel?
B) What is the gel point for a given concentration?
C) What is the gel strength of each gel?
D) What time is needed to match a given reference elasticity level?

To answer these questions, a formulator has to study many samples. In this application note, 12 different concentrations were studied, which is usually really time-consuming with conventional methods (such as mechanical rheology). Thanks to Rheolaser MASTER, 6 samples are studied simultaneously and automatically.
The minimum gelling agent concentration, the gel point and the elasticity of the samples can be determined by a 1-click analysis. A simple system of liquid phase and gelling agent (milk with glucono-δ-lactone/GDL) is studied here.
Of course, this kind of analysis can be generalized for any kind of gelling system.

A) What is the minimum concentration of gelling agent to obtain a gel?

Rheolaser measures the particle Mean Square Displacement, which gives an indication of the viscoelastic properties (Figure 1. I). The MSD curves in the top left are those with low concentration of gelling agent. They are linear, which indicates a purely-liquid behaviour. With increasing concentration, gels are formed, leading to the typical viscoelastic MSD (plateau formation).
The minimal gelling agent concentration is determined with the Time-Cure-Superposition (TCS) method. TCS consists in rescaling the MSD curves, giving characteristic v-shaped curves (Figure I. II) indicating the minimum gelling agent concentration (see application note **"Gel point determination by TCS"** for more details).

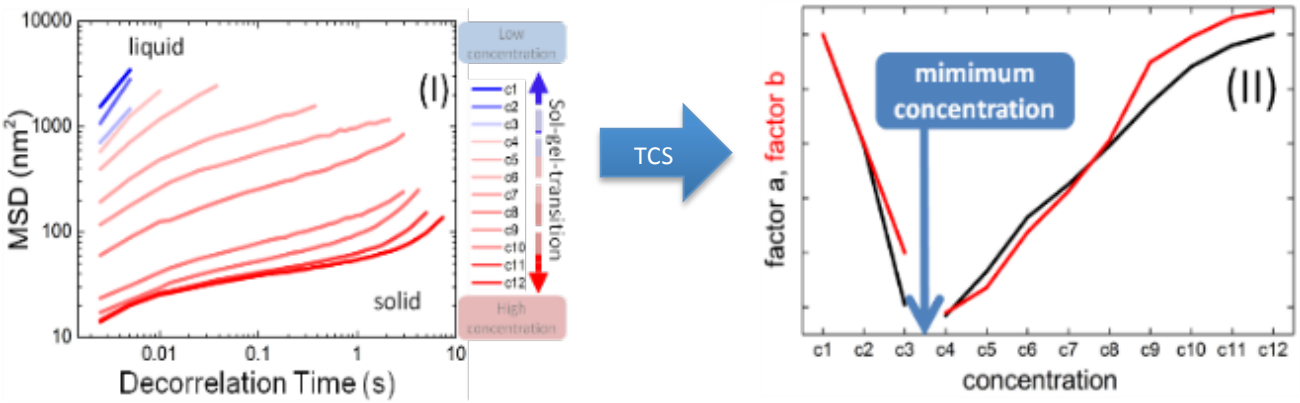

Figure 1. (I) MSD curves of different gelling agent concentrations. (II) TCS results giving concentration to create a gel.

B) What is the gel point for a given concentration?

As seen previously, the samples with the concentrations C4 to C12 form a gel: the gelling time for each concentration was determined by the TCS treatment as shown in Figure 2. The different gel points are listed in the formulation matrix at the end of this application note.