



# Accurate monitoring of gelling temperature of carrageenan dispersions

## Application

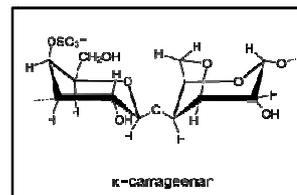
Cosmetics  
Pharmaceuticals  
Food  
Animal food

## Device

Rheolaser®

## Introduction

Carrageenan is a polysaccharide of biological sources used widely in food preparation as gelator. During cooling, Carrageenan dispersions show a liquid-solid transition, which is dependent on the polymer and salt (KCl, KBr) concentration.



In the following, we study four different polymer concentrations (0.1 wt%, 0.25 wt%, 0.5 wt% and 1 wt%) at a fixed salt concentration of 40mM KCl. The dispersions were heated to 90°C and then let cool down to 25°C in the apparatus to detect the gel point. 4 experiments are performed simultaneously with Rheolaser which measures at rest and in real time the liquid-solid transition.

## Experiment and Raw Data

In microrheology, the particle Mean Square Displacement (MSD) is measured, which gives an indication of the viscoelastic properties. Each MSD curve are related to the viscoelastic properties at the corresponding temperature (Figure 1). The MSD curves in the top left are those at high temperatures (red curves). They are linear, which indicates a liquid behaviour of the carrageenan dispersions. As the temperature decreases, a gel network is formed by the polymer chains and the characteristic MSD signature for viscoelasticity (plateau formation) is obtained (blue curves).

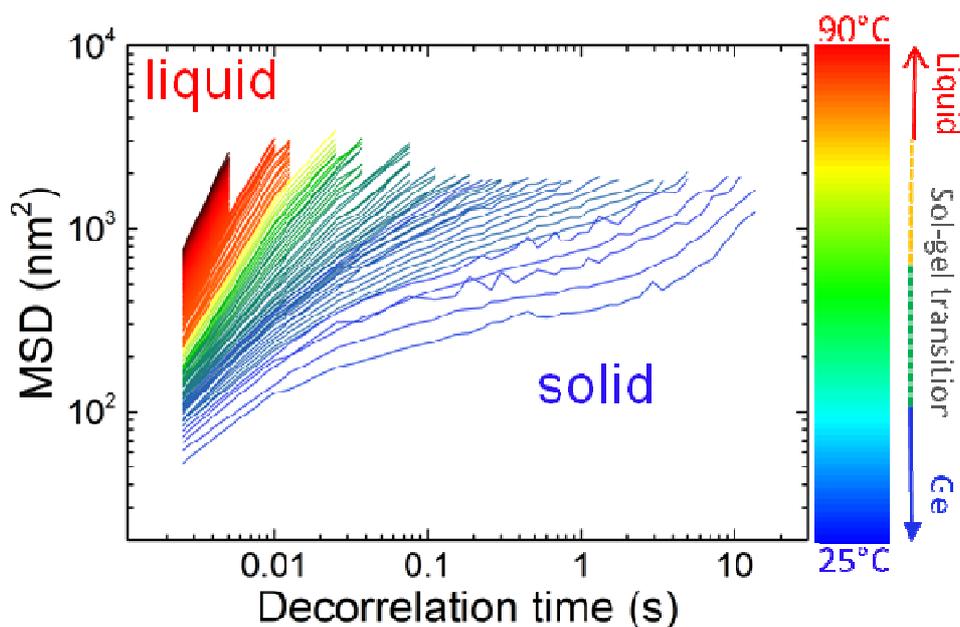


Figure 1 : MSD curves of a 0.5% carrageenan dispersion during cooling.

## Time-Cure-Superposition Data Treatment (TCS)

Accurate gelling time is determined thanks to the TCS method. This method consists in rescaling the MSD curves by factors **a** and **b**, giving a characteristic v-shaped curve that indicates the gel point as shown in Figure 2 (for more details see application note "Gel point determination by TCS"). This is the transition from the diluted regime (single polymer chains) to the concentrated regime with entangled network-forming chains.

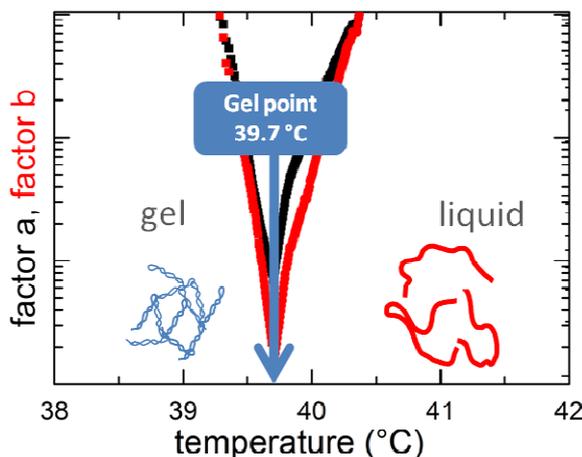


Figure 2: Gel point of a 0.5 wt% carrageenan dispersion with 40 mM KCl.

## Results

Thanks to the 6 measurement positions, up to 6 concentrations can be measured in parallel. Figure 3 shows the v-shaped curves of 4 carrageenan dispersions with different concentrations during cooling. The gelling temperature determined by the TCS-method increases with increasing carrageenan concentration. The higher gelling temperatures can also be related to higher gel strengths, since with increasing polymer concentration stronger gels are formed. Gel formation and gel dissociation take place at higher temperatures.

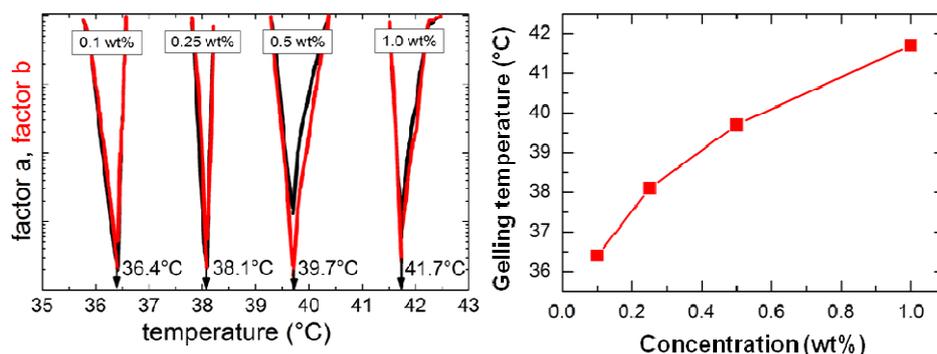


Figure 3 : Comparative plot of factors **a** and **b** against temperature for four different polymer concentrations. The liquid-solid transition is indicated by arrows.

### Benefits:

- Easy: Disposable measurement cells.
- Accurate: High precision gel point determination.
- Fast: 6 simultaneous measurements.