Application note
RHEOLASER®Master

Biopolymers: tablet manufacturing with hydroxypropyl methylcellulose

Introduction

Hydroxypropyl methylcellulose (HPMC) is a modified cellulose derivative, which is often used as thickener, emulsifier and temperature dependent gelling agent. Contrary to cellulose, it is soluble in water at room temperature. It is completely harmless and can therefore be used in food and pharmaceutical products (E464). At higher temperatures, HPMC falls out and forms a gel-like structure. The temperature at which this happens is called “Lower critical solution temperature” (LCSM). This temperature is dependent on the substitution ratio of methyl to hydroxypropyl and on the HPMC concentration.

General results

Figure 1 shows the evolution of the elasticity index (EI) as a function of the temperature (+1°C.min^{-1} ramp). The higher this index is, the higher is the elasticity of the sample. The evolution of the EI can be divided in three steps:

1. Elasticity decreases slightly with increasing temperature, following Arrhenius rule.
2. Network starts to form, indicated by a sudden increase of the elasticity index. The higher the HPMC concentration is, the lower is the temperature at which the gel starts to form.
3. Gel undergoes a syneresis (contraction). The higher the HPMC concentration, the stronger is the network, and the higher is the syneresis temperature

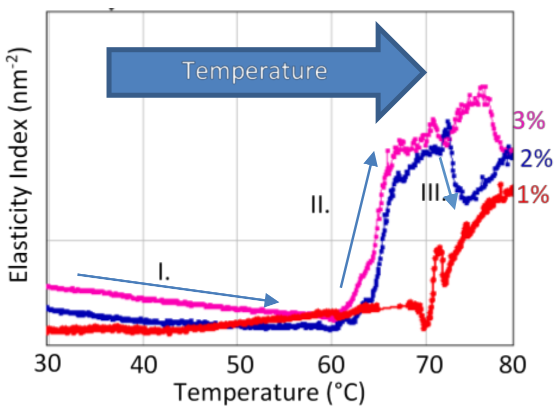

Figure 1. Elasticity Index (EI) as a function of T during a 1°C.min-1 increasing ramp for 3 HPMC concentration.

Figure 2 shows the evolution of the elasticity index as a function of temperature for different concentration of NaCl at a constant HPMC concentration of 2 wt%. The higher the salt concentration, the lower is the temperature at which the gel forms. Salt addition also suppresses syneresis to a certain extent. As one can see, the gels are stronger with salt addition.

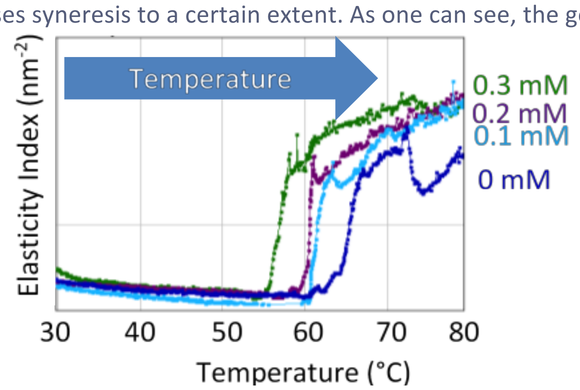

Figure 2. Elasticity Index (EI) as a function of NaCl concentration during a temperature ramp.

Application to tablet manufacturing

HPMC can be used in various applications in food, cosmetic and pharmaceutical industry. In the pharmaceutical field it is mainly used as excipient for tablet manufacturing. In the right combination of HPMC, titanium dioxide, polymer and salt the dispersion forms a strong gel network upon heating. Figure 3 shows the evolution of the elasticity index as a function of temperature for two tablet formulations based upon HPMC. The first one is more elastic and viscous and shows a sharper evolution of the elasticity index. Its LCST is about 48°C. At 60°C, syneresis effect appears suddenly, which gives rise to a very strong gel. The second sample is more liquid at room temperature and shows little changes upon heating. When 50°C is reached, the elasticity index increasing, which indicates the beginning of gel formation. Syneresis starts between 75°-80°C.

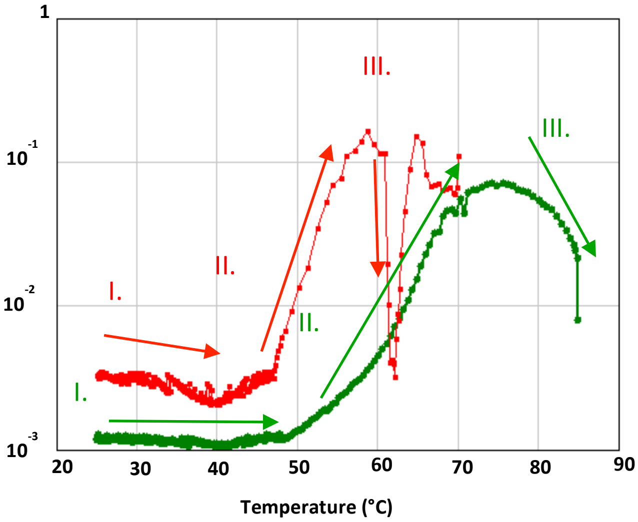

Figure 3. Dispersions for tablet manufacturing that gel at increasing temperature and undergoes syneresis.

While the HPMC dispersions used in Figure 1 and Figure 2 form reversible gels, the dispersion in Figure 3 is more complex. The resulting gel is formed by coagulation similar to **natural latex coagulation**. This process is not reversible. When temperature gets back to room temperature, the gel remains and can be processed further on. The experiment showed that the Formulation 1 gels and at lower temperature than Formulation 2. This is advantageous as the active compound should not be heated over 60°C.

Possible applications

FOOD (baking products for fruit juice retention during heating)
PHARMACEUTICALS (creating of tablets & pills)
ANY GEL SYSTEMS

Benefits

FAST - 6 measurement positions & automatic data treatment
ACCURATE - exact determination of the gel point
EASY - Disposable measurement cells, closed environment, 1-click computation