Thickening Agent with a High Salt Tolerance

Authors: Dr Paul Mallo, Dr. Pascale Bernard, SEPPIC, Paris, France

Abstract

Synthetic polymeric thickening agents are widely used in personal care. They give cosmetic formulations the required level of viscosity, the right rheological behaviour and they strongly impact skin sensation. There are two main families of synthetic thickening agents: the cross-linked polyelectrolytes and the Hydrophobically Alkali Swellable Emulsions (associative thickener). The cross-linked polyelectrolytes give, after swelling, a population of micro-gels which lead to the building of the network structure for the final cosmetic formulation. This kind of structure gives a well appreciated skin sensation.

These polyelectrolytes can thicken several kinds of medium: water; water with salts (electrolytes); acidic or alkaline aqueous phase; water with surfactants; active ingredients and so on. But of course the amount of dissolved salts in the formulation is a key parameter, as the salts strongly decrease the viscosity of these polyelectrolytes because the thickening mechanism is based on electrostatic repulsions.

In contrast Hydrophobically Alcali Swellable Emulsion products (HASE) are not sensitive to electrolytes, as the main thickening mechanism is based on association of hydrophobic groups. But the skin feel given by these HASE products is not as nice, so they are not as widely used.

Besides, more and more often the personal care industry uses actives containing a high level of salts (electrolytes). So today there is a need for a thickening agent working as a polyelectrolyte but able to retain its efficiency in the presence of a high amount of salt (electrolytes).

SepiMax™ Zen was developed to meet this need, providing an ingredient with a very high resistance to electrolytes. It is the ideal technical solution for any formula incorporating a significant amount of salts.

Manufacturing Process

SepiMax™ Zen (INCI: Polyacrylate Crosspolymer-6) is manufactured by precipitation polymerisation in tertio butanol. The monomers, namely Ammonium acryloyl dimethyl taurate (NH4AMPS), dimethyl acrylamide, lauryl methacrylate, laureth 4 methacrylate, are dissolved in tertio butanol. The resulting copolymer precipitates in tertio butanol until a critical molecular weight is reached and then recovered from the medium.

SepiMax™ Zen is a copolymer in powder form, already neutralised and easy to disperse in water or in oil.

Thickening Mechanism of SepiMax™ Zen

The thickening mechanism is based on electrostatic repulsion and hydrophobic interaction. The target was to increase the salt tolerance while keeping the convenient and efficient properties of standard polyelectrolytes.

The challenge is to be able to incorporate a hydrophobic monomer on the hydrophilic structure and to get a thickening effect that is the sum of electrostatic repulsions and hydrophobic interactions.

This target was reached by finding and selecting the mixture of lauryl methacrylate and laureth 4 methacrylate as hydrophobic monomers and then optimising the process.

SepiMax™ Zen is a hydrophobically modified polyelectrolyte.

SepiMax™ Zen is still basically a polyelectrolyte modified with the introduction of hydrophobic groups: the lauryl chains. So its thickening power is governed by two types of interaction:

- Electrostatic repulsions
- Hydrophobic interactions

Depending on the medium, one or other interaction dominates. The diagram on next page illustrates the microgel, inter-microgel and intra-microgel electrostatic repulsions as well as hydrophobic interaction areas.

The curves in Figure 2 give the viscosity of SepiMax™ Zen aqueous gel (Brookfield viscosity measured in mPa.s at 5 rpm) versus the amount of NaCl added.

In pure water, the thickening power is mainly governed by electrostatic repulsions.