Effect of the rheology of the continuous phase on foaming process : viscosity-temperature impact

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Bubble size and its distribution in foamed products is the result of the combined effects of formulation and process parameters.
The aim of this study was to investigate the interactions between the continuous phase viscosity and the process temperature on foaming operation.
Experiments have been carried out with newtonian model fluids, in order to get simple and well defined rheological behaviour with different viscosity levels, and a complex milk based product with two different regulation temperatures.
Whipping operation was conducted on two different continuous pilot scale devices, equipped with sensors.

Viscosity appears to be a key parameter on bubble size. It is directly linked to product formulation, global foaming temperature and also rotation speed (for non newtonian fluids). Formulation allows to select rheological behaviour and viscosity level, considering process parameters : apparent viscosity depends shear rate imposed by rotation speed, and is a function of the whipping head temperature, governed by a double jacket regulation.

However, the continuous phase viscosity is not always under control. We have highlighted the importance of local heating in the narrow gap. At high rotation speed and high viscosity, it could reach more than twenty degrees, leading to viscosity decrease and bubble size increase. This phenomenon is never taken into account in the litterature.