Membrane Emulsification: from laboratory to manufacturing

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Traditionally homogenisation techniques have been used to generate emulsions. However, improvements to emulsion droplet size distribution are required to enhance stability, and so alternative methods to form superior emulsions have been investigated. Whilst membrane emulsification has historically been limited to small scale lab operations, recent developments have led to new scalable systems that have been specifically designed for aseptic applications, such as food and pharma.

Homogenisers can be operated in batch or continuous modes of operation, often needing recirculation, or multiple passes to achieve the targeted specification. The presentation will highlight the benefits of membrane emulsification using a single pass, continuous operation and demonstrate case studies of emulsion systems made in this manner.

A membrane emulsification system is reported, consisting of a tubular steel membrane and housing with PTFE sealing rings. The system contains no moving parts and generates shear for droplet production using single pass crossflow, making the system suitable for highly sensitive and demanding processes in the pharmaceutical, cosmetic and food industries. The system is shown to be highly capable in the large-scale production of emulsions, with a rate of production of at least 200L/Hr. Oil-in-water emulsions across a range of droplet sizes with median diameters 20 - 100µm were produced to demonstrate the equipment's flexibility, and a model encapsulation system was demonstrated on the crossflow system to highlight the potential for continuous production of low-dispersity encapsulates.. Samples produced had a coefficient of variation of droplet size less than 15%. In a single pass it was possible to achieve a high dispersed phase concentration of 40%, further demonstrating potential for highly efficient continuous process.

The benefits of superior emulsion droplet size distribution, leads to a more stable emulsion. This can then, by a variety of chemistries, be converted into microcapsules or other forms of delivery systems with superior performance in terms of mechanical stability, uniformity of dose and rate of diffusion.

In this presentation the benefits of using membrane emulsification, in a continuous, single pass operation, to achieve size control and stability benefits will be discussed. The related cost savings to be made in terms of energy usage and reduced raw material waste will be illustrated to demonstrate how this technology can improve sustainability and reduce environmental impact whilst accessing enhanced performance.