

Production of uniform O/W emulsions through a porous medium of micron-sized glass beads

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ABSTRACT

Premix membrane emulsification, along with other latest emulsification techniques, has established itself as a promising technique for the production of small sized and relatively monodisperse emulsions at comparatively low energy inputs. A drawback of premix emulsification is membrane fouling that may become serious depending on the formulation components, and related to that their interaction with the membrane and their ease of removal.

In this research, an alternative system consisting of a packed bed of glass beads, introduced by van der Zwan *et al.* (2008), which is intrinsically easy to clean, was further investigated for emulsification. The process parameters, especially, related to porous medium like particle size and bed height, were studied.

A coarse O/W emulsion, of 5% hexadecane in water having 0.5% (v/v) Tween-20 as surfactant, was prepared with an Ultraturrax homogenizer (IKA® T-18 basic) operated at 3500 rpm for 10 minutes. The droplet size was typically around 25-30 μm with a span of 0.9-1.0. Premix emulsification was carried out by passing the coarse emulsion under pressure (200kPa) through the porous medium of micron-sized glass beads held in place by a nickel support membrane that has uniform pores of 11.6 $\times$ 331 μm . Four particle diameters; 50, 63, 75, and 90 μm were evaluated for different medium heights, and emulsification results were compared.

Uniform sized oil-in-water (O/W) emulsions having mean Sauter diameter ($d_{3,2}$) less than 5 μm were successfully prepared. The droplet uniformity, expressed as span of distribution ($\delta = (d_{90}-d_{10})/d_{50}$), was typically of the order of 0.7. A considerable higher transmembrane flux, typically 10-100 times higher than values found for premix membrane emulsification, was obtained at as little as 2.5mm height of porous medium without any fouling.

Based on the obtained results, we can conclude this system is an interesting alternative for premix membrane emulsification. It gives a considerable reduction in droplet size, while still keeping the droplet sizes rather uniform, and it can operate at high fluxes while not being hindered by membrane fouling.

Reference: van der Zwan, E.A., C.G.P.H. Schroën, et al. (2008). "Premix membrane emulsification by using a packed layer of glass beads." *AIChE Journal* 54(8): 2190-2197.