FEASIBILITY STUDIES ON EMULSION MANUFACTURING USING THE CO-TWISTER PROCESSING FACILITY

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Introduction

Processing facilities with homogenizer basing on the rotor/ stator principle are utilized in different industries in the manufacture of liquid emulsions and semi-solid dosage forms.
In common used processing plants a homogenization process of these preparations can be mainly influenced by varying the speed of the rotor with respect to the fixed stator, or by concrete design of rotor and stator. In general the shearing effect and the transportation effect of the homogenizer are greater at high rotation than at lower.
However, the maximum shear rate is limited by the dimensions of the rotor/ stator system, and the maximum rotating speed of the drive motor. Furthermore it can be stated, that the shearing and the transporting effect are directly interlinked. Therefore it might be possible, that with a too high homogenizer or motor speed the shearing effect becomes so great, that the substance respectively formulation to be homogenized is affected negatively and could even be damaged.

In this study a SYMEX CML 30 with a special designed homogenizer, the so-called Co-twister system, has been used.
By means of a dynamic stator, which can be driven separately and independently of the rotor, the homogenizing and transporting can be influencend in a great variety of ways and can be adopted to the particular production needs. The dynamic stator can be driven in the same direction or contrary to the rotor, so that the shearing effect can be varied continuously within great ranges.
The shearing effect approaches “zero” if the dynamic stator and the rotor rotate with identical or similar speed in one direction.
On the opposite it reaches its “maximum” at the maximum contrary speed of rotation, while the same shearing effect requires a significantly lower absolute speed of rotation when compared to other homogenizers. In addition the maximum shear rate of this Co-twister system is possibly much higher compared to conventional processing plants.

Investigation scheme

A process development for the production of highly dispersed oil-in-water (O/W) emulsions will be elucidated in the following:

Generally the oily droplets in oil-in-water emulsions for medical use should preferably be small, since the smaller the droplets the more stable is the emulsion in storage. The droplet size is furthermore of particular importance if the emulsion is to be used for parenteral application, especially for intravenous injections. In this case droplets below 1µm should be guaranteed.

Experiments in a larger laboratory scale (batch size from 6 to 30kg) with O/W-emulsions, possibly to be used i.v., have been performed to answer the question, if there is a relationship between process settings and product parameters, especially the droplet size.
The critical process parameters were investigated using a 2^3 –factorial design, which represents a rational method to study production processes. The effects of the tested parameters were calculated and the results were statistically evaluated for significance.
The droplet size distribution of the prepared emulsions were determined by laser light diffraction while the appearance was judged by visual inspection. During stability testing, which is still under evaluation, both methods were performed.
Some batches were subjected to a thermal shock (1bar, 121°C, 15min) after their preparation to accelerate the test for assessing emulsion stability.

Results

The speed of the homogenizer was found to have the highest impact on product quality of all process parameters studied. A strong dependency of the particle size on the shear rate could be shown.
With certain emulsion formulations a particle size distribution comparable to those after high pressure homogenization might be achieved.

References

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