

CHAPTER 1

INTRODUCTION



Processes for the separation of the components of a liquid solution by contact with another insoluble liquid are known as liquid-liquid extraction, or more simply as liquid extraction, and sometimes as solvent extraction.

Liquid-liquid extraction is one of the several mass transfer operations of chemical engineering. It is to be considered where separation by distillation is difficult to accomplish.

In liquid-liquid extraction the two phases involved are both liquid. In the simple case, a solute is removed from one phase by dissolution into the other phase (the extract)¹.

There are many types of liquid-liquid extraction contacting equipment, which do not necessarily require power such as spray columns, baffle-plate columns, packed columns and sieve-tray columns².

The spray column is the simplest of the continuous contacting devices. Two operations are possible: light liquid dispersed operation and heavy liquid dispersed operation. In heavy liquid dispersed systems, heavy liquid enters at the top of the column through a distributor which disperses it into small droplets which fall downward through a continuous phase filled column and flow out at the bottom. The continuous phase passes countercurrently from bottom to top of the column and intimate contact between the two phases leads to solute extraction.

The spray column cannot compete with the sophisticated and efficient extractors now used in industry, however it has the advantages of simplicity, low operational costs, and insensitivity to impurities. Moreover, it provides a suitable standard for checking hypothetical models and theoretical principles, which then may be extended to other extractors. Most of the difficulties in scaling up extractors are caused by nonideality of internal flow, rather than by the complexity of the mass transfer phenomena itself³.

It is necessary for the characteristics of the internal flow in spray columns to be understood in order to modelize the hydrodynamic parameters such as the formation and movement of drops, films, jets, and hold-up of the dispersed phase.

Present day spray columns are modelized following the diffusion model with consideration of plug flow behavior for the dispersed phase. One other major assumption is that piston-diffusion flow is valid for the continuous phase which in fact it is not because a strong recirculation due to droplet entrainment has been shown to exist. This entrainment violates one of the Sleicher conditions concerning radial uniformity in a piston diffusion flow. However the diffusion model is perhaps one of the only tool available up to now. But there exists the possibility of discovery of other models, closer to the physical nature of spray columns and perhaps more accurate in calculating mass transfer in spray columns.

Wijffels and Rietema⁴ have measured flow patterns and the effective axial mixing coefficient of the continuous phase by means of ink injections tracer methods. Predictions of drop diameter, hold-up, backmixing coefficient and mass transfer between the two liquid phases have been presented

by Horvath, Stiener, and Hartland^{3, 5}. In that particular work drop diameter was measured by photography, hold-up was measured experimentally, backmixing coefficients were measured by tracer methods.

The velocity profile and diameter of dispersed phase droplets in spray columns has seldom been touched upon and offer the possibility for a major investigation. Additional drop phase behavior data may lead to better modelization of mass transfer in spray columns.