Formation of giant unilamellar vesicles by phase transfer processes

Prof. Dr. H. Rehage, E. A. Kubatta*
Technische Universität Dortmund
Otto-Hahn-Str. 6, 44227 Dortmund, Germany
E-mail: heinz.rehage@tu-dortmund.de, evelin.kubatta@tu-dortmund.de

Vesicles or liposomes are bilayers of amphiphiles that enclose a fixed volume of fluid. They are of great interest as drug delivery system. In many applications it is necessary to produce vesicles, which are unilamellar, monodisperse, easy to adjust in size and refillable with active compounds. Previous methods of preparation (e.g. ultra-sonication, electroformation) lead to multilamellar vesicles or broad size distributions.

Here we present the preparation of vesicles by phase transfer processes of emulsions\(^1,2\), microemulsions or water droplets. The processes occur in three steps (fig. 1). First, a water phase is covered with an oil phase containing amphiphilic compounds. An emulsion is then added to the oil phase. In the last step the water droplets of this emulsion are transferred into the water phase by centrifugation or flow field.

To understand the complex mechanism we studied the kinetics of adsorption and the rheological parameters for amphiphiles in different solvents. Furthermore we determined the size of the vesicles by static and dynamic light scattering. As the vesicles are larger than the emulsion droplets, we assume that the droplets coalesce at the interface. Thereby an increase of the gravitational or centrifugal force occurs and the interfacial monolayer can be crossed\(^3\). Furthermore we developed a flow cell for the production of monodisperse vesicles. The emulsion droplets are formed in flow field and pass the interface by adjusting their density with saccharose (fig. 2).

To determine the amount of active compounds, enclosed within the vesicles, we used fluorescence measurements.