Size dependent nanoparticle transport in rising bubbles

M. Hermeling[1] and A.P. Weber[1]

[1] Institute of Mechanical Process Engineering. Clausthal University of Technology, 38678, Clausthal-Zellerfeld, Germany

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High product purity and good bioavailability of substances are important in the pharmaceutical industry. Several conventional techniques, like milling or high-pressure homogenization, reduces the particle size, what improves the bioavailability, but the disadvantages are contamination and morphology changes of the product (Juhnke , 2006).

As an alternative supercritical fluids may be used in the form of RESSAS (Türk & Lietzow, 2004; Young *et al.*, 2003). The Rapid Expansion of a Supercritical Solution (CO_2 and solved pharmaceutical substance) into an Aqueous Solution (with added surface active substances) leads to small bubbles, in which the nanoparticles were produced. Due to the high material concentration, the particles tend to form agglomerates by diffusion in the gas phase of the rising bubbles.

Beside the agglomeration, the particles (agglomerates or primary particles) could be transported to the interface and then transferred into the suspension. There the particles are stabilized against further agglomeration by surface active substances.

To investigate the mass transfer of nanoparticles from the gas phase into the suspension depending on the particle size a model system was used, consisting of a bubble column and carbon particles (see Figure 1).

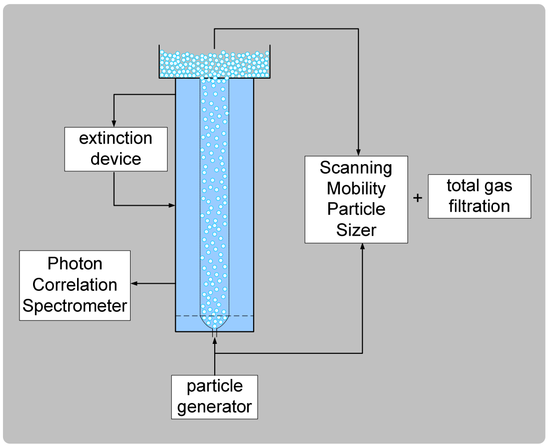

Figure 1. Model system for the investigation of the size depending separation efficiency

For different mean mobility equivalent diameters carbon-nanoparticles were produced with constant number concentrations. The particle mass concentration was determined by filter measurements and compared with the particle mass in the suspension as measured by extinction. Table 1 show the separation efficiency for constant residence time of the bubbles in the liquid (t = 0.75 s). As expected om the basis of existing models for the transfer of aerosol particles to the interface in rising bubbles (Fuchs, 1964; Pich & Schütz, 1991), the separation efficiency of smaller particles is higher than for larger particles.

Table 1. separation efficiency depending on particle size

Particle size (nm)	Total produced particle mass (mg/h)	Particle mass in suspension (mg/h)	Separation efficiency (%)
48	0,114	0,104	91
82	0,174	0,135	77,5

Separation efficiency of further particle sizes, especial smaller mobility equivalent diameter (about 20 nm) will be presented in this contribution. In addition, the results for the overall mass balance will be presented. Therefore, the aerosol behind the bubble column will be measured and compared with the aerosol in front of the bubble column.

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