

Characterization of bubbles in a bubble column by image analysis

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In recent years there has been considerable interest in the use of pneumatic reactors for biological reactions. Bubble size, rising velocity and distribution are important parameters concerning oxygen mass transfer, mixing and heat removal in aerobic fermentation processes.

Several methods for particle size measurement are available. They are generally divided into two categories, depending upon whether or not a sample is removed. The most simple characterization method is the photographic technique that, however, demands for photographs analyses. With the exponential increase of the processing capabilities of computers, as well as their price reduction, image analyses has become a very important tool, being a routine in cellular biology studies.

The most commonly used parameter to describe the diameter of a particle is the equivalent diameter, based on the projected area of the bubbles.

The aim of this work was to study the influence of airflow rate (between 100 L/hr and 200 L/hr), the distribution plate orifice diameter (0.5 mm, 1.0 mm and 1.6 mm) and the presence of a coalescence inhibitor on the size and shape of bubbles in a rectangular bubble column. Water and a 10g/L ethanol solution were used as liquid-phase. Bubble size and shape characterisation was done by recording images with a video camera at 30 cm from the distributor plate. After digitalisation, images were analysed using an image analysis system based on a MATLAB developed software. Values of the projected area, to compute the equivalent diameter, were determined and calculations of the superficial area and the volume of each bubble, by the determination of the lengths of the perpendicular axes, were done. The shape of the bubbles was obtained by comparison of the ratio between its superficial area and volume with the one of a sphere.

It was observed that, in the range of the studied airflow rates, bubble diameter slightly increased. An increase of bubble size was also observed with the increase of the distributing plate orifice diameter, being this variation more pronounced when the orifice diameter increased from 1.0 mm to 1.6 mm. On the other hand, the presence of ethanol did not lead to any significant change on bubble diameter.

Comparison of the ratio between the superficial area and the volume with the one of a sphere, showed that ellipsoidal bubbles are predominant.

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