# ANALYSIS OF MULTIPHASE DISPERSIONS IN A STIRRED TANK USING A HIGH-PERFORMANCE RED LED LIGHT SOURCE PROBE

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**Introduction.** In fermentations processes, an efficient dispersion of the gas phase is important to enhance the oxygen transfer phenomena. A diversity of techniques for analyzing gas dispersion exists and among these techniques, the image analysis has earned good acceptance in research and industrial areas by its feasibility and on-line acquisition of information. The main disadvantage of these techniques is the visual capability that is limited by the biomass concentration and the number of phases involved [1]. The aim of this work was to evaluate a commercial system, having high-performance illumination for *in situ* image acquisition and analysis, for studying multiphase dispersions.

**Methods.** The multiphase systems consisted in deionized water-air-biomass (0.5 $g \cdot L^{-1}$), deionized water-air, and mineral media-air [2], at 1 vvm of air and 400 rpm (0.27 $W \cdot L^{-1}$). The multiphase dispersion was analyzed in a stirred tank, 6.5 L of working volume, with a Rushton turbine (D/T=0.33), and the power drawn was determined using a dynamometer [2]. The zone analyzed was nearby the tank wall, between two baffles. It was used the commercial *in situ probe* image analysis system *EnviroCam*$^{TM}$ (Enviroptics, Colmar, PA, USA). The bubble Sauter diameter of 550 objects and the local gas fraction were analyzed with the *EnviroCam*$^{TM}$ software.

**Results.** It was possible to measure the Sauter mean diameter and the local gas fraction (in the case with two phases). The results obtained were compared with those reported by other authors [3,4] and that predicted with the following equation [5] (Table 1):

$$d_{32}/D = 8.5\left(1 + 32.5\, Q/D^2\right)\left(P_g/V\right)^{-0.24}$$

The *EnviroCam*$^{TM}$ system allowed to measure air bubbles with diameters as small as 30 µm, as compared with 80 µm reported by Laakkonen *et al.* [3] in a conventional image system. This fact changes consequently the bubbles size distribution and therefore the mean Sauter diameter.

The illumination of the *EnviroCam*$^{TM}$ system allowed to obtain images with 0.5 $g \cdot L^{-1}$ of biomass (Fig. 1), a condition under which it is possible to clearly distinguish each dispersed phase for further analysis.

**Table 1.** Bubble Sauter diameter ($d_{32}$, µm) and local gas fraction (vol %), for an air-water dispersion.

| | Bubble $d_{32}$ (µm) | Gas (vol %) |
|---|---|---|
| This work (0.27 $W \cdot L^{-1}$) | 226±29 | 19±1.4 |
| Predicted [5] | 266 | - |
| Falcón-Rojas [4] (0.25 $W \cdot L^{-1}$) | 180 | - |

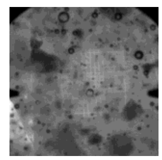

**Fig. 1.** Image captured with the *EnviroCam*$^{TM}$ using a three phases system (deionized water-air-biomass). In the image, a Neubauer chamber was placed in the background.

**Conclusions.** The improved illumination method of the *EnviroCam*$^{TM}$, together with the high resolution (1024x1024 pixels) and the high acquisition rate (100 frames per second) allowed acquiring images of a three phases system. The phases were clearly distinguished, facilitating further analysis. Preliminary data of Sauter diameter were compared with previous data as well as with the valued predicted by a well accepted correlation, showing good agreement.

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