

Understanding multiphase dispersions occurring in bioprocesses

Enrique Galindo, Gabriel Corkidi, Alfonso Rojas, María Soledad Córdova-Aguilar, Axel Falcón Instituto de Biotecnología, Universidad Nacional Autónoma de México Apdo

Abstract

Industrial fermentation processes involve the mixing of multiple phases (solid, liquid, gaseous), where the interfacial area determines the performance of the process. Hence dispersion is a critical issue as it determines mass transfer efficiency and homogeneity. Image analysis techniques are valuable tools that provide insights of interesting hydrodynamic phenomena occurring in multiphase systems. Our research group selected the γ -Decalactone (peach-like aroma) production by *Trichoderma harzianum* as a model for the microscopic analysis of complex multiphase dispersions. We have developed advanced image-analysis techniques, including, more recently, high-speed video camera in order to record the dispersion occurring in a mixing tank and in an actual microbial culture. These techniques have allowed us not only measuring the sizes of the bubbles and drops generated in the model process, but also to record and measure the speed and trajectories of the moving objects as well as the observation of the phase interactions resulting in complex structures (e.g. inclusion of air bubbles and aqueous droplets inside oil drops), phenomena not evidenced with studies focused only on the hydrodynamics or not using the high speed visualization techniques. New approaches have been developed to enlighten the mechanisms involved in the inclusion of air bubbles and aqueous droplets inside oil drops and currently, the developed system has been extended by using high-speed wide-field endoscopy in an actual fermentation process and video tracking to acquire sequences of images at different zones of a mixing tank to visualize and characterize the events occurring in multiphase dispersions in order to obtain a deeper and mechanistic understanding of the complex phenomena determining mass transfer.