PreSens
PRECISION SENSING

Scientific Paper:

Biotechnical Engineering Journal 105 (2016) 379 - 390

Shaken flasks by resonant acoustic mixing versus orbital mixing: Mass transfer coefficient k_La characterization and Escherichia coli cultures comparison

Greta I. Reynoso-Cereceda, Ramses I. Garcia-Cabrera, Norma A. Valdez-Cruz, Mauricio A. Trujillo-Roldán

Departmento de Biología Molecular y Biotecnología, Instiuto de Investigaciones Biomédicas, Universidad Nacional Autónoma de México

Abstract:

Shaken flasks are widely applied in bioprocesses due to their flexibility and ease of operation. Resonant acoustic mixing (RAM) enables non-contact mixing by the application of low frequency acoustic energy, and is proposed as an alternative to solve oxygen limitations in orbital mixing (OM). The aim of this study is to experimentally determine empirical k_La correlations for RAM and compare it with OM by its measurement at different shaking frequencies, nominal flask volumes, and filling volumes. The maximum k_La here obtained were 131.3 ± 5.1 h^{-1} for OM and 435.4 ± 11.7 h^{-1} for RAM. Empirical correlations were validated for k_La as a function of shaking frequency and superficial area/filling volume ratio and rendered adequate values for the adjusted R^2 with an accuracy of ±30%. Further, we compared the *Escherichia coli* kinetics of growth, glucose uptake, dissolved oxygen tension (DOT), and organic acids production in RAM and OM at two equivalent initial kLa. Similar *E. coli* kinetics were observed at an initial k_La of 46 h^{-1}, but not at 92 h^{-1} where differences in DOT and culture parameters were found, mainly in growth rate and biomass yield on glucose, which is the result of different oxygen transfer rates due to the increased gas pressures in RAM.

Keywords: mixing, dissolved oxygen, mass transfer, microbial growth, resonant acoustic mixer, shaken flasks