IMPROVING BIOREACTOR DESIGN THROUGH PH MAPPING OF BIOREACTORS EMPLOYING COMPUTATIONAL FLUID DYNAMICS COUPLED WITH EQUILIBRIUM CALCULATIONS

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Computational Fluid Dynamics has proven to be a very valuable tool in predicting spatial heterogeneities in mixing systems and other vessels used in bioprocess operations. These calculations are performed by typically obtaining steady state velocity profiles and subsequently using tracer type of studies to understand mixing times and heterogeneities. Bioreactor operations involve semi-continuous addition of base of different types of relatively high concentrations and the rate of addition varies constantly as the cell culture process progresses. These additions cause the local pH profiles to be different from the bulk, given the heterogeneities in mixing as well as the position and rate of base addition.

In this modeling and simulation study, CFD simulations of a bioreactor will be coupled with equilibrium calculations to predict pH profiles in bioreactors. Impact of addition point, agitation rates, impeller position as well as type and concentration of base used will be presented. Transient simulations assessing the impact of semi-continuous and bolus feeds will be assessed.

Overall, this study provides the next level of understanding and control of bioreactor processes, with the potential to improve the processes as well as potentially improve product quality.