Improved Hydrodynamic Characteristics for Bioreactors Using Various Designs of Curved Blade Impeller

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Abstract

Studies have proven that six curved blade impeller (6CB) can be retrofitted with 6RT in bioreactors without major modification to vessel, motor and agitation assembly to obtain superior gas holdup and solid suspension for the same power input. However, in most of these works, impeller with six semicircle blades are commonly used. The effect of number of blades (four, eight and twelve) on solid suspension and gas holdup characteristics are not comprehensively concluded. In this work the effect of number of blades on gas holdup and solid suspension in a stirred bioreactor is assessed. Gas holdup was measured by measuring level rise of the medium and solid suspension was determined visually as just suspended speed, \( N_{ss} \). Curved blade impellers with higher number of blades found to achieve the complete suspension level at relatively lower agitation speed where it reduces destruction of microorganism in bioreactors. As for gas hold-up characteristic, relatively better performance can be obtained by using 12CB at lower solid content and lower gas rates. For high solid content and gas rates, 8CB and 12 CB can be considered.

1 Introduction

Six Bladed Rushton Turbine (6RT) is commonly used for suspending the solid mass and dispersing the gaseous phase in bioreactors. However many studies have proven that 6RT may not be able to perform optimally for both dispersion and suspension function at high solid and gas rates due to creation of large cavities behind the impeller blades. Creation of these cavities causes significant power drop which may results in reduced hydrodynamic performance with regard to gas hold-up and solid suspension. This can be improved by modifying the flat into semi-circle shape blades. The modified version is preferred choice in new stirred vessels for dispersion and suspension applications and retrofitting it in the place of Rushton Turbine. However the curve blade studied in most cases were six semi-circular blade impellers where the size of the central disc is \( \frac{3}{4} \) of the impeller diameter and the length of the blade is one fourth of the diameter. To date the effect of other number of blades (four, eight and twelve) on solid suspension and gas hold-up are not comprehensively concluded. This forms the justification for this work. In this work the effect of number of blades is assessed for gas hold-up and degree of suspension in a simulated bioreactor.

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