BIOETHANOL AND SUGARS FROM LIGNOCELLULOSIC BIOMASS

Optimization of the mixing system geometry and of the fed-batch strategy to increase glucose concentration from wheat straw

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ABSTRACT

In order to be economic advantageous, it is necessary that the ethanol concentration must be at least of 4% *v/v* in the reaction medium at the end of fermentation. This requires a minimal concentration of 15% *w/w* of Dry Matter (DM) during the hydrolysis phase. Working at high values of lignocellulosic DM, as wheat straw (WS), increases the reaction medium viscosity, making the mixing inefficient with the traditional agitators used in process industry. The aim of this work is the improvement of the fluid-dynamic performances of the 20% *w/w* WS reaction medium during the enzymatic hydrolysis. Batch and fed-batch tests were conducted at different concentration of enzymes a in a 3L reactor using different impellers: i) inclined blades, ii) single and iii) double helicoidal impeller, iv) anchor and v) marine impeller. The tests were evaluated through three parameters: i) the mixing time, indicator of the mixing efficiency, ii) the energy consumption for mixing and iii) the conversion of cellulose into glucose. Inclined blades appeared as inadequate device for batch and fed-batch tests. As for helicoidal impellers and anchor, they resulted in optimal performances (short mixing times and high glucose yields). However, because of their structural instability and great energy consumption these last mixing systems are not considered as ideal for pilot and industrial scales. A particular fed-batch mode for WS addition, with a higher enzymes concentration and time of residence, allowed to keep low the reaction medium viscosity, to adopt inclined blades and marine impeller for the mixing and to have very good performance of the hydrolysis phase.