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**HYDROLYSIS OF CONCENTRATED LIGNOCELLULOSE SUSPENSIONS WITH A CUMULATIVE FEEDING STRATEGY
BASED ON A CRITICAL CONCENTRATION: FROM LABORATORY TO PILOT SCALE**

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Abstract:

In the context of biofuels and chemical production of petroleum substitutes from renewable carbon, bioconversion of lignocellulose biomasses is currently a major challenge. The limited knowledge of liquefaction and saccharification mechanisms stands as the main factor which penalizes bio-refinery progress. The objective of the present work was to increase the substrate concentration during hydrolysis in controlling transfer limitations by a specific strategy of substrate feeding. This concept was studied at laboratory scale and transposed into pilot scale. In-situ and ex-situ rheometry, morpho-granulometry and biochemical measurements were used to investigate transfer limitations. In a preliminary step (lab scale), rheological behaviour was modelled and a critical concentration (C_{crit}) inducing a sharp increase of viscosity was identified for Whatman paper (WP, 35 gdm.L-1) and paper pulp (PP, 31 gdm.L-1) [1]. Analysing hydrolysis experiments leads to assume an optimal feed rate Q^* linked to this critical concentration. In a first step, cumulative feeding strategies (up to 10%w/w) were conducted for WP and PP in 2L reactor with different ratios Q/Q^* . A cumulative feeding substrate strategy allows to considerably reduce the transfer limitations linked to high concentrations and to control the glucose production kinetics [2]. In the second step, the enzymatic hydrolysis (up to 20%w/w) was investigated in a 20L reactor coupled with an extruder (substrate feeding). This transposition will be discussed regarding the biochemical kinetics and physical limitations.

Reference 1: 1. Nguyen, t.C., et al., in situ rheometry of concentrated cellulose fibre suspensions and relationships with enzymatic hydrolysis. *Biorenewable technology*, 2013. 133(0): p. 563-572.

Reference 2 : 2. Nguyen, T.C., In-situ and ex-situ multi-scale physical metrologies to investigate the destructuration mechanism of lignocellulosic matrices and release kinetics of fermentable cellulosic carbon, in *Institut National des Sciences Appliquées de Toulouse 2014*, Université de Toulouse. p. 190.

Reference 3 :

Reference 4 :

Highlight 1: Increase the substrate concentration during hydrolysis in controlling transfer limitations

Highlight 2: Studie at laboratory scale and transpose into pilot scale

Highlight 3: A cumulative feeding substrate strategy allows to control the glucose production kinetics