



HAL
open science

Hydrolysis of high concentration lignocellulose suspensions with a cumulative feeding strategy: rheometry and morphogranulometry

Tien-Cuong Nguyen, Dominique Anne-Archard, Véronique Coma, Xavier Cameleyre, Eric Lombard, Kim Anh To, Tuan Le, Luc Fillaudeau

► To cite this version:

Tien-Cuong Nguyen, Dominique Anne-Archard, Véronique Coma, Xavier Cameleyre, Eric Lombard, et al.. Hydrolysis of high concentration lignocellulose suspensions with a cumulative feeding strategy: rheometry and morphogranulometry. 10. European Symposium on Biochemical Engineering Sciences (ESBES), Sep 2014, Lille, France. hal-01886482

HAL Id: hal-01886482

<https://hal.science/hal-01886482v1>

Submitted on 5 Jun 2020

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

Hydrolysis of high concentration lignocellulose suspensions with a cumulative feeding strategy: rheometry and morpho-granulometry

T.C. Nguyen^{(1)*}, D. Anne-Archard⁽²⁾, V. Coma⁽³⁾, X. Cameleyre⁽¹⁾, E. Lombard⁽¹⁾, K.A. To⁽⁴⁾, T. Le⁽¹⁻⁴⁾ and L. Fillaudeau⁽¹⁾

⁽¹⁾ Lab. Ingénierie des Systèmes Biologiques et des Procédés (LISBP), Université de Toulouse, CNRS, INRA, INSA, 135 avenue de Rangueil 31400 Toulouse, FRANCE

⁽²⁾ Université de Toulouse ; INPT, UPS, CNRS ; IMFT (Institut de Mécanique des Fluides de Toulouse), Allée Camille Soula, 31400 Toulouse, FRANCE.

⁽³⁾ Laboratoire de Chimie des Polymères Organiques (LCPO), UMR 5629 CNRS/Université Bordeaux 1, IPB/ENSCP, Pessac, FRANCE

⁽⁴⁾ School of Biotechnology and Food Technology, Hanoi University of Science and Technology, Hanoi, VIET-NAM

*Corresponding author: tien-cuong.nguyen@insa-toulouse.fr

Abstract

Bioconversion of lignocelluloses is currently a major challenge if biorefining operations are to become commonplace. The objectives of the present work were to understand and describe the evolution of physical properties of lignocellulose suspensions during enzyme-based hydrolysis reaction. Experimental set-up and methodology were developed in order to carry out a multiscale study of the lignocellulosic materials under high dry content. In-situ and ex-situ rheometry and morpho-granulometry measurements were used to investigate transfer limitations (Fig. 1). Rheological behaviour was modelled and critical concentrations (C_{crit}) inducing a sharp increase of viscosity were identified with Whatman paper (WP, 35 gdm/L) and paper pulp (PP, 31 gdm/L) [1]. In a first step, hydrolysis experiments demonstrate that single dimensionless viscosity-time curves, $\mu^*=f(t^*)$, could be established for each substrates. Analysing hydrolysis experiments lead to assume an optimal feed rate Q^* linked to the critical concentration. In a second step, cumulative feeding strategies (up to 10%w/w) were conducted for WP and PP with different ratios Q/Q^* . Results report the evolution of viscosity, hydrolysis rate (Fig. 2) and mean particle size. Mixing power during suspension and hydrolysis steps are discussed as a function of hydrolysis rates.

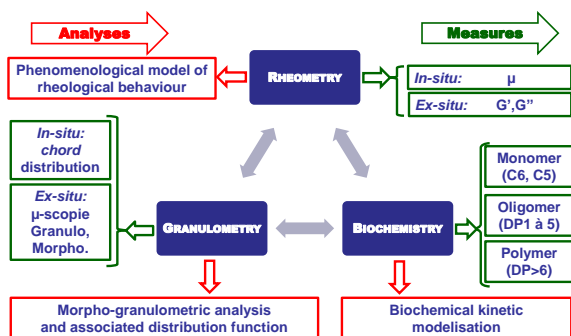


Fig.1: Experimental methodology and strategy

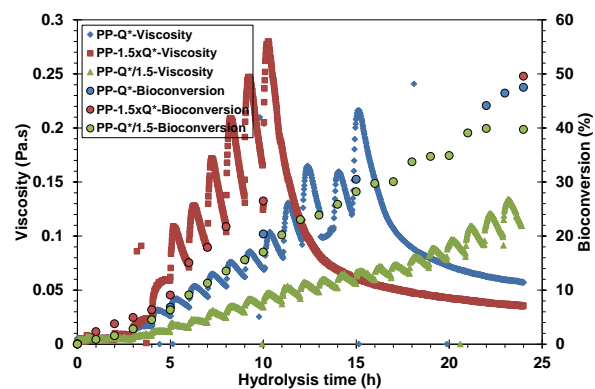


Fig.2: Viscosity and bioconversion rate as a function of hydrolysis time (PP) - Experimental conditions: $1\% \leq [\text{dry matter}] \leq 10\% \text{w/w}$, $T=40^\circ\text{C}$, $\text{pH}=4.8$, Accelerase 1500 (Genencor) 0.5mL/g cellulose -

[1] Nguyen, T.-C., et al., Bioresource Technology, 2013, 133(0), 563-572.

Key-words: hydrolysis, lignocellulose, viscosity, particle size, bioconversion.