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PRODUCTION OF FERMENTESCIBLE SUGAR FROM PAPER-PULP: LOOKING FOR A DYNAMIC AND MULTISCALE INTEGRATED MODELS BASED ON PHYSICAL PARAMETERS

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In order to achieve economic viability, the biorefining of lignocellulosic resources must be operated at very high feedstock dry matter content. The paper pulp product is rather appropriate for modern biorefining, because it displays low lignin content, is free of inhibitory compounds that can perturb fermentations and is devoid of microbial contaminants. Nevertheless the enzyme liquefaction and saccharification of paper-like pulps are subject to the same constraints as other pulps obtained via alternative methods such as steam explosion or dilute acid hydrolysis. Therefore, the better scientific understanding and ultimately the technical mastering of these critical biocatalytic reactions, which involve complex matrices at high solids content, is currently a major challenge that must be met in order to facilitate the intensification of biorefining operations.

Our aim is to investigate dynamic of transfer phenomena and limitation of biocatalytic reactions with lignocelluloses resources under high concentration conditions. Our action focuses on the identification of rate limiting steps of the liquefactions mechanisms by physical and biochemical characterization of pre-treated lignocellulosic resources at a macroscopic scale (power consumption, rheology), microscopic scale (particle size, morphology) and molecular scale (chemical analysis).

Firstly, based on real and model matrices and using Metzner & Reed concept, non-Newtonian rheological behaviour of fiber suspensions are described by a structured rheological model including parameters such as concentration, size and shape.

Secondly, the complex relationships between fibre structure, degradation, chemical composition and rheological behaviour is investigated. To this end, physical and biochemical on-line and off-line analyses will be conducted during bioreaction with a specific and fully instrumented bioprocess. Relation between apparent viscosity change and biocatalytic degradation of fiber may then be discussed.

Key-words: cellulose, fibers, enzymatic attack, liquefaction