Development of an on-line state estimator for fed-batch filamentous fungal fermentations - DTU Orbit (08/11/2017)

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Bioprocesses can be challenging to model due to complex and non-linear process dynamics [1]. In addition there is a lack of robust, on-line sensors for key parameters of interest in the field, such as substrate, product and biomass concentration [2]. These factors lead to limitations in the ability to monitor and control bioprocess systems. There is therefore an interest in state estimation, in order to model these key process states based on available on-line measurements [1].

This work discusses the application of a first principle model to pilot scale filamentous fungal fermentation systems operated at Novozymes A/S. The model comprises of an online parameter estimation block, coupled to a physical model of the system. The parameter estimation block utilizes on-line off gas measurements and ammonia addition in order to model changing reaction rates in the system. Based on a global process stoichiometry, the current rates of product and biomass formation are identified [3]. This parameter estimate is then used as an input to a dynamic physical process model, which describes the mass transfer capabilities of the system based on the operating conditions, including stirrer speed, aeration rate and headspace pressure [4], [5].

This stoichiometric-based coupled process model is successfully applied on-line as a state estimator in order to predict the biomass and product concentration, from robust, available on-line measurements. Such state estimators will be valuable as part of control strategy development for on-line process control and optimization.

General information

State: Published

Organisations: Department of Chemical and Biochemical Engineering, CAPEC-PROCESS, Novozymes A/S

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Number of pages: 1

Publication date: 2015

Event: Abstract from Recent Advances in Fermentation Technology 2015, Clearwater Beach, United States.

Main Research Area: Technical/natural sciences

Fermentation, Modelling, Process Optimization, State estimation

Electronic versions:

RAFT_abstract.docx

Source: PublicationPreSubmission

Source-ID: 118184554

Publication: Research - peer-review › Conference abstract for conference – Annual report year: 2015