Model-Based Monitoring of an Industrial Batch Pectin Extraction

André Fernandes Caroço, Ricardo; Santacoloma, Paloma A.; Abildskov, Jens; Huusom, Jakob Kjøbsted

Publication date:
2016

Document Version
Publisher's PDF, also known as Version of record

Link back to DTU Orbit

Citation (APA):

General rights
Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the URL identifying the publication in the public portal

If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.
1. Pectin Extraction Process

Extraction by acidic hydrolysis from peels of citrus fruits

- Batch operation with several tanks
- The pectin quality can be characterized by intrinsic viscosity (IV) and degree of esterification (%DE)
- Process conditions (Temperature and pH) and proportions of peel/solvent vary within a limited range which is known to result in a desired particular KPI profile

Key Performance Indicators:
- IV
- %DE
- \( C_{\text{pectin,bulk}} \)

2. Objective and Motivation

From recipe-driven to a model-based approach

Lean and robust operation

Waste \( \uparrow \)
Time \( \uparrow \)
Capacity \( \uparrow \)
Product Quality \( \uparrow \)

Knowledge-based decisions to reach target KPI’s

Development of monitoring strategy scheme

3. Dynamic Modelling

First principle model describing the nonlinear process in respect to the KPI

- Prediction of the desired KPI
- Flexible applicability over a wide operational range of T & pH
- Central role in model-based approaches
  - Process understanding
  - Troubleshooting
  - Monitoring
  - Continuous process optimization

Development based on fundamental physical phenomena and a parameter training set: ●Pilot scale ●T vs pH DoE ●one peel type

4. Identified Problems

- Lack flexibility for different peels
- Cross-scale application issues

Parameters that are inherently different from peel-to-peel are fixed or estimated for the training peel: Unaccounted uncertainty propagating into the output uncertainty

Sensitive parameters estimated at a different scale of application:
- Model alteration
- Re-tuning of parameters
- Hybrid approaches

5. Monitoring Strategy

Flexible model scheme that copes with raw material discrepancies by providing better initialization parameters for each different peel that arrives at the process line

Combination of state-of-the-art state estimation algorithms together with chemometric techniques to provide the process operators with a decision making tool for process optimization

6. References