Model-Based Monitoring of an Industrial Batch Pectin Extraction

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Citation (APA):
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

2. Objective and Motivation
From recipe-driven to a model-based approach

- Waste
- Time
- Capacity
- Product Quality

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

Preliminary exploratory analysis of historical dataset includes 3530 peels from a 10 year period (05-15)

Unaccounted uncertainty propagating into the output uncertainty

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

Key Performance Indicators:
- IV
- %DE
- $C_{pectin,bulk}$

Parameters that are inherently different from peel-to-peel are fixed or estimated for the training peel

Cross-scale application issues

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

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