Propositions (Stellingen)

by Daniel Gaida, author of

Dynamic Real-Time Substrate Feed Optimization of Anaerobic Co-Digestion Plants

1. Optimization of biogas plant operation has a multi-objective nature. It encompasses economical, ecological and stability criteria. [This thesis]
2. Given constant substrate parameters it is possible to estimate the state of the Anaerobic Digestion Model No. 1 (ADM1) using time series of the volumetric flow rates of the substrates as well as time series of biogas production, biogas quality and the pH values inside the digesters. [This thesis]
3. Multi-objective Nonlinear Model Predictive Control (NMPC) of biogas plants is only an improvement compared with single-objective NMPC if the weights in the weighted sum of the objective values are selected after the Pareto optimal set is obtained and not beforehand. [This thesis]
4. In the year 2014 feed control of full-scale biogas plants is still performed by rule of thumb or simple calculation. Closed-loop control is only common at lab- and pilot-scale. [This thesis]
5. Calibration of the Anaerobic Digestion Model No. 1 (ADM1) at a full-scale biogas plant is only possible with a very high uncertainty in the model parameters. [This thesis]
6. As biogas plants are nonlinear and very slow systems dynamic real-time feed optimization using a complex and nonlinear process model is a valid approach to optimize their operation.
7. Adding scientifically sound equations to a process model increases the prediction capacities of the model although the uncertainty in the model parameters increases.
8. Closed-loop feed control lacks on full-scale co-digestion plants because of missing instrumentation and a lack of practically applicable control approaches.
9. There is no such thing as environmentally friendly energy production, only renewable energy production. Renewable energies also have their environmental burden.
10. Residues are a valuable resource and not waste.
11. It is better to decrease energy consumption than to increase renewable energy production.
12. Optimal operation of biogas plants is crucial to justify their use for sustainable energy production.
13. Life is a multi-objective optimization problem, without knowing the objectives.