Model-based optimization of sustainable protein isolation processes

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Project Description

Rapeseed is an oil seed crop that is produced as a commodity in Europe. As a waste stream from the main oil production process, rapeseed meal still contains 30 – 40% protein. To recover valuable proteins from rapeseed meal aqueous extraction followed by multiple separation units and multistage ultrafiltration/diafiltration is used. The standard design of such an isolation process requires a large amount of water during the aqueous extraction and diafiltration. Attempts to make the process circular can be done by reusing the water or reducing the required diafiltrate by means of recycle streams. While such a design can significantly reduce the water requirement, it may affect the product characteristics (e.g. purity, productivity). In order to solve such problem, an efficient optimization tool is needed.

In this project process optimization will be performed based on a mathematical model fed with experimental data. The model is developed individually for each unit operation using a mechanistic approach and integrated for the whole process. Using this model, an optimization problem is then formulated as a non-linear programming (NLP) or a mixed-integer non-linear programming (MINLP) with a superstructure. The superstructure represents all alternative designs including the standard one [1]. The use of mechanistic models for an integrated process may lead to a complex overall model that is computationally expensive. To aid the computational process, a hybrid scheme using simpler surrogate models (e.g. neural networks) [2] will be investigate. This optimization tool is then applied to a real industrial case study for canola protein isolation process.

References

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