**Assessment M.Sc. thesis Rebecca Gullberg**

Rebecca Gullberg conducted her M.Sc. thesis in the research group “Process Systems Engineering” under supervision of Prof. Dr. Sigurd Skogestad, Julian Straus M.Sc. ETH (until early March), and Dr. Vidar Alstad (Yara ASA). Her thesis “Controllability Analysis of Ammonia Synthesis Loops” investigated the controllability and dynamic behavior of small-scale ammonia synthesis loops. Based on a sensitivity analysis of said loops, she proposed several control structures for achieving a fast change of the ammonia production rate. I was only involved in the initial programming stage (January and February), but had irregular meetings in the later stage of her thesis. Hence, this assessment will focus on the first two months.

**Planning and Structuring**

Rebecca approached the problem structured. She started her thesis with developing a thorough Gantt chart for the different tasks within the project. She was in the first months able to achieve the planned outcome. As I was not involved in the latter stages, I cannot say if this persisted. She started writing timely and was able to finalize the thesis in the planned timeframe.

**Work attitude and independence**

There were weekly meetings with the supervisors to discuss the achieved results and plan further research questions. Aside from the meetings, I helped her with getting started with the symbolic programming framework CasADi and introduced her to an efficient way of modelling flexible flowsheets. Overall, Rebecca was working very independently on her project. Hence, the work presented in the thesis is an independent work. She showed dedication to the research questions and interest in the challenging topic of developing a control structure which allows a faster change in the production rate while satisfying stability.

**Research creativity**

As I was only involved in the first stage, I cannot say a lot about the development of the different control structures and the investigation of the dynamic behavior of the loop. The first stage only included the development of models based on simple first-principle models. The development of the control structures and the investigation of the limit-cycle behavior shows however research creativity.

**Programming**

The used modelling language was MATLAB with a CasADi interface. She applied principles for modular modelling I developed previously. She programmed all models in a structured way. She did not use any provided code for her model, but used it instead for inspiration on how to write her own code. I personally think that Rebecca is a skilled modeler, who learned a new approach to modelling in a short time frame. Her code is well documented and the experienced reader is able to follow, apply, and modify the presented code. This is in my opinion an important aspect as it allows the verification of the results presented in the thesis.

**Conclusion**

I think that Rebecca did a good job in her master thesis. She came up with new ideas how we can control the ammonia synthesis loop for changing production rates. Her research work is interesting for future developments of ammonia synthesis loops.

Julian Straus M.Sc. ETH