Suggested project and master thesis topics at Frövi/Rockhammar

Introduction

Frövi/Rockhammar (a part of Billerudkorsnäs) comprises a pulp and paper mill producing cartonboard and liquid packaging board. At the plant there are several topics suitable for a specialization project, which can be continued into a master thesis. The supervisor from Frövi/Rockhammar will be Andreas B. Volden. The topics range from process modeling and simulation studies to more hands-on projects. Nevertheless, the topics will either way comprise some degree of analytic work using e.g. MATLAB. It will also be applicable to get acquainted in more specialized software for modeling, MPC development, control systems and such. The initial idea for most of the projects is to focus on modeling during the project and partly during the thesis, and for the latter part focusing on control and optimization. Below pages provide some initial information on suggested projects. For interested students, further information is available from Andreas by email\(^1\). A mill visit at a suitable time will also be applicable.

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Project 1: modeling and MPC development for TCF bleaching of chemical pulp

Bleaching of pulp is necessary to lower residual lignin content and to increase the end brightness. At Frövi, the bleaching plant comprises a TCF (totally chlorine free) bleaching sequence consisting of four stages. At each stage a number of parameters play a vital role, for instance chemical dosing and retention time. The process is dead-time dominating and multivariable, emphasizing the need for MPC. The aim for the project will be to gain process knowledge and eventually model the process, and further - if time allows - to continue on MPC development based on an existing application and findings in the project.

Project 2: Optimal control of a white water system

Rockhammar is a chemi-thermomechanical pulp (CTMP) mill. White water from the process originates from a number of sub-processes. It’s a sidestream along the process and necessary for the mill to run. The white water system serves unit operations throughout the mill, but is also used to balance the mill in total. Hence, the function of the system is important, and especially during disturbances and shutdown/start-up. The task will be to identify bottlenecks and workarounds on current system, but also to investigate opportunities for further improvements. This could for instance be: new control strategies, improving current control structure and so on. A model of the system would indeed be of interest for aid in this work.

Project 3: Evaluating a steam network in search for improved performance

Steam production at Rockhammar comprises two systems: a steam boiler and heat recovery by using reboilers. The steam producers may vary, and additionally steam demand may abruptly change due to process variations. This cause disturbances over the network and decrease steam reliability. The main objective of this project is to investigate steam network dynamics for
modeling purposes, and to evaluate today’s operation of the network. Further, an analysis of the control loops involved and alternative solutions is of significant interest.

**Project 4: Wood chips treatment and level control**

Prior to pulping, the wood logs are cut into chips. The chips are then fed into the process, which prior to pulping, consists of several pretreatment steps. These steps have two major purposes: increase chip temperature as much as possible and treatment with chemicals to lay a best possible foundation for high quality and even pulping. For a successful pretreatment the keywords are retention time and tight level control. This task will investigate how to attain tight level control of dead-time influenced control loops, and to simultaneously minimize chemical dosing.

**Project 5: Lime kiln modeling and optimization**

A part of the recovery cycle at chemical pulp mills include the lime cycle. Recovered lime mud from the recaustisizing process is burned to hot lime (or quick lime), where the hot lime is reused in preparation of white liquor. The conversion from lime mud to hot lime takes place in a rotary tube-oven (lime kiln) at temperatures ranging from 1250 to 600 °C. This projects aims to develop a model of the kiln, where the target eventually is to evaluate suitability of current control structure and an MPC solution for control. However, the MPC part is secondary in this work, as we will focus primarily on the modeling and existing control structure perspective.

**Project 6: Optimizing control of a black liquor evaporation train**

Black liquor from the chemical pulping process contains mostly water. To recover the pulping chemicals, which comprises the inorganic part of black liquor, the black liquor is incinerated in a recovery boiler at 75% dryness. To achieve this level of dryness, a large portion of water needs to be removed
from the black liquor in an evaporation train. The evaporation train consists of several evaporators (effects) and end thickeners, and the operation is a major steam consumer at the mill. To achieve operation closer to optimum presents multiple advantages, a vital part off course being able to lower steam consumption while maintaining throughput. This project focuses on control structure evaluation and moving towards more optimal control, i.e., reducing back-off while maintaining acceptable robustness.