

# Suggested project topics at Norske Skog Skogn

## Introduction

Norske Skog Skogn is a pulp and paper mill producing newspaper and improved newspaper grades. At the plant there are several topics<sup>1</sup> suitable for thesis work for which the supervisor from Skogn will be Andreas B. Volden<sup>2</sup>. Some topics comprise more analytical work using e.g. MATLAB/SIMULINK or similar (Octave and SciLab are preferred alternatives), while other topics are more PLC programming oriented or a combination of both above mentioned. Below page provide some initial knowledge on suggested projects. For interested students further information is available from Andreas by e-mail or for a plant visit particularly on the topics.

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<sup>1</sup>These are a selection of scope-defined projects - there exist suitable projects beyond the ones given here.

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## **Project 1: Steam boiler control, bottleneck identification and moving towards optimal operation**

The mill's primary boiler providing steam is a compact CFB (circulating fluidized bed). Today's boiler production is constrained below rated capacity. Main tasks of this project include identifying active (and potential active) constraints, revise control structure and control loops performance to identify production bottleneck(s). Parallel to assessing an increase of boiler performance, the candidates shall consider boiler emissions and aim to lower these. Initially, the candidates shall review literature on the boiler principle, preferably from similar applications of CFB boilers.

## **Project 2: Steam network dynamics, performance and control**

Steam production comprises two systems: steam boilers and heat recovery. The steam producers may vary, and additionally steam demand may abruptly change due to process variations. This causes disturbances over the network and decreases steam reliability. The network additionally comprises steam condition equipment, accumulators and safety devices. The main objective of this project is to investigate steam network dynamics by using mechanistic and empirical modelling. Further, an analysis of the control loops involved and their suitability is of significant interest and shall comprise a major part of the project together with measures to increase process performance.

## **Project 3: Optimizing control and operation of bark dewatering**

The dewatering of bark comprises batch-wise mechanical pressing. The pressing runs in sequence either by timers or by level measurement. It is advantageous to run all presses by level control. This is, due to lack of measurement, only possible for two of the four presses today. Additionally, the pressing does

not halt optimally. Essentially this project comprises ABB PLC programming and commissioning. Moreover, it requires a thorough study of today's program to fully understand all features, interlocks and potential risks. If time allows it, the program could be further developed to operate presses in obtaining a stable, continuous output downstream.

## **Project 4: Control loop diagnosis and performance assessment of a sludge dewatering process**

Dewatering sludge serves several purposes; recycling water, reducing sludge volume, and increase solids ratio prior to incineration. The dewatering process consists of two main steps, and additionally, water and chemicals are added to improve the dewatering process. The main issue will be to investigate control loop oscillations, and perform tests to verify and substantiate loop diagnosis. Further, the candidates should elaborate means to preferably eliminate oscillations and perform these in a safe and controlled manner. Additionally, the candidates shall investigate optimization of the dewatering process in terms of speed, torque, chemical dosing, and most important, dry matter content.

## **Project 5: Control loop analysis and improvement for an activated sludge effluent treatment plant**

The mill's effluent comprises process water, fibre residuals, rejected pulp and mass from the upstream processes, chemical excess, and cooling water discharges. Flow upstream the treatment plant is constantly varying and causing disturbances at the treatment plant inlet. The main task of this project will be to investigate how to increase process performance by means of rejecting disturbances upstream, and the governing goal would be to ensure operation within the licensed release to recipient. This includes investigations towards, but not limited to feed-forward modelling or pre-positioning, tight controller tuning and gain scheduling if applicable.

## **Project 6: Towards automatic control of boiler fuel silo level and upstream control loops**

Boiler silo is fed by pneumatic transport from the fuel handling process section. Automatic control of fuel silo level is available, but are not utilized by operators. The candidates shall obtain an understanding of today's preferred control scheme and identify why closed loop is not currently employed. The transport delay is significant and need to be addressed, and thus there are several applications relevant for this application, which need to be investigated; cascade control, pre-positioning, Smith-predictor and ordinary feedback loop. This promotes modelling of the system and a comparison of suitable control structure performances.

## **Project 7: Control loop diagnosis, disturbance identification and improved control of thermo-mechanical pulp production**

Pulp production is by far the plant's most energy demanding process. The main pulping process takes place in a rotating grinder, or refiner, and within the refiner steam, chemical additives, and energy are added. Currently, a research project on a control scheme based on internal variables<sup>3</sup> are ongoing. A necessary step of this project is to derive status quo of the current control scheme. Data sets have been collected during process variations and step response tests. The primary goals of this project will be to analyse the data sets to identify and locate disturbances, valve stiction, and poor performing control loops, and accordingly, address the issues identified taking relevant constraints into consideration.

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<sup>3</sup>Today's control structure is entirely based on traditional external variables. Internal variables are either measured or estimated using soft sensor consisting of a non-linear mechanistic model and a regression model.