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# Control stops sugar from clogging the pipes

More knowledge is favorable when it comes to syrup manufacturing

A popular science summary of the master's thesis *Modelling and Control of an Evaporation Process*, conducted at the Department of Automatic Control, Faculty of Engineering at Lund University.

The full report can be found at: <http://control.lth.se/Publications.html>

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**The more you know the more you can control. This is the result of a study on how Lantmännen Reppe AB in Växjö can get better control of their syrup manufacturing. By using more of the present sensors, as well as installing a new sensor, the sugar content in the syrup can be maintained at the desired level. The issue, which the company is facing, is that if the sugar content gets too high the syrup turns solid.**

Lantmännen Reppe AB has been producing syrup at their factory in Växjö since 1886. The production is divided into a number of different parts, of which the last part is the most energy consuming. In this part the syrup is boiled in order to remove water and raise the sugar content. To heat the syrup they use hot steam and when the water vaporizes it is removed. Left is the syrup with higher sugar content since the amount of water is reduced. The syrup entering this system usually has a sugar content at about 50 % and Lantmännen Reppe AB wants the resulting content to be about 80 %.

To get the desired sugar content the flow of steam to the production needs to be controlled. This is done by opening and closing a couple of valves. The production has sometimes had difficulties to keep the desired level of the sugar content. If the sugar content would rise to about 85 % the syrup turns solid and will have to be removed by hand. To remove the solid syrup is both time consuming and expensive. Lantmännen Reppe AB has been doing improvements in the factory as a part of their energy efficiency work and they wish to do further improvements.

Combine Control Systems AB in Lund is a consulting firm that works with model-based design and was contacted by Lantmännen Reppe AB in order to help them with their production. Model-based design is a method to build a simulation model of a system using computer software. The model consists of blocks, which make it visually easy to understand and compare to the real system. In a simulation model it is easier, cheaper and safer to make modifications than to try it out in the real factory. The consultation ended up in a master's thesis where the goal was to investigate how improvements can be made [Davidsson and Hedenberg, 2015].

In this master's thesis the process is modelled in the MathWorks software Simulink in order to gain understandings about how to regulate the sugar content. The model is founded on the fact that all syrup and steam that go into the process also have to come out in the end. To model a system often requires approximations. In this case it is assumed that as much water is vaporized as there is steam entering the system. Neither temperature nor pressure is part of the model. To get similar behavior as the real process the model includes several parameters to adjust its behavior. Comparisons between model simulations and real process data have proven that the model captures the fundamental behaviors of the process.

When boiling the syrup it has to pass through a number of different parts before leaving the system. At the factory it is only measured what enters and what exits the system, creating a black box of unknown properties. In order to peek inside this black box a new sensor is required. The results confirm this theory. Adding a sensor provides information about what is going on inside the black box and this information can be used to improve the control of the sugar content. To install a new sensor will however lead to an investment. Both the capital cost of the sensor itself and the economic losses due to a stop in the production need to be considered.

It has also been clear that other sensors give advantages if used when controlling the sugar content. Especially the present one measuring the steam pressure is proven useful. A general conclusion of the work is that the more you know the more you can control. Even with fairly non-advanced techniques.

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## Reference

Davidsson, E. and H. Hedenberg (2015). *Modelling and Control of an Evaporation Process*. Master's Thesis ISRN LUTFD2/TFRT--5977--SE. Department of Automatic Control, Lund University, Sweden.