



VIPP VALUES CREATED IN
FIBRE-BASED PROCESSES
AND PRODUCTS

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SPRING MEETING AT STORA ENSO, SKOGHALL – AN INTERNATIONAL OUTLOOK WITH AN EYE FOR QUALITY

“Do good for the people and the planet” is the phrase expressing the values of Stora Enso – a multinational company with over 70 000 employees in 35 countries and host of the 2015 Spring meeting of Vipp Industrial Graduate School.

Stora Enso is one of the leading companies in the pulp and paper business, with renewable materials and packaging as identified growth markets.

– At Skoghall Mill and Forshaga there are around 800 employees focusing mainly on liquid packaging board. The carton you pour your milk or your juice from is very likely to come from our plant as we have 16 percent of the total world market, said Ingrid Engström, Manager at Process and Development.

The story goes back to the early 1900’s with Uddeholm Sulphite plant as the starting point towards the modern, environmental and highly competitive plant of today.

Although modern and astonishingly clean, the enormous machine KM7 from 1977 is still in use, more efficient than ever. Together with its neighbour KM8 from 1997, the plant produces around 700 000 tons cardboard per year.

By empowering the organization, working with performance management both as a team and as individual employees, Stora Enso continuously improve their efficiency and capacity to meet customer demand on a highly competitive market.

The theme for this year’s spring meeting was “To value Employees’ skills”. John Sandström of Akzo and a board member of Vipp industrial graduate school, spoke of the importance of recruiting and keeping qualified staff.

– Having employees with a doctoral degree can improve business development. There is something in the way doctoral studies are pursued, the way of thinking and analyzing, which is most valuable to industry. Furthermore, it gives us access to the latest research and a network that is difficult to gain if you’re unfamiliar with the academic world, said John Sandström.

Quality development of Vipp Industrial Graduate Scholl was also on the agenda, with several ideas and valuable input from among others Professor Anders Fundin, of Mälardalen University.

The Spring meeting was concluded with a much appreciated guided tour of Stora Enso Skoghall.



Photo: Sara Kvarforth, Stora Enso.

Ingrid Engström
Manager at Process and Development, Stora Enso.



Asif Javed
Doctoral student at Vipp, presented his project and progress.



Åsa Nyflött
Doctoral student at Vipp, presented her findings so far from her licentiate thesis



Daniel Ekbåge
Doctoral student at VIPP, presented his ongoing project



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LICENTIATE SEMINAR

INCREASING THE VALUE OF HOUSEHOLD APPLIANCES BY ADDING A HEAT PUMP SYSTEM

Historically, domestic tasks such as preparing food and washing and drying clothes and dishes were done by hand. In a modern home many of these chores are taken care of by machines such as washing machines, dishwashers and tumble dryers. When the first such machines came on the market customers were happy that they worked at all! Today, the costs of electricity and customers' environmental awareness are high, so features such as low electricity, water and detergent use strongly influence which household machine the customer will buy. One way to achieve lower electricity usage for the tumble dryer and the dishwasher is to add a heat pump system.

The function of a heat pump system is to extract heat from a lower temperature source (heat source) and reject it to a higher temperature sink (heat sink) at a higher temperature level. Heat pump systems have been used for a long time in refrigerators and freezers, and that industry has driven the development of small, high quality, low price heat pump components. The low price of good quality heat pump components, along with an increased willingness to pay extra for lower electricity usage and environmental impact, make it possible to introduce heat pump systems in other household products.

However, there is a high risk of failure with new features. A number of household manufacturers no longer exist because they introduced poorly implemented new features, which resulted in low quality and product performance. A manufacturer must predict whether the future value of a feature is high enough for the customer chain to pay for it. The challenge for the manufacturer is to develop and produce a

high-performance heat pump feature in a household product with high quality, predict future willingness to pay for it, and launch it at the right moment in order to succeed.

Tumble dryers with heat pump systems have been on the market since 2000. Paper I reports on the development of a transient simulation model of a commercial heat pump tumble dryer. The measured and simulated results were compared with good similarity. The influence of the size of the compressor and the condenser was investigated using the validated simulation model. The results from the simulation model show that increasing the cylinder volume of the compressor by 50% decreases the drying time by 14% without using more electricity.

Paper II is a concept study of adding a heat pump system to a dishwasher in order to decrease the total electricity usage. The dishwasher, dishware and water are heated by the condenser, and the evaporator absorbs the heat from a water tank. The majority of the heat transfer to the evaporator occurs when ice is generated in the water tank. An experimental setup and a transient simulation model of a heat pump dishwasher were developed. The simulation results show a 24% reduction in electricity use compared to a conventional dishwasher heated with an electric element. The simulation model was based on an experimental setup that was not optimised. During the study it became apparent that it is possible to decrease electricity usage even more with the next experimental setup.



Name:	Peder Bengtsson
Licentiate seminar:	4th of November 2014 at Karlstad University
Examiner:	Tomas Persson, tech dr Dalarna University
Examiner:	Professor Lars Nilsson, Chemical Engineering, Karlstad University
Main supervisor:	Jonas Berghel, senior lecturer, Energy and Environmental Systems, Karlstad University.



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LICENTIATE SEMINAR

STRUCTURAL STUDIES AND MODELLING OF OXYGEN TRANSPORT IN BARRIER MATERIALS FOR FOOD PACKAGING

The requirements of food packages are to ensure food safety and quality, to minimize spoilage, and to provide an easy way to store and handle food. To meet these demands for fibre-based food packages, barrier coatings are generally used to regulate the amount of gases entering a package, as some gases are detrimental to food quality. Oxygen, for example, initiates lipid oxidation in fatty foods. Bakery products may also be sensitive to oxygen.

This thesis focused on mass transport of oxygen in order to gain deeper knowledge in the performance of barrier coatings and to develop means to optimize the performance of barrier coatings. This experimental study along with computer modelling characterized the structure of barrier materials with respect to the mass transport process.



Name:	Åsa Nyflött
Licentiate seminar:	11th of December 2014 at Karlstad University
Examiner:	Associate professor Ulrica Edlund, Fiber- och polymertechnolog at Royal Institute of Technology
Examiner:	Professor Lars Järnström, Chemical Engineering at Karlstad University
Main supervisor:	Professor Magnus Lestelius, Chemical Engineering at Karlstad University



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LICENTIATE SEMINAR

ABSORPTION NON-UNIFORMITY CHARACTERISATION AND ITS IMPACT ON FLEXOGRAPHIC INK DISTRIBUTION OF COATED PACKAGING BOARDS

There are high demands on flexographic print quality to be sufficiently high and consistent in order to create a competitive packaging. At the same time the production efficiency need to be high. Printers thus need to achieve the same quality every time and quickly start-up new printing jobs. To accomplish this, one needs to gain a thorough understanding of how the liquid packaging board interacts with the ink and impacts the print quality.

This thesis focuses on water-based ink absorption of liquid packaging boards and particularly on a) how uniformity of ink absorption can be measured and b) to what extent the absorption characteristics contribute to print mottle in flexographic printing.

The work encompasses two parts. First, an absorption non-uniformity test method has been developed using a staining technique. This method is unique as it measures how unevenly an aqueous solution is absorbed, in a short time period and without impact from surface roughness. Moreover, the contributions from

white-top mottle and absorption non-uniformity can be quantified simultaneously from one single measurement.

Second, a method to independently study the effects of absorption non-uniformity on print quality has been established. This is achieved by introducing artificial absorption non-uniformities with well-controlled barrier patterns. A barrier pattern may modify local pore structure and/or surface energy, hence lead to lateral absorption variations. By these means, it is possible to produce a substrate property-matrix; encompassing absorption non-uniformity and for example surface roughness. It was demonstrated that non-uniform absorption indeed has a negative impact on print quality, both on smoother and rougher boards. Low absorption made print density decrease and uneven absorption caused print mottle. This was the case when other properties of the samples were kept within a narrow range; otherwise surface roughness appeared to determine print mottle ranking.



Name: **Sofia Thorman**
Licentiate seminar: **5th of March 2015 at Karlstad University**
Examiner: **Janet Preston, professor, Imerys Minerals Ltd, UK**
Examiner: **Professor Magnus Lestelius,
Chemical Engineering at Karlstad University**



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FENTON PRE-TREATMENT OF A BIRCH KRAFT PULP FOR MFC PREPARATION

The potential to use acidic hydrogen peroxide in the presence of ferrous ions (Fenton's reagent) as a pre-treatment when producing microfibrillar cellulose (MFC) from a bleached birch kraft pulp was investigated and the properties of the produced MFC was compared to the properties of a MFC produced with enzymatic pre-treatment. Additionally, the MFCs evaluated as strength enhancers in test sheets representing the middle ply of paperboard.

From the chemical characterisation, it was concluded that the Fenton pre-treatment caused a decrease in the degree of polymerisation (DP) and an increase in both carboxyl- and carbonyl groups. In

the subsequent mechanical treatment in a colloid mill, the Fenton pre-treated pulps were easier to process mechanically indicating a potential to lower the energy consumption.

When the MFCs were evaluated as strength enhancers in test sheets, Fenton pre-treated MFCs increased the strength properties more than the enzymatic pre-treated MFCs at a given mechanical treatment time. Addition of 5 wt% Fenton pre-treated MFC resulted in an increase in z-directional strength of about 50%, an increase in tensile stiffness index of about 25% and an increase in tensile index of 35% compared to test sheets prepared without MFC addition.



Name:	Pia Hellström
Licentiate seminar:	5th of February 2015 at Karlstad University.
Examiner:	Professor Monica Ek, Royal Institute of Technology, Division of Wood Chemistry and Pulp Technology
Examiner:	Professor Ulf Germgård, Chemical Engineering at Karlstad University
Main supervisor:	Senior lecturer Helena Håkansson, Chemical Engineering at Karlstad University



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OPEN SERVICE INNOVATIONS IN INDUSTRIAL NETWORKS



Photo: Maria Östlund

Per Myhrén

Open service innovation is a way to open up the New Service Development (NSD) process to external partners and knowledge. Several successful cases such as App Store and Amazon have been presented, but little is known about NSD's functioning. In addition, manufacturing firms use open innovation to infuse or defuse their technology, although it is rarely used for industrial services.

Today, innovations are needed in a faster pace, regardless line of business. New technologies decrease the product life cycles and therefore the time from idea to commercial product or service is crucial for commercial success. Resources to create new knowledge and skills within organizations, but also finding ways to create solutions in co-operation with others outside the company sphere. Like the Open source solutions within the ICT-area, Open Innovation can be a way forward. Vipp doctoral student Per Myhrén of Standard Solutions Group, SSG, has chosen to focus on an open service innovation network for his doctoral thesis. He is one of two doctoral students whose mentor is a researcher at Service Research Centre at Karlstad University.

Half way through, he has started to shed light on how manufacturing firms can meet the global challenges through servitization and how an open service innovation approach can be a way to open up the service development process to external partners and knowledge.

– Companies can no longer rely on internal knowledge to gain competitive advantage, due to an increase in labour mobility and knowledge being widely spread across public and private organizations. An open service innovation network can be a way to

gain access to new ideas and applications. I'm interested in how to organize for open service innovation in networks from idea generation to commercial services on the market, says doctoral student Per Myhrén.

A multiple case study of nine groups suggests that open service innovation can be used for incremental service innovation. Different types are used for incrementing and radical service innovations and a firm can use several open service innovation archetypes at the same time. Sometimes there is a great interest for sharing ideas and information. Ideas that may not be of use in one company can be picked up by another and adapted into a useful solution. Rules for the networks are firmly set in contracts between the participants. Certain things are not discussed, such as prices and business models for instance.

– A surprisingly large number of areas gain from the open solutions approach, for instance safety, working environment issues, certain technical problems where a common solution can set a standard. My next step is to try to further understand and describe the roles and functions of different actors in the different networks. Who takes part, what are their competences, how are the networking groups put together.

Per Myhrén is planning for his dissertation in June 2017. He held a seminar in March this year, where he presented his findings and ideas so far.



STANDARD SOLUTIONS GROUP



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CALENDAR

**LICENTIATE SEMINAR:
RAGHU DESHPANDE, DOMSJÖ/MORE
25TH OF SEPTEMBER 2015 AT 13.00
NYQUIST HALL 9C 203, KARLSTAD UNIVERSITY**

Planned licentiate seminars during 2015

Asif Javed, Karlstads universitet

Lisa Mattson, BillerudKorsnäs

Mattias From Aldaron, Stora Enso Skoghall

Pyyr Hämäläinen, Kemira AB

**COURSE
11–12 OF MAY 2015**

**ADDING VALUE THROUGH PROCESS TECHNOLOGY FOR PAPER
SURFACES- SURFACE TREATMENT AND PRINTING
1,5 ECTS CREDITS**

This course gives a short overview of coating and printing processes to be used to convert paper and paperboard to different end-use applications in packaging and printing. The market is driven by the consumers and trends in industry and society, at the same time as the converters require low cost raw materials and paper or board that can be converted without runnability problems.

Lecturers: Lars Järnström, Professor of Paper Coating Technology and Magnus Lestelius Professor of Graphic Technology.
Please register to carin.bergstrom-carlsson@kau.se

**AUTUMN MEETING
29–29 OF SEPTEMBER 2015**