



## How is Royal Warship Vasa faring?

Page 8



# Full speed ahead for new biofuels

Clean Technology has become a concept that has gained a bigger foothold all around the world. The hunt for new technologies, products and processes to replace fossil fuels and reduce the greenhouse effect is intensive. In no way is the forest industry a passive participant in this hunt.

“The forest industry is, by far, the one industrial branch that has the most experience and know-how for how to collect, handle and process large amounts of woody biomass,” says Niklas Berglin, a research scientist and Project Manager at STFI-Packforsk.

Developments have almost exploded in recent times. STFI-Packforsk is involved in a number of projects and, from a general point of view, there are many more potential projects that could come to fruition in the next few years. There are many parties who are interested, while access to risk capital has increased.

“The big thing just now in the USA is that the production of ethanol from cellulose has entered the demonstration stage,” says Niklas Berglin. He goes on to relate that The Department of Energy has allocated money for six pilot plants. Since the plants will be competing against each other, it is hoped to accelerate the commercialisation. Efforts are also underway in Sweden to scale up the ethanol pilot plant in Örnsköldsvik.

Biomass gasification will also begin on a bigger scale at a demonstration plant in Germany, which, to a certain extent, will be producing on a commercial scale,

due to its contract with Volkswagen. It is expected that there will be even more plants starting up within a few years. In Sweden, there are two pilot plants for biomass gasification that, in the long run, are aiming at motor fuel production, viz. black liquor gasification for producing DME (dimethyl ether) and methanol in Piteå and a plant for producing DME in Värnamo. There is also interest for such a plant in Värmland.

These new processes are suitable for operation in connection with pulp mills, but researchers have even played with the idea of producing an intermediate product that could be used in existing ethanol plants instead of grain, for example.

“This is where our expertise comes in handy. We possess the knowledge and know-how for separating compounds and taking care of all aspects of the integration of the processes,” Niklas Berglin emphasises.

## Nordic ethanol project

The beginning of 2007 witnessed the start of a new Nordic collaboration in the field of biofuels. The aim of the four year project is to develop new pre-treatment methods that will contribute to reducing production costs for ethanol coming from Nordic lignocellulose based biomass.

“In this context, wood is currently an inexpensive raw material, which is significant for commodity products such as ethanol. The pre-treatment of biomass is, however, a high cost stage in the process. So, if we can improve in the technology, it will contribute to considerably reduced costs for the production of ethanol as well as the other green chemicals from

cellulose,” says Karin Øyaas of PFI, the Project Manager. By developing technology for utilising low-grade lignocellulosic biomass (forest and agricultural residues, demolition wastes etc.), the cost-effectiveness of bioethanol production can be further improved.

According to Karin Øyaas, cellulose based ethanol, the so called second generation's ethanol, has a lot of advantages when compared to traditional ethanol production from grain or sugar cane, to give two examples. Since the raw material is taken from the forest, there is no competition for land devoted to food production. Cellulose based ethanol has proved that it has greater advantages, when it comes to climate reckoning.

The project is divided into three main areas. One deals with methods for extracting the cellulose and the hemicellulose from wood, another is aiming at simplifying the chemistry in species of sugar, while a third is concerned with the technique of the actual fermentation. Systems analysis also constitutes an important part of the project.

Karin Øyaas has seen flawed interest in bio fuels in the oil rich country of Norway. National and international taxes and regulations are forcing new solutions.

“Biofuels have gone from being a non-subject to a very hot one. This is something that the oil industry companies have comprehended and involved themselves in. For example, they are participating in several projects that we are running at PFI. The expertise they possess, when it comes to refining technology, quality demands, distribution and infrastructure is something that we can utilise in our work,” Karin Øyaas says in conclusion. ●

**CONTACT:** [niklas.berglin@stfi.se](mailto:niklas.berglin@stfi.se) and [karin.oyas@pfi.no](mailto:karin.oyas@pfi.no)



## Jakten på nya teknologier, produk-

ter och processer som kan ersätta fossila bränslen och dämpa växthuseffekten är intensiv. Skogsindustrin har fördelen av att ha både erfarenhet och kunskap om hur man hanterar stora mängder råvara. I USA har framställning av etanol från cellulosa har gått in i demostadiet och i Europa startas även demoanläggningar för biomas-saförgasning.

Ett nytt nordiskt projekt ska utveckla nya förbehandlingsmetoder som ska bidra till att reducera produktionskostnaderna för bioetanol från nordisk lignocellulosabaserad biomassa. Projektet är uppdelat i tre huvudområden; ett handlar om metoder för att utvinna cellulosan och hemicellulosan ur veden, ett annat syftar till att förenkla kemin i sockerarterna, ett tredje gäller tekniken för själva fermenteringen. Systemanalys utgör också en viktig del av projektet.

# Fortum Värme replaces coal with biofuel from LignoBoost

The LignoBoost demonstration plant at the Bäckhammar Mill has well and truly lived up to all expectations, while maintaining the planned production of 4,000 tonnes per year. Most of the lignin will be sold to Fortum Värme to be used as fuel at Värtaverket in north east Stockholm.

"We have an explicit aim in the company to reduce the emissions of greenhouse gases. The majority of the fuels we actually use today are renewable, but we are striving all the time to find new possibilities," says Eva-Katrin Lindman, the Development Manager at Fortum Värme.

The combined power and heating plant at Värtan is the only one of the company's plants using coal as a fuel. In the first half of 2007, trials began with mixing in lignin from Bäckhammar in its commercial production.

"The lignin behaves like coal and can be used in the existing plant without any need for large scale rebuilding. It's therefore been a very good replacement," comments Eva-Katrin Lindman, who continues to relate that Fortum has purchased lignin, equivalent to 2% of the mixture. By the summer stop, 250 tonnes had been used.

"When we started the trial in May, we started with a 2% mixture, calculated as energy. However, when production finished for the season in June, we were up to 7 to 8 percent. The burning of lignin has proved to work very well, without any negative effect. We believe in lignin as a fuel and would like to test how much can be mixed in. We're going to run trials in campaigns with larger doses."

To facilitate the handling of larger amounts of lignin, Fortum Värme is now investing in a pellet making unit that will be installed at Bäckhammar in the second



The power plant Värtaverket in Stockholm.



Fortum Värme is investing in a pellet making unit in order to facilitate the handling of lignin fuel.

half of 2007. In this, the lignin cakes will be broken up and made into pellets, which are significantly easier to transport and manage in the power and heating plant. Another advantage is that pellets do not make dust, in contrast to dealing with cakes. Dust always brings a possible danger of explosion with it.

"Making pellets of the lignin demands special knowledge about the properties of lignin. What's more, the logistics are of enormous importance in our demonstration plant at Bäckhammar. Pelletizing will occur on-line in the entire lignin production process," says Per Tomani, a Major Project Manager at STFI-Packforsk but also the CTO for LignoBoost AB, which is commercialising the LignoBoost process.

"We've jointly developed specialised knowledge with an SME\* company, Sweden Power Chippers (SPC), and Rolf Ljunggren, a consultant from Cortus. In addition to this, we've had collaboration from Kellve Bulkteknik for solving pre-treatment and logistics problems," says Per Tomani. ●

**CONTACT:** per.tomani@stfi.se

\* Small and Medium sized Enterprises



**Det mesta av ligninet** från LignoBoosts demoanläggning i Bäckhammar kommer att säljas till Fortum Värme för att användas som bränsle tillsammans med kol i kraftvärmeverket i Värtan, Stockholm. Under våren inleddes försöken med inblandning av lignin i den kommersiella produktionen. Då förbränningen visat sig fungera bra vill man kunna köra kampanjer med större inblandning. För att underlätta hantering av större mängder lignin investerar Fortum nu i en pelleteringsanläggning i Bäckhammar. Pelletering kommer att göras on-line på hela ligninproduktionen.

I forskningsprogrammet FRAM studeras även sameldning med andra biobränslen samt förbränning i massabrukets mesaugn. Ligninet brinner bra med en het flamma och skulle därför kunna ersätta olja som bränsle.

## Replacing oil with lignin

The co-firing with coal at the Fortum power plant, described here, is one of several possible areas in which lignin can be used as a fuel. In the FRAM research project (Future Resource Adapted Pulp Mill), studies are in progress as to how lignin should be treated for combustion in this process as well as in two other applications, viz. co-firing with other biofuels and burning lignin in lime kilns at a pulp mill.

"The latter alternative is very interesting, since the lime kiln is the last major user of oil in the pulp mill. Replacing this oil with lignin would essentially eliminate emissions of fossil CO<sub>2</sub>," comments Niklas Berglin, who is responsible for combustion activities in the FRAM project.

"It's necessary to have a very good fuel for the high temperatures required in lime kilns. So far, it has not been possible for other biofuels to fully replace the oil used in them," he continues.

Studies of the combustion of lignin powder in conventional powder burners have shown that lignin burns very well with a hotter flame than other biofuels.

When it comes to conventional boilers, what would be the advantages of co-firing lignin with other biofuels that, in themselves, do not emit CO<sub>2</sub>? Niklas Berglin explains that, by mixing in lignin, there is less danger of problems with sticky deposits, which are common when firing biofuels. This was shown in studies on co-firing with bark that were done in a research boiler at Chalmers in Göteborg.

These two processes will both be tested in full scale trials within the next year. ●

**CONTACT:** niklas.berglin@stfi.se

# Yet another leap out into the world

With its setting up of a subsidiary in London, STFI-Packforsk is taking yet another step towards increasing its level of internationalisation. Two very qualified consultants are building up an enterprise that will attract customers, mainly on the European market, resulting in an increase in commissions for its research companies in Stockholm and Trondheim.

Greg Wood and Michael Sturges, formerly Business Manager and Manager for Strategic consulting, respectively, at Pira International, were present for the start of the new company on 20 August, this year. Both of them are highly qualified for the task and are well known consultants in the STFI-Packforsk sphere of activities.

Greg Wood, Managing Director of the new company, STFI-Packforsk UK Ltd, explains, "Our business analysis, strategic planning, creativity and innovation services are designed to assist technology providers, manufacturers, converters, brand owners and retailers to anticipate and manage the demands and dynamics of the supply chains in which they operate. Applying our sector knowledge and experience, we'll be able to help our customers create and capitalise on intellectual assets and business opportunities."

The main aim is that Greg Wood's and Michael Sturges' expertise, together with the reputation of STFI-Packforsk as an

expert research company, will engender commissioned research and consultancy work for the existing research companies. This new subsidiary is a complement to the present operations. It is going to strengthen marketing efforts and will result in new customers and an increase in turnover.

Gunnar Svedberg, President of STFI-Packforsk, comments, "We see the choice of London as being the correct decision, strategically speaking, given that certain of our major customers are established there."

"The language is another advantage, so, when the opportunity presented itself, we took it. The premises in the Surrey Technology Centre in Guildford were chosen with care. The location is extremely good from many points of view and there are opportunities for expansion. The setting up of the subsidiary went smoothly and well, due to the fact, among other things, that Anders Sörås, Senior Vice President of STFI-Packforsk had done such excellent preparatory work."

Internationalisation is one element in the discussions on strategy that are being conducted on the Board at STFI-Packforsk. Developing a unit outside the Nordic region can be done in three ways, viz. by associating oneself with a company working in a similar area, by buying a company or by building up something from scratch. The latter was the most fitting at this moment in time, since the advantage of it is that it is a cautious investment.



**Den 20 augusti** etablerade STFI-Packforsk ett dotterbolag i London och tog därigenom ytterligare ett steg mot ökad internationalisering, allt i enlighet med de strategidiskussioner som förs i styrelsen. Två erfarna konsulter, Greg Wood och Michael Sturges, kommer att bygga upp en verksamhet som ska attrahera kunder och resultera i order till forskningsbolagen i Stockholm och Trondheim.

– Skräddarsydda tjänster inom affärsanalys, strategisk planering, kreativitet och innovation erbjuder utvecklare, tillverkare, konverterare, varumärkesägare och återförsäljare verktyg att tillmötesgå marknadens krav och behov inom de värdekedjor där de är verksamma. Med vår branschkunskap och erfarenhet kan vi hjälpa kunderna att bli mer lönsamma, säger Greg Wood, Managing Director på det nya bolaget STFI-Packforsk UK Ltd.

"We also want to show that our operations don't simply trundle along, but that we're dynamic and are keeping up with the times and our capabilities. The London office will, undoubtedly expand and, furthermore, we're already turning our thoughts towards South America, which, for us, is the most potential region for development. There is currently no research company present there within the sectors we work in. ●

**CONTACT:** [gunnar.svedberg@stfi.se](mailto:gunnar.svedberg@stfi.se) and [greg.wood@stfi-packforsk.eu](mailto:greg.wood@stfi-packforsk.eu)



The first board meeting for the new subsidiary took place at STFI-Packforsk on 19 September, 2007. From the left, Greg Wood, Michael Sturges, Gunnar Svedberg and Anders Sörås.

Catharina  
Ottestam

# A global STFI-Packforsk

"Know-how and knowledge are both global these days. That's why STFI-Packforsk must be that too. The best way to not be afraid of competition is to make certain that you're always coming up with new ideas and that you're the fastest in using them." So comments Catharina Ottestam, the co-ordinator of ECOTARGET, one of the EU Projects that STFI-Packforsk is hosting. SUSTAINPACK, a packaging project, is yet another one. These two big EU Projects have a total of more than 60 participating partners between them.

"This means an enormous amount of work," states Catharina Ottestam. "But it also means that we can use ideas, expertise and equipment way beyond what we have within our own four walls. It's not always possible to have the right resources at hand."

Catharina Ottestam is also the manager for Swedish forest-based trade and industry ventures at the EU Support Office.

"We aim to help companies and researchers in the forest industry sector to have the opportunity of making full use of the possibilities on offer in EU research. We provide assistance with contacts, applications; well, in fact, everything needed to succeed in an EU research programme."

ECOTARGET has succeeded very well, to the great delight and satisfaction of the pulp and paper industry. The EU has named it its 'flagship'. Its aim is to develop new and more sustainable technologies and techniques for central unit processes in the pulp and paper industry.

Catharina Ottestam continues, "ECOTARGET is working very well. It has become an arena where new means of co-operation and development can be found."

Dorotea Slimani, a Major Project Manager at STFI-Packforsk, also considers that it is necessary to have a global perspective today.

"There is a great deal of growth and expansion taking place outside of Sweden and Europe, especially in Asia. In recent years, we, at STFI-Packforsk, have participated in several EU financed projects for developing know-how and knowledge in companies, among others, in Thailand. By creating new IT tools and raising their levels of expertise in the European company culture, we can, in the long run, establish an added-value market for industry in Europe. We can also learn a lot from their outlook and way of approaching things. The business models that we've built up here in Europe don't always work in other parts of the world." ●

**CONTACT:** [catharina.ottestam@stfi.se](mailto:catharina.ottestam@stfi.se) and [dorotea.slimani@stfi.se](mailto:dorotea.slimani@stfi.se)

Catharina Ottestam a Group Manager at STFI-Packforsk, was asked in 2002 to write an application to the EU. The moment that she accepted was the beginning of a long journey.

"The EU had decided that the project would be much bigger and so my work on the application expanded to include more and more countries and research institutions."

Three years later, her comment is that this venture was just the right one, for STFI-Packforsk and for her personally.

"Those that didn't venture internationally at that time are running behind today. We have learnt where the contacts are and how to get in touch with them. EU research is such fun! Southern Europeans and those of us in the Nordic region have different ways of approaching an assignment. Nevertheless, we can in fact collaborate."

The prime mover for her is that there must be something on the go all the time. If the work is interesting and enjoyable, the results will be very good.

Working internationally means that Catharina travels a great deal. Between trips, she enjoys being with her family, preferably in their holiday house in Haverdal, on the Swedish west coast.

"We all need our own little place on this earth. The beach in Haverdal is mine," she says, as she leaves to take a plane to Brussels to discuss an EU strategy. ●

**CONTACT:** [catharina.ottestam@stfi.se](mailto:catharina.ottestam@stfi.se)



**Både kunskaper** och kunder är globala i dag. En konkurrensfördel är att se till att man får in nya idéer och är snabbast med att använda dem. STFI-Packforsk är engagerat i flera internationella forskningsprojekt, bl a ECOTARGET och SUSTAINPACK, EU-støttkontor och satsningar i Asien. De senaste åren har bolaget deltagit i flera EU-finansierade projekt för att utveckla kunskaperna hos företag i bland annat Thailand. Med nya IT-verktyg, och höjd kompetens inom europeisk företagskultur, skapas på sikt en ökad marknad för europeisk industri. Europeer kan också lära sig av det asiatiska synsättet. De affärsmodeller som byggts upp i Europa fungerar inte överallt i världen.



The moisture in exhaled air causes the surface to become coloured, similar to oil on water.

# Optoactive materials

Marketing and product safety are two areas where a new technology using optoactive materials is receiving a great deal of interest. Optoactive materials alter their appearance when they react to different types of stimuli, such as moisture, temperature, electricity, bacteria or chemicals.

A group of research scientists at STFI-Packforsk, with Hjalmar Granberg as their Project Manager and with optics as the speciality, have succeeded in coating paper with a film, which, when it reacts to moisture, produces different interference colours.

“We’ve created a model structure using environmentally compatible, inexpensive, renewable, raw materials. Presently, we’re working with sensitivity to moisture, but we’re going to test other stimuli as well.”

The assembling technique is called ‘layer-by-layer’, which has been further developed by Professor Lars Wågberg’s group at the Royal Institute of Technology (KTH) in Stockholm. With this technique, it is possible to build nano-structures, which Sven Forsberg and Hjalmar Granberg, with the assistance of Master students, have utilised in developing new prototypes.

The thickness of the film determines the colour. Hjalmar shows some samples in which the film is no thicker than one twentieth of a hair’s breadth. The mois-

ture in exhaled air causes the paper to become coloured, similar to oil on water. A countless number of colours and variations of them appear but disappear quickly when the moisture has evaporated.

“It’s not hard to visualise a number of possible applications,” Hjalmar continues. “Authenticity is an example that aids in assuring that a product contains what it says on the label, that it’s produced according to the specifications or that it isn’t a pirate copy. This is becoming more important with the increase in global internet trading, where it can be difficult to know what you are actually getting. If the hidden colour spectrum on a package doesn’t correspond with a given curve, there is reason to be suspicious.”

Another field is marketing. It would be possible for a package to display various appealing messages when it is breathed on or if it is picked up by a hand, for example.

The researchers want to develop this technology further and add the optoactive material to the papermaking pulp.

“It would then be very difficult to manipulate an optoactive effect. Getting hold of a paper machine to imitate this would be far too expensive for anyone attempting it. This could well be a solution for combating banknote forgery,” Hjalmar explains.

The optoactive team consists of research scientists from STFI-Packforsk and KTH, as well as representatives from corrugated board and paperboard producers, which ensures the marketing aspects. Part of the work has

been carried out in the framework of SUSTAINPACK, an EU Project.

“We’ve built the platform. Now it’s up to the industry to order the applications and the stimuli they would like. Due to the fact that it’s possible to develop a material that combines different stimuli, the conceivable areas of use are limitless. We’ve already received enquiries from the industry and we could have products on the market within a couple of years.”

The research scientists would like to start a cluster comprising several companies that would jointly search for solutions and applications to these optoactive materials. ●

**CONTACT:** [hjalmar.granberg@stfi.se](mailto:hjalmar.granberg@stfi.se)

 **Marknadsföring och** produkt-säkerhet är två områden där en ny teknik med optoaktiva material röner stort intresse. Det är material som ändrar utseende efter olika stimuli som fukt, temperatur, elektricitet etc.

En grupp forskare på STFI-Packforsk har lyckats belägga papper med en film, som när den reagerar på fukt, ger olika interferensfärger. De har gjort en modellstruktur med miljöanpassad, billig råvara som är förnyelsebar. I dagsläget arbetar de med fukt-känslighet, men kommer också att gå in på andra stimuli. Det finns ett stort antal tänkbara applikationer, till exempel autenticitet eller marknadsföringsåtgärder. Nu vill forskarna gå vidare och lägga in det optoaktiva materialet redan i pappersmassan. Då blir det svårare att manipulera den optoaktiva effekten.



## IKEA TULIP AWARD 2007

“Based on strong personal engagement as well as organisational resources, STFI-Packforsk has supported and challenged us in our work to secure the sustainability performance of our activities”.

These were the words of the jury for the IKEA Tulip Award, Prize of Honour, which was awarded by Inter IKEA Systems to the STFI-Packforsk Sustainability & Foresight Team. The prize was presented during an IKEA Catalogue Procurement Production Meeting in October.

“Sustainability is so interesting and important. Therefore, we are delighted to work on this issue together with a global company like Inter IKEA Systems,” say Martin Johansson, Maria Enroth and Åsa Moberg at STFI-Packforsk.

## Seminar for Partners

Under the banner of Bioenergy – Opportunities and threats for the pulp and paper industry, Mattias Ringqvist from McKinsey & Company, launched this year’s Research Seminar for STFI-Packforsk Partner Customers, held on 18 September. The fact that the industry is facing many exciting challenges was emphasised by Leif Brodén, CEO of Södra, who rounded off the combined session with Challenges for the future pulp mill.

About 70 listeners gathered to hear the latest results from the Cluster Research Programme for 2006-2008. In the main, this took place in three parallel sessions, (i) Fibre, Pulp, Energy & Chemicals, (ii) Papermaking and Material Design and (iii) User Perspectives. Many of the presentations concerned themselves with new processes and technologies, which, among other things, present new opportunities and possibilities for the industry to enter new markets.

With slightly more than a year remaining for the current research programme, it has been full steam ahead with work on the new programme for 2009-2011 for quite a while. Ideas and concepts have been put together and formulated into concrete project proposals.

“At the moment, we’re holding discussions with our partner companies. By listening to what they need and their priorities, we can identify ideas that are of interest for the research programme,” says Anders Pettersson, Senior Vice President of Research at STFI-Packforsk. ●



Leif Brodén, CEO of Södra and Chairman of the STFI-Packforsk Board presented his vision for future challenges for the industry. Standing to the right is President Gunnar Svedberg.



Invited speaker Mattias Ringqvist of McKinsey & Company presented results from the McKinsey report on bioenergy.



Lisa Tiliander who was the host of the seminar, welcomed everyone who had gathered for a dinner at the Hotel Anglais on the evening before the seminar.

## COMING EVENTS

13 November, 2007

### Packaging and the environment

A course arranged by the STFI-Packforsk Trade and industry group Miljöpack and SIS, the Swedish Standards Institute.

## Packaging Diploma Course is starting up

The STFI-Packforsk Packaging Diploma Course is a wide-ranging training course for those involved with packaging. Theoretical knowledge is illustrated with the aid of study visits and teamwork.

The course comprises 4 sessions in 2008, starting with the first on 21-23 January, 2008. For further information see [www.stfi-packforsk.se/diplomutbildning](http://www.stfi-packforsk.se/diplomutbildning) or contact [stefan.engstrom@stfi.se](mailto:stefan.engstrom@stfi.se).

## NWBC 2008

11 - 14 March, 2008

City Conference Centre in Stockholm, Sweden

The Nordic Wood Biorefinery Conference 2008 covers biorefinery separation and conversion processes as well as energy, chemicals and materials from the wood based biorefinery. The speakers represent the global chemical, energy, pulp and paper industry as well as recognized representatives from the global research community.

The conference will also present the main findings from WaCheUp, an EU-project which has explored the production of value-added substances from bark, pulping spent liquors and cork processing residues.

On 11-13 March, there will be presentations from leading universities and research centres in the field of biorefinery area and a broad range of companies will present their activities. On 14 March, after the conference, there will be visits to demonstration and pilot biorefineries.

For more information, see [www.stfi-packforsk.se/nwbc2008](http://www.stfi-packforsk.se/nwbc2008) or contact [elisa-bet.jepson@stfi.se](mailto:elisa-bet.jepson@stfi.se).

## Have you changed address?

Let us know by sending an e-mail to [info@stfi.se](mailto:info@stfi.se).

# B



# How is Royal Warship Vasa faring?

Sweden's probably most famous tourist attraction and, at one time, King Gustav II Adolf's flagship that sank so ingloriously on its maiden voyage in 1628, is not faring very well. During the humid summer of 2000, 39 years after being salvaged, salt deposits were detected on the inside of the hull. While waiting for more effective methods, it was then that the surface began to be washed with bicarbonate of soda. This helped for a while, but then the deposits started returning. A campaign, "Save the Vasa", was started and, as a consequence, its problems were studied in various projects.

The Vasa Museum, responsible for the preservation of the Vasa, made a decision to widen the research to include the chemistry of the wood. Professor Thomas Nilsson from the Swedish University of Agricultural Sciences (SLU) was appointed as the person responsible for the matter. He, in turn, contacted STFI-Packforsk for expert help.

After many months, researcher Tommy Iversen was able to show that the entire ship, made of oak, was more decomposed than was thought, even deep into the core timber. Oak is very hard and therefore suitable for ship building. However, this also means that it causes big problems when wanting to break down the timber to chemically analyse the wood fibres. Tommy Iversen and his colleague, Eva-Lisa Lindfors, developed a method for this and, in so doing, were able to establish not only that the timber in the Vasa had decomposed but also that the chemical breaking down had spread further than was believed.

One fundamental question to ask was when had this process started. Was it when the ship had lain in mud on the sea bed; when it was salvaged and came in contact with the air; or was it during the treatment phase with polyethylene glycol (PEG) that was carried out to keep the timber moist?

It became evident that it was the rust from the original iron bolts, several thousand in all, which oxidised the cellulose after the Vasa had been brought up into the air. Sulphur from bacteria had also penetrated the timber and had formed sulphuric acid at the same time, which is corrosive.

"In finding a method for analysing the oak, we made great use of our knowledge of wood and fibres," comments Tommy Iversen, who, among other things, has worked with paper stabilisation and paper conservation in an EU project and for the National Archives in Sweden.

"During the course of the project, we have received reference material from other ships, namely the Gröne Jägaren and the Elefanten, that sank at about the same time as the Vasa, but are still lying on the sea floor. These wrecks show almost no chemical breaking down. This new knowledge will be able to be utilised in discussions surrounding the possible salvaging of new discoveries in future."

This new method and the ability to analyse have resulted in a scientific paper written by Tommy Iversen and appearing in *Holzforschung*, the *International Journal of the Biology, Chemistry, Physics and Technology of Wood*. Eva-Lisa Lindfors and Mikael Lindström also participated in the project.

"It has been very interesting and a lot of fun," says Eva-Lisa Lindfors, in the middle of the turmoil.

"Everything has fallen into place. All the straggling issues and points of view have led to the same conclusion."

Nonetheless, it is important to discover if and how the breaking down process will continue, which is vital and burning question. ●

**CONTACT:** [mikael.lindstrom@stfi.se](mailto:mikael.lindstrom@stfi.se)



**Sveriges** kanske mest kända turistattraktion, flaggskeppet Vasa mår inte bra. Sommaren 2000, 39 år efter bärgningen, upptäcktes saltutfällningar på insidan av skrovet. En aktion "Bevara Vasa" startades, och i olika projekt studerades problemen.

Forskare från STFI-Packforsk kunde efter många månader visa att hela skeppet som består av ek var mer nedbrutet än väntat. En metod utvecklades för att lösa upp veden för att kemiskt analysera vedfibrerna. Det är rosten från de ursprungliga järnbultarna som oxiderat cellulosan efter det att Vasa kommit upp i luften. I träet hade också svavel från bakterier trängt in, och det bildas svavelsyra samtidigt som är frätande. Nu är det viktigt att ta reda på om och hur nedbrytningsprocessen fortsätter, och det är bråttom.



STFI-Packforsk AB  
Drottning Kristinas väg 61, Box 5604  
SE-114 86 Stockholm, Sweden  
Phone: +46 8 676 70 00  
Fax: +46 8 411 55 18  
[info@stfi.se](mailto:info@stfi.se)  
[www.stfi-packforsk.se](http://www.stfi-packforsk.se)

Beyond is published by STFI-Packforsk AB  
Legally responsible for the publication:  
Gunnar Svedberg ([gunnar.svedberg@stfi.se](mailto:gunnar.svedberg@stfi.se))  
Editor: Veronica Rudheim ([veronica.rudheim@stfi.se](mailto:veronica.rudheim@stfi.se))  
ISSN: 1652-6503  
Print: SIB-Tryck, Norsborg



Member of the  
STFI-Packforsk group

PFI AS  
Høgskoleingen 6b  
NO-7491 Trondheim, Norway  
Phone: +47 73 55 09 71  
Fax: +47 73 55 09 99  
[firmapost@pfi.no](mailto:firmapost@pfi.no)  
[www.pfi.no](http://www.pfi.no)