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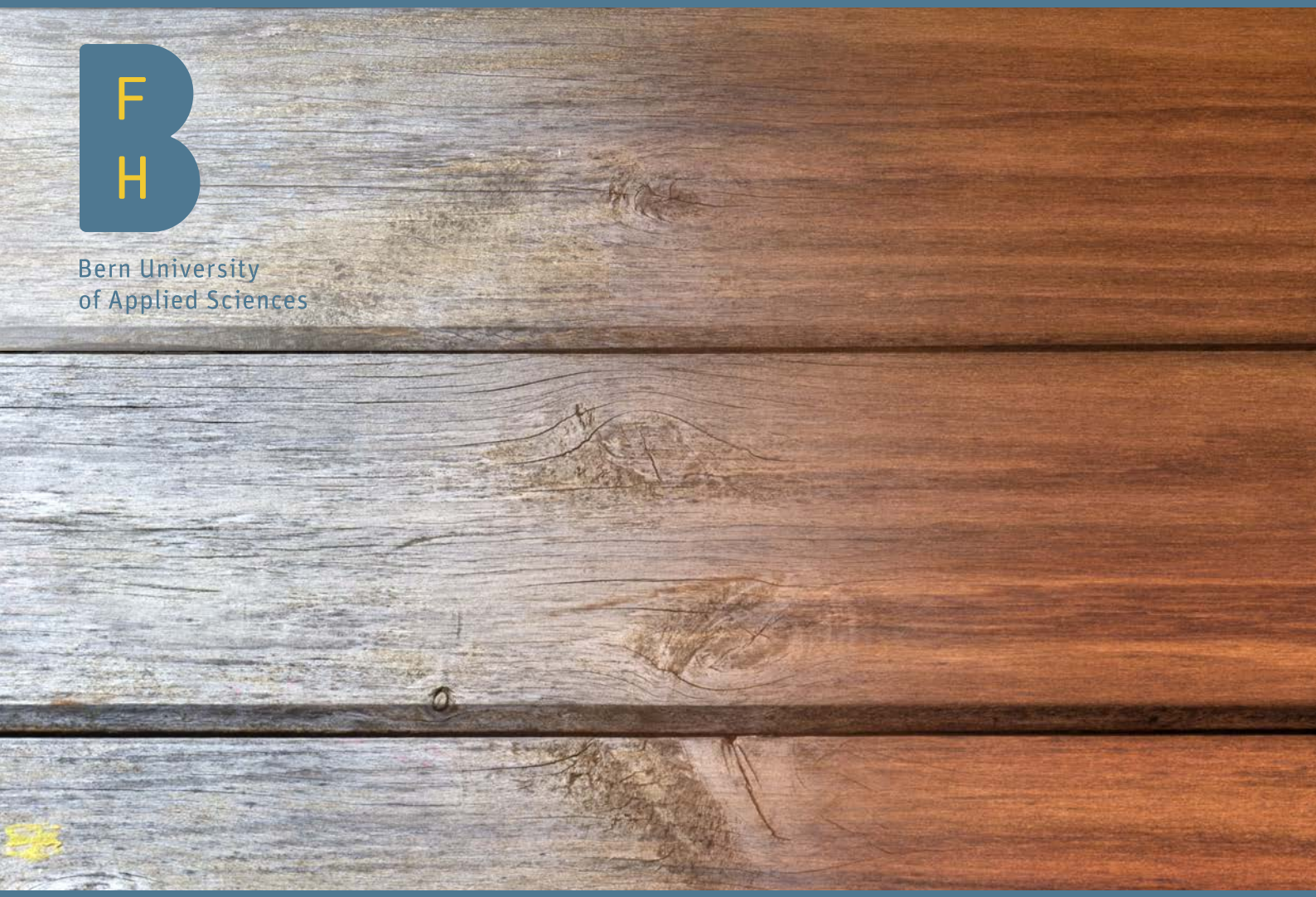

How the wood technology sector can benefit from fundamental and applied research

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Prof. Frédéric Pichelin, Head of the Institute for Materials and Wood Technology (Switzerland), on why the wood sector needs more support from politics and science

The wood products industry is facing several challenges. On one side the use of wood products is a great opportunity to solve the problem of global warming. In this context, many efforts have been done to diversify the use of this raw material, from the use as beam for solid wood products to the valorisation of chemical compounds like lignin or Nano cellulose fibers. This diversification has led to a fast development of the wood-based panel industry and the construction of several bio-refineries in Europe.

On the other side the wood industry is competing with other materials like plastic, concrete and steel. The price competition is very hard, especially due to the low price of crude oil.

What is needed today to raise the awareness of politics and science is a holistic consideration of the resource wood, taking all of the various components, specifics and potential for use into account, and including the entire materials cycle of this highly promising raw material.

The Swiss National Research Programme (NRP) 66

The NRP 66 programme (www.nfp66.ch) was a joint programme run by the Swiss National Science Foundation (SNF) and the Swiss Innovation Agency Innosuisse (previously CTI).

With a total budget of 18 million SFr. and 30 research projects over 5 years (2012-2016), the NFP66 were addressing the complete life-cycle of wood, market mechanisms as well as the problem of insufficient raw wood availability (figure 1). The aim was to improve the management of wood as a resource across its life cycle from availability and use to recycling and disposal. Ecological, economic and social aspects have also been considered.

If the use of wood is to change, business and politics will have to contribute in line with research. There is a real chance of improving wood-based value addition and the competitiveness of the forestry sector. Success will depend on whether the necessary innovation can be triggered in business and on the creation of a framework supportive of sustainable wood provisioning

In this regard, NRP 66 is very similar to the European Union's research activity and resource strategies, which are also aimed at raising the profile of the wood-based value chain.

The Innosuisse agency has made its services and promotion resources for applied research and development available to the programme. The Agency is thus making a major contribution in this NRP to cooperate and transfer knowledge between researchers and industry.

NRP 66 has placed great importance on the imple-

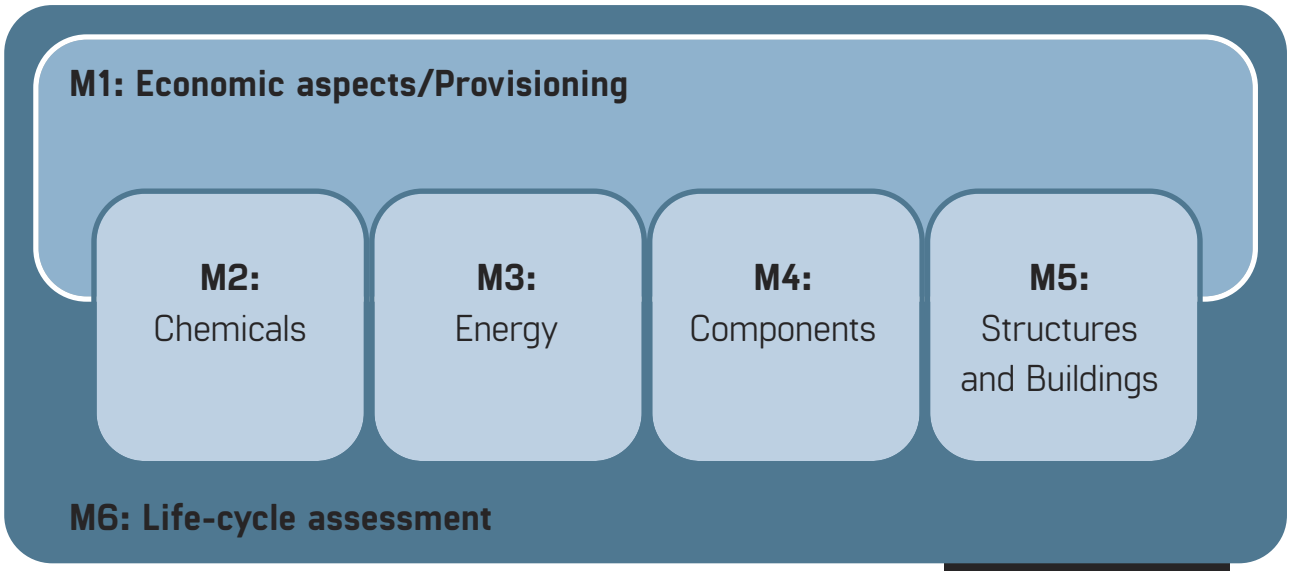

Fig 1. Modules of NRP66

mentation of solutions elaborated by scientists as this is the only way to ensure value addition. In the course of the programme, researchers and the Swiss National Science Foundation have worked closely with Swiss Innovation Agency Innosuisse to turn promising research projects into industrial projects.

3 NRP66 research projects under the lead of the institute for materials and wood technology

A new generation of ultra-light bio-based particleboard produced with an in-line foaming step

In tomorrow's furniture-making industry, light and strong wood-based materials will be in great demand. These materials enable manufacturers to produce furniture that is easy to transport and can even be delivered by mail. The increasing importance of cash-and-carry and Internet business in the furniture sector is prompting manufacturers to produce ever lighter components. Within the scope of NRP66 project, scientists developed an ultra-light particleboard in which a foam core made from a bio-based material is used in order to reduce the overall weight. At the same time they succeeded in maintaining the strength properties at a high level. The process developed by the team has the potential to be used in industrial production.

Weight reduction is achieved thanks to a layered board structure: the board consists of a lightweight foam core and two surface layers with properties similar to those of particleboards. In the past such boards had to be produced from three separately manufactured layers, but this method is relatively expensive and thus only had a chance of success in niche markets.

For the research team, the biggest challenge was to find a way to adapt the temperatures for the production of the surface layers and the foam core so that it would be possible for all processes to be carried out at a uniform temperature. Here, for example, the conditions for the expansion of the foam core have to correspond to those that are required for hardening the bonding agents in the surface layers.

On the one hand, the researchers developed a bio-based foam precursor, and on the other they adapted the board production process to the new conditions. In this way, they were able to attain almost the same temperatures for the production of both the foam core and the surface layers.

They then carried out a comprehensive analysis of the environmental impacts of the new particleboards, the results of which indicated that it is the raw

materials used for producing the foam, together with the end-of-life strategy, that are decisive when it comes to environmental impacts.

Natural UV protection of wood surfaces through cellulose fibres

Wood surfaces become coarse and discoloured when exposed to sunlight and rain. If there were a way to avoid or slow down the weathering of wood, it would be more competitive for out-of-door use in comparison with other materials. This project investigated how wood could be rendered more resistant to UV light.

To create a cellulose-rich, fibrous layer on the surface of wood, the researchers tested various methods to delignify surfaces. These methods transform the wood surface into a protective layer which stops or delays the photochemical degradation and protects the wood underneath from sunlight.

A good method of delignification is natural weathering but this approach is industrially not viable at the moment. In the course of this natural process, lignin degradation occurs according to a specific pattern and depending on the climate after only four weeks most of the lignin has degraded. The process affects wood to a depth of around 200µm. At this point, the surface can be stabilised with a acrylate dispersion; no additional agents are necessary to create the UV protection.

The team explored various mechanical approaches to stabilise the modified surfaces. Stabilising the surfaces is necessary because the delignified surface is mechanically instable and very hygroscopic. To protect the surfaces from water, different polymers systems based on acrylate, natural and synthetic oils as well as functionalising substances were employed.

Extraction of tannins from the bark of local conifers

Tannins can be used in adhesives to produce formaldehyde-free wood-based materials, which are used in furniture production. The researchers have developed a profitable method to extract tannins from the bark of local conifers.

Adhesives based on spruce bark extracts displayed slightly lower strength than typical tannin adhesives based on mimosa bark. The main reasons for this difference are that the spruce extracts are diluted with cabonhydrates and that spruce bark tannins have fewer cross-links. Extracts of fir, spruce, pine, larch and Douglas fir contain varying amounts of tannins, phenolic monomers, monosaccharides and pectins. Significant amounts of carbohydrates are present in all extracts. The tannins differ considerably from those extracted from tropical wood.

The yield of tannins is greater if the spruce bark has been seasoned out of doors.

Already new industrial projects granted

Thanks to the fruitful collaboration between SNF and Innosuisse, the research teams were able to launch new industrial projects at the end of the NRP66 programme. In the field of tannin extraction and valorisation, 4 new projects covering the field of composite, wood-based panels, coating and industrial tannin extraction have been started. The high visibility of these research activities at the national level has also helped the research team to develop synergies with international industrial partners.

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