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Band 2 / Issue 2

Holz:
Rohstoff – Werkstoff – Energiequelle der Zukunft

Wood:
Raw material – Material – Source of energie for the future

Holz ist der wichtigste nachhaltig verfügbare Massenrohstoff und das eröffnet ihm damit eine führende Rolle im Wettstreit der Werkstoffe. Durch die traditionelle Prägung des Holzes als Alltagswerkstoff werden die Zukunftsperspektiven des Holzes aber oft nicht erkannt. Der vorliegende Band 2 von LIGNOVISIONEN gibt das Fachsymposium „Holz – Rohstoff, Werkstoff, Energieträger der Zukunft" im Rahmen des Internationalen BOKU Kongresses 2001 „ Leben und Überleben – Strategien für die Zukunft" wieder.
Exemplarisch wird darin aufgezeigt, wie Holz zu einem der wichtigsten Werkstoffe für das Leben und Überleben der Menschheit wird.

Wood is the most important sustainable mass raw material available. As wood has always been a traditional material used in everyday life, we do not immediately realize its importance for the future. It was the target of the symposium „Wood – Raw Material and Source of Energy for the Future", which was organized within the International BOKU Congress „Life and Survival –Strategies for the Future", to point out the future importance of wood. The present issue 2 of LIGNOVISIONEN summarizes this symposium, where the potential of wood was demonstrated and selected innovative developments were discussed.

... mehr Information / more info:

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Holz als Herausforderung:
Biosynthese, Rohstoffbewusstsein und Kulturerbe

von Rupert Wimmer

Holz ist ein mehrfach intelligenter Werkstoff: Einerseits besitzt Holz hervorragende Eigenschaften durch optimierte Kombination von innerer Holzstruktur und chemischer Zusammensetzung, andererseits ist Holz ein Werkstoff mit „Gedächtnis", der über Klima und Umwelt jahrgenau Auskunft geben kann. Ob raschwachsendes Holz mit genetisch optimierten Eigenschaften oder Wertholz aus alpinen Hochlagen, die tatsächlich erforderlichen Holzeigenschaften und nicht die Herkunft bestimmen auch in Zukunft die Qualität von Holz. Das Holz erfordert ein hohes Niveau holzwissenschaftlicher Erkenntnisse, intensive Forschungstätigkeit sowie eine hervorragende Ausbildung. Nur dann kann der Komplexität dieses faszinierenden Werkstoffes Rechnung getragen werden kann.

Challenge wood:
biosynthesis, raw material awareness and cultural heritage

Wood, a bio-composite consists of three major polymers: cellulose, hemicelluloses and lignin. Cellulose is the fibre-reinforcing component while lignin acts as a supportive material to the cellulose, preventing the cellulose microfibrils from buckling under compression. The role of hemicelluloses is more difficult to describe: since hemicelluloses are deposited in the cell wall before or at the same time as cellulose, the role of the hemicelluloses has been suggested to be the regulation of the tertiary cellulose structures, i.e. its three dimensional structure of the cellulose molecules. Indications also show that the presence of hemicelluloses is an important factor for the polymerization of monolignols.

In all typical woody plants the root and the stem axes continue to grow not only in length but also in diameter. In this, the diameter growth is accomplished by the vascular cambium. This long-lived tissue, which could be active longer than five thousand years, is in simple terms a sheath of meristematic cells situated between the secondary xylem (wood) and the secondary phloem (bark). Different types of cells are laid down in radial files, influenced by various growth factors. Through auxin and gibberelines, two important phyto-hormones, differentiation of wood can be controlled. Different concentrations and ratios of these phyto-hormones may change the vessel diameter of hardwoods: higher auxin concentrations close to leaves (crown) result in smaller and more abundant vessels, while lower auxin concentration are found close to roots with bigger and less frequent vessels. Over the last two decades there was a major shift in research, from discovering and describing externally provided growth factors (e.g. climate, soil,…) to observing organ development in transgenic plants. Tobacco and *Arabidopsis* are two model plants exhibiting a limited secondary growth and they are used to localize and manipulate DNA to study the processes of cambial growth and wood formation.

On the long run, the new opportunities in biotechnology will change the awareness of wood as a material. Key words such as "Designer-wood through biotechnology" are already heard in some countries, and it means manipulation of tree growth for specific wood properties. Through knowledge of internal and external growth factors a future perspective could be that wood is grown with almost any type of properties. Wood – a biotec-designed material? Accelerated growth was and will be a major emphasis in forest management. However, this is usually combined with unwanted effects on wood quality. Faster radial growth is in most cases linked with higher tissue tensions, wood density is usually lower, microfibril angles smaller, swelling and shrinking coefficients higher, stiffness lower and a higher proportion of juvenile wood is expected with a disadvantageous higher lignin content. Areas with fast-growth species are on the increase worldwide and they supply an increasing portion of the worldwide demand for wood. Will it be possible to meet this need for wood and fibres in quantity and quality through high-productive (plantation) forestry? Will development lead to a situation where production forestry is decoupled from non-commercial "eco-forests"?

Wood was always considered to be valuable and the history of wood utilization shows that wood was used with care. The skillful person knew the right species for each use and prevented valuable timber being wasted for low-values purposes, if a lower-value timber was available. Folklore scientists have shown that on a low-income farm 27 different wood species were used and each species was applied according to its properties. The textbook "the art of carpentry in its entireness" from the year 1828 has in the chapter "…of the manifold wood species" descriptions of 56 domestic and foreign timber species. This broad spectrum of wood utilization and craftsmanship is a cultural treasure, important to be preserved. Through dendrochronology wooden artifacts can be dated to the year and tree-ring sequences also allow extraction of facts about e.g. the climate. In this sense wood is a multiple intelligent material, on the one hand with an optimized inner structure and chemical composition, on the other hand with a "memory effect", as wood may hold information about the climate and the ecology. Whether fast-grown timber with genetically optimized properties, or high-value timber from the Alps, the relevant wood properties of a piece of wood will determine the quality and not the origin. This also requires knowledge in wood science, excellent education and research to understand the complexity of the fascinating material wood.