Collaborative shaping of Research Agendas in WoodWisdom-net

RESEARCH AREA 1 Knowledge-based products – new value- added e.g. for construction, interior design, information, packaging and health-care purposes

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Sub-area 1.1 Wood-based biopolymers to composites

1.1.1 HYCOWOOD

Positioning: Applied

Short Description: Lack of adequate research and development has restrained the improvement of wood products and has, thereby, obstructed wood and wood composites from being more widely used for construction, furnishing, interior decoration and other purposes. Modern manufacturing technologies enable combining of wood and wood-based fibres with many different materials (such as plastic, steel, mortar, glass, ceramics etc.) and producing hybrid composites with unique properties. In this field of study, innovative hybrid composites from wood-based materials will be designed to achieve the following objectives: - to develop materials with porosity gradients and low density materials with adequate mechanical properties for building and transport industry - to develop maintenance free (UV-resistant, mildew/soil-free etc.) material surfaces - to improve fire and thermal resistance of building materials - to improve acoustic properties of buildings or to reduce noise level of highway networks and construction sites - to enhance decorative effects of building materials - to improve moisture behaviour of building materials and components. The approaches to produce these innovative composites will include a variety of techniques normally used to create multi-layer structures and multi-material blends. However, in the manufacturing procedures - such as in compounding, extrusion, pressing and glueing - parameter adjustments and pre-treatments of interfacing surfaces will be needed.

Justification: The study will result in following products and innovations • cladding materials with multi-layer structures for maintenance freeness • interior decoration films or wall boards with good fire resistance and/or acoustic properties for use at domestic or office applications (e.g. in home theatres, schools, hall like factories, swimming halls, lobby areas) • mobile elements with good sound absorbing properties e.g. sound absorbing surfaces integrated in furniture, for instances on the undersides of tables or chairs • noise reducing dividers for out and indoor use • materials absorbing impact sounds for flooring structures. The research area will be an "imago-lifting" activity for the timber and forest industry by resulting in highly value-added wood-based products. In addition, environmental aspects will be considered in the study by using waste wood in combination with other materials to make high performance composites. In the long run, maintenance intervals of building structures will be lengthened which reduces chemical consumption and overall costs. By producing clean (mould-free) and functional surfaces, welfare and safety in the society will be improved and health care costs decreased.

European relevance and collaboration: The topic on wood-based composites and nowadays also on the hybrid composites has raised interest throughout Europe. In some European and Nordic research institutes, extensive work on interfacial phenomena of different materials and on surface activation effects has been carried out, whereas in some institutes, focus has been on processes and on performance of composites. Combining the expertise areas of the different institutes lead more cost-effective research concept. The manufacturing and analytical facilities needed for the study are manifold and therefore,

sharing the manufacturing and analytical activities will lead to more reliable and cost-effective results, as well. The potential research groups implementing the research would be the following: Finland Denmark Sweden Norway Germany VTT, Research Centre of Finland, Espoo, Dr. Anne-Christine Ritschkoff Danish Polymer Centre, Roskilde, Dr. David Plackett Dept. of Fiber & Polymer Technology Royal Institute of Technology (KTH), Stockholm, Dr. Lars A. Berglund Norwegian University of Science & Technology, Trondheim, Dr. Kristiina Oksman Institut fur Werkstofftechnik, Kunststoff- und Recyclingstechnik Universität Kassel, Kassel, Dr. Omar Faruk Luleå University of Technology Luleå, Dr. Roberts Joffe Institut fur Polymertechnologien e.V., Wismar, Dr.Hans Korte

1.1.2 Better understanding of role of fibre structure

Positioning: Applied

Short Description: Wood fibres have great potential as reinforcement in composites. However, in order to exploit their potential and to make the competitive with other fibres more research is needed to understand how fibre separation techniques as well as degree of disruption of the cell wall structure affect physical and mechanical properties of composites. Compatibility with polymer resin systems (thermoplastics and thermosets) needs also to be addressed together with the possibility of developing bio-resins. The paper industry has tackled similar problems in relation to papermaking but the equivelent knowledge for wood-based composites is much less

Justification: The demand for sustainable, renewable and biodegradable materials is growing but they will not succeed unless they become competitive on economic as well as performance arguments. The reserach should provide a strong scientific link between the wood fibre as made by trees (fibre quality, control of properties), their extraction (fibre aggregates, individual fibres, cellulose micrifibrils) and their re-constitution within composites. As a result, improving the performance of wood-based composites can make tham more competitive with significant positive environmental impact

European relevance and collaboration: Wood is a European asset with a strong presence in high quality basic and applied research in many countries. Better integration of this knowledge would be enhanced by Europea-wide programmes. There is a very thriving community actively involved in COST Actions which could make a significant contribution. STFI in Sweden, BOKU in Vienna are among the reserach groups which can have a key role

1.1.3 Wood based composite material, with preserved fiber-organization

Positioning: Applied

Short Description: Wood has as material very good properties in elasticity and strength combined with a relatively low density. This is partly due to that wood is organized in several hierarchic levels from molecular to macroscopic scale. Unfortunately it also suffers from problems with unevenity in the structure, which means that a large fraction of the biomass harvested from the forestry cannot be used in sawn timber products. Such material is to a large extent used for pulping, where the fibers are separated from each other by chemical or mechanical means. Except for production of papers and boards, pulps are used in composites. By the fiber separation in pulping, the organization on macroscopic level, i.e., the fiber orientation is lost. In this project, novel types of high performance composites based on wood fiber with preserved fiber orientation. Such materials will have excellent properties and can be used to replace plastics and even metals in many applications.

Justification: The use of non-renewable resources for production of materials of different kinds is not compatible with a long time resistant technical culture. Furthermore, the use of petroleum products for plastics is hazardous on the global climate, since it increases carbon dioxide to atmosphere, which leads to a green-house effect with increased temperature as a consequence. Thus there is a strategically interest to increase the use of renewable raw materials. Unfortunately, the qualities of materials made of renewable resources are not always as good as the corresponding non-renewable materials, as paper compared to plastic films. Therefore it is of large strategic interest to develop novel high performance materials based on wood.

European relevance and collaboration: The European union is a densely populated area with a diverse industry, including a large branch based on forest products. The development of high performance environmentally friendly materials based on the renewable raw material wood is therefore an all-European interest. The project is complex and many different research groups in different disciplines need to be involved. The project shall be coordinated by the department of Fiber and Polymer Technology at the Royal Institute of technology, Stockholm, Sweden.

1.1.4 Rheological properties of woodfibre-reinforced composites using model interfaces prepared by chemical modification

Positioning: Basic

Short Description: The utilisation of wood fibres in polymer-reinforced composites has considerably increased in the last few years. More and more products are now found in the market place, especially in United States (decking, window frames…). To develop this product and create new applications, more basic research is required, especially to understand mechanisms at the polymer/fibre interface. For instance, one critical barrier to obtain valuable agrofibres-reinforced composites is the lack of adhesion between the hydrophilic fibres and the hydrophobic polymer. In the current proposal, the chemical modification of lignocellulosic materials is envisaged in order to improve interfacial properties and to understand the mechanisms involved. The chemical modification of lignocellulosic fibres with model treatments will be carried out, to create model interfaces. These model interfaces will then be studied with regards to their rheological properties.

Justification: - Development of the fundamental knowledge about interfacial properties of woodfibre-reinforced composites - improvment of rheological properties of such composites - New applications for woodfibre-reinforced composites -development of bio-based marterials.

European relevance and collaboration: - this research is important in Europe to conccurence American products and research, which is much more developped. - European groups that could be involved: University Bordeaux1 (France), CTBA (France), The biocomposites Centre (UK), University of Goettingen (Germany), VTT (Finland), University of Lorient (France)

1.1.5 Composite matrix from soluble cellulose (Celmax)

Positioning: Basic

Short Description: The biotechnology-based process (EU project FP6-505567-1 Biocelsol) for producing >98% alkaline soluble cellulose is utilized in thin composite manufacturing. Viscous cellulose solutions are blended with composite fibres (pulp and synthetic) and different shapes of plates are produced by acid coagulation method. The mechanical and durability properties of plates are studied and the manufacturing method is optimiszed.

Justification: The main innovation is related to products based on fibre-cellulose(polymer)-composites, where cellulose (II) is first time used as matric polymer. New products in the area of composite plates for building, machine, and packaging industries offer competitive advantages for old and new companies.

European relevance and collaboration: Within the background project Biocelsol a network of excellence on bioprocessing soluble cellulose from various pulps has been built. The project is realized with the collaboration of Biocelsol solution group and reserch institutes/industries specialised on chip board technology.

1.1.6 heat treated shavings for insulation material

Positioning: Applied

Short Description: This research issue is about heat treated shavings for insulation material. It can be studied on a two disk measuring tool bfor insulation properties and by putting weight on for static resistance.

Justification: Heat treated shavings could enhance regular shavings in terms of insulation properties and static resistance. Therefore it makes the use of wood insulation material more competitive as compared to regular mineral insulation material. This is a step into eco friendly house building and therefore important for a healthy environment. A precondition for the broad use of (heat treated) shavings is the legal authorization by the Bundesamt für Bauwesen.

European relevance and collaboration: The hat treatment of shavings can advantageously be done via the french retification procedure. The testing site for our trials is in Germany. The Rétitech S.A.R L. company (F) specializes on heat teratment, the Technische Hochschule Kaiserslautern and the Forschuungsanstalt für Waldökologie und Forstwirtschaft Rheinland-Pfalz (G) could play key roles in testing the heat treted material.

1.1.7 Mono-Component Cellulose Materials

Positioning: Basic

Short Description: The project aims at developing multiphase mono-component nano-composite materials based on wood cellulose and modified wood cellulose. In a "All Cellulose Composite" by adjusting the cellulose structure by partial dissolution/mercerization so systems with variations in crystal lattice (cellulose I or II), degree of order (crystalline and more or less unordered) and size of load bearing components (crystallite or cellulose fibril dimensions) are obtained. In a "Derivatized Cellulose Composite" by controlled derivatization of cellulose fibril surfaces to obtain partially thermoplastic regions (matrix) reinforced by underivatized cellulose fibrils (fibril cores). The project will involve studies of cellulose substrate (ultra)structure to optimise reactivity and accessibility, followed by chemical and physical modification to obtain mono-component cellulose materials and evaluation of mechanical properties and biodegradability

Justification: Because of recyclability, nowadays there is a major trend to focus on simple, mono-component systems rather than on complex polymer blends. As an alternative to composite materials based on several chemically different components the development of single natural polymer mono-component composites based on cellulose fibrils (or crystallites) in a cellulose matrix might be a promising approach towards renewable, recyclable and environmentally friendly material systems.

European relevance and collaboration: A close and symbiotic relation between the European chemical industry and the forest products industry cluster in the development of material technology for the refinement of wood-based raw materials will be a substantial step to protect the global competitiveness of the European forest products sector. A competitive and sustainable European forest products industry, transformed from resource-based to knowledge-based product concepts, will help to secure employment and infrastructures, of which SMEs are important parts, particularly in rural areas. Research groups in fields of wood morphology/ultrastructure, cellulose chemistry/technology and material technology should play key roles in the implementation of this research.

1.1.8 Wood polymers in coatings

Positioning: Applied

Short Description: The objective is to clarify whether wood based fibers and wood based biopolymers (e.g. lignin, cellulosa, tannins) could be used as effective and cost efficient binders in coating colors instead of currently used oil-based binders. The suitability of the wood based binders in coatings can be fairly well assessed already with laboratory coating trials and laboratory test printings. A interdisiplinary literature review is needed in order to clarify the polymer material sources available.

Justification: Subsitution of oil-based binders with biopolymer ones support sustainable value chain in paper production. Also more better use of by-product streams (in paper making) enhances efficiency and decreases waste. Biodegradability of paper is also improved.

European relevance and collaboration: This kind of approach needs wide networking accross the wood to paper value chain. Knowledge from the coating process technology needs to be combined with understanding of the polymer properties and modification. Institutes, universities and small spin-off companies working on fibre modification or on effective use of raw materials should join in this research project.

1.1.9 Improving interfacial compatibility in biocomposites

Positioning: Basic

Short Description: Nature has been an engineer far superior to man in the design and manufacturing of high performance biomaterials. Mimicking biological systems to synthesise organic polymers and to self-assemble molecules represents an exciting challenge for the future. By learning from nature we can improve biocompatibility and engineer material surfaces to have many different properties for increased functionality. The vision for this part of the proposal is to use the complex cell walls of wood fibres as a biomimetic model for advanced materials design by way of interdisciplinary research.

Justification: In composite materials, the interfacial stability and the mechanical properties depend on good association of the reinforcing unit with a polymer matrix. Since cellulose is hydrophilic it is poorly compatible with most hydrophobic matrices. Surface modification of cellulose is therefore a prerequisite for its effective use as a reinforcing component in high performance composite materials. However, the hydroxyl groups available for chemical modification of cellulose surfaces are also responsible for the mechanical properties of cellulose. Therefore, chemical modification often leads to loss of fibre strength. This has led to increased interest in enzymatic modification of cellulose surfaces by e.g. laccases and peroxidases to activate surface exposed lignin. To permit chemical modification of pure cellulose, the use of other natural polymers such as xyloglucan as chemo-enzymatically modified compatibilizer binding to cellulose surfaces has been recently demonstrated. By integrating top-level European expertise in the key areas of biomaterial science and technology, new types of materials that are both biodegradable but also have high performance can be developed.

European relevance and collaboration: Many very competent European groups have expertise in biotechnological modification of plant fibres e.g. at KTH, Stockholm, Sweden and at VTT, Espoo, Finland. Good biomaterial science is carried out e.g. by at the CNRS in Grenoble, France, and at KTH, Stockholm, Sweden.

1.1.10 New eco-efficient and durable wood polymer composites for outdoor applications

Positioning: Applied

Short Description: One of the major issues of wood based composites is their high moisture sensitivity, and the great difference in hygro-thermal properties between the wood and polymer components. The over-all objectives of this research work is to develop a new knowledge-based generation of eco-efficient and durable wood polymer composites (WPCs) for the use in outdoor applications. Specific scientific objectives are to to achieve a better understanding of I) wood polymer interaction also involving the interference with water; and II) biological and weathering deterioration mechanisms of wood-polymer systems. The goal is to create breakthrough technologies for improved bonding between wood and polymers in the presence of moisture combined with improved resistance against microbilogical decay and weathering. The conceptual idea is based on new eco-efficient wood modification technology which has the potential to create a water resistant wood-polymer bonding. Examples of potential wood modification routes are acetylation, furfurylation and heat treatment. State-of-the-art analytical methods need to be applied to deliver insight into the complex wood-polymer systems in the wood cellwall as well as wood-polymer interfaces. Extensive durability evaluation based on decay experiments in laboratory combined with out-door field test in ground and above ground should be performed as well.

Justification: Environmental concerns about traditional toxic biocides, such as creosote and chromated copper arsenate (CCA), to prevent biological deterioration of wood and wood composites have resulted in an urgent need for new eco-efficient, durable and sophisticated wood-based materials. An example is so-called wood polymer composites, or biocomposites, from renewable resources and recyclable plastics. Such materials are easily formed to building blocks by profile extrusion or to three dimensional shapes, e.g. furniture components, by injection moulding. Demands related to both material properties as well as economical and ecological issues have to be fulfilled, i.e. the materials have to be sustainable or eco-efficient. Wood based materials have an intrinsic potential to fulfil these criteras, i.e. being made from renewable resources avilable in vast quantities and if properly design e.g. a high strength-to-weight ratio. A development of more sophisticated wood-based materials and systems has the potential to create numerous innovative and knowledge based industries in Europe.

European relevance and collaboration: To be able to exploit the full potential of wood, advanced analytical methods need to be applied to engineer new wood-based materials, especially regarding the moisture sensitivity. In this case, multidisciplinary formations between applied wood technology research and more fundamental material science research is necessary. Collaboration between strong research groups at e.g. KTH BiMaC, SP Trätek, VTT, Wood K-Plus, Kassel University could form a strong platform for a successful implementation of the research.

1.1.11 Wood powder as filler in barrier biomaterials for packaging

Positioning: Applied

Short Description: The research aim to develop wood powder filled biomaterials and a production process that can be used by the conventional packaging industry for making packages with special barrier properties. There is a great potential for the packaging industry if wood powder are used in packaging biomaterials. The oil prices increases and so do the demands on environmental sustainability. Renewable, biodegradable, or biofragmentable, plastic materials can be developed by using wood powder fillers, occurring from by-products and virgin products of the forest industry. One of the purposes by this research is to develop and understand the mechanism behind a selected group of renewable and natural compatibilisers that enhance the interaction between the wood powder and the matrices. The methods and equipments that will be used are e.g. co-extruder, rotational die cutter and compression moulder, SEM, AFM, OM, FTIR, DMTA, etc. The studied aspects are, e.g. temperature profiles, shear impacts, surface adhesion, sealability, hot-tack, effects of compatibilisers/surfactants, printability, etc. Migration, permeabilties, and the mechanism that controlls the barrier properties will be studied. Research will be performed on synergistic effects between the wood powder particles and the matrices, which improve the barrier properties. A source of competence that is requested is expertise on wood extractives.

Justification: Potential innovations and products are packaging plastics, based on 75-80 % of wood powders. This aim to replace more than 50% of the traditional plastic materials with wood powder. A limited amount of research has been performed in this area (except for non-renewable plastics), but with less appropriate matrix materials and without renewable compatibilizers. This project will contribute to European industries' knowledge about renewable wood based composites. The social effects will be increased environmental considerations, usage of renewable packages and highly increased use of wood in the traditional plastic industry. Increased usage of environmentally friendly packages, as will turn out of this project, will contribute to a decreased usage of traditional packaging plastics. This will in turn save the environment from pollution, decrease green house effects and plastic waste. The developed materials will be biodegradable or biodefragmentable, so the landfill problems will be strongly decreased. The aimed renewable composites will be developed and studied after the demands set by the industry, and fully competable with traditional plastics All composites will be possible to run in traditional process equipments and the final quality of the wood filled packaging materials will not be less than the traditional plastics that are used today.

European relevance and collaboration: Packaging waste is an international problem, and strongly regards all European countries. European packaging companies, forest industries and retailers are natural partners. By developing renewable wood based plastics, the competitiveness for European companies over e.g. American and Asian companies will strongly be improved. Competence, from several European forest companies, plastic producers and packaging retailers are found in e.g. Finland, Sweden,

Spain, Germany, Poland, Netherlands and Denmark. Specific skils on wood powder is found at e.g. KCL (Finland) and STFI-Packforsk (Sweden). Biomaterial competence are found at e.g. TUT (Finland), Cobro (Poland) and IATA (Spain), ENSA-INRA (France), STFI-Packforsk, KTH, Karlstad University (Sweden), etc.

Sub-area 1.2 Eco-friendly chemicals and polymers

1.2.1 Chemicals of Non Wood Forest Products - Innovation in the forest

Positioning: Basic

Short Description: Organic compounds, obtained of Non Wood Forest Products, parts of the tree other than wood, are tested for their application possibilities and potential to launch the market. In the first phase the project focuses on the identification of NWFP – compounds and substances from selected tree types and their existing areas of applications considering technical, cosmetic and chemical - pharmaceutical utilizations. Phase two will analyze the best possibilities of converting ideas for utilizations/products into tangible product developments (product innovations) for chosen NWFP (4 or 5 substances). Furthermore a technological feasibility for the intended products will be given. Meanwhile market research will be carried out. This will identify the most suitable NWFP with the highest market potentials as well as show the market requirements for derived products. By doing so the potential value added and the market impact will be obtained allowing detailed estimations on the socio-economic implications of NWFP product developments. Derived from these three working packages possible steps to NWFP - product developments as well as steps to concrete market launches and to the production (up to pilot scale) of NWFP products will be facilitated. These outcomes should be implemented with the foresters and industrial partners in following projects.

Justification: - implementation of new and innovative applications of chemical compounds from Non Wood Forest Products (NWFP) for technical, cosmetic and chemical - pharmaceutical applications in industry - development of rural areas - transformation to a knowledge-based industry in a sustainable context - creating new employment and qualified jobs - raise the awareness of the forester for NWFP and their utilization potentials - created structure is intended to keep the bulk of value added within the circle of foresters - will open new opportunities to use materials of the wood in different parts of industry - ambitious highly innovative project with a potential for a real breakthrough in this specific research field - new technologically and economically feasible value chains for NWFP - product developments from NWFP - generate a platform of stakeholders from industry and silviculture

European relevance and collaboration: - important role in the generation of value added for the European forestry sector in order to strengthen sustainable incomes and create additional jobs in rural areas - Major competence needed: A multidisciplinary team consisting of : chemists, economists, foresters, representatives of industries (chemical, pharmaceutical, technical and cosmetic), technicians

1.2.2 New techniques for wood modification

Positioning: Applied

Short Description: Wood is an aesthetic and renewable material which is available worldwide and can be used in a wide application range. Due to of its natural characteristics it shows some disadvantages compared to other materials, like metal, plastics or concrete. The resistance against biodegradation and the weathering performance of most wood species grown in our moderate climate is relatively low. Normally biocide preservatives are used to elongate the service life of wooden products. Alternatively, highly durable tropically wood species can be used for outdoor applications. The public discussion about the sustainability and management of rainforests as well as about toxic substances used for wood preservation requires the development of new treatments for our native wood species. The objective of wood modification is to improve specific disadvantages of wood, such as low dimensional stability, biological durability or resistance against UV-light, by changing its cellular and molecular structure. Various chemicals and treatment techniques offer significant potential for wood modification, but only a very few processes, like heat treatment or furfurylization, have reached the industrial scale. Further investigations will be necessary to make these promising processes available for wood working companies and to widen the application rang for our native wood species.

Justification: The competition of wood against alternative high-tech materials for all kinds of applications is intensified. Especially the high maintenance costs of wooden products in outdoor usage have negative influences on its image. Various thermal wood modification techniques have been investigated and scaled up in recent years, so that presently approximately 26 companies produce thermally treated wood in Europe. That indicates the big demand for durable and environmentally friendly wood. Although a lot of different types of non toxic and eco friendly chemicals showed very promising results on a laboratory scale, only Furfurylization has reached the industrial scale in 2000. In contrast to the thermal treatments, by using chemical wood modification, different mechanical properties, like surface hardness, compression strength and E-modulus can be improved as well. Other polymerizing resins, which have been used by the textile and paper industries for many years and which are available in a huge amount, have already proven their modifying potential. Different kinds of silicon compounds have shown potential for hydrophobating effects as well as for an increased durability against fungal attack. Moreover, different anhydrides are suitable for wood modification. These techniques are able to improve the characteristic properties of our native wood species without using toxic substances, so that their application range could be improved and the wood consumption could be stimulated.

European relevance and collaboration: The development of modification techniques on an industrial scale requires the collaboration of research institutes, wood working companies, the chemical industry and mechanical engineers. A lot of knowledge in all of these fields is necessary to establish new methods. All over Europe wood science institutes are already dealing with the modification of wood, for example in Great Britain

(University of Wales Bangor in Gwynedd; Centre for Timber Technology and Construction, Building Research Establishment in Garston), Netherlands (SHR Timber Research in Wageningen), Germany (Institute of Wood Biology and Technology in Göttingen, Federal Research Centre for Forestry and Forest Products in Hamburg; IHD in Dresden); Belgium (Laboratory of Wood Technology in Ghent), France (Laboratoire de Chimie des Substances Végétales in Bordeaux), Norway (Norwegian Forest Research Institute in Ås), Latvia (Latvian State Institute of Wood Chemistry in Riga), Sweden (SP Swedish National Testing and Research Institute in Borås) and Austria (University of Natural Resources and Applied Life Sciences in Vienna).

1.2.3 Development of WPC for outdoor appalication in hazard class 4

Positioning: Basic

Short Description: The aim of this research is to find environementally friendly alternatives to the classical preservation techniques involving heavy metals used actually for hazard class 4. The approach envisaged concerns chemical modification of the wood polymeric backbone through impregnation of easily curable waterborne monomers able to penetrate in cell walls and to fill lumina.An important part of this project concerns the nature of the investigated monomers which should be if possible obtained from renewable materials.

Justification: Developp green chemistry in the field of wood preservation. Promote the use of wood allowing to stock Carbon

European relevance and collaboration: Several groups are working in the field of wood chemical modification and could be implied in such program

1.2.4 Modified Biopolymers for wood preservation

Positioning: Basic

Short Description: The modification of biopolymers is a eligible candidat to replace inorganics salts for the preservation of wood. The chemical modifications focus on the understanding about the antimicrobial and antifungi properties of chitosan and chitosan derivatives.

Justification: The main innovation is the selectivity of this kinds of chemical for bacterial, fungi and insects. The preconditions of these impacts dependent on a better understanding of the iteractions between microorganisms and these new chemicals.

European relevance and collaboration:

1.2.5 New glues and coatings for wooden interior components for building and furniture

Positioning: Applied

Short Description: For the next years, environment, health and safety will be always the main words for the production and the using of wooden components in the interior usage (doors, floorings, furniture, ...) For that the green chemistry must be developed to propose new glues, coatings or polymers materials. The research must be a collaboration with the raw materials, the glues and coatings producers, equipment suppliers and users. The Nanotechnologies may be inclused to obtain some performance. The REACH programme will modify the supply of raw materials. Coatings and glues must integrate this new data in the future. In the same time new products provided by the green chemistry will have to be assessed in terms of processes, performances and end of the life but also during their use by consumers (related to the Indoor Air Quality)

Justification: This research must give solutions to continue to produce in European Countries, for that solutions must be innovative, safe with regard to the European Regulations, competitive. The aim is to keep some industrial activity in European countries for the emplyoment (for example for furniture coatings are very crucial to be innovative and reactive on the market).

European relevance and collaboration: This research must be a collaborative research between the market demand (furniture, flooring, interior build compoents, ..) the different supplies (products, chemistry, processes, ..) and R&D units and Universities. For some part of studies, Industrial Associations or end-users or consumers associations may be involved to integrate all parameters.

1.2.6 Health-care products from wood and bark components

Positioning: Basic

Short Description: It is well known that extractives such as e.g. certain lignans and flavanoids may have medical, e.g. antiviral effects on human and animal cells. Similar types of effects have been reported for lignins. Numerous examples from the polysaccharide field are also well known. The search for such compounds has, however, not been done in a very systematic way and a cooperation between wood chemists and medical/pharmaceutical chemists seems highly justified. In that way, the isolation technique of individual components from wood or bark, their possible chemical or enzymatic modification and their structure – efficiency properties in medical applications could be elucidated and further developed. This research area requires a broad range of scientific and technical knowledge as well as work on a variety of selected tree species.

Justification: The development of non-toxic compounds of plant origin that can interact with biomolecules including proteins can have potential medicinal benefits. Such high value-added products from low value starting materials would contribute to the competitiveness of the European industry and provide opportunities of using former agricultural land for the production of new types of biomass. In selected rural areas in Europe, such a development may strongly increase job opportunities and thus the standard of living. Health-care products based on renewable resources and with an emphasis on biochemical conversion processes will also add to the sustainability of the society.

European relevance and collaboration: The forest-based sector in Europe is wide-spread, has a strong economic and social weight and a global technological leadership. The traditional production of solid wood, pulp and paper products is, however, challenged by similar production in other parts of the world enjoying much lower raw material and labour costs. At the same time, the manufacturing technology is available everywhere. The strongly growing competition will result in successively decreasing margins in traditional forestry products. A development of new areas of use for wood combining smaller scale of production with sophisticated new technology aiming at high value-added products therefore seems highly justified. Suitable academic and institute participants in such a development are available throughout Europe thus making this area very suitable for joint research efforts. The presence in Europe of world-leading companies within the pharmaceutical, the forestry and the enzyme supplier sectors should give a strong industrial backup.

1.2.7 Novel Adhesives from Derivatives of Vegetable Oil Components

Positioning: Applied

Short Description: Other than surfactants and soaps, vegetable oils like palm oil being triglycerides of fatty acids, have a number of excellent properties, which could be utilized in producing valuable PU products. These PU products could be coatings and/or adhesive binders. The research should focus on the development of adhesive binders for the gluing of wood based panels (eg. MDF, OSB, Veneers, Malamine Paper). The first step is the screening of potential vegetable oils for their suitability as adhesive resins. The functionality must be checked and adapted to be well above 1.5 being suitable for polymerisation. To enhance the functionality crude vegetable oil must be refined and synthesized via reactions typically carried out in the oils and fats industry such as esterfication, transesterification, epoxidation or alcoholysis. The characterisation of modified oilderivative such as determination of hydroxyl value (OHV), acid value (AV), iodine value (IV), viscosity and colour follows. In the next step desired polyester polyol resin will be synthesized and finally will be tested in commercial adhesive formulations used in the wood based industry in Europe. The provision of fundamental vegetable oil derivates will involve close by Fraunhofer WKI well established collaboration with respective chemical companies in Europe.

Justification: Owing to the steady rice in crude oil price, polyols based on vegetable oils are increasingly becoming more viable alternatives to the petrochemical polyols. Now polyester polyols account to 25% of the market and this upward trend is expected to continue. In line with this development, Fraunhofer Wilhelm-Klauditz-Institut WKI in Germany has invented a new type of polyol derivative (polyester polyol resin) made from palm oil products, which is found suitable for applications in 2K PU adhesives. However, substantial R&D is needed to convert these findings to other vegetable oils being more pre-dominant with higher supply rates in Europe (eg. rapseed, soya bean, sunflower oil). These developed vegetable oil based adhesives can be supplied roughly 25% cheaper on a long-term basis given that the price for crude oil will further rise in the next 5 to 10 years. Besides the vegetable oil based adhesives can be produced on an industrial scale process.

European relevance and collaboration: The wood industry enterprises in Europe are facing similar challenges such as reducing their overall production costs, improvement their eco-balance and to identify alternative more eco-friendly solutions to replace the conventional materials. Thus to foster the development of adhesives from natural resources, European research institutes and industrial R&D departments shall collaborate to develop suitable resins from different vegetable oil resources. Many European organisation and global industrial players already possess significant knowledge and experiences in this field. Here, public R&D centres in Austria (University Vienna), France (NCTRM, ISPA, Alencon), Germany (Fraunhofer WKI, Universität Freiburg), the U.K. (BC, Bangor) and Nordic Countries (Technical University of Denmark, Department of Chemical Technology, Lyngby, Denmark, Riso National Laboratory, Roskilde,

Denmark, Lund University of Technology, Sweden) together with key industrial core groups (Cognis, Akzo Oleochemicals, BASF et al.) shall effectively cooperate to up-scale the existing current developments in this area.

1.2.8 Reduction of VOC from solid wood and timber materials

Positioning: Applied

Short Description: Forest-fresh pine wood contains approximately 0.5 and 2 % mono-terpenes, above all a- und b-pinene, 3-Caren and carvenes. The typical odour of fresh pine wood results from these compounds. Therefore all natural construction units from pine wood contain terpene emissions in combination with pine wood odour. Additionally from these fatty acid-rich woods smell-intensive aldehydes are set free within the hot drying process and pressing by thermo-oxidative reactions. However hardwood only contains small quanti-ties of terpenes. Wood based material is manufactured from cut wooden particles (ve-neers, strands, splinters, fibers) under addition of an adhesive usually manufactured into board shape products. Oriented strand boards "(OSB) made of laminar splinters ("strands") are in the meantime the third-most important wood based materials and predominantly applied in the building branch. Also wood based materials of this kind emit volatile organic compounds (VOC Volatile Organic Compounds) due to the pres-ence of pine wood as raw material. New legal regulations or stipulations for building products complicate the competitiveness of ecological wood products compared with other, probably more less emitting products but altogether less ecological products (primary energy need, CO^2-Emissionen). In order not to discriminate wood as building material, the technical and material bases for the wood working manufacture process to solid wood products or high-quality innovative oriented strand boards (OSB) obtaining low emission values shall be researched upon.

Justification: To fulfil the requirements of given limit values, the users, e.g. the building industry, will request the building suppliers to deliver products with appropriate characteristics. Under these aspects the manufacturers and processing plants of wood products (solid wood, wood based material) must be able to estimate both the emission potential as well as possible room air concentrations of VOC and their sensory effect. Thus consumers can better be protected and informed as well as problems (complaints, rework etc.) can be avoided in advance. For this purpose the knowledge of suitable process engineering processes and or a choice raw material (wood based materials) and/or a pre-treatment is necessary. Questions raised in connection with the emission evaluation of building products have to be explained in order to obtain the meaning of importance of the wood as building product. Besides the fundamental research analysis, a co-operation with the respective industries to develop the process engineering that can reduce the emission potential to erase any doubts about a health impairment shall be sought. With the results of different individual work packages a technology shall be generated to the manufacturers of wood products which enables them to reduce the emission potential of resin-rich wood species to a large extent and/or the production of low-emission OSB from hardwood. The acceptance of wood products as ecological building material will clearly increase subject to building products of natural resources, which are considered at the same time as low emission products.

European relevance and collaboration: In case that justified or unfounded doubts about the ecological compatibility of wood should arise through the building product evaluation

direct economic consequences would follow. Primarily the European building industry and particularly small and me-dium-sized enterprises of the sawing industry and carpentry would be affected. For many smaller sawmills a further, even smaller decrease in sales would bear economical risks. The loss of further jobs, usually in structure-weak regions, would be one result. Disadvantages to the ecological building material wood can result from regulations for the permission of building products as well as from new standards for the interior air hygiene law by the EC and the corresponding critical behaviour of many consumers. This is actual neither justified nor intended. The solution of the emission problem is a multi-national European task, because only by a close collaboration of most diverse national research establishments solutions in the total European interest can be compiled, which consequently do not lead to a competitive distortion. The problem resulting for building products from the building product evaluation, is also for the manufacturers of painting systems, floor coverings, adhesives and wall coverings of importance. Research partners could be BC (U.K.), HFA (Austria), Trätek (Sweden), VTT (Finland), CTBA (France) and others.

1.2.9 Development of innovative cellulose solution formulation technology (Cellatex)

Positioning: Basic

Short Description: Alkaline soluble cellulose (II) manufactured by biotechnical method is basing on enzymatic activation of bleached pulp. The use of sodium hydroxide in dissolution and sulphuric acid in regeneration of cellulose (II) needs large amounts of water and produces electrolytes (Glauber´s salt) into process water. The aim of this study is to research and develope stable cellulose water-based latexes by using cellulose with reduced molecular mass, high concentrations and latex surfactans.

Justification: The demand for using latex-binders for coating of paper and package materials is high. The main innovation of this project results in creating a natural cellulose(II)-polymer-based coating for paper and packaging products. These new types of latexes offer new business-opportunities for related paper and chemical industries. The use of cellulose in coating decreases the oil-dependency, water pollution and favours the utilisation of renewable raw materials.

European relevance and collaboration: There are basic groups in EU (Biocelsol)and Scandinavian (NewCell) projects formed by researchers and industrial partners for developing technology for activation, direct dissolution and derivatives of cellulose. These groups include TUT, VTT Biotechnology, Univ.Helsinki,Åbo Akademi, and KCL Finland, KTH Sweden, Univ. Potsdam Germany, Inst.Chemical Fibres, Poland.

1.2.10 Biodegradable substances in wood protection

Positioning: Applied

Short Description: Controlling the moisture content is very effective way to protect timber. Natural oils are capable of preventing the water uptake by wood. Additionally, these unsaturated oils can oxidize when exposed to the air, which results in a more protective layer at the wood surface. However, the oil oxidation within the wood is slow, and oil tends to be exuded from the wood. The aim of this research is to enhance the durability of the wood with environmentally friendly, biodegradable substances such as natural oils. More specific, the methods to accelerate the oil oxidation within the wood will be studied.

Justification: Systems enhancing the durability of wood should be sustainable both in production and use. In addition to this, treated wood products should, at the end of their life, be suitable for energy production by combustion, composting or for use as a secondary fibre source by related industries, without presenting any problems of residual chemicals arising from the treatment. Using this method increases the durability of sapwood, and also makes the wood more homogenous. This wood protection method can produce water repellent, environmentally friendly, more functional, and above all safer wood products that can be burned after the end of its useful life.

European relevance and collaboration: The European directive place restrictions on the substances, that have been used in wood protection. Also Americans have been banned some of these. Many new substances and methods have been widely studied all over the Europe, but none of these have proved to be excellent compared to the others. Collaborative European research might produce the substitute for the old systems. Professor Holger Militz from University of Göttingen could have the key role in the implementation of this research.

1.2.11 Nanotechnology applications in wet-end chemistry, paper laminates and coatings

Positioning: Applied

Short Description: There are several emerging nanotechnology applications in papermaking. Two groups of substances are nanocellulose/microfibrillar cellulosics and exfoliated clays. One aspect is their manufacture in large scale. Another aspect is their use in the above mentioned applications. Apart from patent literature/proprietary developments little is known about these fields of application.

Justification: A new generation of ecologically friendly (recyclable, less waste) barrier materials to replace PE-laminations on papers/board maybe developed. New high performance bionanocomposites may also emerge.

European relevance and collaboration: The complexity of the practical application of these additives onto paper/board is high. Many different approaches are possible and different competences are needed. This is a typically value added function late in the manufacturing chain. Greg WOOD, Pira International, UK; Tom LINDSTRÖM, Royal Institute of Technology and STFI-Packforsk, Sweden; Susana AUCEJO ROMERO, Itene, Spain; Christine CHIRAT, Ecole Française de Papeterie et des Industries Graphiques (EFPG); Lars Berglund, Royal Institute of Technology, Sweden; Lars Wågberg, Royal Institute of Technology, Sweden; and Sören Östlund, Royal Institute of Technology, Sweden

1.2.12 Cereal betaglucans as performance chemicals in cellulose composites

Positioning: Basic

Short Description: This research aims at creating novel biodegradable composite materials, made from renewable resources in the form of a wood cellulose fibre or fibril reinforced biopolymer matrix. One difficulty that has prevented a more extended utilization of wood cellulose is the lack of good adhesion to most polymeric matrixes. The hydrophilic nature of cellulose surfaces adversely affects adhesion to a hydrophobic matrix, resulting in both poor strength properties and moisture resistance. In the project plant hemicelluloses and their derivatives will be evaluated as performance chemicals for compatibilization and increased adhesion to cellulose surfaces. The main target hemicelluloses will be cereal betaglucans (for example oat and barley), and as reference xyloglucans will be used. Betaglucans are built up by β-(1,3)-linked cellotriosyl and cellotetraosyl units, and of more cellulose-like structural sequences and should therefore be able to show strong interaction with cellulose surfaces The project has the following objectives: § Characterization and selection of betaglucans based on European agro-industrial resources. § Chemoenzymatic synthesis of betaglucan derivatives. § Preparation of cellulose composites. § Demonstration on a pre-competitive level of composite performance.

Justification: There is an increasing demand for sustainable development and the replacement of heavy and non-renewable materials with new bio-based high performing materials. Hence, new products and materials are of great interest to the European forest products industry (pulp and paper, packaging and wood products). In the continuous strive to improve business; new products and the associated materials are of increased importance. Many of these materials consist of biofibres and are essentially biocomposite materials, on either micro- or macro scale.

European relevance and collaboration: In 2001, 15,100 tons of natural fibres were used for composites in the German and Austrian automotive industries. For the period 2001-2005, an annual growth of approx. 14 to 15% is expected. The current requirements of 5 to 10 kg natural fibres per vehicle – and the present production of 16 million vehicles in Western Europe – gives a market potential of 80,000 - 160,000 tons per annum for natural fibres in press moulding. To speedy expand the cellulose composite market collaborative European research in the fields carbohydrate chemistry, cellulose technology, biotechnology and material science is of outermost importance.

1.2.13 Tailor-made Polysaccharide Derivatives for New Biomaterials

Positioning: Applied

Short Description: The material properties of cellulose derivatives are highly dependent on their molecular structure. Conventional production processes of cellulose derivatives give only a very limited control over the distribution pattern of the substituents on the cellulose backbone. A precise control of the substitution pattern of the cellulose derivative structure bears the potential of biomaterials with tailor-made properties. Not only cellulose derivatives but also derivatives of other polysaccharides like hemicelluloses are subject of scientific interest. Addressing the potential of new raw material sources, like wood hemicelluloses, an in-depth knowledge of the raw material structure is necessary. Central objective of the research is to achieve good control over the substitution pattern to control the material properties. Since chemical synthesis of regioselective substituted cellulose derivatives are rather complex, it shall be focused on the usage selective enzyme catalyzed processes. Enzymes offer the possibility to modify biopolymers in a highly selective way. Screening of existing enzyme libraries as well as engineering enzymes is promising. Additionally the relationship between structure and properties of the new biopolymer materials needs to be addressed.

Justification: Polysaccharide derivatives with controlled substituent distribution promise new up to now unachieved material properties. Potential high-tech applications include membranes, liquid crystals, medical applications, paper-like TV screens, biodegradable plastics, food additives etc.. New materials with controlled properties are always desired by engineers in all industrial sectors. Cellulose derivatives are produced since 100 years without major changes to their production processes and they are possibly the wood based products with the highest added value. Recent developments especially in the application of enzymes in chemical processes have the potential to improve those processes. Enzyme-catalyzed chemical processes – referred to as ‘green chemistry’ – are environmental friendly industrial processes, avoiding or reducing problematic chemicals and energy consumption. In the spotlight of the growing environmental consciousness and the knowledge of the limitation of the current main resource for polymer materials – mineral oil – the usage of renewable sources becomes a future necessity. Wood as abundant renewable and sustainable managed resource of biopolymers will play a key role.

European relevance and collaboration: Europe, as a net importer of mineral oil, needs to find alternatives not only for energy production but also for raw materials for polymer material production. Using enzymatic processes for the production of improved polysaccharide derivatives is a highly complex issue. It requires the expertise on the enzymes, the polysaccharides, the derivatisation chemistry and their material properties. This expertise is available in different research institutes around Europe. A combined effort can boost the development of the above described new materials and production processes. Some relevant research groups are: Friedrich Schiller Universität Jena, Germany (T. Heinze); Federal Research Centre for Forestry and Forest Products,

Germany (J. Puls, B. Saake); University of Helsinki, Finnland (Maija Tenkanen); STFI-Packforsk, Sweden (O. Dahlman); CEMEF, France (P. Navard); University of Natural Resources and Applied Life Sciences, Austria (A. Potthast); Chalmers University, Sweden (P. Gatenholm); VTT-Biotechnology, Finnland (L. Viikari).

Sub-area 1.3 Creating new functionalities or improved to materials/products

1.3.1 Improvements in adhesives for bonded-in connections and reinforcements for timber

Positioning: Applied

Short Description: Joining timber using bonded-in rods is a rapid method for construction and the repair and reinforcement of timber buildings. Rods are frequently reinforced plastic pultrusions. However there is a question mark over the durability of these joints in a range of environments and the choice of adhesive is critical. A concerted effort is required to assess the environmental stability of candidate resins in various bonded configurations. In addition standard methods for the application of resins should be embodied in new codes of practice.

Justification: The results are immediately applicable to the construction of new buildings and the repair of old buildings. In socio-economic terms wood waste is reduced in construction and the fabric of old buildings can be preserved.

European relevance and collaboration: The issue is very pertinent to Europe where levels of new building are high and there is a very large stock of old buildings that require repair. Research groups throughout Europe are already involved in research into bonded-in connections but environmental aspects of joint performance are little researched.

1.3.2 Forecasting multidimensional feature parameters for sawn softwood

Positioning: Applied

Short Description: Sub-topics I. Multidimensional pre-conversion strength modelling for single boards a. based on traceable stand, tree and log predictors b. based on new technology for log quality assessment c. advanced physical and statistical modelling and analyses II. Improving accuracy of grading machines for sawn, dried boards by adding information from sub-topic I. III. Application and logistics in the production and merchandising chain a. discriminate when to apply such boards and when use traditional ones b. analyse the market potential c. calculating constructions with multidimensional strength parameters Multidimensional strength parameters: implies independent estimation for each of the strength parameters in question: rupture, stiffness, hardness, etc. Advanced modelling: physical models combining from molecular to full board level; involve the most recent multivariate statistical methods. Multi-disciplinary: involves foresters, engineers, architects, economists, mathematicians ...

Justification: In general, timber strength classification in use (EN 338) is one-dimensional, i.e. collinear for rupture, stiffness, hardness, density etc.. This implies per se a shortcoming of the system, which might also be related to strength assessment demonstrating generally low accuracy. Most grading systems, visual as well as machine stress grading, operates on a statistical basis for a timber lot, rather than on each single specimen. The struggle for better wood science analyses, grading technology, statistical approaches, and commercial implementation should continue, both to provide efficient European resource utilisation, and to improve the efficacy of timber as compared to competing building materials.

European relevance and collaboration: Historically, there has been European collaboration through CEN, and also Nordic projects, e.g. "Styrkesortering ger mervärde"; this cooperation should be continued. Specifically, the fundamental modelling approach of Lund University (SE), the wood property forecast model of Skogforsk (SE) and the partners in the first Wood Wisdom program should be involved. The Italian/Austrian company Microtec is the main supplier of innovative systems for the wood industries, and involves in turn RTD bodies in several countries. (The description is in no way exhaustive, but I didn't want to be too specific on all those topics well beyond my own competence.)

1.3.3 FiberPlastic - new eco-friendly fiber-based carriage material

Positioning: Applied

Short Description: - Idea is to study & develop new fiber-based "plastic" as a replacement for normal petro-chemical thermoplastic products for the case of future crude oil shortage & high prices - FiberPlastic could be realized by utilizing wood(?) fiber treated so that critical material plasticity properties are improved - Fibers will be treated chemically, mechanically and also with special paper machine configuration increasing plastic-like properties of final product

Justification: - FiberPlastic would be new fiber-based eco-friendly product which could open new industrial possibilities in chemical, machinery and wood product engineering in europe and in scandinavia. - At this moment the price of "paper bag" is much higher compared to "plastic bag" - BUT, the price of petro-chemical products is dependent of the price of crude oil. As the price climbs up, final price of the petro-chemical products will also increase. Finally in future, at some level, price competitiviness of wood(?)-based fiberplastic is equal with normal plastic products. - The time span of the price increase is diffcult to estimate, crude oil resources, however, are limited

European relevance and collaboration: - In future, fiber resources for normal papers will be located in south america and in asia. With they wood (eucalyptus, acasia) growth and manufacturing price level, european papermaking will be in great difficulties. - With this new product europe could fight back creating new prodcuts applied specially to nordic/european (long-fiber) resources - Research would need wide chemical-, wood-, machine supplier collaboration in order to fully reveal all benefical polymer-like properties in each process in production of fiberplastic - Main role in research would be in skandinavian forest cluster

1.3.4 Management of strength of sawn timber and laminations

Positioning: Applied

Short Description: This is a coordinated European action for management of strength of structural timber. It includes representative (species, growth areas, dimensions) sampling of sawn timber to be first characterised by NDT-methods and tested in bending, tension. compression and shear. Models for strength prediction will be developed.

Justification: Results contribute to strength grading methods and to strength values of European wood given in EN-standards. It improves competiveness of wood industries by enabling better optimisation of the use of raw material. In improves the competivenes of wood as structural material by giving more reliable strength data. It is based on improved strength grading methods, which are developed in the project.

European relevance and collaboration: This is a common problem of wood producing countries, which can be solved more cost effectively as a joint effort. Leading research groups of major wood producing countries in the area of strength grading and testing should be included.

1.3.5 High strength glulam

Positioning: Applied

Short Description: Modelling and understanding of strength of glulam needs to be improved. This includes bending and shear strength of large beams under long term loading in normal variable climate. Both numerical modelling and testing is needed. Theoretical backgroung exists to large extent.

Justification: To improve competitiveness, strength glulam needs to be incresed. Simultaneously, the capacity of different failure modes needs to be known to better accuracy than today because of structural safety concerns.

European relevance and collaboration: Best expertise is distibuted in different institutions accross the Europe. Best experts of fracture mechanics, moisture effects, modelling of bending strength, size effects, finger joints, and use of hardwood are working at different institutes.

1.3.6 Automatic grading of sawn timber and engineered wood products

Positioning: Applied

Short Description: The objectives of the research project are: - to carry out a testing program that covers all relevant European origins of timber (acc. to EN 14081 machine settings have to be developed individually for each timber source) and all existing grading systems in order to identify the advantages and disadvantages of different systems and to find out which geographic areas of Europe can be identified as a common growth area (so that the same settings are applicable). - to develop new technologies which are capable of detecting strength reducing characteristics that cannot be detected with existing systems, such as local grain deviations caused e.g. by breakage of the top of the tree, in order to make machine grading more reliable. - to investigate whether the "output control" quality assurance is better suited for the European wood industries than the presently used "machine control" system.

Justification: The target of this project is to provide the technologies to produce reliable wood products with improved material efficiencies. Thus, the competitiveness of timber as structural material will be improved and the market share of timber in construction will increase. The project will be beneficial for sawmilling, glulam and wood construction industries. The increased use of wood will improve the economic situation of forest industries; it will contribute to maintain and create new jobs in rural areas. The main reasons for improved automatic grading systems are: - Traditional visual grading systems do not allow to make full use of the inherent properties of the material. - At processing speeds in modern sawmills and woodworking industries of up to 300 m/min visual grading is no longer feasible. - The presently available grading systems are not approved for all commercially important species, origins and dimensions and the quality assurance systems need further improvement.

European relevance and collaboration: The present development of machine grading has been slow. The main reasons for this are that many wood industries are not familiar with opportunities of grading, grading equipment developers are small companies, which have not enough resources for strong development; so far research activities were made as separate actions; a lot of resources are wasted in small non-coordinated projects. A co-ordinated effort is needed to wake the industry up and to form an economic platform for SME's to obtain setting for grading machines, and to obtain a public database of strength values. All relevant European origins of timber have to be included. Therefore, research groups from North, Central and South Europe have to participate in the project. Within the CEI-Bois Roadmap 2010 activities "building with wood" a joint research proposal is under preparation.

1.3.7 Wood Modification to Improve the Properties of Timber

Positioning: Applied

Short Description: There has been considerable activity in Europe in the development of new wood modification technologies (heat treatment, hot oil treatments furfurylation, acetylation, resin impregnation, bio-treatments). Some technologies are already on the market, some are entering the commercial arena, and others are at an earlier stage of development. The developments of these technologies are being driven by current or impending legislation leading to conventional preservative syatems being phased out. It is very important that these new developments are integrated within a pan-European framework, similar to that of the Thematic Network on Wood Modification. This will allow for exchange of information, clustering of researchers and an efficient use of the European reasearch base. The development of these new technologies is important if wood is to remain competitive against non-renewable materials.

Justification: By adopting a pan-European approach, it will be possible to ensure that there is a crtical mass of researchers to drive new developments to commercialisation. New appropriate standards can be developed for these novel wood products. Public awareness of modified wood will be raised. Timber obtained from plantation resources can be upgraded by using appropriate modification methods. New markets can be found for timber products. Timber will be more competitive against non-renewable materials. These impacts will only be achieved if a pan-European integrated approach is adopted, this will greatly enhance local initiatives.

European relevance and collaboration: Only by collaboration at a European level will it be possible to obtain a significant impact in this area. This project will build upon the highly successful Thematic Network on Wood Modification. The research groups in the original network (Uni. Bangor, BRE, Uni. Gent, SHR, Uni. Hamburg, Uni. Goettigen, VTT, CTBA, INF Poznan, Royal Veterinary and Agricultural University (Copenhagen), Uni. Limerick, Uni. Brasov, Uni. Chalmers, Uni. Ljubljana, plus industrial partners) will be expanded.

1.3.8 Improved use of European hardwoods

Positioning: Applied

Short Description: Value-added use of European hardwoods is in target of this research area.

Justification: Improved / innovative use of European hardwoods to get more valuable products.

European relevance and collaboration: Analogical research is made all over Europe in the field of hardwoods for different hardwood species - technology/knowledge transfer between countries would bring more efficiency.

1.3.9 Prevention of mould on wood-based packaging materials

Positioning: Applied

Short Description: Wood packaging material for export to certain countries and for import into the EU market has to be heat treated according to ISPM No 15 standard (phytosanitary treatment). On most sapwood species which have undergone such treatment profound mould growth develops rapidly which is not acceptable. To temporarily prevent mould growth on packaging material before the wood has a chance to dry appropriate measures must be developed which do not include the application of wood preservative.

Justification: In Europe the production of wood based packaging materials (pallets, crates, boxes, cases, etc.) takes up considerables quantities of low value sawn timber. Since the phytosanitary heat treatment has to be carried out huge problems arise from mould development. Environmeltally friendly methods for prevention of this damage would help to overcome substitution pressure on wood pallets (e.g. by plastic pallets). Up to now wood packaging material can be considered non-contaminated by wood preservatives, a situation which will certainly change if no appropriated means for mould prevention are developed.

European relevance and collaboration: Wood packaging material is produced and used in all European countries mainly by SMEs. The problem specially occurs in cross boarder trade and for this reason cross boarder collaboration in problem solving is needed. Cooperative research between universities and SMEs in two or three neigouring countries provide considerable benefits.

1.3.10 Durable wood materials and products with environmental and consumer friendliness

Positioning: Basic

Short Description: "Environmental performance and long-term durability of wood materials and wood producs, and the relationships with the quality of life for people". Identification and evaluation of the main European wood materials that: 1) can stand the in-situ use conditions of use in their natural physiological, anatomic and chemical form, 2) need different treatments for the durability. Basics and evaluation of selected treatments for improved weather, fungal and insect resistance, fire resistance, and, simultaneously, for long service life, easiness for maintainance and DIY installation as well as healthy living and working environment for human beings (physical health, thereafter "mental" features of the "wooden" environments). Basic anatomic, chemical and physical characterisation of wood materials. Comparative and benchmarking studies on the product performance woods vs. woods and woods vs. competing non-wood products in selected end-use segments. Main European species with assumed durability should be included. Empirical focused sampling from green and dried wood should be the basis for the chain of wood material-wood product-in-situ utilisation studies. The field of studies may become large, so focusing is essential. However, both indoor and outdoor uses of wood should be included.

Justification: Value-added of wood products based on long-term, consumer-friendly durability and easiness of use. This helps to position different wood and wood products realistically in medium-term and long-term market, indicate/justify product development efforts, develop the standardisation of wood products and improve wood sourcing for the end-uses to be defined. The results contribute positively to the environmental, carbon sink and climate change discusssion, and the customer acceptance of wood products.

European relevance and collaboration: The theme is relevant for the consumer and public acceptance of wood in Europe, incl. environmental discussion, and, thus, contributes positively to the grounds of European wood products sector in the medium and long terms. The theme requires various competence and its developments from the partcipating research groups, thus, contributing to the scientific networking within Europe. The nature of the research is mainly basic research, however, with direct links to the industries ("applied basic research"). See also the justification (before). Wood scientists and technologists, chemists and molecular physicists as well as wood engineering scientists and medicine scientists should participate in the implementaion. Simulatneously, different climatic zones and the representing groups should be included. I suggest research groups from Finland (Metla, VTT/HUT, Åbo Akademi/University of Jyväskylä) and Austria (BOKU) completed with experts from UK and Italy or Spain, maybe also from Sweden.

1.3.11 Carefree wood surfaces with functional properties

Positioning: Applied

Short Description: Wood and wood composite materials have many advantages. However, in order to conserve the competitiveness of wood material there are some material based disadvantages which should be improved with economical and technical feasible modification methods. The following properties are to be improved: hydrophobicity, dimension instability under fluctuating moisture conditions, poor UV-light and fire resistance. Emissions released to indoor air by wooden material have recently been a interesting research topic. The properties of wood material can be modified and functionalised by exploiting nanostructures, such as nanoparticle additives and nanocoatings. The properties to be improved are controlled water vapor permeability and release of wood based VOCs, moisture resistance, resistance against UV radiation and weather, resistance against soil and contaminants as well as mechanical durability of wood surfaces (scratch resistance and surface hardness). The approaches to produce improved and functional wood material for different end-use targets will include the exploitation of barriers formed by non film forming nanostructures, such as carrier mediated nanoparticles and nanobarriers, active particles and nanocaotings. Nanocoatings provide a new transparent coating system with controlled properties and functionality

Justification: The study will result in following products and innovations • carefree wood material for building and construction targets o cladding materials with multifunctional properties (anti-soiling, UV-resistance, micro-organism repellency fire-resistance, maintenance freeness, moisture repellancy) o self-repairing surfaces against cracking • multifunctional wood material for interior use o controlled water vapour and moisture behavior, abrasion and scratch resistance, controlled voc emission properties o carefree and abrasion resistant material for furnitures • wood material with good performance properties for vehicles • interior decoration films or wall boards with good fire resistance and/or acoustic properties The research area will be an "imago-lifting" activity for the timber and forest industry by resulting in highly value-added wood-based products. In the long run, maintenance intervals of building structures will be lengthened which reduces chemical consumption and overall costs. By producing clean (mould-free) and functional surfaces, welfare and safety in the society will be improved and health care costs decreased.

European relevance and collaboration: The topic on improvement of wood material has raised interest throughout Europe. In some European and Nordic research institutes, extensive work on interfacial phenomena of different materials and on surface activation effects and functional nanomaterials have been carried out, whereas in some institutes, focus has been on processes and on performance of wood products. Combining the expertise areas of the different institutes lead more cost-effective research concept.. The potential research groups implementing the research would be the following: Finland Sweden France UK Germany VTT, Technical Research Centre of Finland, Espoo, Dr. Anne-Christine Ritschkoff Dept. of Fiber & Polymer Technology Royal Institute of Technology (KTH), Stockholm, Dr. Lars A. Berglund Centre Technique du Bois et de

l´Ameublement Dr. Laurence Podkorsky Coating Technology Centre, Teddington Fraunhofer Institute , Wurtzburg Dr. Klaus Rose Institute for surface Chemistry (YKI), Stockholm Universty of Göttingen, Göttingen Prof. Holger Militz

1.3.12 Inhibition of fungus on wood packaging material (wpm)

Positioning: Applied

Short Description: According to the FAO – ISPM No. 15 "Guidelines for regulating wood packaging material in international trade", heat treatment is one kind of requirement to reduce the risk of the introduction and/or spread of quarantine harmful organisms associated with wpm from raw wood. Based on various reports from operational practice, mainly fresh sapwood (that may have undergone a pure heat treatment without any kind of drying) shows a great affinity to fungus. The risk of mould increases with the heat-treatment process. The infestation causes no loss of the wooden strength property but it constitutes an optical and a hygienic problem. It is necessary to detect the reason for the increased mould risk by chemical analysis. Based on the result of this analysis different agents (environmentally compliant) should be tested on their inhibiting effect to fungal attack.

Justification: As a result of this research different environmentally compliant agents should be found, which avoid or inhibit at least temporary a fungal contamination of wpm. It is essential to bridge the critical period between the moistured and fungal sensitivity status and the arid and fungal unalluring status. One searches for alternatives to conventional methods and preservatives. Beside the effectiveness these alternatives should be economically acceptable and practically convertible.

European relevance and collaboration: The problem with moulds on heat treated wood is a common one in the countries which have adopt the IPM No. 15. Especially European softwoods used as packaging material (pine..) are susceptible to moulds after heat treatment. In order to be in business in international trading operations, it is vitally important to solve this problem. Otherwise those European woods might be substitute by tropical woods with less mould-risk. The Federal Research Centre for Forestry and Forest Products in Germany should have the key role in the implementation of this research. The Cooperation of similar European research institutes and industrial European partners is supposable.

1.3.13 Mould-resistent wood based panels

Positioning: Applied

Short Description: Throughout Europe there are plenty of damages of wood based panels in consequence of increased surface near relative air humidity and increased humidity of boards itself with different sorts of mould. The problem is described relating to a specific phenomenon, but knowledge of definite processes of genesis is still missing, such as the exact identification of ingredients of species of wood and involved species of mould which lead to increase mould growth. The influence of modern glueings on panel moisture in consequence of moisture cycles, the influence of production processes on the release of substances (drying, glueing process) or the influence of moisture absorption through cutted edges. E.g. a summarising question: Why is a plywood cave panelling out of mediterranean pine 2-4 times more affected by mould than a similar cave panelling out of douglas fir?

Justification: It is necessary to find out, what sort of changes of the production process or the glueing are reasonable and if it is possible to achieve through additives out of biogene-based substances in the production process an increased mould resistence, if necessary in cooperation with coating. In combination of basic research and applied research it is necessary to find out what sort of substances, which possibly release to a special degree through the production process and depending on the species of wood commonly used, lead to a special sensitivity towards mould. Furthermore it needs to be analysed what sort of steps could be taken in order to enable the dimerisation and neutralisation of these substances in the production process, for example through changes of the ph-value. In addition it is necessary to run laboratory tests with wood based panels with different glues (plywood, OSB, wood fibre boards, MDF, particle board) to analyse moisture content values of the boards in dependency on moisture cycles, which correspond to the cycle of a year of moisture changing of a not directly weather-exposed exterior board. Different climates have to be considered. From these tests perceptions for the further development of different sorts of glues have to be developed. Also it is necessary to develop and to test additional extended methods of coating and edge treatment of the boards, depending on special purposes of use (cladding, underside view of a roof, roof overhang).

European relevance and collaboration: The described infestation of mould on wood based panels spreads across Europe. Also manufacturers throughout Europe are affected (i.e. plywood and LVL- manufacturers in Scandinavia and France or OSB-manufacturers in Austria, Germany and France). The frequency of damage and the phenomenon have been evaluated so far in Scandinavia and Germany. In this case we suggest a cooperation between plywood, LVL- and OSB-manufacturers and groups of researchers of the Helsinki University of Technology (HUT), the Technische Universität München (TUM), possibly the CTBA and if necessary another East-European University. At these universities a cooperation between applied researchers and basic researchers of wood technology exists already.

1.3.14 Development of different function for a same material

Positioning: Applied

Short Description: The aims of this research is to develop multi fonctions wooden materials. The objectives could be the study of all abilities of nanotechnologies for wooden materials in order to give properties such as : fire resistance, colour resistance, biology resistance, ... These particules would be integrated in the wood may-be in the matrix. Researches exist on others materials, may-be transfers may exist. At present, wood must be innovative to be more used in buildings with fire property. In furniture, it is difficult to use wood in th contract usage because it is too weak. The demand is to have wood with the behaviour of metal, plastics...

Justification: For this work, it would be mandatory to have links between the labs who work in the Nano, the chemists, the different Wood Labs and the wood industry. The impact of this research is to produce new wooden materials which can be use in the place of metal, plastics in buildings but also in automotive, aeronotics, ... These two last sectors will want to use wood but wood must integrate new functions : fire, colour resistance, heat resistance, new decors....Positive results would be able to open new markets for wooden components

European relevance and collaboration: This study must be a collaboration between Wood and furniture industry, chemistry,physics, processing, Labs to assess performances....

1.3.15 Fibre modification

Positioning: Applied

Short Description: Find much better ways to modify kraft pulp fibres before papermaking. Methods could be chemical or biological. Methods should be economically and environmentally useable in millscale.

Justification: Better methods to tailor fibres according end-user/customer needs. Better quality, cheaper, bioproduct.

European relevance and collaboration: Europa cannot compete with China and S-America if same technology is used. We need to be ahead. KTH, Darmstadt Chem.

1.3.16 Nanostructures for improved stiffness of light products

Positioning: Basic

Short Description: The development in paper and board products has lead to increased use of mineral pigments. The products typically contain 20 to 40-45 % stone material in the structures. The idea here is to develope new technologies for paper inductry to utilize in the design and manufacture of products containing less high density mineral materials in structures, having excellent stiffness and keeping the good printing properties. Utilization of nanotechnology.

Justification: Lower transportation and postage costs, improves ability to compete with other materials, could create new applications to the fibre based products. efficiency and thus the competitiveness of forest industry. This would also improve the competitiveness to are also evident for

European relevance and collaboration: The emerge of nano to public discussion has created once again oversized expectations, "hype", and lead to national reseach programmes of publicv funding throughout Europe and globally. Woodwisdom-net could utilize here networking in these programmes in Europe.

1.3.17 Minimisation of emissions from wood-products with relevance for the indoor air quality

Positioning: Applied

Short Description: In order to reduce and control potential indoor emissions (formaldehyde and VOC) sources, several national and European initiatives have been launched. Their main task is the establishment of a harmonised health-related assessment scheme. Additionally, target values for indoor air concentrations of some compounds indicate thresholds. Consequently, control and reduction of emissions will become relevant for the manufacturers of wood-based materials. But the knowledge to adapt product emissions is still limited and not sufficiently sophisticated (e. g. change of raw material). New approaches to minimise emissions have to be developed. Additionally, the measurement of emissions is time consuming and not applicable for the online-control of the production (e. g. for wood-based panels). Consequently, new methods have to be elaborated and evaluated.

Justification: This research issue delivers improved material properties in order to meet future requirements. On the one hand higher expectation on building products with respect to indoor air quality and consumer protection can be ensured, and additionally conservation and the European wood building industry will be strengthened.

European relevance and collaboration: This subject is particularly suitable for collaborative European research activities, because national and European initiatives have already been launched to establishment of health-related assessment schemes. Therefore this topic is on the agenda in most European countries. There is a need of collaboration on the European level in the wood research sector to minimise wood product emissions. This is to strengthen the competitiveness of the European wood industry mainly in the building sector against non-wood products.

1.3.18 Durability and life cycle costs in wood construction

Positioning: Applied

Short Description: A long term, strong and goal-oriented R&D-program focussed on wood durability and life-cycle costs with relevance for modern timber construction is proposed. The main goal is to develop practically feasible engineering tools for decision making about and design of built facilities with wood. These tools should make it possible for developers and other decision makers to make reliable estimates of life cycle costs for wood structures. The scientific activities in the project consists of • Long term durability testing programs • Systematic evaluation of performance for existing built facilities • Documentation of practitioner´s experience (carpentry tradition) • Development of risk-based engineering models and tools The project shall deal with untreated wood, modified wood as well as wood protected by new environmentally friendly methods, for applications • outdoors above ground • in the building envelope The results from the project are independent scientific verification and documentation of • methodology of design for durability and moisture safety for above ground timber outdoors and wood in the building envelope. • effectiveness of new environmentally friendly methods for wood protection (thermal treatment, acetylated wood etc) • requirements and associated costs for maintenance of wood in different parts of a building • service life and effectiveness of surface treatments

Justification: There is a large potential to increase the use of wood in construction significantly on the European market today. Although wood building concepts are very cost-competitive and favourable for sustainability, there is often a strong resistance among decision makers and building professionals. The most common argument against wood is that there is the risks related to durability issues and cost of maintenance. The present practice of durability design is more or less based on carpentry tradition, and is only to a limited extent scientifically documented. This type of experience is also difficult to transfer between generations in modern education systems. Furthermore, past research about wood durability has been concerned with chemical wood preservation, and with methods which are not accepted today from environmental point of view. Scientifically documented information about maintenance intervals and service life in wood construction and rational methods and tools for durability design are necessary if we want to expand the use of wood in construction from todays level in Europe. Thereby, one very important obstacle will be removed so that the obvious advantages with wood construction can be realized.

European relevance and collaboration: The proposed project is very suitable for collaborative research activities since • The ambitious goal and size of the project means that concerted, long-term effort is necessary • The results must be widely accepted and valid for different building traditions • A common view in Europe is that the built environment is part of the culture, rather than a commodity with limited service life A powerful project organisation with the best European competence and expertise, should be created. Researchers from fields such as Building Physics, Wood Chemistry and Biology, Wood Durability, Risk Analysis and Structural Engineering must work in

collaboration. The following institutes/groups are mentioned initially, but further partners may be added as the project is developed further. • TU Munich, Germany, prof. Peter Glos, prof. Gerd Wegener • Univ of Hamburg, Germany, prof. Arno Fruhwald • VTT, Finland, prof. Alpo Ranta-Maunus • SP/Tratek, Sweden, prof. Carl-Johan Johansson • Lund University, Moisture Research Centre

1.3.19 Market relevant applications for lignin considering technological and environmental aspects

Positioning: Applied

Short Description: The challenge is to develop large scale applications of products that are based on lignin with significant impact on economy, environment and wellness of European population. Firstly the end user has to be investigated as well as market aspects. For these product groups, specific data on different lignin applications such as quality and quantity requirements, properties, optimised formulations, toxicity tests, and implementation in the market must be raised. Secondly, in order to ensure that the most energy efficient, low emission and cost-effective conversion routes are encouraged for further development, parallel to this technical work, a sustainability evaluation on a life cycle basis has also to be taken into consideration. The integration of these aspects will enable a harmonized combination of market aspects, use of biomass raw materials, technological and environmental aspects.

Justification: Lignin is abundantly present on the waste of industrial processing of wood and in the biofuel production. It is a left over part which cannot be converted into ethanol. Due to the lack of sufficient fundamental data on these materials, the reuse of this important resource has been concentrated on their incineration with energy recovery for the paper industry or some limited commercial applications. Although the potential of these resources can be widely found in the literature, the presently available information was not sufficient for convincing an important fraction of the market to carry out more advanced and detailed application tests. So the need of high quality data for each product group, lignin production, modification and characterisation as well as end user related tests are clearly seen. On this the project will contribute. The overall use of biomass and sustainable aspects from a life cycle perspective should be also taken into consideration.

European relevance and collaboration: This issue is in agreement with the Waste Strategy Communication (CEC, 1990) and supports the EU ‘Environmental Technology Action Plan’. The development and rapid implementation of bio-feedstock technologies can be an important route towards reduction in greenhouse gas emissions in the short and medium term and in line with Kyoto Protocol. With the assessment of the environmental impact in all stages -from planning to commercialization- the maximization of the environmental benefits and the minimization of potential risks are ensured. Therefore the goal of sustainable industries is also met. Moreover the potentially more labour intensive bio-feedstock compared to crude oil promises a positive net job-effect in rural regions of the EU and upcoming EU members. Partners: - EUROLIGNIN Network - International Lignin Institute, ILI, Switzerland - Institute for Chemical Technology, ICT; Germany - Stuttgart University, IKP, dept. Life Cycle Engineering, Germany

1.3.20 Chemical changes in wood during thermal treatments and resulting properties

Positioning: Basic

Short Description: The changes and their extent during a temperature load depend considerably on the chemical structure of the used material apart from many other factors, such as the type and duration of thermal treatment. Due to the different chemical compositions of wood species, accurate predictions of the thermal behaviour and the respective product properties are extremely difficult. Moreover previous investigations on this topic could not reveal all basic processes. Often the results of the different research groups are not comparable, due to the lack of standard methods within this research and development field. The knowledge about existing and formed functional groups is however essential e.g. for further surface treatments like paintings/coatings or for the prevention of corrosion. In addition some products have an unpleasant odour, why measurements of volatile organic compounds (VOC) should be performed. The objectives of the research project are: - to characterise the basic chemistry of thermally modified wood species depending on the applied temperatures with several defined methods, e.g. to determine extractives, polyoses, cellulose, lignin, pH-values and in particular functional groups, - to analyse the formation of VOCs depending on process conditions, storing conditions and time by means of microwave thermodesorption and GC/MS, - to quantify durability performance by means of decay tests, - to specify quality parameters for the end-use.

Justification: The target of this project is to lead to further and improved applications and therefore to a wider range of wood products. The increased use of wood products would also enhance the economic situation of respective wood industries and their suppliers. One essential precondition for the realisation is an advanced knowledge about the properties of the different wood species after thermal modification. Beside that, a better European quality assurance system is needed for both existing and newly developed market products in order to avoid problems during use. Products which cannot fulfil the expectations of consumers will lead to a loss of prestige of all new technologies within the wood industry. Due to the improved natural durability of thermally modified wood this new technology furthermore will protect the environment by reducing chemical additives (e.g. toxic wood preservatives) and easier recycling or re-use of wood products.

European relevance and collaboration: Previous research activities have been carried out mostly on national level for the respective market requirements. An European network would be helpful to harmonise analytical methods, quality assurance systems etc. Potential partners in this project are VTT (Finland), FH Salzburg (Austria), University of Kuopio (Finland), Stora Enso Timber (Finland). Other research institutes may be included.

1.3.21 Wood property based multifunctional impregnation treatments based on using hydrophobic oils that are environmentally gentle.

Positioning: Applied

Short Description:

Justification:

European relevance and collaboration: Groups in Sweden, Norway, Finland and Belgium.

1.3.22 New functional cellulose derivates (FUNCELL)

Positioning: Basic

Short Description: There exists evidence on new alternative ways to manufacture functional derivatives of cellulose by enzymatic-chemical synthesis in various media. Additionally, more controlled synthesis offers possibilities in producing existing cellulose derivatives by tailored ways. The aim of the FUNCEL project is to develop newand controlled synthesis of derivatives. The hydrophilic-hydrophobic, physico-chemical, anti-microbial and rheological behaviour of the derivatives will be investigated. Specific application studies of the materials include film formation, blendability with paper and fiber formation.

Justification: The innovations of this issue are related to improved homogeneity and quality of present cellulose derivatives e.g. CMC. and additionally to create new derivatives e.g. with controlled side-chain properties and chain length. Manufacturing studies and related research on process parameters and product properties serves as the basic information for feasibility estimations of new products. Different shapes of controlled polymers, eg. films, fibres, beads, composite structures enable innovative applications of polymers for different end-uses.

European relevance and collaboration: The Northern and North-European (Finland, Sweden, Norway) forest resources are of a major share of total European forest resources. On the other hand the applications and end-users are mainly in big Mid-European countries. Thus, it is important to create collaboration with the producing pulp and paper research institutions and industries with end-users and research. A Nordic present practice of cooperation comprises Univ. Helsinki, Tampere (Tech.) and Turku, VTT Biotechnology Espoo, KTH Stockholm, pulp producers Domsjö, Metsä Botnia and Borregaard, and relevant industries, as well. Most of those end-user are operating World/European wide: Astra Zeneca, Akzo Nobel, Visko, CP Gelco, Vivoxid. The reasonable - project oriented - cooperation is fulfilled by finding research institutions and industries in Germany, UK, and France.

1.3.23 Fibre engineering and micro mechanical modelling for efficient materials design

Positioning: Applied

Short Description: Detailed knowledge of the relation between the fibre level and the paper performance level is a prerequisite for efficient materials design. The ability to quantitatively control, design and optimise the properties of wood fibre based materials therefore requires detailed knowledge on the fibre properties, fibre-fibre joint properties and the applied processing conditions. An efficient procedure for materials design is only obtained by combining advances in fibre engineering with detailed knowledge of the deformation and failure mechanisms and advances in micromechanical modelling of fibrous networks process technology. The formulation and accurate calibration of micro-mechanical models is dependent on detailed information about the fibres and joints. Important is to experimentally and theoretically study the micro-mechanical properties of bio-chemically modified single fibres, fibre-fibre joints, assemblies of few fibres and fibre networks subjected to loading under different environmental conditions. Fibre materials with well-defined properties are valuable to considered in the initial phase of the experimental work in order to verify theoretical models. Today this type of materials design is primarily inhibited by the lack of detailed knowledge of fibre and fibre-fibre joints.

Justification: The results from this research will create direct links between biochemical modifications of fibres and fibre-fibre joints and the performance of paper and board. Such knowledge is indispensable in the design of wood-fibre based materials that can efficiently compete with for example plastics in packaging applications. Challenges that are essential for the competitiveness of the industry include the development of paper materials that are stiffer and dimensional stable than the materials of today without being brittle, and materials that are less sensitive to long time loading (creep resistant), particularly during varying climate conditions. The new materials that will be possible to develop using the results from the proposed research will strongly enhance the competitiveness of wood-fibre based materials made from renewable resources in applications where materials such as plastics today frequently is the choice of the customer. This of course also requires that the processes that will be used to manufacture these new materials can be made so efficient that the cost of the new materials can be kept at a reasonable level. Thus, micromechanical modelling of fibrous network process technology will be an important part of the research.

European relevance and collaboration: This is an extensive research effort that in order to be successful in a reasonable time requires utilization of the competence that today exists in a number of European countries. This list includes for example Lars Wågberg, Royal Institute of Technology, Sweden; Lars Berglund, Royal Institute of Technology, Sweden; Tom Lindström, Royal Institute of Technology and STFI-Packforsk, Sweden; Øyvind Gregersen, Norvegian University of Science and Techology, Norway; J.-F. Bloch, Ecole Française de Papeterie et des Industries Graphiques (EFPG), France. Tuula Teeri, Royal Institute of Technology, Sweden. It is, furthermore, of importance that

RESEARCH AREA 1: Solicited issues

Europe plays a leading role in the development of a sustainable society, and here particularly, design of advanced materials from renewable resources such as wood fibres.

1.3.24 Target oriented functionalization of fibres by biocatalysts

Positioning: Basic

Short Description: There is a clear demand for increasing the science based development of value-added products of the forest sector. Novel, targeted methods for introducing novel functionalities into fibres have been recently developed. For the first time, this approach also allows to understand what the consequences of a single, designed chemical substituent on various fibre properties are, without simultaneously affecting other chemical structures. However, further improvements and optimization are needed for the full exploitation of the possibilies offered. Furthermore, discovery of novel funtionalization biocatalysts may further expand the applicability and specificity of the method. Thus, eg the exact requirements of the enzymes involved, boosting their action on the fibre matrix and optimization of the various details will be needed for fully understanding the mechanisms. A knowledge based approach is needed for further improving this approach. In this context, it is also important to emphasize the possibilities offered by various biomimetic approaches, in which the natural reaction may be mimicked by chemical or chemo-enzymatic methods. The methods involve basic enzymology and fibre chemistry and physics, as well as knowledge on specialized product development areas.

Justification: Several possibilities for introducing novel functional properties into fibres are created. These functionalities can be explored both for improving the processability (for improved process performance or saving of resources), as well as for designing completely novel properties into fibres. The latter option is especially tempting with regard to extending the uses of paper for novel areas, such as a carriers for printed electronic circuits or novel consumer products. The proposed theme combines novel technologies, such as biotechnology and material sciences and is strongly oriented towards nanotechnologies, and consequently requires strong competencies in these areas.

European relevance and collaboration: Various expertise areas are needed to accomplish the goals. Partners can be identified among groups specialized in: enzymology, wood chemistry and pulping technology and will be named later.

1.3.25 Fibre engineering and micro mechanical modelling for efficient materials design

Positioning: Applied

Short Description: Detailed knowledge of the relation between the fibre level and the paper performance level is a prerequisite for efficient materials design. The ability to quantitatively control, design and optimise the properties of wood fibre based materials therefore requires detailed knowledge on the fibre properties, fibre-fibre joint properties and the applied processing conditions. An efficient procedure for materials design is only obtained by combining advances in fibre engineering with detailed knowledge of the deformation and failure mechanisms and advances in micromechanical modelling of fibrous networks process technology. The formulation and accurate calibration of micro-mechanical models is dependent on detailed information about the fibres and joints. Important is to experimentally and theoretically study the micro-mechanical properties of bio-chemically modified single fibres, fibre-fibre joints, assemblies of few fibres and fibre networks subjected to loading under different environmental conditions. Fibre materials with well-defined properties are valuable to considered in the initial phase of the experimental work in order to verify theoretical models. Today this type of materials design is primarily inhibited by the lack of detailed knowledge of fibre and fibre-fibre joints.

Justification: The results from this research will create direct links between biochemical modifications of fibres and fibre-fibre joints and the performance of paper and board. Such knowledge is indispensable in the design of wood-fibre based materials that can efficiently compete with for example plastics in packaging applications. Challenges that are essential for the competitiveness of the industry include the development of paper materials that are stiffer and dimensional stable than the materials of today without being brittle, and materials that are less sensitive to long time loading (creep resistant), particularly during varying climate conditions. The new materials that will be possible to develop using the results from the proposed research will strongly enhance the competitiveness of wood-fibre based materials made from renewable resources in applications where materials such as plastics today frequently is the choice of the customer. This of course also requires that the processes that will be used to manufacture these new materials can be made so efficient that the cost of the new materials can be kept at a reasonable level. Thus, micromechanical modelling of fibrous network process technology will be an important part of the research.

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1.3.26 wood-fibre based packaging providing enhanced product protection

Positioning: Applied

Short Description: Good packages for easy handling and protection and efficient distribution chains will be an increasingly important feature of a service society. For achieving sustainability the growing society needs renewable and reus-able materials, which have non or low impact on CO2 emission. These mate-rials need to deliver the same or better performance than alternative mate-rials such as fossil based materials (metal, glass, aluminium) and synthetic, crude oil based materials. Packaging needs to respond to changes in society and in the customer and consumer base. It must be responsive to demographic shifts and closely fol-low the effects of changing habits in society amongst the young, middle-aged and elderly. New solutions need to be based on good understanding such areas like per-ception, social behaviour and social changes. They need to be customer value and consumer needs driven rather than process and production driven. Development and implementation of these solutions will require networking that includes partners from the entire value chain. Via this network, it is possible to develop on-demand innovative fibre-based packaging that is sophisticated, cost efficient and safe while also improving the post-use value and environmental impact of the package.

Justification: Enhanced barrier properties (water, vapour, gases, light) and specific, dedicated surface properties due to new, innovative surface coatings ("structure" polymers, nanoparticles…) Protection functions (preservation in high/low ambient humidity and temperature) and active conservation functionality: microbiology, chemical treatment (eg by using micro-encapsulation, micro-sorption..) New forms and packaging structures aimed to fulfil consumer demands for functionality, durability, transportation & storage, cost reduction, recyclability, biodegradation. Customer preferences, consumer perception of paper and board based packages. New, integrated logistic solutions, specific for certain products group

European relevance and collaboration:

1.3.27 Paper as an efficient medium for communication and education in knowledge based society

Positioning: Applied

Short Description: Communication will be an increasingly important human and social need. Dynamic information and education society will consume more and more information carriers of different shape and nature. Electronic media can not replace/perform the unique characteristics printed communication. Only printed paper can fulfill the sustainability criteria of the growing society. It is manufactured from renewable raw material, it is recyclable, biodegradable and also user friendly. Its unique features for communication, education and culture, as well as aesthetic and durability are well adapted to human perception. To provide value for the customer, paper document must be technologically superior, more cost effective, more user friendly and meets other demands and criteria important for the user.

Justification: Developing the printing process for improving the quality of printed communication products (consumer perception, novel printing technology demands,…) Developing new manufacturing concepts for superior fibre based substrates (advanced sheet structures, novel coating and surface treatment technologies …) Developing on-demand printing and new services (business concepts, personalisation, …) Enhancing Sustainability of printed paper value chain (recyclability of inks, adhesives, substrate components, ..)

European relevance and collaboration:

1.3.28 Fibre structures for new and improved material properties and products

Positioning: Basic

Short Description: In papermaking, a wide spectrum of functionalities may be achieved through the engineering of fibre networks with different characteristics. Fibre networks are also utilized in many other types of products. The potential of developing new and improved products is large. In the project, different ways to create fibre networks with new and improved properties are studied and compared: Selection of fibre materials, processing and modification of the fibres, network stucture (fibre distribution, layers, …), etc. A number of fibre types, traditional and novel, of interest in fibre networks for different uses, are characterized with respect to their virgin properties in trees as well as to their state after processing. Models are extensively used to describe fibre materials used and network structure and for the the estimation of resulting properties. Effects from use of various approaches on material and product properties are evaluated and compared. New possibilities are suggested. A holistic perspective is applied from the fibre resources in the forest to the functionalities of the products. This means, for instance, that even if generic properties are investigated, these are identified in close cooperation with the industry, to shorten the road to application.

Justification: New fibre networks, designed from a product perspective, may result in new and improved properties. Examples are better printability, stronger or more efficient packaging products, more functional hygiene articles, etc. They could also result in reduced use of material, chemicals and energy in the production of the products, reduced volumes/weights to transport. All these factors may contribute to increased industrial competitiveness, better products for the end-users and reduced environment load. New work opportunities could be created or existing employment secured, not the least in forest regions, with positive side effects for the regional society. Even though parts are rather basic there are close links to industrial applications.

European relevance and collaboration: Optimal use of the European forest resources in new products would be an important positive factor in the competition the industry is now facing form countries with wood raw materials from fast-growing plantations. There are strong European traditions in the research areas relevant for the project. Research groups at STFI-Packforsk, KCl, PFI, CTP, KTH and NTNU are expected to be able to make key contributions in this research. These groups have also good channels with industry and suppliers for the implementation of the project results.

1.3.29 Improvement of the relevant performance criteria for the service life of fire retardant impregnations and coatings

Positioning: Applied

Short Description: Fire retardant coatings and impregnations improve the reaction to fire of wood and wooden components. Recent developments in this respective area (e.g. high performance fire protecting coatings) open up new end use applications. For example it will be possible to protect wooden floors or stairs against the impact of fire. The performance in service life of this novel generation of intelligent coatings is mostly unknown. The research will focus on the performance in service life, on the identification and improvement of the crucial factors in service life, and on the development of guidelines for such coating systems. The knowledge gained due to the new insights into the performance of such systems will build a basis for better and more reliable fire retardant coatings. Neither the mechanical, nor the chemical impacts on such coatings in service life have been analysed properly. In these research work the overall performance in conjunction with variances like UV stability, abrasion, aging, humidity or temperature will be observed. Subject to the utilization different classification requirements and levels of use and the necessary measures to be taken will be defined, e.g. the restoration intervals Furthermore it is planned to develop a care taking guide for such systems.

Justification: Fire retardant coatings and impregnations are limited to fields of application where no stresses (climatic, physical or mechanical) are applied. A common floor coating for example underlies certain stresses, e.g. abrasion. This abrasion results in a loss of optical properties, which is not a problem for normal applications and is renewed after a certain time. In case of fire retardant coatings or impregnations the problem is more complex. Simultaniously with the layer thickness, the performance of the flame retardancy is reduced. The interrelation of the decrease of function and the effective forces are not known. The fact that the fire retardant properties (due to safety regulations) need to be available unreduced at all time limit the use of such solutions in most cases. The definition of fire protection classes depending on the circumstances of use, resulting from these research work, will bring a calculateable solution for such problems. A even bigger impact will be taken on the development of new coatings. Tailor made solutions for special requirements will be possible. Increased basic knowledge of the breakdown reasons will lead to new approaches in formulation. In succession the overall safety in public buildings like in train stations or airports will advance, assuring the increasing need of security.

European relevance and collaboration: ·Fire safety is widely considered as one of the most significant obstacles for increased use of wood in construction. European fire regulations have traditionally been very prescriptive and based on experience from large city fires. The increased use of fire safe wood products will provide industry and society with new opportunities to increased use of renewable resources that will stabilize the CO2 balance. Thus to foster the increased use of fire safe wood products, European research institutes and industrial R&D departments shall collaborate to develop a performance based approach. This should provide new means for achieving

harmonisation for increased use of wood in construction across Europe. New research and effective information transfer to designers, national and European authorities is needed. Partners could be: The University of Innsbruck, Die Holzindustrie (Austria); Woodfocus, VTT (Finland); TU München (Germany); Skosgsindustrieerna, SP Trätek (Sweden); UK Timber Frame Association, BRE (UK); CSTB, Blase PAscal Univsersity (France)

1.3.30 Modification of functional groups on wood fibers using ligninolytic peroxidases

Positioning: Applied

Short Description: The objective is to introduce reactive functional groups on lignin of wood fibers to increase hydrophilicity or to make linking of different compounds on fibers easy. These new functional groups may change physical or chemical properties of fibers and create new properties. Lignin can be selected as the target, and for that lignin modifying enzymes will be used. The most powerful enzyme known at present is manganese peroxidase (MnP) produced by efficiently lignin degrading fungi. MnP in a mixture consisting of Mn(II), a chelating organic acid, unsaturated lipid, and hydrogen peroxide is able to cleave benzene ring and create muconic acid residues, thus to increase the amount of carboxyl groups. It may further decarboxylate the created groups and phenolic groups are formed. MnP is a powerful oxidative enzyme found so far in almost 60 different species of white rot and litter decomposing basidiomycetes. It oxidizes Mn(II) to Mn(III) that in the chelated form with organic acids such as oxalate is the oxidizing agent. MnP may mineralize, when amended with a chelator and unsaturated lipid, in vitro 14C-labelled synthetic lignin to 14CO2 (up to 16%) by a hypothesized mechanism including benzene ring-opening and formation of carboxyl groups.

Justification: The increase of carboxyl or hydroxyl groups in wood may decrease energy consumption during mechanical refining of wood. These modifications should make mechanical pulp smoother and stronger with good binding properties. Efficient biopulping fungi (fungi that degrade more lignin than cellulose in wood and decrease energy requirement in refining) produce manganese peroxidase, which indicates that it is the key enzyme in biopulping. In a French study, laccase treatment caused fiber separation near the middle lamella, and caused 53 % energy savings. The effect of manganese peroxidase has not been studied as much as laccase, but it is more efficient oxidative enzyme than laccase. The new compounds attached may e.g. react differently under different pH and temperatures, change surface charge, respond to different oxygen concentrations, air pressure, have antimicrobial properties etc. “Intelligent” properties can be introduced to fibers through linking compounds to reactive groups in lignin. E.g. for food packaging materials it is important to use non-toxic environmentally friendly materials. Cereal brans from gramineous plants and other agricultural wastes are sources of aromatic acids e.g. ferulic acid, which can further be enzymatically modified to different compounds, and attached to wood lignin.

European relevance and collaboration: Collaboration between mycology (production of enzymes), enzymology (enzyme properties, wood fiber treatments etc), wood chemistry and physics (wood fiber properties), pulp and paper research institutes (refining, preparation of paper samples, pulp and paper properties) and companies (test of the concept, applicability to industry). Different European laboratories can collaborate (e.g. mycology & enzymology from the University of Helsinki and CIB/CSIC in Spain, wood chemistry from University of Helsinki & KTH, Sweden; microscopy: SLU, Sweden & Grenoble, France etc). Pulp and paper companies may utilize the results for

the development of processes that save energy in mechanical pulping and improve the fiber properties to fiber surfaces. The production of enzymes for pulp and paper industry will create jobs in enzyme producing industry (biotechnology), and thus strengthen this industry in Europe. Some of these aspects have been studied, but with a small funding. Good ideas cannot be verified with too little research input.

1.3.31 Adding value to under-utlised European hardwoods

Positioning: Applied

Short Description: The objective is to increase the value and profitability of selected under-utilised European-grown hardwoods using innovative sawing, bonding and secondary processing techniques. Across Europe there are specific hardwood species which are under-utilised due to their poor stem form, size and/or logistical constraints. Many of these species have good performance characteristics and/or highly attractive or unusual appearances which could make them desirable for a range of high value added end-uses (e.g. joinery). The project would: 1. Provide improved knowledge and guidance on the availability, quality, consistency, grades and sizes and mechanical and physical properties of the selected species. 2. Develop innovative sawing and drying methods that optimise for quality and 'fitness for purpose'. 3. Using innovative secondary processes (defect cutting, re-engineering and wet gluing techniques) transform sawn material (and round wood) into added value products. 4. Evaluate the mechanical and physical properties of the manufactured components to ensure they meet the performance requirements for end products. Produce a selection and end-use guidance tool that facilities the specification, selection, design and use of these hardwoods. 5. Demonstrate that products perform in-service by carrying out commercial trials (with industrial collaborators) that spans the entire supply chain from forest to end-user.

Justification: There is very limited information relating specifically to the many under-utilised (secondary) hardwood species growing in European forests. The quantity and quality of this resource has not been well assessed and the potential for its use in high value-added applications has not been analysed. This material is often grown under different forestry regimes (low-intensity management, coppice forests, and agro-forestry plantations) and often exists as small-dimension lower-grade timber with poor stem forms and internal stresses. Many small hardwood plantations and woodlands are in a state of decay due to the difficulties and economics of selling lower quality material. In many cases, woodlands remain under-managed because economic returns are lower than management costs. New and innovative processing methods are required to produce outlets for this material and provide an incentive to manage woodlands productively.

European relevance and collaboration: This project will contribute to a concerted European approach to the sustainable evolution of forests by encouraging increased planting and management of a diverse range of species, which will also increase biodiversity. It will help to increase the competitiveness and optimise the value of forest resources through the development of new innovative products made from under-utilised hardwoods. The project also supports the pan-European forest policy on sustainable forestry. Community forest measures will also be addressed, in so far as these forest types are often comprised of mixed hardwood species. A number of European member states have verbally agreed an interest in becoming partners within such a project, these include Spain (AIDIMA), Slovenia (University of Ljubljana), Greece (Forest Research Institute of Athens), Poland (Agricultural University of Poznan), France (Ecole Du Bois) and Italy (CATAS).

1.3.32 Timber for foundations and civil engineering

Positioning: Applied

Short Description: Aims: • Develop enhanced durability large section timber components for piles, poles, bridges and other civil engineering applications • Develop and provide guidance on the use of timber as an industrial/civil engineering material Project participants will develop improved durability large section timber for use as foundation piles, utility poles and other high value in ground contact or in seawater applications. Higher durability will be achieved through a combination of enhanced preservative treatment, wood modification, and through the application of polymer technologies, together with the development of installation and usage techniques designed to maintain the integrity of the protection systems. Full scale demonstration projects will be a feature of this work.

Justification: Timber is a highly capable material for engineering applications, but recent environmental legislation has discouraged its usage. Recently there has been increased interest in the use of sustainable materials for building foundations as alternatives to concrete. However, the limited durability of treated European timber above the water table is a major disincentive. Competing materials also include a new generation of fibre reinforced plastic lumbers and polymer composites. Major markets for timber such as utility poles and fender piles may be lost because of doubts about long term durability and environmental concerns over treated timber. Whilst timber piles below the water table may last indefinitely, the section of above the water table is vulnerable to decay. Traditional methods of preservative treatment alone may not provide sufficient lifespan for many potential construction projects. In order for timber to maintain its market share in foundation piles, utility poles and other in ground contact engineering applications reliable enhanced protection systems need to be developed. Innovative combinations of other materials with timber might be enabled from this project.

European relevance and collaboration: It will help to increase the competitiveness of forest resources through the development of new innovative products. The project also supports the pan-European forest policy on sustainable forestry. A number of European member states would be needed as partners within such a project, particualrly national centres of expertise in civil engineering and timber.

1.3.33 Delivering enhanced durability through wood modification

Positioning: Applied

Short Description: Wood modification techniques provide an opportunity for timber products to effectively challenge potentially less sustainable construction products. The properties of many modified woods include features of enhanced biological durability, dimensional stability and coating performance, amongst others. The technologies do not sit comfortably with the existing framework for specifying and using treated timber. This barrier needs to be addressed by: 1. Providing a comprehensive performance and property database 2. Developing technical standards to enable the appropriate use of these materials 3. Developing a foundation for understanding and demonstrating the sustainability benefits of these materials Task groups will be formed to deliver solutions for technical specifications and to gather and process data for sustainability assessments.

Justification: The results will be: 1. A performance database to support application and use of modified wood 2. CEN Technical Standards for modified wood products 3. A tool for demonstrating the sustainability of the product technologies and to stimulate the continuous process and production improvements Modified wood products will be able to compete more effectively with metal, plastic and cementitious construction products. The focus will be on continuous improvement to minimise environmental impacts through process improvement and delivering long service life, predictable construction products. This work would enable innovation in wood products by offering opportunity to open new markets or diversify in established markets.

European relevance and collaboration: The wood modification production technologies are primarily concentrated in Scandinavia, Germany, the Netherlands and France. Collaborative research is required across Europe to bring together the commercial experts in these countries with the laboratory researcher groups, the manufacturers who might want use modified wood and the construction product markets. An excellent foundation of partners for this work would be from the former Thematic Network for wood modification funded in FP5.

1.3.34 Development of innovative forest-based products for changing markets and customer needs

Positioning: Applied

Short Description: A multidiciplinary approach is needed. New enabling technologies will create opportunities for responding to the new habits and fashions of future consumers and to the increasing competition. This will be an opportunity for the European forest-based sector to change its product mix from mainly "bulk commodities" towards a new range of knowledge-demanding and high value-added products.

Justification: For example: Smart systems solutions for the use of wood and wood-based products Future generations are characterised by a growing percentage of aged people and singles or small families. With respect to housing and living, this means that special attention needs to be given to lifestyle products, flexible building systems and innovative services. In a rapidly changing working and living environment, the flexibility and mobility of European citizens will increase. Wood and wood-based products for daily use and for the built environment will play an important role in this context. As an example, future buildings and furniture must take into account that its proprietor's expectations will change over the life span. They will either have to be multi-functional or highly flexible. Innovative and environment friendly solutions for wood-based packaging materials and transportation systems for goods must also be developed. Environmental, human well being and safety aspects will have to be addressed when novel solutions for fast and flexible e.g. wall cladding, flooring, packaging etc. are developed. Future solutions must focus on a stronger consideration of industrial hygiene, natural anti-septic properties of wood as well as on phyto-sanitary aspects in conjunction with world-wide transport of wooden goods. A second example: Wood-based specialty chemicals and particles Wood has the potential to provide a substantial and renewable source for the production of a large number of specialty chemicals. This is, however, far from being utilised. The core idea of this research theme is to take full benefit from the structures and chemistry of different wood constituents (preferably as isolated in a wood biorefinery), from all tree parts (including bark, foliage, and different residues), and from specific features of different European tree species. Using this approach, it will be possible to convert wood into high-value added, CO2 neutral and biodegradable products. They can generate new business opportunities and replace petroleum-based chemicals and polymers.

European relevance and collaboration: Please submit a targeted call with emphasis on multidiciplinarity and co-operation.

1.3.35 Nanotechnology in wood protection

Positioning: Applied

Short Description: Wood is an often used material for construction purposes, furniture and interior applications, caused by its good strength properties, easy handling and natural character. But there are some disadvantages limiting the use of wood. Variation of climate induces dimensional changes (swelling and shrinkage), reducing the adhesion of coatings and the precision of construction components. Danger of attacks by fungi or insects requires the use of biocides or resistant wood species (often tropical woods). The aim of this research project would be a detailed study of the possibilities nanotechnology gain to the field of wood protection. One main aspect is hydrophobicity. However, also easy-to-clean as well as hydrophobicity might be an aspect. On the other hand UV-protection has to be fullfiled and this needs quite intensive studies. Last but not least aspects of self-cleaning like photocatalysis should be investigated. After a screening of raw materials (maybe self-synthesized) by contact angle as well as weathering studies (QUV) and water-uptake studies an optimiziation regarding user-friendliness has to be done. Desirable effects are altering of sorption behaviour, improvement of durability and better UV- as well as dimensional- stability.

Justification: The general long run achievements of the project are to facilitate the exploitation and development of alternative nanobased wood protection treatments and decrease the use of biocides. In addition, the aim is to increase utilisation of hydrophobisised European grown softwood products for future use in exterior constructions or niche markets where high quality materials are required.

European relevance and collaboration: Nanotechnology is a quite interdisciplinary topic. Thus, research networks are necessary.

1.3.36 Feeding properties of extractives from wood and conception of attractive baits.

Positioning: Applied

Short Description: Termites cause damage in south of Europe or in French overseas department. There are two solutions to protect the house, or agricultural area or ornamental trees. Traditional termite treatments afford structural protection by creating a persistent chemical barrier in the soil. And termite bait , foraging termites consume the bait and share it with their nestmates, resulting in a gradual decline in termite numbers. The first step of the treatment consists to attract the termite with cellulose before the installation of the bait material. Some tropical wood contains various extractives that have some attractive effect on termite. The objective of this work consist to study some tropical woods (Schefflera morototoni, Couatari guianensis, simarouba amara, virola michelii…) non resistant to termites, to search the compounds which have an attractive effect on the termites. Lab tests will allow to identify the more interesting species, then determination of chemical composition in order to find relation between attractiveness and chemical composition. In a last step, fields tests in order to study the behaviour of the termites in real conditions (tropical and temperate fields).

Justification: One of the biggest challenges in baiting is getting termites to find the baits in the first place. The timetable for discovery will vary from property to property, depending on such factors as termite foraging intensity, time of year, moisture, and food availability. This study will allow to propose several species which have feedent properties against termite. They will be use as wooden monitor and allow a rapid infestation of the termites. Significant results will contribute to bring new information to the formulator biocide product and allow to propose a rapid treatment of the concerned zone. The biological activity of wood extractives had been often study but not the contrary. The results will bring new informations about the behaviour of termites against wood extractives. It will be also the occasion to promote secondary species which are less used on tropical forest or abandon after harvesting ; develop a effective use of wood waste for some species.

European relevance and collaboration: Termite infestation concern all the south of Europe: France, Italy, Spain, Portugal and also overseas department and they cause a lot of damage. Several institutes are interested about the behaviour of termites, the impact of wood extractives on termites like CIRAD (France), LERBI (CNRS in Dijon – France), LNEC (department of civil engineering in Madrid), Istituto per la Valorizzazione del Legno delle Specie Arboree (CNR-IVALSA in spain). It will be possible to incorporate institute from French overseas department like CTBA in Reunion or CIRAD in French Guiana.

1.3.37 Developing the use of wood in construction

Positioning: Applied

Short Description: A multitechnical approach with regard to each of the essential requirements of the construction products directive (comfort, safety, etc) should give high performance building solutions. This issue wil be derived in subprojects depending on the structural elements (eg floors, walls, roofs,...) and the requirements (eg mechanical behaviour, thermal comfort, acoustics, etc).

Justification: The increase of wood in construction gives a positive energey balance as well as a mean to encounter greenhouse effect by carbon storage.

European relevance and collaboration: This project depends on the building systems used in different countries, as well as specific environments and social issues. A European approach will facilitate European convergence.

Sub-area 1.4 Combining fibres with other materials

1.4.1 Improvement of dimensional stability and other material properties of wood-plastic composites.

Positioning: Applied

Short Description: Wood-plastic composites (WPC) or natural fibre reinforced thermoplastic composites represent a relatively new class of hybrid materials which have gained significant market share in North America during the last decade, primarily as a substitute for wood decking. In Europe, WPC are currently being introduced to the market, with an annual production of approximately 10,000 t. Wood-plastic composites primarily consist of wood filler and a thermoplastic polymer matrix (polyethylene, polypropylene or polyvinyl chloride) and are most commonly produced by extrusion or injection moulding. Because of the limited thermal stability of wood, only thermoplastics that melt or can be processed at temperatures below 200ºC are used in WPC. Wood or other natural fibres such as hemp, straw, sisal or kenaf, are added in particulate form (e.g., wood flour) or as very short fibres. In North America, commercial WPC formulations generally contain 65% wood filler or less. The objective of this research is to manufacture WPC based on a higher amount of natural fibre filler that display equal or improved product properties when compared to formulations containing a high amount of plastic. This will be achieved by chemical modification of the wood filler prior to combining with plastic using N-methylol-compounds, silanes and waxes.

Justification: Due to limited petroleum resources worldwide and increasing costs for petroleum it is desirable to limit the amount of plastics (polypropylene, polyethylene) used in WPC production. In addition, mechanical properties (strength and stiffness) of WPC may be improved when relatively high amounts of wood filler are used in formulations. However, a drawback of WPC with a high amount of hydrophilic wood filler, i.e., a low amount of hydrophobic plastic matrix, consists in increased swelling and shrinking of the material. This may lead to problems with interfacial adhesion, a reduction in strength and stiffness as well as biological durability of the composite. These drawbacks could be overcome if the filler was chemically modified prior to processing. Wood modification was shown to be an effective alternative for chemical wood protection of solid wood as well as an alternative to the use of naturally durable wood species which are in short supply and expensive. The application of products made from renewable resources contributes to the protection of fossil fuels and climate. Economical competitiveness of European WPC producers will be improved if high quality formulations containing up to 85% wood filler can be manufactured.

European relevance and collaboration: In contrast to North America, the European WPC market is still undifferentiated but significant market growth is being predicted. In 2003, 400.000 t of WPC were produced in North America, compared to approximately 30.000 t in Europe. This research project will contribute to promotion and market development of WPC on a European level and may demonstrate that high-quality WPC formulations can be produced which are based on significant amounts of renewable resources. This in turn will achieve economic competitiveness for WPC manufacturers

while increasing ecological friendliness of the product. European research groups that may contribute to the implementation of this research are: · The BioComposites Centre, Bangor, Wales: http://www.bc.bangor.ac.uk/index.htm · Fraunhofer Institut für Holzforschung WKI, Braunschweig: http://www.wki.fhg.de/ · Institut für Werkstofftechnik – Kunststoff- und Recyclingtechnik – Universität Kassel: http://www.kutech-kassel.de/ · Wood KPlus Kompetenz-Zentrum für Holzverbundwerkstoffe und Holzchemie, Linz, Österreich: http://www.kplus-wood.at/ · Fraunhofer-Institut für Werkstoffmechanik, Halle/Saale: http://www.iwm.fraunhofer.de/

1.4.2 Novel WPC packaging materials

Positioning: Applied

Short Description: Considerable quantities of wood are used for packaging. New packaging systems demand for high flexibility as far as form giving is concerned. In combining low quality plastic materials (e.g. recyclat) with wood or sawdust could be a very economic and environmentally friendly solution.

Justification: New packaging materials; considerable reduction of fossile oil resource; save, durable and environmentally friendly packaging;

European relevance and collaboration: Recycling issues in the field of wood and plasic materials is a Pan-European problem. Joint university and industrial research and development activities will help to speed up the process of intrduction of novell solutions.

1.4.3 Hybrid composites approaches

Positioning: Basic

Short Description: Combinations of wood fibres with other materials may provide useful composites for many application sectors. However, there is comparative little reserach done in this area, compared to the effort in 100% wood-based composites or, for example, 100% glass-fibre based composites. Yet, there are cost reduction and mass reduction benefits to be exploited in trying to extract the best of combination of different fibres in composites, i.e. developing hybrid systems

Justification: Given the volume of the market, replacing even modest amounts of general purpose fibres,like glass, with wood fibres can be beneficial provided that the hybrid systems can combine effectively the relative advantages of the various fibres. Increasing the proportion of renewable, sustainable materials in composites in an important aspect of composites development

European relevance and collaboration: The issue of increasing the sustainability and biodegradability of composites is relevant across most of Europe. A large volume of composites suitable for introduction of wood fibres is used by the automotive industry which is increasingly looking at end-of-life issue and sustainable sources of structural or semi-structural materials.

1.4.4 Wood polymer composites development : Eco-Design and Life Cycle Assesment

Positioning: Applied

Short Description: Wood polymer composites (wood flours or fibers associated to thermoplastics like PP, PE and PVC) are in higher development in Europe. To enhance the environmental issues of theses innovative products used in Construction and furniture, it is necessary to have more informations on (1) performances of products in service life (resistance to weathering), (2) Life Cycle Assesment of such products (windows, cladding, ...), and (3) development of Eco-design methodology.

Justification: This work will be useful to enhance - the development of markets for these bio-composites by Eco-design approach, - contribute to use renewable ressources instead petroleum olefins, - purpose easy maintenance and recycling wood based products.

European relevance and collaboration: Some countries (Belgium, Germany, Austria, France) are actively involved in definition of standards (CENTC264). Eco-design and LCA applied to these innovative materials will be studied by European groups invloved in LCA (Belgium, Austria), in research (University of Austria, ...), in markets (Belgium, industrials groups, ...). The objective is to create a EU WPC Cluster.

1.4.5 Fibrecomposites

Positioning: Applied

Short Description: Use of chemical pulp fibres in plastic composites.

Justification: New materials, biomaterials.

European relevance and collaboration: To be able to compete with USA where they have started huge Nanotechnology program. KTH, STFI, NTNU

1.4.6 Composites of wood fibres with modified starches

Positioning: Applied

Short Description: The ever increasing importance of the electronic media will ultimately diminish the need of printing paper. The use of paper based packages will increase especially because of depletion of oil resources. Plastic packages will be replaced by products made of renewable resources. Strong plastic like structures could be made of structured composites of wood fibres and modified starches. The possible alternatives of the wood fibre resources include current chemical and mechanical pulp fibres but also fibres liberated by high temperature treatments could be considered. The emphasis should be in hydrophobic fibres. The properties of starch could be tailored by depolymerization, oxidation and hydophobization.

Justification: New packaging and construction materials could be developed. European forest industry could maintain its competiveness through the new innovations. The alternative ways of using wood could also attract young talented people. Replacement of synthetic polymer materials with renewable ones would decrease Europe's dependence on imported oil.

European relevance and collaboration: Most of the last major investments of forest industry has been made in China and South America. The expanding EU urgently needs investments in local production sites in the new member countries.

1.4.7 Development of new paper and nonwoven coating method based on cellulose formulations (CELCOAT)

Positioning: Applied

Short Description: Selected cellulose-containing latex formulations are applied by various technologies on selected papers amn nonwovens. The effects of coatings on bonding strength, durability and printing properties are investigated. The effect of coatings on hydrophobic nonwovens´hydrophilicity and durability are investigated.

Justification: Within the CELCOAT project, new methods of coating paper and nonwovens with cellulose are developed. The paper nonwoven industry could recieve a new natural-polymer-based coating alternative for selected products.

European relevance and collaboration: The basic technology is developed in Biocelsol EU-project. Additional to the project working groups Solution, Films and Casings, paper and nonwoven industries are potential partners, as follows: TUT Fibre Materials and Paper Converting Finland, KCL Finland, Ahlström Finland, Visko Oy Finland, an international paper company to be discussed.

1.4.8 long time durability of wood-plastic composites

Positioning:

Short Description: long time durability of wood-plastic composites. Field test and speed up test in laboratory.

Justification: To find new target for WPC-material To find new target for sawdust material Find new easy materials to recycle

European relevance and collaboration: WPC materials can produce in many different ways. This material is bossible to use in many products (cars, buildings etc.)

Sub-area 1.5 Creating new innovative wood and fibre structures for different end-uses

1.5.1 Compression Behavior of Fiber Composites

Positioning: Basic

Short Description: Materials fail by separation. In other words, in a molecular level, failure always is tensile failure. Instability in compression occurs as plastic flow, or through some kind of buckling or splitting. In the case of non-brittle structures, macroscopic failure is preceded by damage evolution, often in the form of evolving damage bands. Most of the research, regarding fiber composites and laminates, has been of empirical nature, and of limited value for in-depth understanding of their compression behavior. Using modern techniques, damage evolution can be monitored during compressive loading of structures. The design of relevant experiments does require thorough analysis of the mechanics of composites and laminates.

Justification: Fiber reinforcement very effectively improves apparent tensile fracture energy in the fiber direction. Thus, such reinforced structures tolerate tension, but they are vulnerable to compressive loading. Compressive loading however appears rather frequently, in particular in the case of structural and packaging applications. Improved compression behavior not only prevents failure, but makes it possible to apply composites in lighter basis weight.

European relevance and collaboration: http://power2.fsv.cvut.cz/qfs/ http://cml.fsv.cvut.cz/~milan/ http://www.chalmers.se/HyperText/Prof-E/Petersson-E.html http://www.byggmek.lth.se/ http://joyx.joensuu.fi/~karenlam/petri/petri.htm

1.5.2 Fatigue Behavior of Fiber Composites

Positioning: Basic

Short Description: Under cyclic loading, materials get damaged at stresses and strains far below those typical for failure within single loading event. Mechanical fatigue is induced by some sort of local kinematic irreversibility. Such kinematic irreversibility may be manifested in the formation of slip bands or other kinds of shear bands, grazes, rotation or other changes in orientation of molecular chains, nucleation of pores, or a variety of other microscopic mechanisms. Fatigue damage does not need to be due to external mechanical loading – themperature or moisture variations, for example, may cyclically induce internal stresses. Surprisingly little is known of fatigue damage in fiber reinforced composites, or laminates made thereof. Careful analysis of the mechanics of such situations should lead to computer experiments, from which the most promising results should be subjected to physical experimentation.

Justification: Vast majority of structural failures is related to fatigue situations. Hygroscopic materials are particularly vulnerable due to cyclical hygroexpansive loading, which often is combined by external mechanical loading. Premature failure may be prevented through careful design of materials, as well as structural configurations, provided the necessary knowledge is available.

European relevance and collaboration:
http://www.mct.ro/web/2/fp6/3/parteneri/Polonia/midi/data/57.html
http://www.lms.polytechnique.fr/annuaire_nom.php?id=26 http://www-mech.eng.cam.ac.uk/profiles/vsd/ http://fb7-fg6.uni-duisburg.de/nowack/
http://joyx.joensuu.fi/~karenlam/petri/petri.htm

1.5.3 Solid Timber Constructio

Positioning: Basic

Short Description: Solid wood constructions are, originally located in North America and Central Europe, the traditional technology for residential timber construction. Specific deficiencies of log constructions – subsidence, deflection and air leakage for instance – have recently led to advanced solid wood construction elements: large-scale, massive, monolithic elements, manufactured from small cross-section boards are massive, dimensionally stable, rigid and load bearing elements autonomously developed by several wood-working enterprises in Central Europe. Even though massive wood elements applied in (multi-storey) residential buildings, public and business facilities possess, compared to conventional construction methods, eminent economical and ecological advantages, missing standards and insufficient design rules often inhibit design and building permits and hinder implementation, opening of new markets and export. The aim of further research has to adapt basic principles of design, calculation and dimensioning. Assumption for heat requirement prognosis, thermal insulation and heat retention of massive timber structures will be identified by long-time investigations. Missing or inadequate calculation methods require measurement of full-scale experimental building, fundamentals of security levels and seismic design of massive timber construction are to be investigated in laboratory testing. Accompanying work groups have to ensure technology transfer and incorporation into accredited standards.

Justification: extend timber part in the construction area

European relevance and collaboration: standarisation

1.5.4 Timber concrete construction

Positioning: Applied

Short Description: In the last three years the Austrian market in wood construction for residential buildings has tripled. However the part of industrial and public buildings in wood remained constant. Wood-concrete connected slabs are used since 15 years but never a prefabricated system has been intended. The aim of the research cooperation is to provide a high performance wid-span slab with timber concrete elements in order to allocate a competitive floor system with an industrial production.

Justification: extend timber part in the construction area

European relevance and collaboration: standardisation since there is a large research activity in the field of timber concrete composites there is a high demand for collaboration

1.5.5 Structures made from imperfect logs using CNC machined connections

Positioning: Applied

Short Description: At present, durable timber structures in Europe are only possible by either using structural protection, e.g. a building envelope, treated timber or naturally durable tropical timber. This presents a difficult competitive situation for timber structures like bridges. There are naturally durable species like Robinia pseudoacacia with high strength and stiffness properties and a high natural durability. European Robinia is not available, however, in straight, large diameter logs needed to economically produce sawn or glued laminated timber. Round timber even containing large imperfections is perfectly feasible for truss structures, where the member shape between the joints is not important. There are two research areas to be covered to enable the use of imperfect logs in structures: The load-carrying capacity of tensile or compression members with large geometrical imperfections and the production and the load-deformation-behaviour of precise mechanical connections for imperfect logs. The load-carrying capacity of members can be studied using both, tension and compression tests on full-size members as well as mechanical models based on the stochastic geometric and strength and stiffness properties of the logs. The production of precise connections in imperfect logs has to be studied in co-operation with CNC machine producers and the load-deformation-behaviour by calculation and testing.

Justification: The load-carrying capacity of timber is only known for members whose imperfections do not excess limits defined by visual strength grading. Members having larger imperfections will have lower capacities and, due to bending, lower axial stiffness. On the other hand, round timber members show higher strength and stiffness values than sawn timber. With the knowledge regarding large imperfection timber and their connections it is possible to design and build weatherproof structures for bridges, masts and towers, if durable timber like Robinia pseudoacacia is used. The industrial competitiveness of the timber industry would be strengthened since new markets would open for timber structures. Examples are pedestrian and road bridges, masts and towers for power lines or windmills, or guard rails. Using imperfect round timbers of durable European species would significantly decrease material costs. The socio-economic impacts envisaged include the increased work in rural and forested areas, the increased value of hitherto low-value trees as well as the new opportunities for SMEs in the timber industry. The environmental impacts comprise the abandonment of chemical treatment and an increased lifetime for weather exposed timber and the decreased zinc deposit from corrosion protected steel members.

European relevance and collaboration: While the main producers of durable Robinia are situated in Eastern Europe, the main producers and operators of CNC woodworking machines as well as the main knowledge regarding mechanical timber connections are placed in Central Europe. Moreover, for the machine strength grading of imperfect round timber there is knowledge available in Finland. This necessitates a collaboration between the forest research institutes in Hungary and Slovakia, the timber structures research and

the CNC development for the machining of imperfect round timber in Germany and the machine strength grading of logs in Finland. Possible European research groups are: VTT Finland Lehrstuhl für Ingenieurholzbau und Baukonstruktionen, Universität Karlsruhe, Germany Faculty of Forestry and Faculty of Wood Sciences, Sopron, Hungary Forest Research Institute, Zvolen, Slovakia

1.5.6 High capacity building systems from sustainable hardwoods

Positioning: Applied

Short Description: The main species for structural timber in Europe are spruce and pine. These two species are mostly used as sawn or glued laminated timber or as laminated veneer lumber. Many structural applications are not yet possible in timber because of the low strength and stiffness values of coniferous timbers and hence the necessary large cross-sections. For sophisticated filigree structures like wood-glass-facades, steel or aluminium is therefore often used. European hardwoods, showing much higher strengths compared to softwoods, often cannot be used efficiently in sophisticated structures because of the missing strength and stiffness properties. Suitable European hardwood species have to be identified regarding availability, esthetical properties, durability, and strength and stiffness properties. Many species are not yet used structurally, but they will be increasingly available because of the changing supply in Europe's forests. The main strength and stiffness properties of European hardwoods have to be determined by testing in order to allow a classification into the European strength class system. For this purpose, also an efficient log grading procedure needs to be developed, based on non-destructive measurements. Additionally the suitability for the use of adhesives has to be studied and highly efficient mechanical connection systems need to be developed for hardwoods.

Justification: The timber supply from Europe's forests will change considerably in the future. While the share of softwoods is decreasing, hardwoods of different species will be abundantly available. It is necessary to find additional high-value applications for this future source of material. One example for sophisticated structures are wood-glass-facades where the load-bearing structure is made of timber and the building envelope of glass panes. Advantages of timber for these structures are the low thermal conductivity of wood, the low thermal elongation, the lower production energy and the lower costs. The results of the project will enable highly competitive structures for ambitious buildings in timber. The customers may then chose from different hardwood species according to different esthetical requirements. Invisible mechanical connections will contribute to the overall esthetical quality of the finished structures. The industrial competitiveness of the timber industry would be strengthened since new markets would open for timber structures. Examples are wood-glass-facades or visible engineered structures in public buildings. The socio-economic impacts envisaged include the increased work in rural and forested areas, as well as the new opportunities for SMEs in the timber industry. The environmental impacts comprise the decrease of the use of aluminium and hence a CO2 reduction.

European relevance and collaboration: There are many hardwood species in Europe and the problem of finding suitable applications applies to any European country. Because of the large number of species, the effort to determine strength grading procedures and characteristic values for sawn and glued laminated timber will exceed the capacity of each single country. European cooperation therefore is the key to solve this

problem. This necessitates a collaboration between the forest and timber research institutes in most European countries. Possible European research groups are: Universität Karlsruhe, Germany: Determination of characteristic values, mechanical connections TU München, Germany: Forestry, wood supply, determination of characteristic values and strength grading VTT Finland: Determination of characteristic values and strength grading

1.5.7 Alteration of wood based particles and fibres for building blocks of sensing and monitoring and special functionalities providing structures

Positioning: Applied

Short Description: Biobased polymers, such as wood-based particles and fibres, offer an excellent substrate or matrix for integration of novel and more effective functionality. Cellulosic materials are known to have pronounced absorption properties. These properties, for instance, can be modified towards more specific and controllable functionality by means of enzymatic or nanotechnological approaches altering the porosity and/or the chemical properties of the material. The ability of biobased matrices to pass through moisture and volatile compounds (VOC) can be adjusted by making the materials breathable; the CoreTex-products are good examples of this concept. In these products, the mechanism is based on vapour transport through a microporous structure where small holes in the film allow the water vapour molecules to pass through but not liquid water. The same analogy can be utilized to trap molecules responsible for unpleasant odours. In addition, biopolymer network can be enzymatically modified to a matrix which contains capsules or capsule moieties for pigments, organic dyes in waterbased systems, functional dyes, active agents (monitoring and sensing materials), and other ingredients. The capsule systems may perform in a way that capsules or the components of the capsules react with (harmful) chemical or biological compounds and as an active barrier. capture of spesific agents from the environment could lead to chemical and biological detectores. Enzymatic and nanotechnological modification methods themselves are environmentally friendly by minimising the consumption of chemicals and additives. The approaches to improved the properties and functionality of the matrix will be included the modification by tuning the pore size of the material or by binding functional groups to the matrix by means of nanotechnology, chemical or enzymatical reactions. The materials to be developed can be utilized in a variety of applications: controlled moisture behaviour, elimination of odours, encapsulation of emissions and controlled release of active agents are included in these applications.

Justification: The study will result in following products and innovations • lignocellulosic fibre/particle containing film-like matrix with moisture and odour absorption properties o for buliding material use (wall papers, inslulation materials) o for health care targets (daily sanitary products, such as diapers, sanitary towels, bandages) • lignocelluloic fibre/particle conatining matrices with active agents for monitoring and sensing purposes o moisture sensing /monitoring agents (colour indicators) o odour and emission sensing/monitoring agents • lignocelluloic fibre/particle containing matrices with antimicrobial properties The research area will intensify the exploitation of wood raw material side streams in a the most economically feasible phase and way. In addition, environmental aspects will be considered in the study by using waste wood in combination with other materials to make new high performance products.

European relevance and collaboration: The topic on improvement of the use wood material has raised interest throughout Europe. In some European and Nordic research

institutes, extensive work on wood based particles and fibres have already carried out. .However, the utilisation of lignocellulosic material in the novel product applications as well as improvement of the degree of upgrading of wood -based products need more multidisiplinary research. Combining the expertise areas of the different institutes lead more cost-effective research concept. The potential research groups implementing the research would be the following: Finland Sweden France Germany VTT, Technical Research Centre of Finland, Espoo, Dr. Anne-Christine Ritschkoff, Dr. Salme Koskimies, Dr. Liisa Viikari Dept. of Fiber & Polymer Technology Royal Institute of Technology (KTH), Stockholm, Dr. Lars A. Berglund University of Bordeaux, Bordeaux Dr. Gilles Sebe University of Potsdam, Potsdam NN University of Helsinki, Department of Polymer Chemistry Prof. Heikki Tenhu Institute for surface Chemistry (YKI), Stockholm Max-Planck Institute, Potsdam NN

1.5.8 Conseptualisation of wood based products for leisure, moving and transportation

Positioning: Applied

Short Description: Based on user oriented setting and different future scenarios, the project aim to conceptualise products for leisure, moving and transportation. The wood based product applications will be composed and tested. The project creates opportunities to developing new type of constructions and aesthetic solutions.

Justification: The wood industry is currently renewing and expanding its product categories. In the field of wood industry in Northern Europe, new businesses are evolving. The main tendency is to develop products, which can utilize the wood materials from Finland and neighbouring regions. Kuopio Academy of Design is a part of Savonia-Polytechnic which is multidisciplinary institution of higher education. It offers degree programmes and R&D in seven fields of study and has 5000 students. Kuopio Academy of Design has 60 to100 co-operation projects/year with enterprises. During 2005-2007 it has PUUMI-wood design project funding by ESF. Participators are wood working enterprises from East Finland.

European relevance and collaboration: International exchange of experts is essential in order to efficiently utilize the latest technology. The project brings together a versatile group of wood specialists from different countries. Furthermore the project utilizes know how and experience concerning the traditional ways to using and manufacturing wood products.

1.5.9 Prefabricated wall-elements out of biogene-based materials and timber for building and renovation

Positioning: Applied

Short Description: Europe's dependency on fossil energy should be dimished, according to the political point of view of the European Union. One of the essential instruments to achieve this is the use of potentials to save energy. The reduction of energy consumption of buildings becomes more important due to the 25-30% part of the total energy consumption and the reduction potential of CO2-emissions resulting from this fact. Especially buildings, which have been constructed between 1950 and 1980, have extremely high consumptions of energy. In the new European countries also modern buildings offer additional potentials of saving energy. In addition to the huge demand for improvement of thermal insulation there is also a fundamental demand for renovation to improve protection against moisture and the architectural design. Nowadays such renovations are usually done with thermal insulation and stucco systems out of polysterol or mineral wool. The implementation of these renovations happens in situ and leads, in addition to the use of predominant petroleum-based products, furthermore to long times of construction, as building with elements / prefabrication is not done. So in addition to the further development and standardisation of the application of pre-manufactured timber elements in reinforced concrete skeleton constructions the target is the development of a dimension-evaluation and fabrication system for the production of pre-manufactured timber parts including insulation, façade panelling and windows for the application on existing window facades (masonry, reinforced concrete).

Justification: This project should enable the timber engineering to get in touch with the amazing field of renovation of facades in order to make use of CO2 neutral and easily manufacturable constructions when thermically renovating the necessary building stock. In doing so the existing methods of survey should be further developed, especially by using laser technics. Also CAD-based planning and fabrication instruments should be further developed. This requires a close cooperation between survey engineers, building engineers, civil engineers, architects and the manufacturing industry. A successful research and development would open up a complete new market for the whole area of timber engineering and it would contribute to the goals of saving energy by the European Union. In addition to design-engineering and questions relating to technical production especially questions regarding noise insulation, fire protection, thermal insulation and moisture protection should be considered.

European relevance and collaboration: A specific European relevance exists due to the reduction of energy consumptions of buildings by using low energy biogene-based construction and insulation materials. Particularly the building stock of the new European countries is predestinated for appropriate applications. This is also valid for concrete and masonry constructions of the sixties and seventies in all European countries. Therefore a cooperation between Scandinavian, East European, Middle European and South European institutes is necessary. In doing so the basic questions such as dimension evaluation and data transfer to production need to be solved in a collaborative way,

whereas for application, architecture and construction regional construction traditions need to be considered. The research could be done e.g. in cooperation of Technische Universität München, Helsinki University of Technology, Universität Innsbruck, Universidad Politecnica de Madrid and other interested groups from other European countries. The development needs to be done in close coordination with the manufacturing industry.

1.5.10 Wood-Concrete Composite Action for Prefabricated Housing

Positioning: Applied

Short Description: Timber floors have been a long quest in research due to its low stiffness combined with a relatively high strength, which leads to vibrations resulting in uneasiness for residents. The combination of timber joists and a concrete slab is not new. The current practice is to install the timber beams and cast the concrete on top of these, then leaving the concrete to set for an appropriate time. For industrial construction (lean construction) this approach is impossible since the curing time for concrete would set back the production time severely. This research project is instead founded on the idea of establishing a connection useful for connecting timber to concrete after the curing of the concrete slab. Similar approaches can be found in bridge engineering where prefabricated slabs are mounted with studs to steel beams. Theoretically, the approach will lead to discrete points in the structure where forces are transferred i.e. the composite action of the structure is discontinuous. Currently, mechanical shear tests are carried out on potential connections, with the aim of testing a full scale timber floor with respect to load carrying capacity, stiffness and vibrations. A parametric FE model focused on the discontinuous composite action will be made.

Justification: The result from the research will present an efficient way of incorporating old technology into modern construction. It will combine two materials in a way that the components are separable after use, which is environmentally friendly and gives the possibility to enhance the system in use. For the timber housing industry it will present a high performance building component, enabling larger spans in timber buildings leading to a potential market share increase. Composite timber-concrete floors would also be a possible constituent in commercial buildings, where timber today has difficulties competing due to the large spans and open spaces required.

European relevance and collaboration: Research within the field timber-concrete components has been carried out in Europe for some fifty years. Knowledge on the composite action between timber and concrete is available. The idea behind this project is to introduce this technology into the modern construction industry, which is currently moving towards more prefabrication and less on-site work. In Sweden the lean construction trend is prominent, providing good settings for testing the product. However, research groups in Germany, Switzerland and Italy are the ones who are excellent on the theoretical framework behind composite action in timber-concrete components.

1.5.11 Strengthening of Glulam with Natural Fibres

Positioning: Applied

Short Description: Glulam members are commonly used as high performance girders in timber floors, roof systems and bridges. The applications are sometimes limited due to the low strength perpendicular to the grain of timber. Strengthening in the direction perpendicular to the grain has been tested by others using glass fibres, nail plates, plywood, glued-in rods etc. All of these approaches, however, rely on technology which is not environmentally friendly in the sense that a structure not easily dismounted or combustible is created. Since one of the arguments for choosing timber as a material is the environmental friendliness, it is logical to look into the quest of strengthening timber using natural fibres such as hemp, flax, wool or even wood. To achieve the strengthening effect a matrix to carry the fibres is needed, commonly some plastic resin (polyurethane, polyester, epoxy etc.). This research investigates the possibilities of using natural fibres in combination with glulam to achieve high performance structural elements. Different types of natural fibres are currently investigated and the work is now focused on finding suitable matrices. Laboratory tests on simple coupons will commence the laboratory work which will finally focus on strengthening of full size glulam beams.

Justification: The result from the research will present a new technology to increase the competitiveness of timber yet preserving its environmental benefits. In the industry context, timber strengthened with natural fibres will lead to a high performance product that can be made competitive for demanding applications thus increasing the market for wood. Ongoing efforts in the field of wood composites can also be canalised towards the construction market, which is the largest recipient of sawn lumber and glulam. From an environmental point of view the use of natural fibres is commercialised and spread, which in the long run supports the development towards a sustainable material use in the construction industry.

European relevance and collaboration: Research within the field of composites and wood composites has been a growing area. However, there is currently a lack of large scale applications used in a real industry setting. This project idea is very much funded on the thought of establishing a cross industry setting for the product to develop. This means communicating between material scientists and construction scientists, two worlds with quite differing functional requirements on the product. The project can be seen as a technology transfer project guiding material science into the framework of construction.

1.5.12 Development of new cellulose fibres for nonwovens in hygienic and health-care products (CELCARE)

Positioning: Applied

Short Description: A new patented method for production of regenerated cellulose fibres in lab scale for nonwovens has been developed in 2005. These cellulose fibres are specially suitable for hygienic and health care applications due to their purity, mechnical characteristics, and absorpency chracteristics. The CELCARE project developes a pilot production line of 100 kg/d of biocelsol fibres and produces optimised fibres for carding, hydroentangling and blend-thermobonding processes. The properties of nowovens are investigated by the manufacturer and the end-users. The results of the CELCARE project are used for planning an industrial-scale fibre production line of 5000 kg/d.

Justification: The results offer to fibre producer a new environmentally friendly and economically feasible process and for nonwoven manufacturer competitive accepted products in hygienic and health care sector.

European relevance and collaboration: The basic technology is developed in laboratory scale in EU project Biocelsol. The fibre working group with research and industrial partners fullfilled by end-users could be the partners of CELCARE project as follows: TUT Finland, Inst Chemical Fibres Poland, VTT Processes, Säteri Oy, Suominen Nonwovens, Mölnlycke Health Care, Procter&Gamble

1.5.13 Incorporation of smart features into fibre-based materials

Positioning: Applied

Short Description: During the recent years the research on smart, packaging related features has proceeded considerably. The trend is definitely to replace the separate labels with printed or material integrated solutions. First smart concepts based on printed, intelligent inks have been presented. However, the vast reservoir of biological molecules having the capacity to specifically react with numerous microbes and their metabolites has been underutilised. In this theme the research will combine the profound knowledge of biocatalysts, their modification and their reactions to technologies developing different printing methods for fibre-based products. Additionally, electronics will be combined to the system when biofuel cell based sensor constructions are developed. In addition to the main methods related to biocatalysts and their reactions, printing and electronics, the methodologies involved in the theme will include studies related to the correlation between the packaged product and the parameter to be measured using the new, smart features combined to the fibre-materials.

Justification: The high standard of living continuously supports new consumer demands for e.g. high-quality food products. Smart features incorporated into the packaging material offer a tool to enhance the quality of the packaged products. Concepts reacting to the time-temperature history or gas-space composition of the package (product) are already commercially available. The presently available concepts are, however, separate label-type structures. Other production methods, like printing, would enable the production of low-cost, package integrated systems. The goal of the present theme is to produce new, smart features to be utilised in fibre-based packaging applications. Among these are e.g. printed, indicator systems based on reactions catalysed by selective biological molecules. Even printable biofuel-cells can be utilised to introduce more sophisticated sensor functionalities into or on the fibre-based packaging material. The theme strongly supports the Vision 2030 by introducing a possibility to create new, high value-added products among fibre-based products.

European relevance and collaboration: Various expertise areas are needed to accomplish the goals. Partners can be identified among groups specialized in: enzymology, wood chemistry and packaging industry and will be named later.

1.5.14 Interactive and intelligent paper products:

Positioning: Applied

Short Description: New enabling technologies will be strong drivers of industrial development. This will create opportunities for responding to the new habits and fashions of future consumers and responding to the increasing competition, from other ma-terial sectors and the electronic media. Cooperation and alliances with other industrial sectors and technologies offer op-portunities for creating new, high-value added products and services. These will incorporate combinations of fibre-based materials with other materials, utilizing, micro-electronics, information technology and automation, bio-technology, nano-technology and other emerging technologies. This will be an opportunity for the European fibre-based sector to change its product mix from "bulk commodities" towards a new range of knowledge-demanding and high value-added specialty products. These specialties include both packaging solutions and new communication prod-ucts.

Justification: Developing printed static markings, visible or invisible codes and information to be read by specific optical devices (e.g. cell phone cameras) Developing multilayered structures of electronics and optics for producing active components like displays, indicators, or batteries. Developing anti-counterfeit effects like decorations, tracking and identification features etc. Developing low-cost, printed, package integrated systems for controlling packed product quality (e.g. time-temperature history etc.) Developing intelligent components, printed optics and electronics (smart or intelligent codes, tags etc. like printed RFID) having the capability of being read and also updated.

European relevance and collaboration:

1.5.15 Enzymatic modification of cellulosic fibres with spatial control

Positioning: Basic

Short Description: The uncontrolled degradation of cellulose occurring throughout the cell wall during enzymatic treatment of cellulosic fibres severely limits the use cellulose degrading enzymes for the manipulation of cellulose and fibre properties. The main reason for this is the porous structure if the fibres allowing for rapid penetration of enzymes into the interior of the cell wall. If the infiltration could be minimized or prevented selective manipulation on the true fibre surface (as opposed to the total surface, including all pore surface) could be achieved. A possible approach would be to increase the size of the enzymes. The possibility to specifically target e.g. tumour cells has lead to the development of a large number of strategies for the coupling of proteins to different carriers. Such an approach can increase the apparent size of the enzyme to several *f*Ým. Different coupling strategies will be tested and evaluated by e.g. the measurement of conjugate activity, cellulose molecular weight and disintegration of treated fibers.

Justification: Possible applications could be e.g. selective degradation of surface cellulose increasing the number of short chain molecules extending from the surface or the selective removal of the outermost part of the cell wall improving the possibilities to disintegrate fibers into micro fibrillar cellulose (MFC). The molecular weight of surface cellulose has important implication for the formation of interactions with other fibers and other materials such as a polymer. The weakening of the S1 layer can have important implication both for the energy consumption during MFC production and more generally when activated cellulose is needed e.g. during cellulose derivative production. If successful the use of developed techniques would enable decreased energy consumption in industrially important processes.

European relevance and collaboration: Many countries in Europe have a large industry involved in the processing of cellulose or cellulose containing raw materials. In order to continue to be competitive in the future continued development of processing techniques are needed. This is recognized and many strong groups are active within the cellulose field in Europe. In order to develop new methodologies for enzymatic treatment of cellulose collaborations between different groups will ensure success.

1.5.16 Next generation wood based composites

Positioning: Basic

Short Description: Four main research issues: 1) Impact of raw material changes on the production of wood based composites, short term and long term performance 2) Innovative processing parameter and its impact on the property of wood based composites 3) Bio-resin binding systems for the production of wood based composites. 4) Zero defect wood based panel production (on line quality control) Trends are towards the use of increased levels of recycled fibre and these bring problems of the need to sort, identify and classify types and identify contamination. Current press temperatures require large energy input and lead to internal stresses, which results in problems such as thickness swelling. The challenge is therefore to develop the use of lower, or even cold, curing adhesives for the panel industry, without a loss in performance. Bio-resin is currently being considered as an alternative for traditional formaldehyde based resin systems for wood based composite manufacture. This could lead to produce a true eco-composites for construction. However, the research to verify its viability has yet to be carried out.

Justification: This research will address the above issues and examine the impact of these innovations to the final performance of wood based composites and their life cycle costs. The production of zero defect wood based composites will be the goal of both panel and construction industries. Quality control procedures are currently based on destructive testing of small samples taken from each batch of production. Some non-destructive (e.g. ultrasound) tests are used for monitoring the panel manufacturing process, for example to check mat density, but are not in regular use for monitoring the properties of the finished panel. EN326-2 allows the use of alternative procedure for demonstrating compliance with the specification and this research will develop and apply non-destructive test procedures that can achieve this with the finished panel. Thus every panel produced could be inspected and accepted or rejected on a panel by panel basis, thus improving the consistency and reliability of the finished product. The results will enable: 1. high quality next generation wood based composites 2. innovative applications of composites in construction 3. efficient use of European resources

European relevance and collaboration: These issues are related to both European timber and construction industries. There is insufficient critical mass to address these issues through individual member states. The research should be carried out by a collaboration of major European research institutes in partnership with construction companies and composite manufacturers.

1.5.17 Highly stressable flexible connecting system

Positioning: Basic

Short Description: We want to find a highly stressable connecting system for a modular timber construction in the housing sector. The system should be used for most timber construction details. This new product should be manufactored fast and easy. The customers are carpenters, joiner and prefabricated house sector. First we have to collect the data of the most timber construction details. With this informations we will develop a flexible connecting system for this sector.

Justification: The customers are joiner, carpenter and the prefabricated housing sector. With this new connecting system the customers can manufacture their products more cost efficient and faster. KNAPP delivers connecting systems all over the world, it results in a significant economic factor such as extensions for a large range of applictions. KNAPP can save market shares and maximize the sales volume. For enviromental impacts we can save buildung material. Apart from that there is no positive or negative enviromental impact.

European relevance and collaboration: In the near future the housing sector will manufactures timber construction walls, ceilings and roofs faster and the production costs should decline. The demand of a flexible wood connecting system with low costs will be rise in the European countries, North-America and Japan. KNAPP will be develop this new connecting system with the European collaboration . In most of the European countries KNAPP requires for the new connecting system the national technical approvals from the testing laboratories.

1.5.18 Solid Mechanics for wood

Positioning: Applied

Short Description: Wood has different mechanical properties in axial, radial, and tangential direction. Further it differs in strength between tension and compression. This makes it very hard to calculate the strength of different structures by use of modern software, e.g. the Finite Element Method. The project aims to examine how close it is possible to predict movements in different members of the structure because of applied known forces.

Justification: Finite Element calculations for wooden structures, such as furniture and buildings, will almost always fail to predict the true behaviour of that structure. Because of this, many structures are far too strong, while others collapse earlier than expected. In order to utilize wood efficiently we must therefore learn how to optimise wooden structures far better than is possible today.

European relevance and collaboration: Linköping University, Chalmers Institute of Technology and one university in Poland have contributed to research on small wooden structures, such as chairs and furniture. Larger stuctures are dealt with in civil engineering at many universities.

Sub-area 1.N Other

1.N.1 R&D of composite products. Researching emotions originated from sensing

Positioning: Applied

Short Description: The project studies potential uses of composite materials and different material applications such as wood combined with plastics, metals, stones and stone ingredients. The project also maps the services and competencies of research institutions specialized on wood materials. Special interest will be concerned with reactions and emotions originated from the sensing of materials.

Justification: The project produces designs for products and environments, where the selecting of the materials and their combinations create new types of product appearances. Eventually the designs improve cosines, comfort and well being. The research and testing is needed for to consider the social and psychological influence of natural materials. Kuopio Academy of Design had 2002-03 a research project LUMA concerning sensing of natural materials. Results were published in LUMA report.

European relevance and collaboration: European organisations will develop activities like seminars and work shops as well also the exchange of experts. On basis of the cultural anthropology the project observes how new product concepts apply to different user groups as well as to the built cultural surroundings in different countries.

1.N.2 INFLUENCE OF WOOD-BASED PRODUCTS ON INTERIOR AIR QUALITY

Positioning: Applied

Short Description: Nowadays, Wood is widely used in building industry, from walls, timbers, frames, floors to furniture and source of heating energy. But these different wood-based products have a significant influence on the quality of air indoor and could be somehow hazardous for our health. Indeed interior air quality constitutes a major topic for which the European Commission worked on many regulations in order to impose emission ceilings. Thus, it would be interesting to follow and characterize the emissions of Volatile Organic Compounds (VOC), Carbon Monoxide, Carbon Dioxide, Formaldehyde and Particle Matters generated by wood-based products (that could be composed of adhesives or preservation products, or during wood combustion, …) in a room of a building. It would be necessary to define a standard way of measurement and a standard room in order to be able to compare the pollution of the emissions of different materials and different uses.

Justification: This study would enable to define clearly if some materials have a serious influence on the pollution of interior air and if they can be dangerous for our health. The results could lead to change the composition of some materials and to work on the production of new products, environmentally friendly and suitable for a use indoor. This study could also help industries to understand the influence of their made products on air pollution : everybody is concerned and directly exposed on his work place or inside his house.

European relevance and collaboration: Depending on weather conditions, cultural habits or architectural preferences, each country owns its proper style of construction and uses different materials to build or to decorate a house. Thus, it would be possible to compare the quality of interior air for different buildings representative of the European standard types of construction. This study would be interesting not only to collect data on the air pollution in Europe but would also interest scientists working on environment and sustainable development, chemistry, construction …

1.N.3 The innovation system for sustainable materials development

Positioning: Applied

Short Description: An important part of the innovation system is an end-user and an enduser that has the force to benchmark and also order the first products. When developing composite material from renewable resources it is important to remeber that there has to be a potential buyer and that the benchmarking in order to select unique materials properties in order to justify a reasonable price has to be done in collaboration with the enduser. New production processes adapted to biofibres and biopolymers has to bedeveloped in the project. Fibre composites that are dimensionally stable and has a controlled lifeexpectancy. Renewable polymers need to be developed that are compatible with natural fibres. Micromechanical modelling is needed in order to speed up development and to leave the empirical era of "blend and see what happens materials research" behind.

Justification: Renewable materials and products to be used in the interior of buses and trains, at hospitals and schools etc. Materials with superior accoustic properties, high performance per weight unit and being carbondioxide neutral. These materials will contribute to a sustainable growth and a better environment. Through the force of the collective public ordering of these new materials it will be easier to find risk capital for starting production units for renewable products. There also need to be a system for the recovery and reuse of these materials. The impact of the research depend upon the market and the strength of a European public buyer.

European relevance and collaboration: A European project with identified regions that strive to follow the Lissabon protocoll on sustainable growth could together put some pressure on the market to develop renewable materials through the collective ordering of renewable products for the medical sector, public transportation, energy etc. In that way there will be a driving force for the development and also a strong incentive for the establishment of an efficient technology transfer to new or already existing industries.

1.N.4 Modified wood – eco-efficient alternative to tropical and preservative treated wood

Positioning: Applied

Short Description: The overall objective is to make an assessment of the long-term suitability, in a sustainable society, of wood modification methods that may serve as alternatives to conventional wood preservatives (toxic agents) and/or durable tropical timbers. Specifically: A) To reach a fundamental understanding the protection mechanisms of the new "non-toxic" preservation methods against decay by fungi, bacteria, insects and marine borers. B) To assess the environmental impacts of alternative wood preservation (i.e. wood modification) methods, and their effect on the products structural performance. Most non-tropical wood species are susceptible to moisture changes and decaying organisms. To increase the durability of non-durable wood species, wood is traditionally impregnated with toxic preservatives. However, alternative and more environmentally acceptable treatments, e.g. heat treatment and furfurylation are emerging on the market. Another treatment close to commercialisation is acetylation. These modified wood products show high resistance to microbial decay, insect and marine borer attack. They are also less moisture sensitive and thereby dimensionally stable, leading to less maintenance of the wood product. Preliminary ecotoxicological studies of preservative-treated wood and naturally durable wood species clearly indicate that the water leachates of these materials have a fatal effect on aquatic organisms unlike modified wood leachates.

Justification: Most studies indicate that an increased use of wood will contribute positively to a sustainable development of the society. The total environmental impact of wood products is highly influenced by the limited durability of the untreated wood material. However, methods to improve the durability by conventional wood preservation, may also lead to increased environmental impact due to the highly persistent toxic compounds introduced to the wood. Non-toxic alternative wood preservation methods should therefore be attractive in a life cycle perspective. The design of timber structures is very often governed by serviceability requirements. Insufficient knowledge exists especially when it comes to the climate effects on structures and material performance. More reliable data of the performance of new chemically modified wood materials will increase the understanding of the protection mechanisms of these new wood materials. It would strengthen wood manufacturing industry and end-users in their choice of product for a desired product life time with minimal environmental impact, and it also contributes to the fulfilment of central goals of the European Commission concerning human health issues.

European relevance and collaboration: The research group established within the European Thematic Network of Wood Modification (that ended 2003) would naturally be a suitable basis for further cooperation within this area and implementation of this research. Furthermore, these researchers have been cooperating in several EU-projects before. Members of this group were e.g.: Dr. Callum Hill, University of Wales, UK Waldemar Homan, SHR, the Netherlands Dr. Dennis Jones, BRE, UK Dr. Prof. Holger

Militz, University of Göttingen Dr. Nils Morsing, DTI, Denmark Antti Nurmi, VTT, Finland Dr. Andreas Rapp, BFH, Germany Prof. Joris VanAcker, Ghent University, Belgium Dr. Mats Westin, SP Trätek, Sweden Suitable additional partners would be: Dr. Morten Eikenes, Skogforsk, Norway Dr. Bartek Mazela, Agricultural University of Poznan, Polen

1.N.5 Knowledge-Based Building with Wood

Positioning: Applied

Short Description: Erection of homes, offices and production sites account for a very significant part of all building activities in Europe. The role of wood and wood-based products as a sustainable construction material has a long history. Throughout Europe enormous differences exist in the way wood is used in construction and the assumption quantities vary to a large extent. Increasing the share of wood in construction helps to improve sustainability and to reduce CO2 emissions. For achieving this goal existing building products and novel concepts have to be optimised and further developed. In future living and working of European citizen will be closely related to urban planning and rural development. People will spend at least half of their time at work and an increasing part is consumed by travelling to workplace. Due to this fact, European citizen desire to live in dwellings which provide a pleasant living environment and which are located close to workplace and leisure activities. Character of the work (R, T, D): All types of research (generic, applied), technology development, transfer from and between different sectors, demonstration activities Major competence needed: Civil engineering, material sciences, process design, process engineering, process development, systems analysis, LCA, information technologies, standardisation

Justification: -Reduction of GHG emissions resulting from production and use of buildings by increasing the share of wood and wood-based products. -Securing of comfort and flexibility of European citizen taking into consideration the needs of the increasing share of aged population. -Improving the living quality of the European citizens by increasing the use of wood and wood-based materials for interior furnishings and furniture. Novel and improved concepts for realising environmentally friendly construction and erection of buildings. Provision of healthy and safe living and working conditions for European citizen. Realisation of sustainable building concepts in a large share of all newly erected buildings in Europe. Substantial contribution of the building industry to the GHG emission reduction targets in Europe. 2015 Newly erected buildings consume in average 30% less energy compared to 2000. Share of wood in construction has increased by 20% compared to 2000. Wood, concrete, steel and glass sector have fully realised the

European relevance and collaboration: Strong effort is needed to promote renewable building material systems. Competitiveness and efficiency can only be reached with harmonisation and industrialised pan-European systems. Too much overlapping and locally differentiated systems exist now. Compeating materials more consolidated and rule the market.

1.N.6 Indoor environment in wooden houses

Positioning: Basic

Short Description: Untreated wood emits natural volatile compounds, very often what you would recognize as the smell of wood. In softwood the terpenes are the dominating the emissions. Engineered wood also emits natural volatile compounds, and if glue has been added, these products might give increased levels of formaldehyde. Improvement of positive and negative aspects of wood emissions, as well as obtaining substantiated documentation on the positive properties of wood, will be central in this part of the project. This project will investigate and verify research already accessible, and supplement this with new knowledge if needed. - Health effects on the different emissions from wood and wood products will be investigated through existing knowledge and new research on the emissions effect on human health - New technologies for reducing or eliminating natural emissions from wood will be developed - New test methods and assessment/certification of natural emission from wood will be investigated

Justification: Indoor environment factors has become an important environmental argument in the wood industry. It is therefore important to gain knowledge and information on how the most typical indoor environmental factors influence human health. The project can be closely linked with projects dealing with other indoor environment factors. Germany has notified a draft decree “Principles for the health assessment of construction products used in interiors”, based on the German AgBB-scheme. This AgBB scheme is still subject to substantial debate and opposition from experts in the wood sector, because it does not take account of the fact that wood emits natural and non-harmful VOCs (Volatile Organic Compounds). So far no scientifically-based relationship has been established between emissions exceeding a threshold value and a risk to health. If such a decree is approved and implemented, products that do not achieve the requirements may no longer be used in interior applications in Germany. This could establish a dangerous precedent.

European relevance and collaboration: There are movement within CEN on emissions from construction products where VOC and formaldehyde are high in the agenda. A common European collaborative work will therefore be suitable as there should a common European understanding on the health effects of wood emissions. Key roles in this project will need to be established at a later stage, several research groups and types of research will be needed to implement this research.

1.N.7 Analysis of wood demand structure of Chinese solid wood processing/using industries

Positioning: Applied

Short Description: The research is to clarify the implication of the growing Chinese solid wood processing/using industry to the European wood industry as wood demand is concerned. China now has a fast-growing wood processing industry to supply both its rapidly surging domestic market and international market. This research is to analyse wood demand structure of Chinese industrial buyers of solid wood to understand its price pattern for wood raw material input in various processing degrees, quality requirements, operational environment and business practice etc. Special attention will be paid to the current wood supply sources, availability, tree species, quality features etc. Such industrial buyers would include sawmills, secondary processing mills, various wood products manufacturers ranging from wood floor factories, furniture mills to window/door mills, and building constructors. The research also address issues of quality, price level, market targets of the final wood products of those industrial buyers. A qualitative approach will be adopted for the research. Mill visits and field survey will be done to 30 representative Chinese solid wood processing/using companies ranging from small to large firms. A large literature review on the topic area will be carried out to collect secondary data for the research topic. Collaboration with some Chinese universities and research institute will greatly facilitate successful implementation of this research.

Justification: The research results will benefit European wood industry in following ways: • Help European wood industry to understand the solid wood demand structure of Chinese market along with operational environment, business conditions, and operational practice of Chinese wood business. • Provide information for spotting possible business opportunities, export of wood products or/and wood processing machines and investment ventures in China. • Provide useful information for European wood industry to develop its global business strategy. • Find opportunities for cooperation in business and research area between Chinese wood industry and European wood industry.

European relevance and collaboration: The issue is suitable for a collaborative European research project for following reasons: • Chinese wood industry is large and growing. It consumes a lot of both softwood and hardwood species for various end user products. So both European softwood and hardwood processing industries will be covered while assessing business implications of Chinese solid wood processing/using industries. Therefore wood species considered would include such as pine, spruce, larch, oak and beech etc from Nordic countries and middle and south European countries. • As European Wood Council (EWC) has been established to coordinate business development efforts of European wood industry, this research project would be in line with the business development spirit of EWC.