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## Wood-Based Multi-Material Systems For Technical Applications – Compatibility Of Wood From Emerging And Developing Countries

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### Abstract

Lightweight construction with the objectives of weight and resource savings are at present and in the future most important in all engineering systems. One attempt to lowering weight is to change the employed materials. In this topic the implementation of sustainable material into structural constructions is an alternative to be considered. “Sustainable” here refers specifically to materials, which are eco-friendly, recyclable, renewable, not complex and inexpensive for processing. By fulfilling those requirements while ensuring the technical performance and reproducibility, wood and its reinforced material systems turn out to be very promising for all technical applications. The originality of this paper come from the assignability of the method of approach done in European research to other wood species. These species are widely available in developing countries, where the sustainability topic begins to play an essential role in the industry.

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### 1. Introduction

Environmental issues caused by negative effects from industries are brought into discussion very regularly and a variety of worldwide research efforts are being taken to efficiently make progress in solving these issues. Addressing

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the aspects also means dealing with the problem of resource – either energy or material – exploitation, production and utilization [1]. There is a strong correlation between these two types of resources, i.e. any possible alternative implementation of one would lead to a significant improvement of the situation in general and a reduction of our dependency on the traditional resources of which the use should be limited [2]. In this case, materials are the main focus. The materials employed have to be renewable, recyclable, as well as not complicated and inexpensive for processing. In that sense, wood is a type of sustainable material [3, 4]. Investing time and effort in new materials is not always the best choice, as possibilities may also come from the right combination of the existing ones. By fulfilling the technical requirements, wood-based multi-material systems, or in other words, fortified compositions of wood with other technical textiles, synthetic materials or metals turn out to be potentially appropriate for a wide range of lightweight structural applications, ensuring quality, stability, safety and comfort [5, 6].

An example for the application is the transportation sector, which is considered to be one of the biggest contributors to the deteriorating environmental situation. This is due to its CO<sub>2</sub> emission into the atmosphere and a high consumption of metals, e.g. iron and aluminium for the production of vehicles. Notable efforts regarding such issues have been the recycling and remanufacturing of materials and components, which is, however, not enough to compensate for the high consumption demand. Another approach is to reduce the weight of the vehicles, which mainly depends on the material used [7]. Nowadays, not only metals, alloys and synthetics are used in the construction of the vehicular shell, but also sustainable materials. This is where wood-based material combinations come into force.

So the aim of this paper is to show the assignability of research done in Europe to wood species which are legally and commercially available in regions with a more tropical climate.

## 2. Unconventional wood materials

The approach presented in this paper principally follows the way of building a multi-material system, with wood as the main component, presented in former work: The wood veneers are adhesively bonded to the enhancing technical materials, in this case, *aramid fibres* and *stainless steel*. Research on such materials has already been conducted with beech wood [5, 6, 8]. The results of this research serve as a technical base for further development in this approach, as there are no research records on wood species that are popular in emerging regions. Many countries from these regions are global manufacturing hubs, where the introduction of new materials can be noticeably beneficial. They do not have to be imported and simultaneously do not require complex production technology [9] which is only affordable in developed countries. This, therefore, results in possible cost reduction and a larger global implementation impact. For example Vietnam; besides having a high interest for sustainable growth, also has a widely renewable variety of commercially local wood selection, and very importantly, sufficient know-how to actively pursue the alternative technology.

In this project, three new types of wood are examined: *pine*, *cedar* and *khaya*. These species are legally and commercially available in regions with a more tropical climate, which means higher temperature and humidity. Such a wood selection aims to broaden the combination possibilities for further material systems, taking into consideration the fact that many emerging countries, such as Vietnam, are located in tropical areas. Cedar and khaya, in normal condition, possess fairly good mechanical properties, i.e. light weight and fairly high strengths, thus offering huge application potentials. These alternative potential wood combinations will be experimentally tested and analysed in order to obtain an initial impression of their feasible application range.

## 3. Reinforced material systems

The experiments were conducted on samples of various reinforced material systems, including samples for reference purposes. For specific applications in lightweight constructions, it is of great interest to ensure the possibility of analysing the multi-material systems as regards bending and tensile modulus of elasticity plus strength. These are the basic characteristics to evaluate the feasibility for further applications.

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