Development of High-quality Semi-finished Products of Special Wood-based Materials for Application in Mechanical Engineering and in Conveyor Technology

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Initial Situation and Objective

The wide use of ecologically beneficial and sustainable wood-based materials in mechanical and plant engineering, especially as regards conveyor technology, is hampered basically by the "emotional attitude" towards wood being considered as weak and of limited performance.

Mechanical and plant engineering, interfacing with conveyor technology, require semi-finished products of wood-based materials in which adjustable and high mechanical properties are controllable to the largest extent or are permanently available at high quality. The sizes of semi-finished products applied in structural parts (profiles, covers, etc.) tend to be smaller than in the building or furniture sectors. Thus, faults are more precarious and may, under certain circumstances, result in the functional failure of the structural part. Moreover, the fire protection issue and that of resistance towards certain media must not be neglected. Also, it would be of great benefit to maintain the "well-known" or actual advantages of wood-based materials, such as:

- advantage in price as compared to metal-based materials,
- lower demand for primary energy in their manufacture,
- its eco bonus, as it is a near-nature material (with high shares of renewable materials),

to the largest possible extent.

It was the target of research to develop a semi-finished product of suitable wood-based materials in panel design, whereas the addressed disadvantages would be minimised, so that that highly qualitative semi-finished structural parts for use in sustainable solutions could be provided to mechanical and plant engineering and, therefore, also to the conveyor technology. Their development was also expected to include a characterisation of properties regarding various types and periods of load. With that semi-finished product in hand, the later user would have a material basis of secured and high-quality properties that vary only slightly and "behave" in a well-known way. This was expected to contribute to an increased acceptance of wood-based materials by the mechanical and plant engineering sector. After first referential applications in mechanical and plant engineering have become available, the wood-based material industry has, out of this niche, been given access to a new and steady market.

It was the superior objective to purposefully modify properties for application in mechanical engineering by beneficially arranging layers in the panel-like semi-finished product.

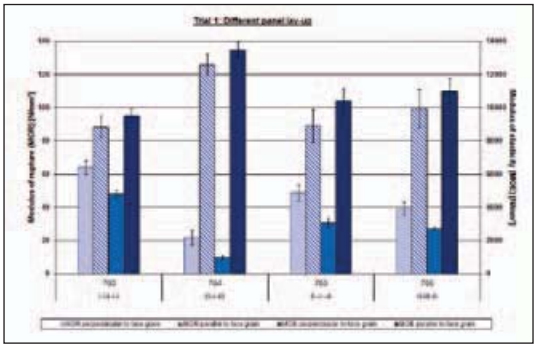

Fig. 1: Bending strength and bending modulus of elasticity of the plywood variants in the main and side lines, depending on panel structure

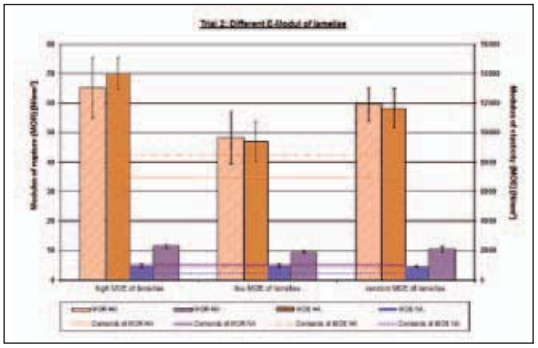

Fig. 2: Bending modulus of elasticity of solid wood panels in the main and side lines, with strength-assorted lamellas applied

Results

So far, two development or optimisation criteria have been defined for analyzing existing materials and developing a special material for application in mechanical engineering.

$$\frac{\sum \text{mechanical parameters (strengths or moduli)}}{(\text{density} \times \text{price (per } m^2))}, \text{unit } \frac{N \times cm^3 \times m^2}{mm^2 \times g \times €}$$

This criterion is expected to lead to materials allowing for reasonable lightweight design. The criterion can be applied to both the sum of several mechanical parameters (E moduli, strengths) and to one selected parameter (e.g.), the bending modulus of elasticity, bending strength. The following applies: the higher the calculated parameter, the more suitable is the material. The target is to reach the parameters of usual metal-based materials used in mechanical engineering (e.g., AlMgSi0.5, S235JR) or to exceed them in their optimum.

The application was implemented preferably by using special plywood superstructures (Fig. 1), solid wood panels (also using strength-assorted lamellas, Fig. 2) and several OSB variants. It has become obvious that an application-specific setup is able to increase the strengths in one direction. However, the variation coefficients of the wood-based materials were generally too high. Homogenisation must be improved further by using customised designs.