New uses of wood.

Densified wood, liquid wood, transparent wood: materials suitable for new shapes and ideas of designers

Angelo Speranza

DENSIFIED WOOD .

The results of a study, carried out by the University of Maryland (USA), have conducted the researchers to the production of a "densified" wood with improved mechanical resistance and sensitivity to moisture. This new material is suitable for buildings but also for other solutions such as bulletproof vests.

The process would seem simple, even if it takes a long time. Another limitation is that the present process do not allow the production of large surfaces.

The wood, in a first phase, is treated with sodium hydroxide (NaOH) and sodium sulfite (Na2SO3), a similar process already used for the production of pulp in the paper manufacture. This process removes lignin and hemicellulose (natural polymers that stiffen the walls of wood cells), but leaves cellulose (another natural polymer) largely intact.

The second phase consists in pressing, in the presence of heat, the resulting product until it collapses.

Pressure and heat favor the formation of various chemical bonds between hydrogen atoms and related atoms in the adjacent nanofibers of cellulose, considerably strengthening the material.

Altoparlanti con cassa modellata in Arboform

A material derived from wood is obtained which, in addition to being harder and more resistant than natural wood, is also easily moldable, while remaining recyclable and available in large quantities.

Furthermore, the densified wood swells very little in the presence of high humidity. Another interesting application was to create a sort of plywood with five layers of densified wood that seems to even stop the bullets fired from the weapons, similar to the vests currently in use, however, having much lower costs.

There are also plans to replace carbon fiber components, which require expensive and difficult to recycle adhesives and components for the automotive industry (bumpers, frames, etc.), substituting steel, aluminum and plastics.

At the current stage of the research, conclusive considerations can not be made as it is necessary to wait for possible industrial applications of this material. In any case, the prospects seem really interesting.

LIQUID WOOD.

The results of the American research here presented seem similar, at least partially, to those of the project known as "liquid-wood", a thermoplastic composite polymer developed by the German company TECNARO®, in collaboration with the Fraunhofer Institute for Chemical Technology. Also this biomaterial is produced starting from the lignin extracted from wood and then mixed with fibers and natural additives. Whith this process a thermoplastic material is obtained, supplied in pellets, which can be used with the injection and mol-

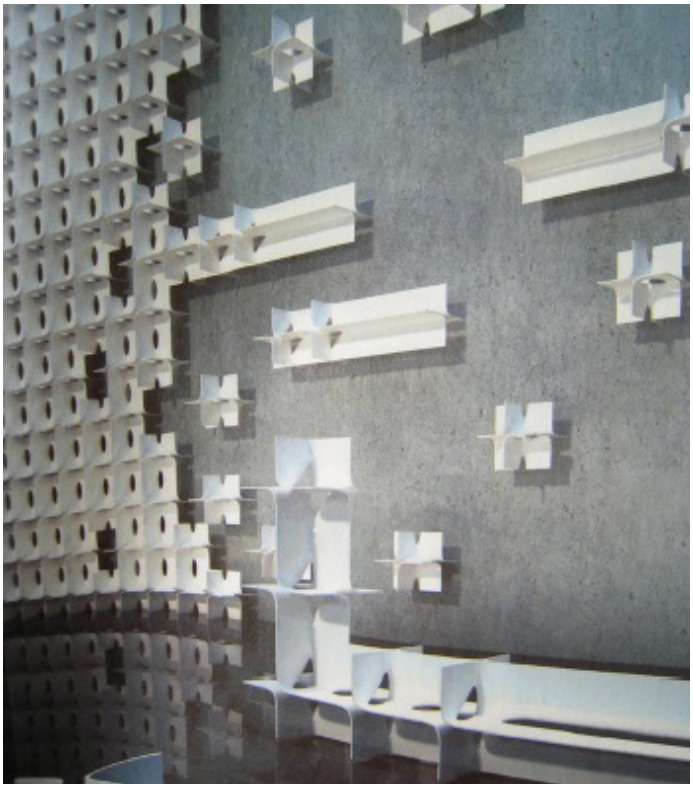
New uses of wood.

Densified wood, liquid wood, transparent wood: materials suitable for new shapes and ideas of designers

Angelo Speranza

ding equipments typical of other plastic materials.
However, this new material has already passed the research phase and has become a product industrially used through all those operations known for the transformation of thermos plastic materials. The product is marketed under the brand name Arboform®. The liquid wood is declared to be a product made of 100% renewable, biodegradable raw materials, with the natural appearance of the wood fibers, with a high rigidity, low shrinkage, excellent acoustic properties, moderate thermal resistance and with a natural odor or even odorless.

The manufacturer considers the liquid wood suitable for internal components in automobiles, musical instruments, toys, furniture and thanks to its acoustic qualities - in the creation of designer speakers.
Apart from furniture, also shelving, shoe details just to mention the best known have been already produced.
A critical consideration that can be made is that this material requires, at least in the furniture sector, a surface coating since its natural appearance is not satisfactory, lacking the design of the wood from which it derives.



TRANSPARENT WOOD

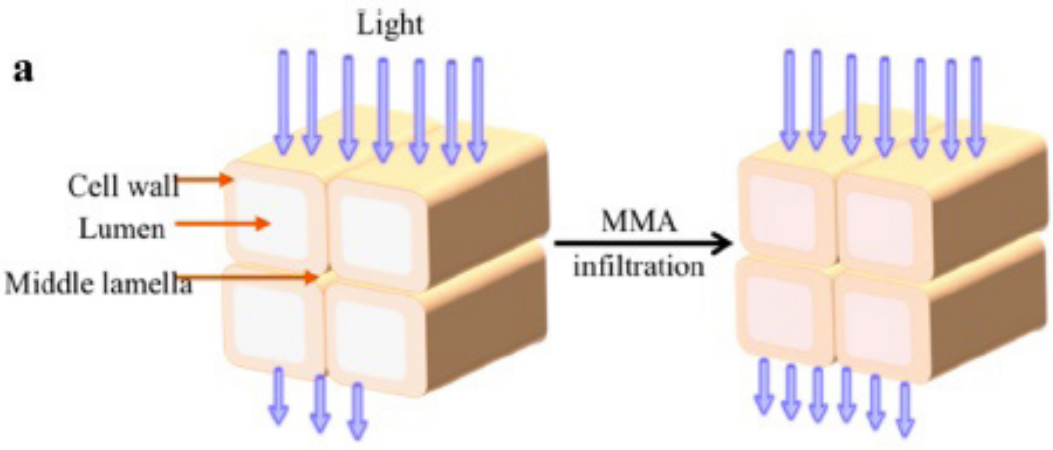
An additional product derived from wood is called transparent wood.
The project was developed by the same researchers of the densified wood belonging to the University of Michigan and others belonging to the KTH Royal Institute of Technology in Stockholm (Sweden).
In particular, the latter have succeeded in making the wood transparent through a chemical process through which the wood cells have been “cleaned” of the opaque components (lignin) and combined with transparent polymers.
The first step in this process is precisely to remove the lignin, a substance that not only stiffens wood but also creates its brownish color.
Researchers using wood veneer, after removing the lignin, impregnate the cell cavities with pre-polymerized methyl methacrylate (MMA) at the nanometric level.
Since the refractive index of MMA corresponds to that of lignin-free wood, light rays pass through the MMA-wood composite without being reflected internally.

New uses of wood.

Densified wood, liquid wood, transparent wood: materials suitable for new shapes and ideas of designers

Angelo Speranza

The goal that the researchers have set themselves was that of replacing glass sheets for windows, windows with glazed surfaces and being used in the realization of the transparent part of the solar cells.
The new material would have a remarkable mechanical resistance typical of the base wood used, resistance to shocks, a characteristic that glass envies wood, low thermal conductivity and lightness. Good transparency must also be added to these properties.
The tests have shown that a sheet of transparent wood can pass 85% of the light. The incomplete transparency (relative opacity) can however be an advantage in terms of solar irradiation of the interior environments.
To all this is accompanied by the fact that the raw material for the production of transparent wood is absolutely renewable. The development of the research will be to improve transparency, use other wood species, the study was done on balsa wood, and make larger samples. Also in this case it is perhaps too early to draw conclusions on the objective characteristics of this product until it is industrially realized and its costs and performance over time are not known.



For info:
+39 0432 747211
lab@catas.com