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# Renewable Adhesives for Wood Composites

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Chimar Hellas S.A.



## Profile

CHIMAR HELLAS S.A. is an innovating technology provider for the resin and wood-based panel industries (particleboards, fibreboards, plywood, oriented strand boards, laminating papers). It develops in-house and licenses know-how for the production of formaldehyde, urea-formaldehyde pre-condensate (UFC), formaldehyde-based resins and resin additives as well as their application in the manufacturing of wood-based panels. It also develops processes that enhance the productivity and profitability of manufacturing of resins and wood panels, and is active in the engineering works for the construction, start up and operation of respective resin and additive plants. CHIMAR continuously focuses on "green" chemicals and technologies, fulfilling eco-efficiency principles.

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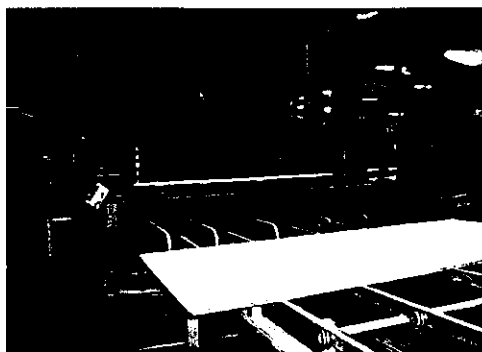


Figure 1. Plywood production.

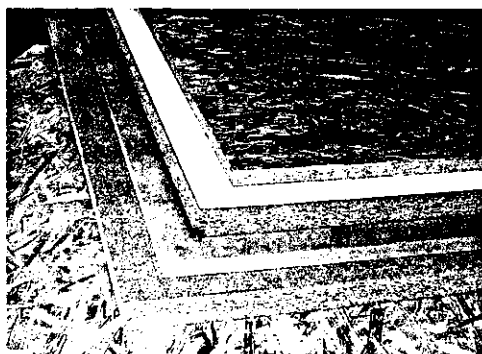


Figure 2. Particleboard, MDF, OSB (Source: EPF website).

**Renewable Adhesives For Wood Composites**

Synthetic resins like urea-formaldehyde (UF), phenol-formaldehyde (PF), and melamine-formaldehyde (MF) are commonly applied in the production of composite wood panels (wood-based panels), to bind the wood elements together and form the final panel products. These resins are synthesised from petroleum and natural gas derived chemicals and therefore their prices are directly dependent on the fluctuation of oil prices. Moreover, given the finite nature of the oil deposits, the long-term availability of petroleum-derived products is not guaranteed.

The use of wood panel products contributes to more efficient forest utilisation and thus provides a cost effective solution to related environmental problems. To utilise large quantities of forest residues for conversion into low cost panel products, it is necessary to develop less expensive adhesives with secured availability, in order to gain meaningful advantage. Adhesives from renewable (non-petroleum) raw materials have a significant role to play in this regard. The promising renewable resin contenders should match the reactivity, applicability, bonding performance and cost requirements of the synthetic resins and outperform them in environmental acceptability and safety of use.

Large quantities of renewable biomass materials and natural derivatives are available, which can be converted into adhesives for panel products. The use of biomass as a source of chemicals and energy enables closed-cycle material changes and contributes to the efforts to reduce the atmospheric CO<sub>2</sub> emissions worldwide.

In this framework, CHIMAR HELLAS has worked extensively on developing resins from renewable resources for application in wood-based panel production, aiming for:

- Environmentally friendly adhesives for the wood panel sector ("natural binders")
- Adhesive resins that contribute to the reduction of panel formaldehyde emissions
- High performance, low cost resin products for the wood panel manufacturers and the panel end users: the sector as a whole.

The know-how and experience gained focuses on resins derived from natural products or by-products. An extensive but not exhaustive list includes: tannin, lignin from paper production, pulping spent liquor, pyrolysis oil (bio-oil), extraction or liquefaction products of agricultural and forestry residues (i.e. cashew nut shell liquid (CNSL), liquefied wood, liquefied olive stones), soy. The above resins developed by CHIMAR have been tested in the production of panels at laboratory scale, pilot scale and the most successful ones at industrial scale, in direct comparison with the commercial resins that are commonly applied.

**Highlights of Achievements**

Phenol-formaldehyde resins were produced by substituting up to 50% of the phenol needed in the formulation with biomass pyrolysis oils (bio-oils) and by modifying the resin synthesis procedure. Glue mixes containing these resins together with/without using CHIMAR proprietary activator technologies also based on renewable resources, were successfully applied in large-scale production of oriented strand boards and plywood panels. The resin production sequence was adapted to accommodate for the difference in the field of resin application. The use of bio-oil resin systems has provided reactivity and performance equal to the non-modified PF resin systems in both products. Such systems are currently being used commercially in North America.

Furthermore, tannin adhesives for particleboards were developed and applied commercially. In these systems, the tannin represents almost 90% of the adhesive used in the core phase of three-layer particleboard, while the rest components are urea and formaldehyde. Tannin is also sometimes added to the surface layers of the particleboards together with melamine-urea-phenol-formaldehyde resin. It was also proven that phenol-tannin-formaldehyde (PTF) resole resins prepared by CHIMAR with 20% substitution of the phenol with tannin provide plywood panels with acceptable performance at industrial scale.

The above renewable materials offer cost savings to the resin and panel manufacturers and to the panel consumers. They also promote the sustainability of the same industries and respective products. Most importantly, they are in line with the efforts to prepare natural resins and environmentally friendly products. Further increase in the substitution level is envisaged, with the aim to achieve a higher reduction of the resin cost and increase the positive environmental impact.

The renewable adhesive systems developed by CHIMAR contribute to the above positive effects and pave the way for the development and commercial adoption of natural resins for wood products.

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