**Thermally modified plywood production technology description**

A new technology has been developed for obtaining thermally modified (TM) birch plywood from TM birch veneers using hot pressing with phenol-formaldehyde (PF)-containing adhesives. The veneers are TM in a water vapor environment at high pressure. The veneers are heated to the required maximum temperature, held at this temperature for the required time and then cooled. TM veneers are covered with adhesive and glued using hot pressing. Bonding of TM veneers can be done both with wet PF adhesives together with the necessary additives, and with dry PF adhesives in laminate form. In addition, external surfaces of the TM plywood can be covered with PF laminate in parallel with the gluing of the TM veneer sheets. TM plywood composite boards can be made from both untreated and TM birch veneers, by gluing them alternately into plywood and placing TM veneers on the outer layer. TM plywood composite boards can also be made, with only 2-3 outer layers made of TM birch veneers, but the middle layers have raw veneers.

Various properties of TM plywood have been tested. The bending strength of TM birch plywood (9 layers of veneers) according to EN-310 standard requirements is 70±10 Mpa, which corresponds to F40 class according to EN-636 standard. The bonding strength of the glue line according to the requirements of the EN-314-2 standard after boiling water pre-treatment (section 5.1.3 of the standard) for TM plywood is 1.3±0.2 N/mm2, which corresponds to the bonding class 3 according to EN 314-2, and it can be used in high humidity and outdoor conditions. The anti-swelling efficiency (ASE) of TM plywood after 5 soaking-drying cycles is 32.0±0.6%. ASE shows the efficiency of TM (swelling reduction in volume) compared to untreated, industrially produced birch plywood. It is expected that the production of TM plywood is profitable and economically justified, especially if the technology is implemented in an already operating plywood production company. Biorefinery Laboratory of Latvian State Institute of Wood Chemistry has developed and patented a method by which TM plywood is obtained from TM veneers. A Latvian patent "Method of manufacturing thermally modified plywood" (application no. LVP2022000064) has been submitted for technology ownership and protection.

**The most important properties of thermally modified plywood:**

**Moisture resistance.** TM plywood has a hydrophobic surface and reduced water absorption, making it suitable for use in wet conditions.

**Good dimensional stability.** By absorbing moisture, TM plywood has significantly lower swelling throughout the volume of the board, especially in thickness.

**Acceptable mechanical properties.** The bonding strength of TM plywood glue line using PF adhesives is adequate for outdoor use, but the bending strength is only slightly lower than untreated birch plywood.

**Improved resistance to biodegradation.** TM plywood has a lower risk of being infected and damaged by fungi in high humidity.

**Advantages of the product obtained with the technology:**

* TM, compared to chemical modification or protection with biocides, is an ecological technique for improving the physical and durability properties of wood without using compounds dangerous to the environment and humans.
* TM plywood has better functional properties (dimensional stability, hydrophobic surface, moisture and water resistance, improved resistance to staining and decay fungi) than commercial plywood throughout the cross-section of the material and easy disposal at the end of the life cycle.

**Product target group**

The potential application of TM plywood is for products in high humidity and outdoor conditions without contact with the soil. Potential areas of application are concrete formwork, sea container floors, transport trailer floors, outdoor furniture, building facades, terraces, walkways, stairs, etc. elements. The primary market is large birch plywood manufacturers who are interested in introducing a new product of improved quality and durability to their sales portfolio.