DOI:10.58168/SAS2025_295-299
УДК 674.048.5:621.791.05

ИННОВАЦИИ В КЛЕЕВЫХ СОЕДИНЕНИЯХ В ДЕРЕВООБРАБОТКЕ

INNOVATIONS IN ADHESIVE JOINTS IN WOODWORKING

Грачев Д.С., студент магистратуры ФГБОУ ВО «Воронежский государственный лесотехнический университет имени Г.Ф. Морозова», Россия, Воронеж

Маклакова Е.А., доктор филол. наук, профессор, ФГБОУ ВО «Воронежский государственный лесотехнический университет имени Г.Ф. Морозова», Россия, Воронеж

Grachev D.S., student of master courses, Voronezh State University of Forestry and Technologies named after G.F. Morozov, Voronezh, Russia

Maklakova E.A., Doctor of Philology, Professor, Voronezh State University of Forestry and Technologies named after G.F. Morozov, Voronezh, Russia

Abstract: The article examines current innovations in adhesive joints within the woodworking industry. Special attention is paid to environmental aspects, improved bond strength, and new types of adhesive formulations including thermosetting, modified, and biodegradable adhesives.

Keywords: adhesive joint, woodworking, innovations, thermosetting adhesives, biodegradable adhesives.

Аннотация: В статье рассматриваются современные инновации в области клеевых соединений в деревообрабатывающей промышленности. Особое внимание уделено экологическим аспектам, улучшению прочности

соединений и новым видам клеевых композиций, включая термореактивные, модифицированные и биоразлагаемые клеи.

Ключевые слова: клеевое соединение, деревообработка, инновации, термореактивные клеи, биоразлагаемые клеи.

Modern production of furniture, building structures and decorative elements based on wood is unthinkable without adhesive joints. However, with the development of technology, the requirements for strength, durability, moisture resistance and environmental safety of adhesives are increasing. That is why innovations in this field have become a key area of scientific and technological progress in woodworking in recent years.

With the increase in production growth, the amount of waste generated that does not find rational use increased. This situation soon caused serious environmental problems of deforestation and the formation of a significant number of landfills and landfills. At the same time, wood waste is the most valuable secondary raw material [1].

One of the promising directions is the use of modified thermosetting adhesives, in particular, based on carbamide—formaldehyde resins with reduced formaldehyde release. By introducing special inhibitors and biocidal additives, it is possible to increase both environmental safety and the resistance of compounds to bio-contamination. According to research by the Institute of Forestry Chemistry and Biotechnology, such adhesives demonstrate a reduction in the emission of volatile compounds to the E0 level according to the European classification, which makes them suitable for interior decoration of residential premises.

The second area of research includes the development of technology for modifying low-liquid wood and lumpy wood waste of coniferous species in order to improve their physical and mechanical properties to the level of hardwood [2].

An equally important area is the development of biodegradable adhesives based on proteins, starch, lignin and tannins. These adhesives are especially

relevant in conditions of increased environmental control. For example, industrial tests of soy protein-based adhesives are already underway in Canada and Germany, which show stable shear strength and moisture resistance at temperatures up to 60 °C. Despite the fact that they are inferior to synthetic adhesives in a number of mechanical characteristics, they are increasingly used in the packaging and production of children's products.

Innovations have also affected the methods of applying glue, including microdosed feeding technologies with laser positioning. This allows you to precisely control the thickness of the adhesive joint, reducing glue overspending and improving the quality of the joint. In addition, control systems based on machine vision allow you to monitor the uniformity of glue application in real time and automatically adjust the feed parameters.

In recent years, adhesive systems with an intelligent polymer matrix capable of changing the properties of the adhesive layer depending on external conditions have been actively introduced. Such adhesives can independently increase their viscosity at high humidity or, conversely, become more elastic under vibration loads. This opens up new horizons in the production of bent-glued structures and in woodworking for facilities with variable climatic operating conditions.

It is also necessary to note the development of nanoadhesive technologies, which use nanoparticles of titanium dioxide, graphene or silica to enhance adhesion at the molecular level. The test results presented in [3] showed that the introduction of only 0.5% of nano-additives increases the tensile strength by an average of 25-30%.

Innovative adhesive systems are still being implemented unevenly at domestic woodworking enterprises. The main constraining factors are:

high cost of imported components for biodegradable and nano-reinforced adhesives; insufficient modernization of equipment necessary for precise dosing and quality control of glue application; lack of qualified personnel capable of managing and configuring intelligent adhesive systems.

Nevertheless, positive developments have been observed in recent years. Thus, within the framework of federal import substitution and "green industry" programs in 2023-2024, subsidizing projects for the development of domestic adhesives with low formaldehyde emissions began. Scientific collaborations are emerging between technological universities, research institutes, and industrial enterprises.

In addition, Russian manufacturers are actively developing the production of polyurethane melt adhesives (PUR), which are characterized by high strength, elasticity and moisture resistance. Their use is particularly promising in the production of bent-glued furniture and laminated wood panels, where shape stability and durability of joints are required.

There is also increasing interest in infrared and microwave activation of adhesive joints, which makes it possible to accelerate the curing cycle without overheating the wood, which opens up new opportunities to increase productivity without compromising quality.

Thus, innovations in adhesive compounds cover not only the formulations of adhesives, but also the methods of their application, quality control, as well as environmental and functional characteristics. The introduction of such solutions in the woodworking industry not only increases the competitiveness of products, but also contributes to the sustainable development of the industry as a whole.

References

1. Tarbeeva N. A. Innovative technologies for efficient processing of secondary resources of woodworking industries // N.A. Tarbeeva, O.A. Rubleva // Ecology of the native land: problems and ways to solve them. Materials of the XVIII All-Russian Scientific and Practical Conference with international participation. Kirov, 2023. – 2023. – P. 369.

2. Tarbeeva N. A. Substantiation of the possibilities of the method of strengthening decorative treatment of low-grade wood N.A. Tarbeeva, O.A. Rubleva // Forestry

Engineering Journal, 2020, vol– 10. – №. 3 (39). – Pp. 145-154.

3. Ramage M.H., Burridge H., Busse-Whicher M. et al. Wood from trees: the use of wood in construction // Reviews of renewable and sustainable energy. – 2017. – Volume 68. – pp. 333-359.

Список литературы

1. Тарбеева Н. А. Инновационные технологии эффективной переработки вторичных ресурсов деревообрабатывающих производств // Н.А.Тарбеева, О.А.Рублева // Экология родного края: проблемы и пути их решения. Материалы XVIII Всероссийской научно-практической конференции с международным участием. Киров, 2023. – 2023. – С. 369.

2. Тарбеева Н. А. Обоснование возможностей способа упрочняющей декоративной обработки низкотоварной древесины Н.А. Тарбеева, О.А. Рублева // Лесотехнический журнал. – 2020. – Т. 10. – №. 3 (39). – С. 145–154.

3. Рэймидж М.Х., Барридж Х., Буссе-Уичер М. и др. Древесина из деревьев: использование древесины в строительстве // Обзоры возобновляемой и устойчивой энергетики. – 2017. – Том 68. – С. 333-359.