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Preparation of Phenol-Formaldehyde-Based Glue and its Use

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Abstract:

The thermodynamic properties of adhesive compositions based on phenol-formaldehyde resin with modification with furfural acetone monomer FA at the stage of mixing the components. Physical and mechanical properties are presented particle boards based on a modified adhesive composition and technological features of production. Determined that

The best physical and mechanical properties of particle boards are achieved by introducing 2–4 wt.% into phenol-formaldehyde resin, furfural acetone monomer FA, which increases strength, reduces swelling, water absorption, and weight loss of slabs during burning. Wood boards based on modified phenol-formaldehyde resin according to physical and mechanical characteristics meet the requirements of GOST 10632–2018 “Wood-based particle boards. Technical specifications" are superior to analogues based on phenol-formaldehyde resins. With minor costs for modifying the adhesive composition and minor changes technological process increases the competitiveness of the slabs.

Keywords. particle board, physical and mechanical properties, phenol-formaldehyde resin, furfural acetone FA monomer, modification.

Wooden house construction has recently begun to develop at an accelerated pace, due to increased consumer interest in comfortable and environmentally friendly housing with a special microclimate volume, sufficient and constantly renewable raw material base, development of house production technologies both from chopped, rounded or laminated timber, as well as frame and panel houses using we eat wood-based panel materials [1]. Large-format particle boards are widely used both in the formation of house frames and in the finishing of large areas - wall and ceiling cladding, roof sheathing, flooring, facade cladding. Currently, in the domestic production of particleboards used in construction, the most widely used are urea-maldehyde resins (for boards used indoors) and phenol-formaldehyde resins (for boards used indoors and outdoors) [2]. However, the bulk of the produced boards have insufficient physical and mechanical properties, and above all, insufficient water resistance, which limits their use in conditions with variable temperature and humidity conditions. One of the ways to increase the water resistance of wood-based panels is to use modified adhesives in their manufacture that have high adhesion, cohesive strength, and resistance to aggressive environments [3, 4], or the use of alternative binders with improved properties, for example, oligomers of the furan series [5]. It is known that to reduce the cost of furan resins and increase their water resistance, as well as to impart greater alkali resistance of phenol-formaldehyde resins is possible by mixing or combining some phenolic and furan resins [2, 6]. The main representative of furan oligomers, which are quite widely used in industry, is the furfural acetone monomer FA, obtained from the synthesis of furfural and acetone. In a cured state

In addition, it has increased water resistance and strength [7].

It is of interest to modify phenol-formaldehyde furan resin in order to improve the properties of wood boards made on its basis. Summary results are presented for determining the thermodynamic properties of adhesive compositions based on the phenol-formaldehyde oligomer SFZh-3014 modified with the furfural acetone monomer FA combination themes. With an increase in the proportion of the addition of furfural acetone monomer FA in an adhesive composition based on phenol-formaldehyde resin, the surface tension and contact angle on the surface of birch wood particles decrease slightly, which helps to increase the uniformity of adhesive distribution during the resinization of wood particles, although complete wetting does not occur. Despite the decrease in surface tension, the viscosity of modified adhesive compositions increases due to a decrease in pH and initial gelatinization processes during the interaction of the acidic furfural acetone monomer with the alkaline phenol-formaldehyde oligomer. With an increase in the proportion of furfural acetone monomer additive, the gelatinization time of the modified adhesive composition decreases, which makes it possible to reduce the time of piezothermal treatment in the production of wood boards and increase the productivity of pressing equipment. To produce samples of single-layer particle boards 16 mm thick, special cut shavings of deciduous wood were used with the selection of fraction 10/2 and adhesive compositions based on phenol-formaldehyde resin SFZh-3014 with the addition of furfural acetone monomer FA in various proportions. The physical and mechanical properties of the plates are presented. Analysis of the results obtained showed that the best physical and mechanical properties of particle boards are achieved with the introduction of 2–4 wt. including furfural acetone monomer FA into a phenol-formaldehyde oligomer, while the strength increases significantly, swelling, water absorption, and weight loss of the slabs during combustion are significantly reduced. The increase in the strength and water resistance of the boards is associated with the acceleration of the curing process in a more acidic environment of the modified glue with the formation of more rigid mesh-type structures with phenolic components of the lignin part of the wood [8].

The difference between the technological process of producing wood-based panels using a modified phenol-formaldehyde binder and traditional production begins at the stage of preparing the binder and resinizing the wood filler. At the first stage, it is necessary to prepare a modifying additive by mixing furfural acetone FA monomer and hardener in a mixer with a water jacket until homogeneous. From the mixer, the prepared modifying additive is supplied to the supply container. The initial components of the modified adhesive are mixed in continuous binder preparation plants, for example DKS-1. The binder components (a solution of phenol-formaldehyde resin and a modifying additive based on furfural acetone monomer FA) are fed separately by dosing pumps into a labyrinth mixer, where the adhesive components are mixed together and a homogeneous adhesive composition is formed. From the labyrinth mixer, the prepared binder is fed into the mixer for the stage of resinizing the wood filler. At the stage of mixing wood chips with a binder, the working solution of the prepared modified adhesive composition is fed by a peristaltic pump into the mixing chamber of a high-speed mixer. The binder is fed through the hollow shaft of the mixer and nozzle into the working chamber of the mixer, where With the help of blades located at a certain angle to the shaft axis, wood chips are mixed with the binder and the mixture moves towards the unloading apparatus. The resinous chip mass is transported to the forming machine for forming laying the shaving carpet. In order to make the package transportable, To ensure free loading of it into the hot press, as well as to improve the quality of the slabs, the chip package is cold pressed in a cold press. The pressed briquettes are sent to a loading shelf and then to a hot multi-story hydraulic press. Pressing modes are determined by the features of the technology; it is recommended that the temperature of the press plates range from 180 to 200 ° C, the specific pressure pressing pressure 2–2.5 MPa, holding time under pressure 0.5 min/1 mm of plate thickness. The pressed slabs are simultaneously unloaded by an unloader into a shelf and enter the post-press stage. The main output.

Wood boards based on modified phenol-formaldehyde resin meet the requirements of GOST 10632–2018 in terms of physical and mechanical characteristics and are superior to analogues based on phenol-formaldehyde resins. With insignificant costs for modifying the adhesive composition and minor changes in the technological process, the competitiveness of the slabs significantly increases.

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