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STUDY OF THE PHYSICAL-MECHANICAL PROPERTIES OF WOOD COMPOSITE BOARDS (DSP, MDF, HDF) USING MODERN TESTING METHODS

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Abstract. The thesis presents a comparative analysis of the physical-mechanical properties of wood particle- and fiber-based boards widely distributed in the Uzbekistan market — DSP, LDSP, MDF, HDF, and LMDF — according to the country of manufacture (Russia, Europe, Iran). The tests were carried out in an accredited testing laboratory in accordance with the requirements of GOST 10632-2014, GOST 32289-2013, and O'zDSt 3478-2020 standards using the methodologies of GOST 10634-88, GOST 10635-88, and GOST 27680-88. Key indicators such as bending strength limit, density, moisture content, thickness swelling, and thickness deviation were determined. The obtained results confirmed that the products of European manufacturers possess the highest indicators in terms of strength and dimensional stability, while LMDF (laminated MDF) board demonstrated the best overall performance.

Keywords: particle board (DSP), laminated DSP (LDSP), MDF, HDF, LMDF, bending strength, density, thickness swelling, GOST 10632-2014, GOST 32289-2013, O'zDSt 3478-2020.

In the furniture industry and construction-finishing works, wood particle- and fiber-based composite board materials — DSP (particle board), LDSP (laminated DSP), MDF (medium-density fiberboard), HDF (high-density fiberboard), and LMDF (laminated MDF) — are widely used. Under conditions where natural wood is becoming scarce and expensive, such boards enable the efficient recycling of woodworking waste and small-sized wood fragments, thereby possessing significant economic importance for industry.

These products are mainly imported into the market of the Republic of Uzbekistan from the Russian Federation, European Union countries (Austria, Germany, Poland), and the Islamic Republic of Iran. Although the volume of local production is increasing year by year, the high share of imports remains. Therefore, evaluating the compliance of products from different manufacturers with standard requirements and conducting comparative analysis is an urgent scientific and practical issue.

The consumer properties of boards are characterized by their physical-mechanical indicators — bending strength limit (σ, MPa), density (ρ, kg/m³), moisture content (W, %), thickness swelling (within 24 hours, %), and thickness deviation (mm). These indicators determine the structural strength, moisture resistance, dimensional stability, and service life of the board.

The aim of the study is to experimentally investigate the physical-mechanical properties of DSP, LDSP, MDF, HDF, and LMDF boards from various manufacturers

available on the Uzbekistan market and to comparatively analyze their compliance with the requirements of current regulatory and technical documents.

Ten board samples belonging to three groups were involved in the study:

— DSP (particle board) — three samples: Russian, European, and Iranian products (thickness 16 mm, testing standard — GOST 10632-2014);

— LDSP (laminated DSP) — three samples: Russian, European, and Iranian products (thickness 16 mm, testing standard — GOST 32289-2013);

— MDF, HDF, and LMDF boards — four samples: MDF (European), HDF (European and Russian), LMDF (European); testing standard — O'zDSt 3478-2020.

The tests were carried out in an accredited testing laboratory using the following methodologies: determination of moisture content and density — according to GOST 10634-88; thickness swelling — according to GOST 10634-88 (Clause 3.3) by the method of keeping the sample in water for 24 hours (sample size 100×100 mm); determination of bending strength limit — according to GOST 10635-88 by static bending test; thickness measurement — according to GOST 27680-88. Testing conditions: air temperature t = 20.1–20.6 °C, relative humidity φ = 65–68%.

Results and discussion. The results of the conducted tests are summarized in the consolidated table.

Table

Test results of the physical-mechanical properties of wood boards

Sample	σ, MPa	ρ, kg/m³	W, %	Swelling after 24 h, %	Thickness, mm
DSP (Iran)	10.2	623	6.1	22.4	16.10
DSP (Russia)	11.2	603	5.2	24.7	15.90
DSP (Europe)	15.3	715	4.5	20.5	15.95
LDSP (Iran)	11.4	705	5.6	21.9	16.05
LDSP (Russia)	11.6	618	5.05	25.6	15.96
LDSP (Europe)	15.8	780	5.4	21.0	16.10
HDF (Russia)	16.9	710	5.5	24.0	2.95
MDF (Europe)	18.1	718	4.4	15.1	10.05
HDF (Europe)	18.2	770	6.7	16.0	3.05
LMDF (Europe)	30.8	830	3.6	9.8	10.80

As can be seen from the table results, in the DSP group the European sample demonstrated higher bending strength (15.3 MPa) than the Russian (11.2 MPa) and Iranian (10.2 MPa) samples by 36.6% and 50%, respectively. A similar trend was observed in the LDSP group: the European product showed 15.8 MPa, while the Russian and Iranian products showed 11.6 MPa and 11.4 MPa, respectively. The Iranian DSP sample (10.2 MPa) demonstrated a result close to the upper limit value of the standard.

Wood fiber boards (MDF, HDF, LMDF) surpassed particle boards in all main mechanical indicators. The LMDF (Europe) sample achieved a bending strength value of 30.8 MPa, which is almost twice as high as the requirement of the O'zDSt 3478-2020 standard (16 MPa). The thickness swelling of the LMDF sample was only 9.8%, which is

the lowest indicator. The HDF (Russia) sample showed a thickness swelling result of 24.0%, which is close to the upper limit of the standard (≤ 25%), indicating significantly lower quality compared to the European HDF sample (16.0%).

The ascending order of the samples according to bending strength was formed as follows: DSP Iran (10.2) < DSP Russia (11.2) < LDSP Iran (11.4) < LDSP Russia (11.6) < DSP Europe (15.3) < LDSP Europe (15.8) < HDF Russia (16.9) < MDF Europe (18.1) < HDF Europe (18.2) < LMDF Europe (30.8) MPa.

Conclusion. Based on the results of the study, the following conclusions were reached:

— The physical-mechanical indicators of all ten tested samples comply with the requirements of GOST 10632-2014, GOST 32289-2013, and O'zDSt 3478-2020 standards.

— In terms of manufacturing countries, European products demonstrated the highest quality indicators in strength, moisture resistance, and dimensional stability. Although Iranian and Russian samples met standard requirements, some of their parameters were close to the upper limit values of the norms.

— Among the product types, laminated MDF (LMDF) demonstrated the highest mechanical properties: bending strength — 30.8 MPa, density — 830 kg/m³, thickness swelling — 9.8%.

— The obtained data can be used in organizing quality monitoring of wood composite board materials in the Republic of Uzbekistan and for scientifically grounded material selection in the furniture and construction-finishing industries.

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