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COMPARISON OF SORPTION HUMIDITY INDICATORS OF INSULATIONS BASED ON NATURAL RAW MATERIALS

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The article presents indicators of sorption humidity of thermal insulation materials based on natural raw materials and provides a comparison with each other. Based on the results of the research, the factors that have the greatest influence on the value of sorption humidity were determined.

The main indicator when choosing a thermal insulation material is the thermal conductivity coefficient. Currently, many insulation materials from natural raw materials have been developed, characterized by high thermal properties. However, changes in thermal conductivity are associated not only with the nature of the structure of the material, but also with phenomena that arise during operation. One of the most negative factors that changes the properties of thermal insulation during operation is exposure to moisture. For this reason, the study of sorption humidity is of particular interest to developers

A study of the sorption humidity of heat-insulating boards based on plant raw materials was carried out at Polotsk State University named after Euphrosyne of Polotsk. Based on the test results, it was established that insulation based on flax tow and liquid sodium glass as a binder (Fig. 1) at a relative air humidity of 97% has a sorption humidity of 47%. The use of lime and gypsum as a modifying additive makes it possible to reduce the sorption moisture content to a value of 38%. At the same time, the value of sorption humidity of thermal insulation made from flax tow from a relative air humidity of 60% is 14% [1].

Figure 1. – Thermal insulation boards made of flax tow

The sorption humidity of thermal insulation materials based on chopped straw and liquid glass at a relative air humidity of 60% is 9%. An increase in relative air humidity leads to an increase in sorption humidity by 10 times to 85%. The introduction of flax seeds makes it possible to reduce the value of sorption humidity by 15% to 72%. At the same time, insulation made from a mixture of chopped straw with flax shreds and sodium liquid glass has a sorption moisture content of 10% [2].

The determination of sorption moisture by the desiccator method was carried out on samples from eucalyptus fibers of various fractions. Based on the results of the studies, it was established that the large fraction of eucalyptus bark fibers has lower sorption rates compared to samples of the medium and small fractions. At a relative air humidity of 40%, the sorption of the large fraction of fibers was 6%, which is 19% lower than that of medium and small fibers. The sorption humidity of large fibers reached 10% at 60% relative air humidity, which differs by 16% from the values of the medium and fine fractions. The values of sorption moisture content of bark fibers of the medium and fine fractions are equal to 16% and 17% at a relative air humidity of 80% and exceed that of the large fraction by 14% and 18%. At 90% relative air humidity, the excess of the sorption humidity of samples of the medium and fine fractions relative to the large fraction corresponds to 12%. It should be noted that the sorption rates of all fractions have insignificant differences and vary within the range of 27,5 – 30,9% at a relative air humidity of 97% [3].

Studies of water vapor sorption were carried out on rice husks without a binder component and on composite compositions from a mixture of husks and straw using modified liquid glass (liquid glass, lime and gypsum) [4]. The maximum sorption humidity of rice husk corresponds to 19,25–19,5% at a relative air humidity of 97%. The duration of the sorption process at a relative air humidity of 40–97% is 28. At a relative air humidity of 60–80%, the sorption rates of rice husk are in the range of 7,75–12%.

The data on the kinetics of water vapor sorption of a mixture of rice husks and straw do not differ significantly from the indicators at relative air humidity of 40% and 60%. Significant differences appear when samples are kept at a relative humidity of 80–97%. Thus, already at an air humidity of 80%, the sorption rate reaches 20%. At a relative air humidity of 90%, the sorption humidity indicator increases by 2 times compared to the husk sorption value and reaches 30,7%. The maximum sorption rates that were recorded were 48,2–49,5% and were achieved at an air humidity of 97%.

The described indicators of sorption humidity of thermal insulation are summarized in Table 1.

Table 1. – Sorptive humidity of thermal insulation boards

Structure-forming insulation material		binder	additive	Sorption humidity at relative air humidity	
				60	97
flax tow		liquid glass	-	16	47
flax tow		liquid glass	lime and gypsum	14	38
chopped straw		liquid glass	-	9	85
chopped straw	fire flax	liquid glass	-	10	72
eucalyptus fiber		liquid glass	-	10	31
rice husk		-	-	8	19
rice husk	chopped straw	liquid glass	lime and gypsum	16	49

Analysis of the presented data (Table 1) allows us to establish that at a relative air humidity of 60%, thermal insulation materials based on rice husks have the lowest sorption humidity, equal to 8%. The highest indicator - 16% - has thermal insulation made from flax flakes and liquid glass, as well as insulation based on a mixture of chopped straw with flax shreds and modified liquid glass.

At an air humidity of 97%, thermal insulation boards made from rice husks have the lowest sorption humidity value (19%). The sorption moisture content of insulation materials based on chopped straw and flax husks is 4,5 times higher than the value of slabs made from rice husks and is equal to 85%.

Conclusion. The given values of sorption humidity of thermal insulation based on natural raw materials allow us to conclude that insulation materials without a binder have the lowest sorption humidity. It is also worth noting that the addition of lime and gypsum makes it possible to reduce the sorption moisture content of thermal insulation boards.

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