Tests of log-cabin mastic Woodchink

Woodchink is acrylic dispersion mastic developed specially for sealing of wooden joints of log-cabins and timber houses both for interior or exterior use. It is mastic of coarse-grained structure, which, from an aesthetic point of view, prevents unwanted glaze of the fissure and simultaneously prevents the possibility that, as time goes on, the dust particles could cling to the surface of the mastic, which would seem aesthetically intrusive.

With regard to the fore-mentioned purpose of use, it stands to reason that the demands being put on the Woodchink mastic are relatively high. In particular, the external application of this material requires a high level of utility characteristics of the mastic. From this perspective, there are three most essential categories of characteristics:

1) With respect to the variable moisture content in wood and the resulting size changes of the joints, it is necessary that the mastic would show a sufficient level of expansion when broken. The level of expansion during overload for the Woodching mastic was determined and verified by the modified test according to EN ISO 8339: Engineering construction – sealants – mastic – determination of the tensile properties (expansion during overload) and according to ISO 37 – Rubber, vulcanized or thermoplastic elastomer – Determination of the tensile properties.

Determination of the tensile properties verified by the modified test according to EN ISO 8339

Samples consisting of two pine-wood balks with dimensions of 75 x 25 x 12 mm were glued together, with the use of spacer cubes, by the Woodchink mastic, in order to create a test joint measuring 51 x 12 x 12 mm. The test specimens prepared in this way were left to dry out for 37 days at 23±2°C and relative humidity of 55±5 %. After the lapse of this time, the elongation at failure, ultimate elongation, tensile strength limit and the type of failure at the tearing point were measured on the tensile testing machine. The results are summarized in the sheet No.1.

Summary sheet No.1: Results of tensile tests according to EN ISO 8339

Woodchink – standard storage of 37 days (temperature 23±2°C, relative humidity 55±5 %), joint length 51 mm, joint width 12 mm, joint thickness 12 mm, cut section of joint 612 mm^2				
Test specimen	**Elongation at failure * [%]**	**Ultimate elongation [%]**	**Tensile strength limit [MPa]**	**Type of failure [% K]****
1	58	133	0,165	100
2	67	133	0,165	100
3	58	133	0,163	100
4	67	125	0,170	100
5	67	125	0,162	100
Average	**63**	**130**	**0,165**	**100**

* during the stretching of the test specimens there were, at first, local cracks in the contact point with the coarse-grained filler, 'Elongation at failure' is expressed as a percent increase of the original width of the joint up to the point in which the local cracks first occurred.

** % K indicates the percentage proportion of the cut section area in which the tearing of the test particle within the mastic mass occurred, the rest up to 100% indicates the proportion of the cut section area, where the tearing between wood and mastic occurred.

The Summary sheet No. 1 implies that up to 63 percent of expansion of the joint (i.e. 1.63 times the original width of the joint) there weren't any functional or aesthetic changes in the

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mastic. Above this percentage, in the places of contact between the coarse-grained filler and the bonding agent there appeared to be small barely perceptible cracks. The mastic's rupture occurred on average at 130 % elongation i.e. when stretched to 2.3 times the original width of the joint. Mastic adhesion to the wood was absolutely fantastic which is also indicated by the 100 % of cohesion fracture at ultimate elongation, which means that the specimen got ruptured in all cases in full mass of the mastic.

Determination of tensile properties according to ISO 37

The measurements were made on a desk, which was 2 mm thick created with the use of Woodchink mastic. The desk was left to dry out for 7 days under standard conditions (temperature 23±2°C, relative humidity 55±5 %). Subsequently, the test specimen in form of double-ended, 4.3 mm thick spatulas were cut out of this desk. Then, ultimate elongation and tensile strength limit were measured with the use of tensile testing machine Tiratest 2160. The results are summarized in the sheet No.2.

Summary sheet No. 2: Results of tensile tests according to ISO 37

Woodchink – standard storage of 7 days (temperature 23±2°C, relative humidity 55±5 %), Dimensions of the test specimen: width 4,3 mm, thickness c/a 2 mm		
Test specimen	**Ultimate elongation [%]**	**Tensile strength limit [MPa]**
1	310	0,200
2	300	0,186
3	260	0,185
4	230	0,197
5	300	0,203
6	250	0,195
7	270	0,199
Average	**270**	**0,195**

The results of the tensile tests show that, despite the content of coarse-grained fillers, which often reduce the overall tensibility of the film, the tensile stress-strain properties are high above the value required for the use as joint mastic between wooden balks or logs used for construction of log-cabins and timber houses. The results of the test made according to EN ISO 8339 can be summarised as that the final rupture of the mastic which is 1.2 cm thick will only appear during working procedures that extend the width of the joint by 130 %, i.e. 2.3 times the original width, while the first local defect appears not earlier than when the joint expansion reaches 63 %, i.e. 1.63 times the original width. At the same time the tests show that the mastic has excellent adhesion characteristics to soft wood in which case the ruptures of the test specimen during the tensile tests didn't occur in the place of contact between the mastic and the wood, but in the middle of the mastic itself. The results of the test according to ISO 37 can also be interpreted that in case of mastic thickness of 2 mm the rupture of the mastic would appear at the joint elongation of 270 %, i.e. 3.7 times the original width of the joint. In case of the commonly used thickness of the mastic in the joint, the rupture of the mastic in the joint

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would not occur before the elongation of the joint, due to the size changes of wood, up to 200 %, i.e. 3 times the original width.

An important feature of the mastic is also its higher (84 %) dry mass percentage (non-volatile part) than in similar types of materials, which usually have dry mass percentage 75 to 80 % of the mass. This has the effect that the mastic is not so tensioned already in the process of drying-out in the joint. During the drying-out of the dispersion mastic, due to its shrinkage, it must be compensated with its own elongation of the material, which creates inner tension in the dried mastic, which is fixed in the joint and therefore its ability to endure bigger joint expansions is lowered. In case of Woodchink mastic the size shrinkage is lower than in cases of common dispersion mastics. Even so, the good workability of the Woodchink mastic is not affected.

2) Since it is 'log cabin' mastic, it is completely apparent that it will mostly be used in areas where, in winter, the temperatures reach levels deeply below the freezing point. The most demanding for these kinds of materials are the conditions in which the temperature and humidity of the wood keeps changing. These most demanding conditions are especially reached in the period when at night the temperatures fall below freezing point and during the day reach above freezing point, it can also rain occasionally. These temperature changes along with the change in the humidity of the wood and also with the size changes associated with the transformation of water into ice and conversely, are often very demanding to the material itself. Woodchink mastic was subjected to the laboratory tests of resistance to these kinds of effects during the test according to EN ISO 8339 with the previous cyclic tensile tests. First, the test specimens were prepared in the same way as in the normal tensile test according to EN ISO 8339. After 15 days of drying-out of the mastic in standard conditions (temperature 23±2°C, humidity 55±5 %) the complex cyclic tests started. The tests consisted of storing the test specimen in a freezing box at -17 ° C that lasted for 16 hours and then an 8-hour-long storage of the specimen in warm water (+20 ° C) and this was repeated in 15 cycles. After the end of the cyclic test, the test specimens were left to dry-out in standard conditions for 24 hours. Consequently, their state was judged on visual basis and than ultimate elongation, tensile strength limit and type of failure were measured on the tensile testing machine. The results are summarized in the sheet No.3.

Summary sheet No. 3: Results of the cyclic test of frost resistance with the use of EN ISO 8339

Test specimen	**Elongation at failure* [%]**	**Ultimate elongation [%]**	**Tensile strength limit [MPa]**	**Type of failure [% K]****
1	92	125	0,116	100
2	83	133	0,113	100
3	92	133	0,114	100
4	83	125	0,111	100
5	83	133	0,113	100
Average	**87**	**130**	**0,113**	**100**

* during the stretching of the test specimens there were, at first, local cracks in the contact point with the coarse-grained filler, 'Elongation at failure' is expressed as a percent increase of the original width of the joint up to the point in which the local cracks first occurred.

** % K indicates the percentage proportion of the cut section area in which the tearing of the test particle within the mastic mass occurred, the rest up to 100% indicates the proportion of the cut section area, where the tearing between wood and mastic occurred.

There were not any visual changes in the test specimens during the cyclic tests. The results that are shown in the sheet No.3 and their comparison with the results measured on the

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specimens that were stored in standard conditions for 37 days (see sheet No. 1) indicate, that after cyclic pressure ‘freeze – water’ a minor change in the structure and characteristics of the mastic occurred specifically the increase in elongation at failure from 63% to 87% (which is a good result) and the decrease in tensile strength limit from 0,165 MPa to 0,113 MPa (- 31,5 %), these changes, however, are not drastic and do not lower the ability of the mastic to imitate the joint movement. Moreover, after longer period of time since the frost resistance measuring tests were made, the material tended to return to its original characteristics. It is also important to mention that when applying it as log-cabin mastic, the value of tensile strength limit is not decisive. This parameter is important especially in areas where the mastic itself connects the parts, i.e. where it is used as an adhesive and where the glued part presses onto the adhesive with its own weight.

3) The third essential characteristic that is significant in terms of durability of the exterior joint is the resistance of the mastic to the ultraviolet radiation. The most important influence on this parameter has the UV-resistance of the bonding agent in the mastic. In case of Woodchink mastic the bonding agent is UV-stable, purely acrylate copolymer that is (on long term basis, c/a 15 years) used in forming of acrylate dispersive mastics with excellent references related to UV-stability. In comparison with the styrene acrylate copolymers that are also often used in forming of acrylate dispersion mastics, this bonding agent indicates a much higher level of UV-stability.

We can conclude, based on the results of the performed test, that the log-cabin mastic Woodchink meets very strict requirements that are needed for sealing and bonding of the wooden joints of log-cabins and timber houses in interiors and especially in exteriors. The carried out test verified the suitability of this mastic to perform the declared function to the highest satisfaction of its users.

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