SZKOŁA GŁÓWNA
GOSPODARSTWA
WIEJSKIEGO

R e p o r t

from commissioned work

consisting in evaluating
resistance to indentation
EN 1534, Brinell method

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1. General information

1.1 Object of study

The tests of resistance to indentation were carried out on the basis of order commissioned on 8.12.2020 by the company ZIP Sp. z o.o., ul. Zamkowa 34, 34-200 Sucha Beskidzka.

The object of study consisted in evaluating the product − Venifloor brand floor − in relation to one of its basic functional parameters, and namely: the resistance to indentations (hardness). The material submitted for research by the company was tested for Brinell hardness (resistance to indentations), in accordance with the PN-EN 1534:2011 standard: Wood flooring − Determination of resistance to indentation − Test method. The comparison of resistance to indentation involved two materials: Venifloor oak board covered with veneer finished with wax oil and Venifloor oak board covered with veneer and finished with lacquer.

1.2 Surface hardness – test method and results

The hardness of the floor board surface was determined on the basis of the PN-EN 1534:2011 standard: Wood flooring − Determination of resistance to indentation (Brinell method) − Test method. The tests were carried out with the use of the hardness testing machine CV Instruments 3000LDB (Fig. 1). The diameter of the steel ball used in the tests as the indenter was 10 mm. In accordance with the recommendations from the standard, the measurements were performed at the minimal distance of 20 mm from the edge of the samples. The indenting force of 1 kN was applied to the surface of floor boards during 25 seconds. After that time, the load was removed. The test consisting in indenting the steel ball into the surface was repeated 50 times for each of the two kinds of boards that had been submitted for research. Subsequently, the diameter of the indentation left in the wooden surface was measured two times. The indentation diameter was measured with the use of a Nikon SMZ 1500 microscope connected to a digital camera, with the help of the NIS-Elements D 2.30 software.

Brinell hardness was calculated from the following formula (1):

$$HB = \frac{2 \cdot F}{g \cdot \pi \cdot D \cdot [D - (D^2 - d^2)^{0,5}]} \qquad (1)$$

$$d = \frac{d_1 + d_2}{2} \qquad (2)$$

where:

HB – Brinell hardness [kg/m2],

g – gravitational acceleration [m/s2],

F – test force [N],

D – steel ball diameter [mm],

d – indentation diameter [mm],

d_1 – the first measurement of indentation diameter [mm],

d_2 – the second measurement of indentation diameter [mm].

Fig. 1. Machine used for testing resistance to indentation with the Brinell method

Tests of resistance to indentation consist, among others, in measuring the diameter of indentations made on the wooden surface in both anatomical directions (along and in perpendicular to the wood grain) by a steel ball with the diameter of 10 mm. On the basis of the indentation diameter

values, it is possible to perform a preliminary evaluation of the surface's resistance to indentations (Fig. 2). The bigger the indent diameter, the smaller the resistance to indentation. On the basis of Figure 2, it can be noticed that the indentations that appeared on the surface of the Venifloor oak board covered with veneer are small, much smaller than the indentations made with the same kind of device on the surface of a pine board or a laminated oak board. The average diameter of the indentation made in the laminated oak board was by **41%** bigger than the diameter of the indentation made on the Venifloor oak board covered with veneer. In turn, in case of pine boards, the indentations were by ca. **88%** bigger than the ones that appeared on the Venifloor oak board covered with veneer.

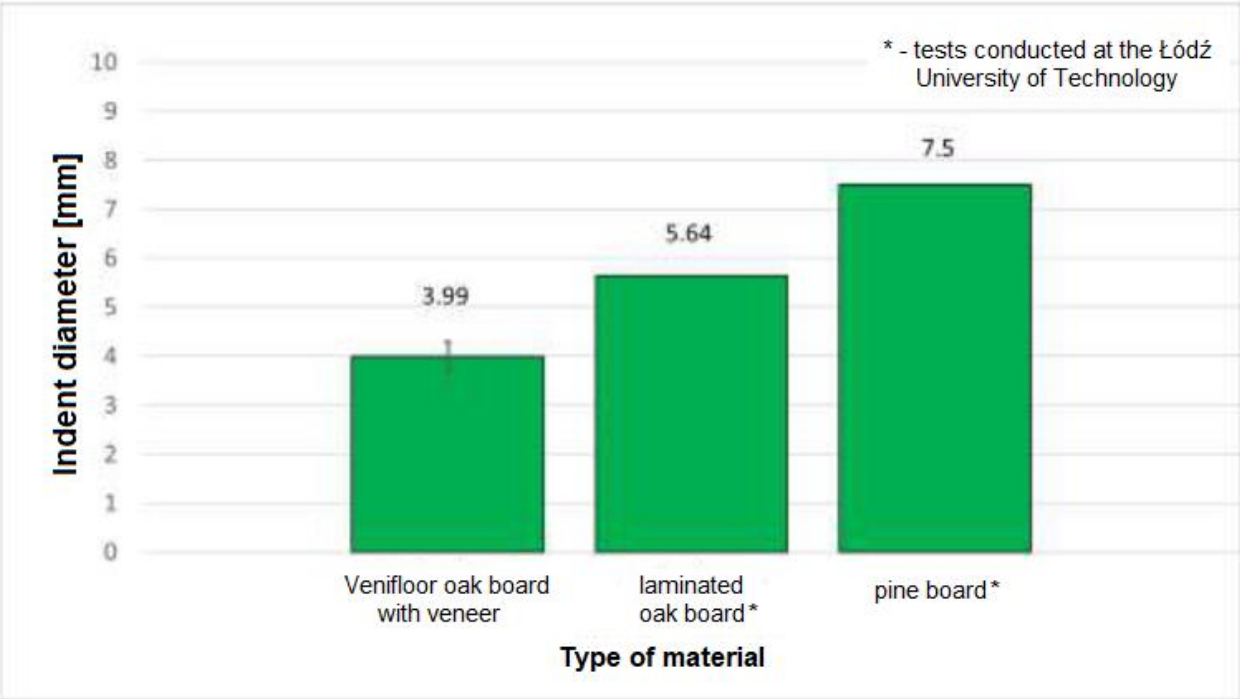

Fig. 2. Diameters of indentations made in flooring materials

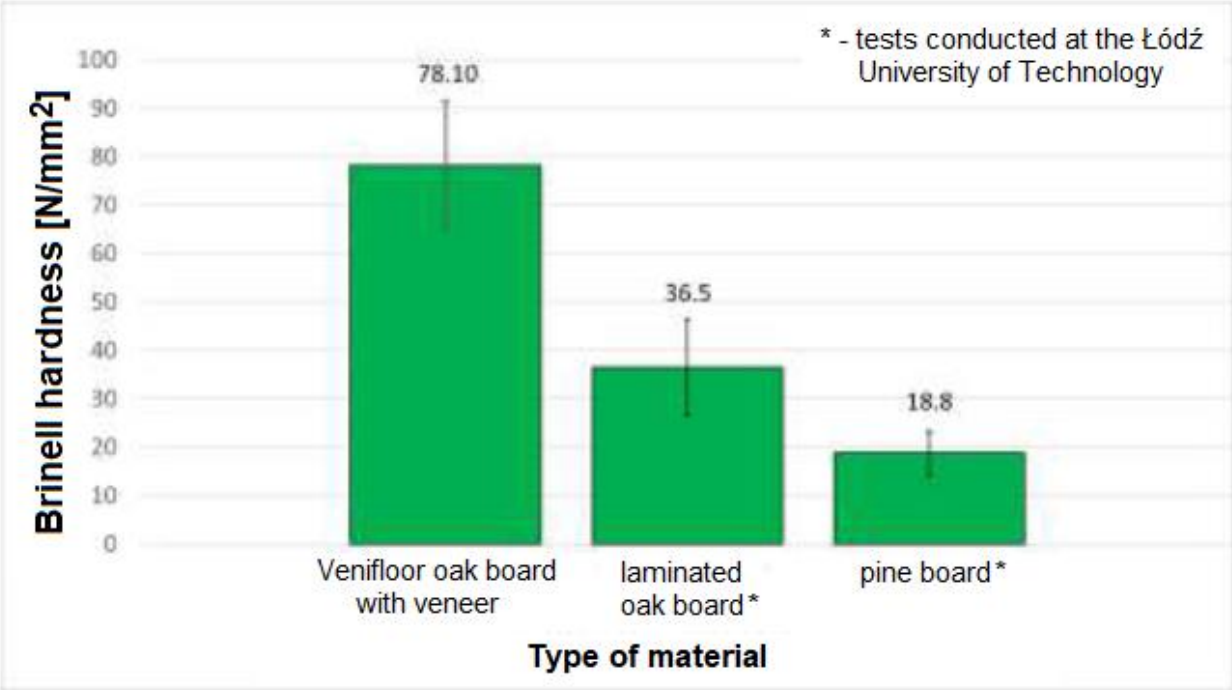

Fig. 3. Resistance to indentation of the flooring materials

On the basis of Figure 3, we can conclude that Venifloor oak boards covered with veneer are highly resistant to indentation. The average values of Brinell hardness of Venifloor oak boards covered with veneer are by **114%** higher than the Brinell hardness of laminated oak boards and by **315%** higher than the Brinell hardness determined with the same method for pine boards.