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Commissioning party
GIG-PIB
DEPARTMENT OF WATER PROTECTION

Title of work

Absorbency/water resistance and compression strength analysis of coated cardboard pallet feet

Katowice, April , 2024

Państwowy Instytut Badawczy

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~~Agreement~~/Order*) No. ..... date: 22.04.2024

Computer number of the work in GIG-PIB: 500 1372 24-183

Finalization date: 25.04.2024

Sequence number of the copy:

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1. Object of the study:

The object of the study were cardboard feet coated with wax mixture and uncoated cardboard feet. The feet are used as pallet supports.

The aim of the study was to determine the water absorption of uncoated and coated cardboard feet, and to test the compressive strength of coated cardboard feet after contact with water.

2. Evaluation criteria:

Criteria used for the evaluation:

Compressive strength determination was carried out according to standard PN-EN ISO 604: 2003.

The samples were analysed for moisture absorption before testing. The samples were kept in a vessel filled with distilled water. The samples were immersed in the liquid to a depth of 10 mm. The samples were kept in the liquid successively for: 1, 2, 3 and 4 hours.

The samples were weighed before and after the absorption test. The results of the coated cardboard feet were compared to the results of the cardboard uncoated feet.

3. Test procedures used to evaluate coating materials:

- resistance to water absorption
Tests have been performed based on the standard PN-P-50159:1992

- determination of compressive strength
Tests have been performed based on the standard PN-EN ISO 604: 2003

Remarks on the samples:

Samples for testing were prepared by Commissioning party delivered to the Laboratory by courier, protocol of receipt of samples No. BL-3/24-12 of April 22, 2024.

The samples were labelled at the Laboratory:
BL-3/24-2-1 to 5 for coated pallet feet made of cardboard.

Explanation of labels:
BL-3/24-2-1 – coated cardboard feet, water immersion time 0h
BL-3/24-2-2 - coated cardboard feet, water immersion time 1h
BL-3/24-2-3 - coated cardboard feet, water immersion time 2h
BL-3/24-2-4 - coated cardboard feet, water immersion time 3h
BL-3/24-2-5 - coated cardboard feet, water immersion time 4h

4. Test results:

Water absorption tests

The evaluation was carried out on the basis of the standard PN-P-50159:1992. The tests were carried out in a thermal bath. The samples were immersed in distilled water to a depth of 10 mm. The test was conducted in a liquid at 23°C.
Weight was measured on a scale Radwag WCL6/A2.

The test results are shown in Table 1.

Table 1. Results of water absorption tests for coated cardboard feet

Sample No.	Water immersion time h	Mass measurement before immersion g	Mass measurement after immersion g	Change in mass g
BL-3/24-2-1	0	146.3	-	-
BL-3/24-2-2	1	149.7	149.9	0.2
BL-3/24-2-3	2	142.3	143.0	0.7
BL-3/24-2-4	3	145.9	146.6	0.7
BL-3/24-2-5	4	146.9	147.6	0.7

Determination of compressive strength

The evaluation was carried out on the basis of the standard PN-EN ISO 604:2003. Tests were performed on a strength testing machine Mitutoyo ATX-10. The test was conducted at 23°C. The traverse speed was 10mm/min. The value of the force at 10% deformation was used as the result. The results are shown in Table 2.

Table 2. Compressive strength test results for cardboard samples

Sample No.	Force at first peak N	Deformation at first peak %	Strength at first peak MPa	Strength at second peak N	Strength at 10% deformation MPA	Strength at Fmax MPa
BL-3/24-2-1	5070	4.34	0.22	7530	0.27	0.34
BL-3/24-2-2	5020	4.79	0.23	9550	0.31	0.44
BL-3/24-2-3	3530	6.33	0.17	8580	0.29	0.42
BL-3/24-2-4	2890	4.93	0.13	8710	0.31	0.40
BL-3/24-2-5	2700	3.83	0.12	9130	0.27	0.41

Comment: the strength at the first peak relates to the "compression" of the corrugated cardboard forming part of the base of the cardboard feet.

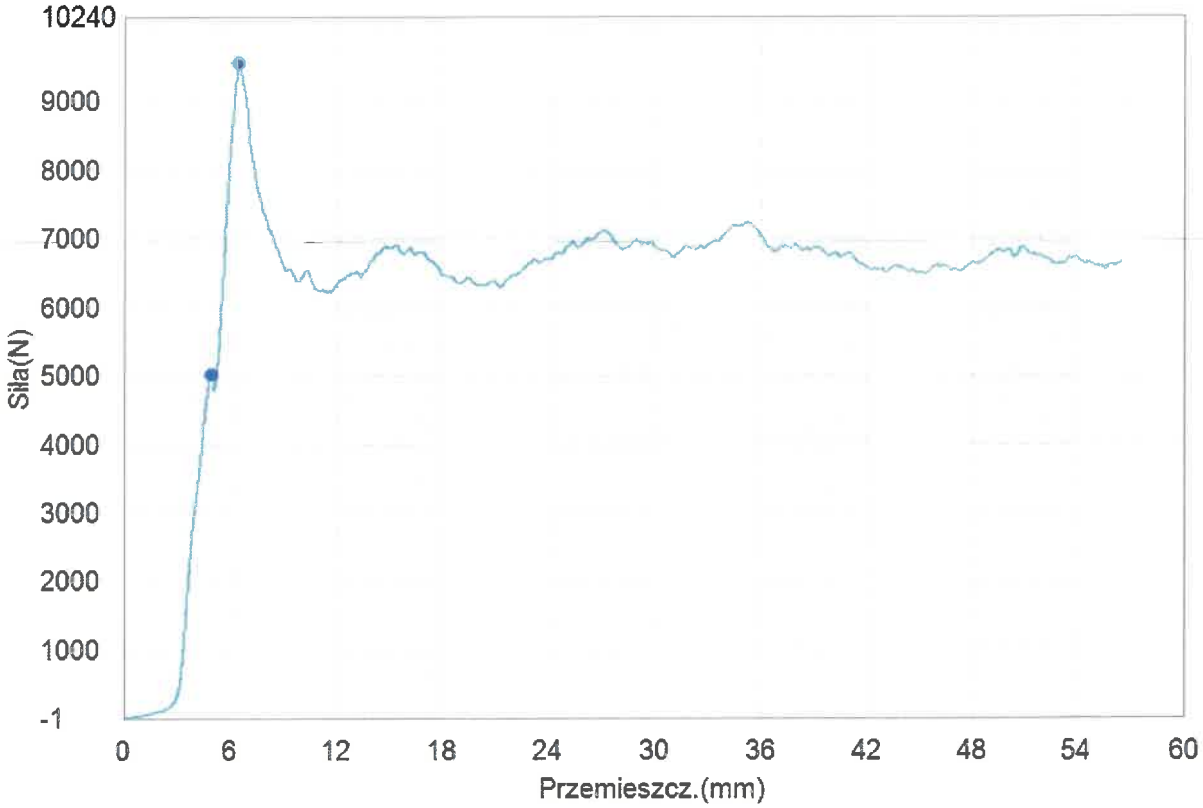

Figure 1 Compression diagram for the sample BL-3/24-2-2

Explanation:
Siła (N) – Contact force (N)
Przemieszcz. (mm) – Displacement(mm)

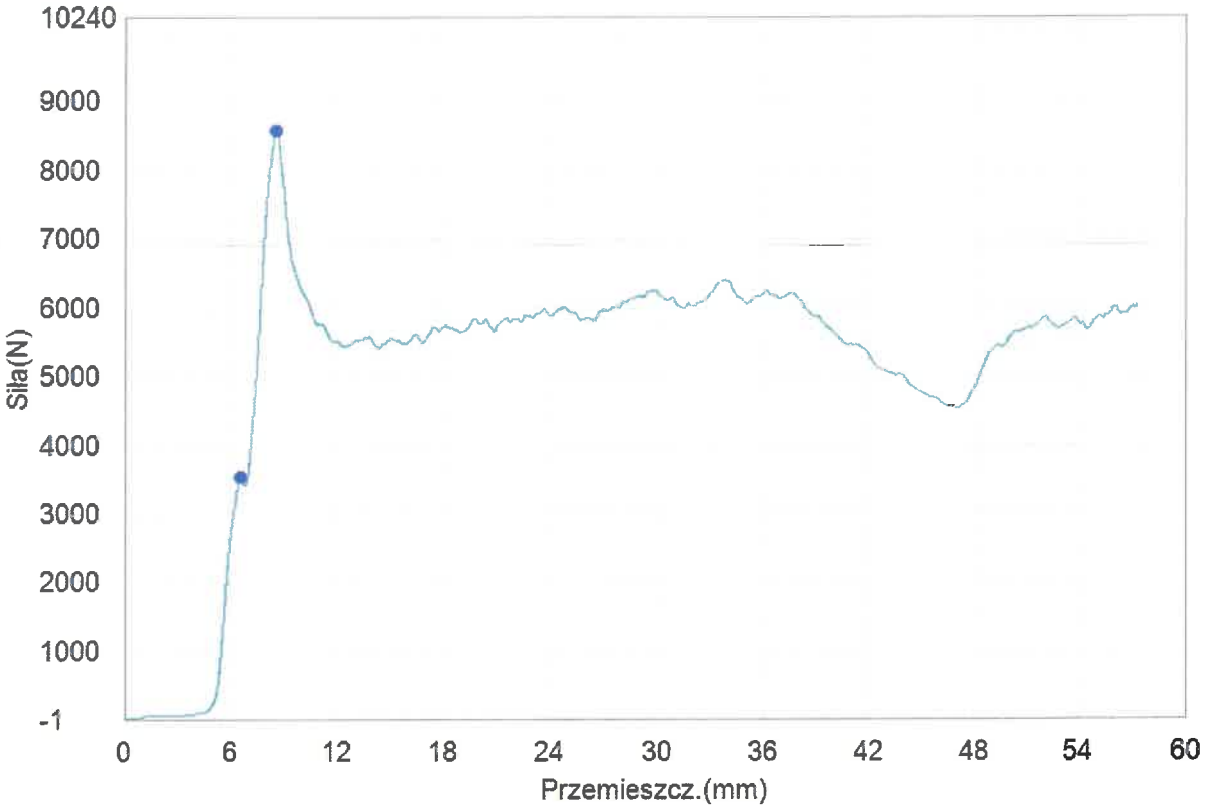

Figure 2 Compression diagram for the sample BL-3/24-2-3

Explanation:
Siła (N) – Contact force (N)
Przemieszcz.(mm) – Displacement(mm)

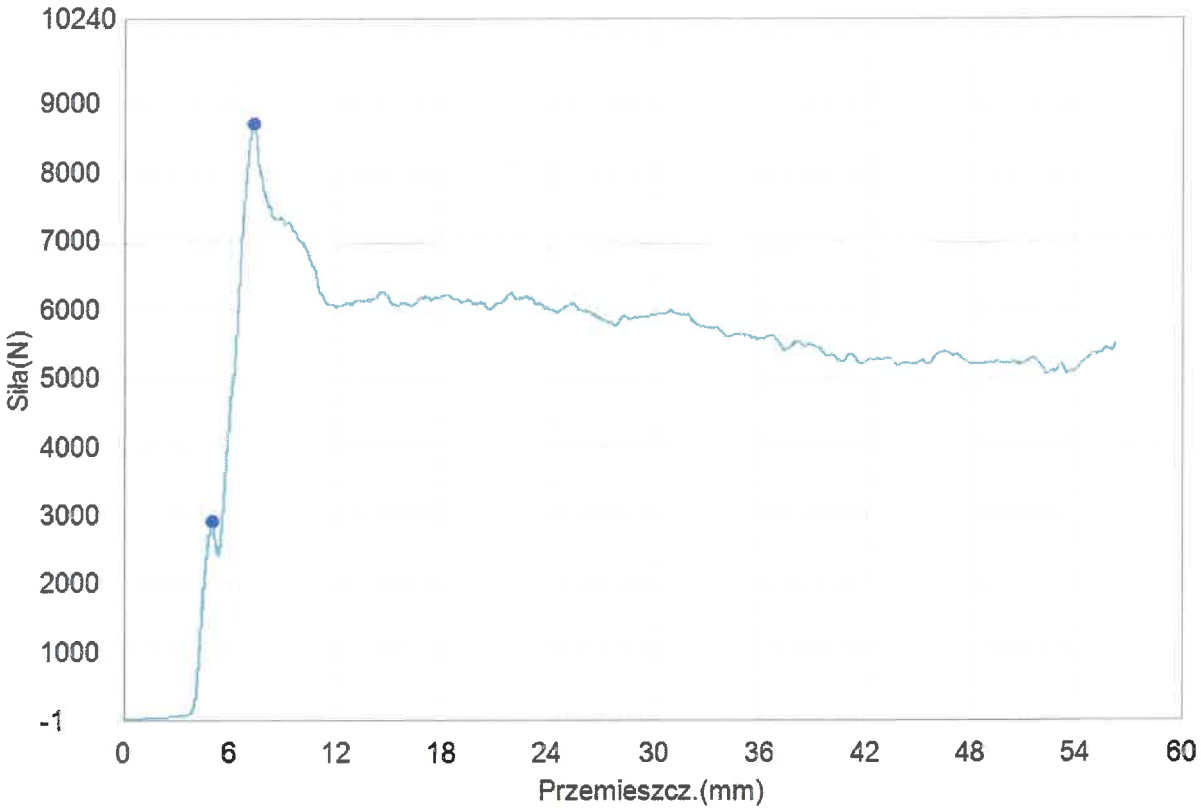

Figure 3 Compression diagram for the sample BL-3/24-2-4

Explanation:
Siła (N) – Contact force (N)
Przemieszcz. (mm) – Displacement(mm)

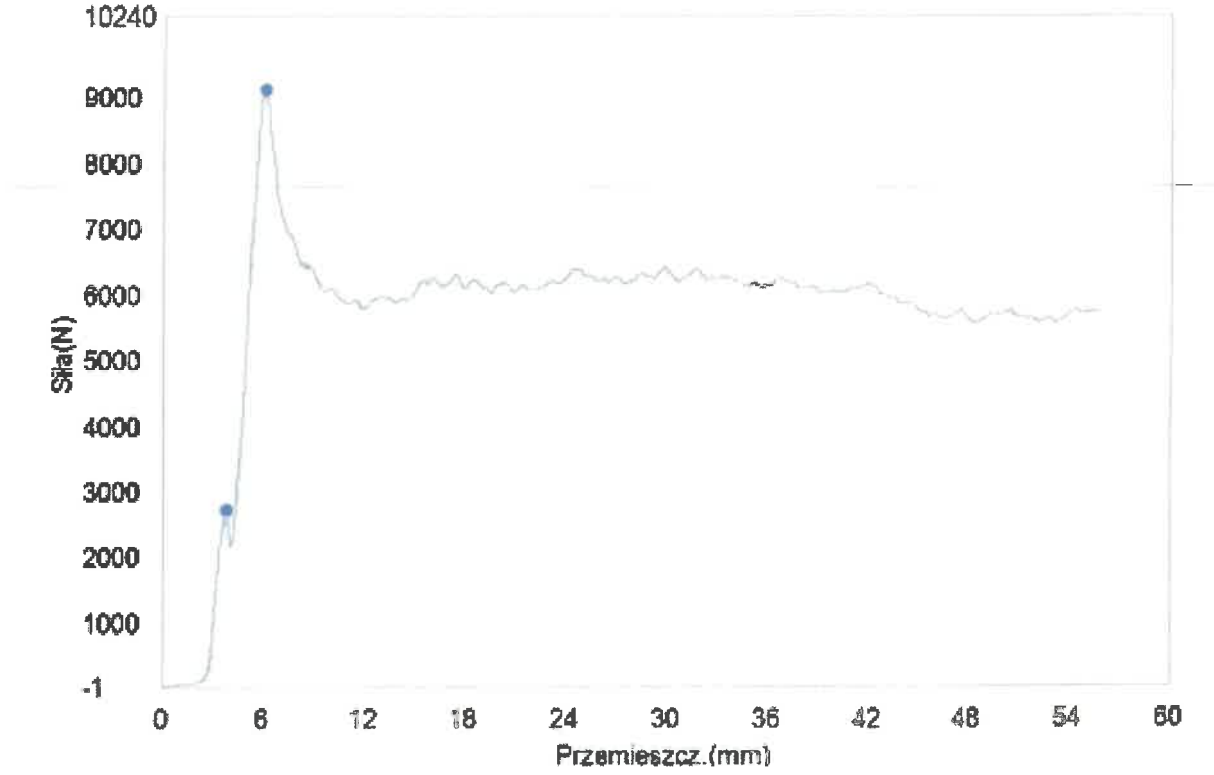

Figure 4 Compression diagram for the sample BL-3/24-2-5

Explanation:
Siła (N) – Contact force (N)
Przemieszcz. (mm) – Displacement(mm)

5. Evaluation of research results:

Water absorption tests:

The coated cardboard feet increase in weight by a maximum of 0.49% regardless of contact time.

The coated cardboard feet have a high resistance to water absorption.

Compressive strength tests:

The maximum contact force of the coated cardboard feet is 9550 N, and after 4h contact with water is 9130 N.

The strength value at 10% deformation for the for non-immersed, coated cardboard legs is 0.27 MPa, and after 4 hours of contact with water this value is the same.

Immersion in water and four hours' contact with water of coated cardboard feet does not change their compressive strength parameters.

The coated cardboard feet have stable compressive strength parameters even after 4h contact with water.

6. Summary:

The coated cardboard feet are characterised by their high resistance to water absorption and stable compression strength parameters even when exposed to water for up to 4h.

Finalization date of the study: 24.04.2024

End of the Report