



Name of ITD department Wood Protection Department

Poznań, 15-01-2016

Test report no. U-426-BOD/2015

Subject / Order title **The resistance against basidiomycetes fungi of WPC Gamrat 2015 material**

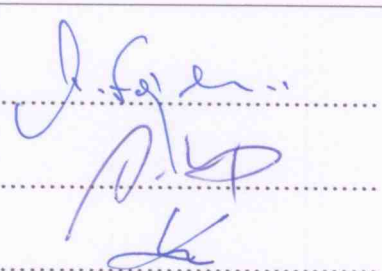
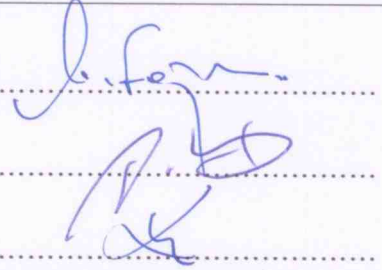
Form of order realization
(report, opinion, etc.) Test report (tests and analysis)

Order number client/Contract Order N° GA/072/23/2015-07-31 dated July 31, 2015 /Contract 48/2015 (U-426-BOD/2015)

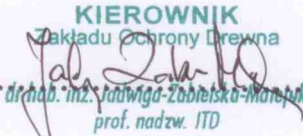
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The term of work 22.01.2016

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1. IDENTIFICATION (DESCRIPTION) OF THE TEST OBJECT

Samples of profiles of composite decking (WPC material - wood-plastic composite) produced by the company Gamrat SA, with nominal dimensions 80mm - along the extrusion direction×10mm-width×5mm-thickness, in the amount of 50 pieces from production batches No 3/15 of 20.05.2015; No 7/15 of 24.07.2015 and No. 10/15 of 31.07.2015. From the supplied batch of samples for laboratory tests were collected randomly samples in the amount required for individual determinations, as shown in the indication of the used research methods. The surfaces of the samples with dimensions of 80 mm×10 mm are the primary surfaces arising in the course of production-the extrusion of the material. The general view of the samples taken for laboratory tests and numbered is shown in Photo 1. In each test, equal amounts of samples were used from each batch of samples. The samples - all 3 batches were delivered for testing by DHL express courier. There was no damage to the shipment. The samples were provided for the determination of the material's resistance against basidiomycetes fungi.

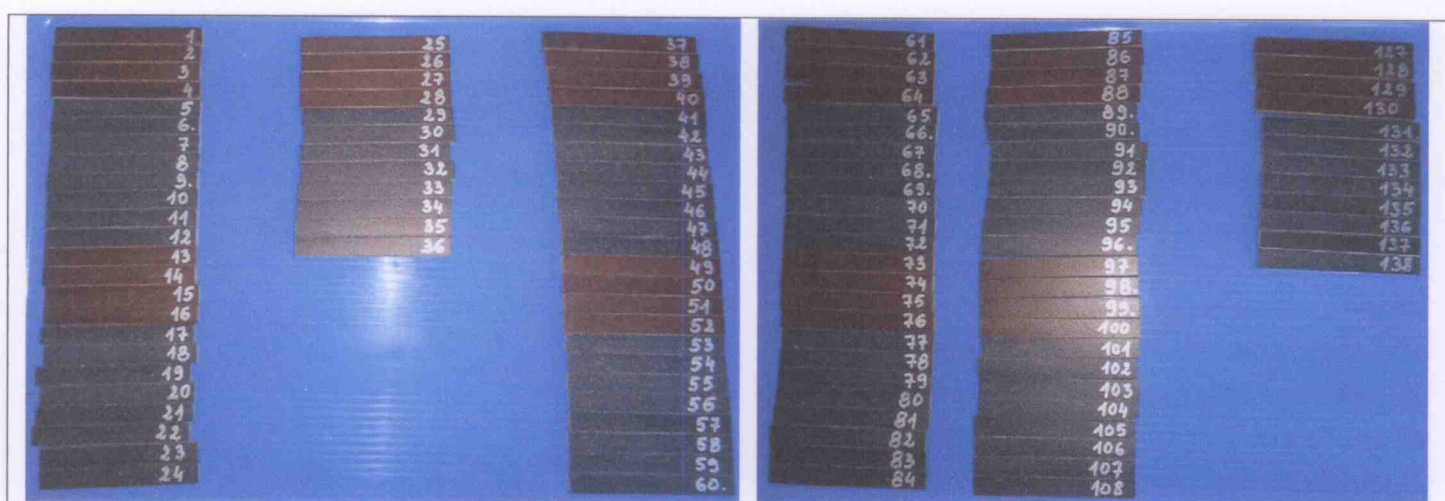


Photo1. The general view of the tested samples of WPC material (sample 1-4 from batch 3/15; 5-8 from batch 7/15; 9-12 from 10/15, and the next four samples again in the same order of individual batches).

2. DATE OF THE OBJECT'S DELIVERY FOR TESTING

07.08.2015

3. METHODS AND SCOPE OF TESTING

Resistance tests of the above mentioned material against basidiomycetes fungi were carried out according to EN 15534-1: 2014-04 "Composites made from cellulose-based materials and thermoplastics (usually called wood-polymer composites (WPC) or natural fibre composites (NFC)) – Part 1: Test methods for characterisation of compounds and products", p.8.5.2 and the resulting further requirements. This standard indicates ENV 12038: 2002 as a research method. This standard has been implemented as Polish Standard with registration number PN-ENV 12038: 2002 „Durability of wood and wood-based products – Wood-based panels – Method of test for determining the resistance against wood-destroying basidiomycetes”. The PN-EN 15534-1: 2014-04 p.8.5.2 indicated the necessary changes adapting the provisions of PN-ENV 12038 to the needs of WPC composites testing and added a requirement of performing strength tests according to EN ISO

178: 2010 implemented in the PN-EN ISO 178: 2011 „Plastics – Methods for determination of flexural properties”. Pure cultures of fungi *Coniophora puteana* (Schum. Ex Fries) Karst. (BAM Ebw. 15), *Gloeophyllum trabeum* (Pers. Ex fries) Murrill (BAM Ebw. 109), *Coriolus versicolor* (L.) Quel. (CTB 863A) held in the collection of the Wood Technology Institute were used in the study. Necessary determinations of weight changes of samples from the effects of fungi, flexural strength and modulus of elasticity in flexure and humidity were made, a photographic documentation and the test report were prepared.

4. LIST OF MEASUREMENT AND TEST APPARATUSES, AND MATERIALS

- Brinell magnifier, room A 221 station G1, identification number G1 / 01,
- Sartorius weight: room A203 station G8, type ED 8201-OCE
- DENVER weight: room A218 type TB-215B
- Gauge line: room A 221 station G1, identification number G1 / 02S,
- Digital caliper: room A 221, wardrobe No. 1 station G1, identification number G1 / 05S
- Vacuum dryer Vacucell, room 203, No. G8 / 25
- Laboratory dryer: room A 203 station G9, identification G9 / 7
- Strength testing machine INSTRON, room A 129 B1 15.

5. TESTS RESULTS

The results of the research presented in the Report 1 Resistance of WPC material GAMRAT SA against basidiomycetes fungi Cp, Gt, Tv - U-426-BOD / 2015.

Mean losses in mass of wood samples caused by basidiomycetes fungi are greater than those required by the standard. So, the test results are valid.

Mass losses of the WPC samples caused by the basidiomycetes fungi used in the study are relatively small compared to wood relatively easily decayed by the actions of fungi.

The flexural strength and modulus of elasticity of WPC samples are reduced mainly due to the increased humidity of the material, as indicated by the very similar properties of the samples treated by fungi and untreated by fungi, but stored under the same conditions as the samples treated with the fungi. The samples stored in the absence of fungi have no significant weight loss, and their moisture content is similar to the moisture content of samples treated by basidiomycetes fungi.

Report 1 Resistance of WPC material GAMRAT SA against basidiomycetes fungi Cp, Gt, Tv-U-426-BOD/2015

Number and date of European Standard (main for the WPC testing)	PN-EN 15534-1:2014-04
Number and date of the European Prestandard (executive) – determination of resistance against basidiomycetes fungi	PN-ENV 12038:2002
Number and date of European Standard (executive) – strength determination	PN-EN ISO 178:2011
The name of the test customer	Gamrat SA, Jasło
The name of test product	Decking board WPC produced by GAMRAT SA
Product type	WPC (wood-polymer composite)
Nominal thickness of the product	5,5 mm
Nominal density	1350 kg/m ³
Added biocides	None
Ageing procedures	Pre-treatment of WPC with water according to PN-EN 84
Sterilization method	Steam sterilization, 121°C, 20 min.
Test fungi	<i>Coniohora puteana</i> BAM Ebw. 15 <i>Gloeophyllum trabeum</i> BAM Ebe. 109 <i>Coriolus versicolor</i> CTB 863A
Exposed to fungi	17.09.2015
Assessed	07.01.2016
Duration of exposition to fungi	16 weeks
- Losses in mass of test product caused by fungi and mass changes of test product in condition as with fungi but without fungi = test of Environmental influence (7.1.3 according to PN-EN 12038) - Moisture content after pre-treatment with water according to PN-EN 84 - Final moisture content after test with basidiomycetes fungi	Table 1
Extent of overgrowth by fungi, as at the end of the test	Table 2, Photo 2
Losses in mass of wood samples – virulence control of fungi	Table 3
Flexural strength, Modulus of elasticity in flexure	Table 4
Relative loss of the flexural strength and modulus of elasticity in flexure	Table 5
Deviation from the standard PN-EN 12038	acc. to p.8.5.2 PN-EN 15534-1:2014
Assessment of results	<p>- According to PN-EN 15534-1 p.8.5.2.1 at present there is no sufficient database to provide a valid classification</p> <p>According to self-assessment:</p> <ul style="list-style-type: none"> - the differences between the test mass losses of tested product WPC GAMRAT SA averaging 6.0% for the fungus Cp, 3.7% for the fungus Gt and 3.9% for the fungus Cv and weight losses of wood samples amounting to 36.3% -Cp , 36.5%-Gt and 20.4% - Cv, - and the decrease in flexural strength (σ_{ff}) of the product WPC GAMRAT SA caused by basidiomycetes fungi and flexural modulus (E_{ff}) of only from minus 0.7 to + 3.0 and from +0.4 to +4.8 respectively, <p>shows a high resistance of the tested product WPC GAMRAT SA against basidiomycetes fungi.</p> <p>The flexural strength (σ) and flexural modulus (E) of the product WPC GAMRAT SA becoming relatively reduced in comparison with the natural (as sold for use):</p> <ul style="list-style-type: none"> - to 24.6% σ and 48.2% E, after pre-treatment (saturation with water under vacuum) acc. to PN-EN 84 - and to 49.6% σ and 70.2% E after pre-treatment (saturation with water under vacuum) acc. to PN-EN 84 and maintaining for 16 weeks in high humidity ($\sim 70 \pm 5$)%, <p>indicate the need to recognize the reduction of these characteristics of the product under conditions simulating the natural conditions of use or in such natural conditions.</p>

Report prepared by	Wood Technology Institute, Wood Protection Department, Poznań, Poland
Name of the officer in charge	Assoc. Prof. Andrzej Fojutowski DSc,

Table 1

The results of mass loss determination of WPC Gamrat SA samples by the resistance against basidiomycetes fungi activity testing

The exposition of WPC Gamrat SA samples to													
pre-treatment with water according to EN 84 and exposition to fungi activity									pre-treatment with water acc. to EN 84 and the influence of environmental conditions such as with fungi, but without fungi (samples type 7.1.3 acc. to ENV 12 038)			pre-treatment with water acc. to EN 84 (samples type 7.1.2 acc. to ENV 12038)	
<i>Coniophora puteana</i> BAM 15			<i>Gloeophyllum trabeum</i> BAM 109			<i>Coriolus versicolor</i> CTB 863A							
Mass loss	Moisture content		Mass loss	Moisture content		Mass loss	Moisture content		Mass loss	Moisture content		Initial moisture content (before saturation)	Final moisture content (after saturation)
	initial	final		initial	final		initial	final		initial	final		
%													
2,6	12,1	5,3	0,8	12,1	4,5	4,5	12,1	4,6	0,4	12,1	12,8	2,0	11,7
4,3	12,1	5,2	1,0	12,1	4,5	3,9	12,1	4,6	0,6	12,1	13,5	2,0	12,8
4,2	12,1	4,6	0,0	12,1	8,6	4,1	12,1	7,8	0,0	12,1	13,6	2,0	12,0
3,1	12,1	4,3	3,8	12,1	9,1	6,0	12,1	7,8	0,0	12,1	12,5	2,0	11,9
8,6	14,6	4,7	14,7	14,6	14,6	4,3	14,6	15,2	0,0	14,6	12,8	2,5	14,9
8,8	14,6	4,8	7,9	14,6	13,7	5,6	14,6	16,5	0,0	14,6	13,8	2,6	14,2
9,9	14,6	5,2	5,6	14,6	13,3	3,5	14,6	6,8	0,0	14,6	12,1	2,5	14,3
7,0	14,6	5,3	6,6	14,6	14,3	5,6	14,6	7,1	0,0	14,6	12,2	2,2	14,9
5,8	11,0	6,0	1,9	11,0	8,2	3,2	11,0	6,5	0,5	11,0	11,9	1,9	11,2
4,2	11,0	6,1	5,6	11,0	7,7	3,2	11,0	6,6	0,5	11,0	11,6	2,0	11,0
6,0	11,0	4,5	4,4	11,0	11,3	3,4	11,0	10,8	0,0	11,0	6,0	2,0	11,2
4,6	11,0	4,5	4,0	11,0	10,6	3,4	11,0	11,2	0,2	11,0	6,2	1,9	10,7
2,5	12,1	4,6	2,6	12,1	5,1	3,8	12,1	5,9	0,0	12,1	13,7		
3,7	12,1	4,5	1,7	12,1	5,1	3,5	12,1	5,8	0,0	12,1	14,7		
3,4	12,1	5,2	0,0	12,1	11,2	4,1	12,1	18,5	1,2	12,1	13,9		
3,6	12,1	5,3	0,3	12,1	11,6	3,4	12,1	18,5	0,7	12,1	13,3		
10,4	14,6	5,1	6,6	14,6	12,4	4,6	14,6	18,5	0,4	14,6	17,6		
9,7	14,6	5,0	2,1	14,6	12,8	3,8	14,6	17,3	0,0	14,6	16,6		
9,5	14,6	12,7	3,2	14,6	5,4	3,6	14,6	5,6	0,7	14,6	14,3	-	-
8,2	14,6	12,1	0,4	14,6	5,6	3,7	14,6	5,7	0,3	14,6	13,3		
6,2	11,0	4,8	2,3	11,0	11,5	4,1	11,0	9,3	0,1	11,0	11,2		
4,6	11,0	4,8	4,1	11,0	11,3	3,9	11,0	9,2	0,2	11,0	11,0		
6,0	11,0	6,5	5,0	11,0	5,5	2,5	11,0	5,3	0,1	11,0	14,0		
6,5	11,0	6,5	4,5	11,0	5,4	1,9	11,0	5,3	0,1	11,0	13,2		
mean¹ :6,0	12,6	5,7	3,7	12,6	9,3	3,9	12,6	9,6	0,2	12,6	12,7	2,1	12,6

1 – the mean arithmetical data of individual determination are given at the line

Table 2

Extent of overgrowth of WPC Gamrat SA samples by fungi, as at the end of the test

Test fungus	The growth by fungi	Collocation of decay
<i>Coniophora puteana</i> BAM 15	Samples completely covered, all around, abundant mycelium	Decay invisible
<i>Gloeophyllum trabeum</i> BAM 109	Samples completely covered, all around,	Decay invisible
<i>Coriolus versicolor</i> CTB 863A (= <i>Trametes versicolor</i>)	Samples completely covered, all around, thin mycelium	Decay invisible



Photo 2. The overgrowth of samples by fungi at the end of the test.

The mass loss of wood samples – virulence control of basidiomycetes fungi

Table 3

<i>Coniophora puteana</i> BAM 15 Scots pine – sapwood		<i>Gloeophyllum trabeum</i> BAM 109 Scots pine – sapwood		<i>Coriolus versicolor</i> CTB 863A Beech wood	
Mass loss	Final moisture content	Mass loss	Final moisture content	Mass loss	Final moisture content
%					
43,7	41,0	38,0	44,9	24,4	25,4
44,3	41,4	37,7	45,4	20,5	29,7
28,0	13,9	31,9	27,2	19,7	18,9
29,0	14,0	34,3	28,8	19,4	25,5
33,7	23,7	38,5	34,9	18,5	24,5
45,0	23,0	38,2	36,0	20,1	30,1
32,1	24,7	35,8	39,6	-	-
34,2	25,6	37,4	38,4	-	-
Mean	36,3	Mean	25,9	Mean	20,4
		Mean	36,5	Mean	25,7
		Mean	36,9		

The results of determination of flexural strength (σ) and modulus of elasticity in flexure (E) of WPC Gamrat SA material

Values	The test after the WPC Gamrat SA samples exposition to										The samples that did not undergo any treatment; in condition as in delivery for testing	
	pre-treatment with water according to EN 84 and exposition to fungi activity						pre-treatment with water acc. to EN 84 and the influence of environmental conditions such as with fungi, but without fungi (samples type 7.1.3 acc. to ENV 12 038)		pre-treatment with water acc. to EN 84 (samples type 7.1.2 acc. to ENV 12038)			
	<i>Coniophora puteana</i> BAM 15		<i>Gloeophyllum trabeum</i> BAM 109		<i>Cortolus versicolor</i> CTB 863A		σ_d	E_d	σ_m	E_m		
	σ_{Cp}	E_{Cp}	σ_{Gt}	E_{Gt}	σ_{Cv}	E_{Cv}						
MPa												
Individual	23,64	1116	20,59	891	20,61	812	21,87	983	27,85	1708	39,04	3218
	20,31	905	19,94	773	16,84	812	21,75	921	31,60	1820	39,69	3267
	20,56	852	22,22	934	19,84	847	18,21	953	28,62	1480	39,83	3248
	19,73	795	22,82	984	19,89	900	20,33	899	30,96	1736	38,20	3175
	13,16	622	11,16	522	13,21	705	16,86	957	25,66	1648	33,39	3279
	12,33	598	14,41	710	16,91	947	15,89	-	21,78	1484	30,89	2917
	12,97	600	15,74	809	15,70	895	17,51	978	26,32	1639	31,07	2956
	15,20	685	14,29	699	14,10	793	16,69	1117	21,51	1537	32,87	3234
	15,32	757	19,44	1027	19,76	932	17,79	1102	28,99	1960	36,81	3716
	15,20	725	15,84	803	20,87	1284	19,50	1385	26,55	1659	37,22	3588
	18,13	841	18,61	993	18,91	1137	18,80	1048	28,62	1886	38,14	3305
	19,75	1120	18,96	1038	19,25	1147	19,84	1054	26,57	1799	33,88	3384
	20,36	1076	21,11	848	22,69	1153	18,30	1002				
	20,76	904	23,45	947	22,33	1056	21,84	1077				
	17,40	835	21,61	1102	23,04	1187	20,63	935				
	20,55	834	20,09	901	22,53	1140	19,06	905				
	12,54	623	13,54	762	15,27	847	14,81	801				
	13,07	637	17,87	891	13,05	858	14,84	872				
	13,37	781	15,35	766	14,80	738	15,81	798				
	12,55	666	20,05	1192	14,76	699	12,76	795				
17,21	869	18,06	1094	20,44	1135	18,46	976					
18,45	943	17,64	990	18,06	965	16,58	818					
19,30	985	18,67	865	21,10	1178	16,65	915					
17,06	909	18,87	888	19,00	953	19,81	1154					
Mean	17,04	820	18,35	893	18,46	963	18,11	976	27,09	1696	35,92	3274
Standard deviation	3,36	159	3,12	150	3,12	172	2,39	136	3,11	153	3,31	224
Minimum	12,33	598	11,16	522	13,05	699	12,76	795	21,51	1480	30,89	2917
Maximum	23,64	1120	23,45	1192	23,04	1284	21,87	1385	31,60	1960	39,83	3716
variation coefficient %	20	19	17	17	17	18	13	14	12	9	9	7

Table 5

The relative loss of flexural strength (σ_{ff} - MPa) and modulus of elasticity in flexure (E_{ff} - MPa) of WPC Gamrat SA material

σ_{fm}	E_{fm}	σ_{fd}	E_{fd}	σ_{fCp}	E_{fCp}	σ_{fGt}	E_{fGt}	σ_{fCv}	E_{fCv}	σ_{ffCp}	E_{ffCp}	σ_{ffGt}	E_{ffGt}	σ_{ffCv}	E_{ffCv}
24,6	48,2	49,6	70,2	52,6	75,0	48,9	72,7	48,6	70,6	3,0	4,8	-0,7	2,5	-1,0	0,4

σ_{fm} – the loss of flexural strength caused by pre-treatment of the samples with water, acc. to Formulae 9 in PN-EN 15534-1

E_{fm} – the loss of modulus of elasticity in flexure caused by pre-treatment of the samples with water, acc. to Formulae 12 in PN-EN 15534-1

σ_{fd} – the loss of flexural strength caused by degradation procedure for 7.1.3. samples, acc. to Formulae 10 in PN-EN 15534-1

E_{fd} – the loss of modulus of elasticity in flexure caused by degradation procedure for 7.1.3. samples, acc. to Formulae 13 in PN-EN 15534-1

σ_{fCp} , σ_{fGt} , σ_{fCv} – the loss of flexural strength after a fungi activity, Cp or Gt or Cv respectively, acc. to Formulae 9 in PN-EN 15534-1

E_{fCp} , E_{fGt} , E_{fCv} – the loss of modulus of elasticity in flexure after a fungi activity, Cp or Gt or Cv respectively, acc. to Formulae 12 in PN-EN 15534-1

σ_{ffCp} , σ_{ffGt} , σ_{ffCv} – the loss of flexural strength caused by fungi activity Cp or Gt or Cv respectively, base. to Formulae 11- PN-EN 15534-1 ($\sigma_{ffCp} = \sigma_{fCp} - \sigma_{fd}$)

E_{ffCp} , E_{ffGt} , E_{ffCv} – the loss of modulus of elasticity in flexure caused by fungi activity Cp or Gt or Cv respectively, base. to Formulae 14

PN-EN 15534-1 ($E_{ffCp} = E_{fCp} - E_{fd}$)

Report prepared by:
Name of the officer in charge
Date

Wood Protection Department
Assoc. Prof. Andrzej Fojutowski, DSc
18.01.2016

Note : The interpretation and practical conclusions that can be drawn from the test report demand a specialized knowledge on the subjects of wood durability and wood preservation and, for this reason, the test report cannot of itself constitute an approval certificate.

7. STATEMENT

Test results refer only to the examined samples.

The test report cannot be copied in parts but only in its entirety.

The End