EPH®
SUCCESS BY QUALITY

Entwicklungs- und Prueflabor Holztechnologie GmbH · Zellescher Weg 24 · 01217 Dresden · Germany

Vastern Timber Company Ltd.
Mr Thomas Barnes
The Sawmills Wootton Bassett Swindon
Wiltshire SN4 7PD
United Kingdom

Entwicklungs- und Prueflabor
Holztechnologie GmbH
Zellescher Weg 24
01217 Dresden · Germany

Phone: +49 351 4662 0
Fax: +49 351 4662 211
info@eph-dresden.de
www.eph-dresden.de

Dresden, 01.04.2019

Test Report
Order no. 2218026

Client:	Vastern Timber Company Ltd. Wootton Bassett, Swindon Wiltshire SN4 7PD United Kingdom
Date of order:	18.09.2018
Order:	Test of thermally modified timber (TMT): durability against wood-decay fungi and selected physical and mechanical properties
Contractor:	Entwicklungs- und Prüflabor Holztechnologie GmbH Laboratory Unit Biological Testing Zellescher Weg 24 01217 Dresden · Germany
Engineer in charge:	Dipl.-Ing. Kordula Jacobs

Dr. Wolfram Scheiding
Head of Laboratory Biological Testing

The test report contains 5 pages and an annex with 3 pages. Any duplication, even in part, requires written permission of EPH. These test results are exclusively related to the tested material.

1 Task

The EPH was engaged to determine the biological durability and selected physical and mechanical properties of thermally modified Sycamore timber (TMT). Parts of the tests were also carried out on untreated Sycamore for comparison reasons.

2 Test material

- TMT Sycamore, delivered 18 September 2018
- native Sycamore, delivered 18 September 2018

3 Test procedures (overview)

This report summarizes the test results of the positions 1 to 5 of order 2218026 (Table 1).

Table 1: Test procedures

Pos.	Test, property	Test standard
1	Biological durability against wood decay basidiomycetes (relevant for wood in use class 3)	EN 350 CEN/TS 15083-1
2	Bending strength (MOR) and bending modulus of elasticity (MOE)	EN 408
3	Impact bending strength (IBS) for indirect measure of brittleness	DIN 52189-1
4	Equilibrium moisture content (EMC) at climate 20/65 (as indicator for modification intensity)	EN 13183-1
5	Maximum swelling ratio α_{max} and anti-swelling efficiency (ASE)	DIN 52184, AA-20-38

4 Results

4.1 Biological durability against wood decay basidiomycetes (order position 1)

4.1.1 Test specification

Test method	CEN/TS 15083-1:2005 Durability of wood and wood products – determination of natural durability of solid wood against wood decay fungi, test methods – part 1: basidiomycetes.
Test material:	TMT Sycamore, delivered 18 September 2018
Reference timber:	*Fagus sylvatica* L.
Test fungi:	*Coniophora puteana*, strain DSM 3085 *Trametes (Coriolus) versicolor*, strain CTB 863A
Replicates:	30 specimens for each test fungus
Specimen size:	(50×25×15) mm³
Ageing prior to test:	Leaching according to EN 84:1997 29 October 2018 – 12 November 2018
Sterilisation:	Water damp
Test duration:	16 weeks
Emplacement/Removal of specimens:	28 November 2018 / 20 March 2018

4.1.2 Validity of the test

The test was valid. The demanded values of mean mass losses with reference wood were exceeded by both test fungi. Summarized validity data are shown in Table 2, single values are given in the Annex, Tables A3 and A4.

Table 2: Virulence values

test fungus	mean mass loss (n=15)	required minimum mass loss (DIN CEN/TS 15083-1)
Coniophora puteana	31.4 %	≥ 30 %
Trametes versicolor	28.3 %	≥ 20 %

4.1.3 Test results

Summarized results of dry mass loss and the assigned durability classes are shown in Table 3. Single values are given in the Annex, Tables A1 and A2.

Table 3: Results of the durability test with TMT Sycamore according to CEN/TS 15083-1 (basidiomycetes) and EN 350

test fungus	mean dry mass loss [%] (n=30)	median dry mass loss [%] (n = 30)	Percentage of specimens belonging to		durability classification (see scheme Table 4)
			DC 1 [%]	DC 2 [%]	
Coniophora puteana	2.84 ± 2.9	1.45	76.7	23.3	DC 1 "very durable"
Trametes versicolor	1.09 ± 0.5	0.92	100	0	DC 1 "very durable"

Table 4: Scheme for preliminary classification of durability (CEN/TS 15083-1:2005 Annex D)

durability class	description	median dry mass loss
DC 1	very durable	≤ 5 %
DC 2	durable	> 5 % up to ≤ 10 %
DC 3	moderately durable	> 10 % up to ≤ 15 %
DC 4	slightly durable	> 15 % up to ≤ 30 %
DC 5	not durable	> 30 %

4.1.4 Evaluation

The basis for the classification is the result of the fungus that causes the greatest mass loss. In this test, the critical fungus was *Coniophora puteana*, with 76.7 % of test specimens achieving DC 1 and 23.3 % of test specimens achieving DC 2. According to the evaluation criteria in CEN/TS 15083-1:2005 (Annex D) and EN 350 (Tables 5 and 7) for wood decay basidiomycete fungi, the TMT Sycamore is classified in durability class 1 (very durable).

4.2 Bending strength characteristics (order positions 2 and 3)

Summarized results of bending properties are given in Table 5. Single values of the results are deposited at EPH and can be handed out after request.

Table 5: Bending strength

test method	material	number of specimens	mean value	standard deviation	coefficient of variation [%]
Modulus of rupture (MOR) according to DIN EN 408, flatwise [N/mm²]	treated	10	55.46	13.64	24.6
	untreated	10	89.81	8.99	10.0
Modulus of elasticity (MOE) according to DIN EN 408, flatwise [N/mm²]	treated	10	15,280	2,508	16.4
	untreated	10	14,911	3,169	21.3
Impact bending strength (IBS) for indirect measure of brittleness [kJ/m²]	treated	10	19.1	5.7	30.0
		all specimens with blunt fracture			
	untreated	10	45.6	9.2	20.2
		all specimens with blunt fracture			

4.3 Equilibrium moisture content and swelling behavior (order positions 4 and 5)

Summarized results of EMC and swelling characteristics are given in Table 6. Single values of the results are deposited at EPH and can be handed out after request.

Table 6: Equilibrium moisture content and swelling behavior

test method	material	number of specimens	mean value	standard deviation	coefficient of variation [%]
Equilibrium moisture content at 20/65 [%] acc. to EN 13183-1	treated	20	7.88	0.75	9.6
	untreated	20	13.49	0.56	4.2
Raw density at 20/65 [g/cm³] acc. to DIN 52182	treated	20	0.55	0.04	6.5
	untreated	20	0.56	0.06	10.2
Maximum swelling ratio α_{max} radial [%] acc. to DIN 52184	treated	20	2.35	0.29	12.3
	untreated	20	4.12	0.37	9.0
Maximum swelling ratio α_{max} tangential [%] acc. to DIN 52184	treated	20	4.68	0.50	10.6
	untreated	20	8.78	0.66	7.5
ASE (anti-swelling efficiency) radial [%] acc. to AA-20-38	treated	20	42.80	-	-
ASE (anti-swelling efficiency) tangential [%] acc. to AA-20-38	treated	20	46.65	-	-

Dresden, 01.04.2019

K. Jacobs

.....

Dipl.-Ing. Kordula Jacobs
Person in charge

Annex to test report 2218026: Results with TMT Sycamore

Single values of the durability test according to CEN/TS 15083-1 (basidiomycetes)

Table A1: Mass loss of TMT Sycamore with *Conophora puteana* (test period 28/11/18-20/03/2019)

No. of specimen	Density (oven dry) [kg/m³]	Dry mass loss [%]	Wood moisture content after removal [%]	DC acc. to CEN/TS 15083-1, Annex D
1	442.1	1.0	58.1	1
2	494.4	3.8	41.4	1
3	508.3	2.0	57.7	1
4	493.3	0.4	47.4	1
5	524.8	0.4	39.7	1
6	496.0	0.4	35.4	1
7	444.3	5.2	31.3	2
8	493.9	0.1	48.6	1
9	498.7	1.1	40.6	1
10	480.5	0.7	45.3	1
11	555.7	2.0	40.0	1
12	444.8	9.1	38.1	2
13	492.3	2.9	28.0	1
14	494.4	0.6	47.2	1
15	494.9	1.1	49.7	1
16	507.2	0.8	48.5	1
17	530.7	1.7	28.5	1
18	477.3	0.6	39.9	1
19	445.3	8.4	40.0	2
20	494.4	0.5	53.1	1
21	492.3	4.0	41.5	1
22	444.3	5.8	42.3	2
23	496.5	1.2	47.8	1
24	494.4	1.1	44.1	1
25	491.7	3.6	30.3	1
26	438.4	9.6	32.4	2
27	493.9	5.0	23.1	2
28	492.8	2.5	38.1	1
29	440.0	9.6	32.7	2
30	475.7	0.2	46.3	1
Mean values	**485.8 ± 28.1**	**2.84 ± 2.9**	**41.2 ± 8.5**	**76.7 % in DC 1 23.3 % in DC 2**
Median values	**493.6**	**1.45**	**41.0**	

Table A2: Mass loss of TMT Sycamore with *Trametes versicolor* (test period 28/11/18-20/03/2019)

No. of specimen	Density (oven dry) [kg/m³]	Dry mass loss [%]	Wood moisture content after removal [%]	DC acc. to CEN/TS 15083-1, Annex D
31	505.1	1.0	39.8	1
32	491.2	0.9	36.9	1
33	476.8	1.2	50.4	1
34	436.3	2.2	42.8	1
35	545.6	1.7	46.4	1
36	475.7	0.9	40.4	1
37	482.1	0.8	34.3	1
38	488.0	0.7	32.6	1
39	489.1	1.1	54.1	1
40	494.9	1.1	52.7	1
41	512.5	1.6	38.1	1
42	530.1	2.3	44.4	1
43	475.2	0.9	50.2	1
44	477.9	1.2	33.6	1
45	491.7	1.6	44.3	1
46	497.6	2.3	39.1	1
47	491.2	1.2	55.3	1
48	498.1	1.7	32.5	1
49	509.9	0.5	25.3	1
50	485.9	0.8	38.5	1
51	493.3	0.4	50.5	1
52	493.3	1.0	54.9	1
53	493.3	0.9	29.7	1
54	494.9	0.6	38.8	1
55	478.9	0.8	36.5	1
56	493.3	0.6	35.6	1
57	575.5	0.6	42.8	1
58	562.7	0.5	35.0	1
59	486.9	0.8	50.9	1
60	447.5	1.0	42.0	1
Mean values	**495.8 ± 27.9**	**1,09 ± 0.5**	**41.6 ± 7.9**	**100 % in DC 1**
Median values	**492.5**	**0.92**	**40.1**	

Table A3: Mass loss of virulence specimens with *Conophora puteana* (test period 28/11/18-20/03/2019)

No. of specimen	Density (oven dry) [kg/m³]	Dry mass loss [%]	Wood moisture content after removal [%]
V1	657.6	32.8	56.9
V2	628.8	30.9	60.0
V3	633.1	31.7	62.4
V4	656.5	32.8	57.7
V5	622.9	32.0	63.2
V6	634.1	32.8	58.2
V7	596.8	30.1	57.2
V8	614.9	31.4	58.4
V9	602.1	30.2	56.7
V10	600.0	31.8	58.3
V11	585.6	31.9	61.6
V12	634.7	31.5	64.4
V13	604.8	30.8	57.7
V14	601.1	29.5	58.8
V15	651.7	30.3	58.7
Mean values	**621.6 ± 22.3**	**31.4 ± 1.0**	**59.4 ± 2.3**
Median values	**622.9**	**31.5**	**58.4**

Table A4: Mass loss of virulence specimens with *Trametes versicolor* (test period 28/11/18-20/03/2019)

No. of specimen	Density (oven dry) [kg/m³]	Dry mass loss [%]	Wood moisture content after removal [%]
V31	600.0	27.6	43.7
V35	587.2	24.3	54.3
V40	600.5	21.3	68.1
V42	660.3	25.6	59.5
V43	618.1	31.7	47.9
V44	594.1	30.6	43.7
V45	608.0	33.3	45.9
V47	632.5	31.2	51.2
V48	624.0	34.3	50.2
V49	612.8	31.6	57.1
V50	632.5	28.0	48.7
V51	584.0	22.8	46.0
V52	603.2	21.8	40.6
V53	622.4	27.7	41.7
V54	616.0	32.3	46.4
Mean values	**613.0 ± 19.2**	**28.3 ± 4.2**	**49.7 ± 7.2**
Median values	**612.8**	**28.0**	**47.9**