Title: Janka hardness of Accoya™ wood

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Summary

Titan Wood B.V. appointed SHR Timber Research to determine the Janka hardness of Accoya™ wood according to ASTM D143. The technology behind Accoya™ wood is based on wood acetylation. In this investigation Accoya™ wood and the untreated original wood species, Radiata Pine, was tested as part of the research scheme for KOMO certification BRL 0605 “Modified Timber”.

This report shows that the acetylation process significantly increases the Janka hardness of Radiata Pine. The average Janka hardness of Accoya™ wood in radial, tangential and end grain orientation was 47%, 52% and 81% higher respectively, compared to untreated Radiata Pine.

Contents

1 Assignment

Titan Wood B.V. appointed SHR Timber Research to determine the Janka hardness of Accoya™ wood. The technology behind Accoya™ wood is based on wood acetylation, a chemical modification process that improves the dimensional stability, UV-stability and durability of wood. The process modifies the wood without the addition of toxic chemicals. Accoya™ wood's durability and dimensional stability can be determined after the acetylation process has taken place by analysing the wood's acetyl content.

In co-operation with a Dutch certification body, SKH, and research institute, SHR Timber Research, Titan Wood has established a research scheme to independently prove the quality of Accoya™ wood. This scheme consists of:

1. KOMO certificate BRL 0605 "Modified Timber". Here the emphasis is on the uniformity and reproducibility of the production process, as well as on Titan Wood's quality system.

2. Fulfilment of the (material) requirements as listed for in use of certified Dutch joinery (SKH Publicatie 97-04). Emphasis is on material properties, such as durability, dimensional stability and paintability.

In this research the Janka hardness of Accoya™ wood and the untreated (original) wood species, Radiata Pine, was tested as part of the research scheme described above.

2 Execution of the test

2.1 Identification and description of the samples

Sampling was performed according to BRL 0605 "Modified Timber" by Titan Wood. Accoya™ wood samples were taken from 3 batches produced in Titan Wood's pilot plant (15 samples per batch), originating from different boards. In total, 45 samples Accoya™ wood and 15 samples of (untreated) Radiata Pine were tested, each with a dimension of 50 x 50 x 150 mm.The codes of the samples and the correlating batch numbers can be found in appendix 1.

2.2 Procedure

The Janka hardness was determined according to ASTM D143. In this test a modified "ball" with 11,3 mm in diameter is used for determining the hardness. The load is recorded at which the "ball" has penetrated to one half of its diameter into the wood. Penetrations are made on the radial, tangential and end grain surface of each sample.

3 Results of the test

The average Janka hardness values of Accoya™ wood and untreated Radiata Pine are shown in table 1. All individual values can be found in appendix 2.

Table 1. The average Janka hardness (n=15) of Accoya™ wood and (untreated) Radiata Pine.

		Janka hardness ASTM D143						65% RH; 20 °C	
		Radial		Tangential		End grain		Density	Moisture content
	Batch number	[N]	*[stdev]*	[N]	*[stdev]*	[N]	*[stdev]*	[kg/m^3]	[%]
Accoya™ wood									
	LG118	4103	*570*	4427	*614*	6621	*632*	532	4,2
	LG122	4308	*569*	4043	*425*	6791	*474*	527	4,2
	LG123	3727	*687*	4090	*589*	6373	*794*	503	4,1
Average		**4046**	***608***	**4187**	***543***	**6595**	***634***	**521**	**4,2**
Radiata Pine									
	Ref-LG122	**2750**	***528***	**2748**	***611***	**3637**	***463***	**479**	**12,1**

4 Discussion and conclusion

Based on these research results, it can be concluded that the acetylation process significantly increases the Janka hardness of Radiata Pine. The average Janka hardness of Accoya™ wood in radial, tangential and end grain orientation was 47%, 52% and 81% higher respectively, compared to untreated Radiata Pine. These higher values of hardness can be partially explained by the slightly higher density (8%) and substantial lower moisture content of Accoya™ wood under the same climatic conditions (65% RH and 20 °C)

References

BRL 0605 (dated 31-01-2003). National Assessment Directive for the KOMO® Product Certificate Modified Timber. Stichting Keuringsbureau Hout SKH, Wageningen, the Netherlands.

SKH Publicatie 97-04 (Nieuw concept 13 april 2006). Beoordelingsgrondslag Houtsoorten voor toepassing in geveltimmerwerk; eisen en bepalingsmethoden. Stichting Keuringsbureau Hout SKH, Wageningen.

ASTM D143 (1994). Standard Test Methods for Small Clear Specimens of Timber. Section 13 – Hardness. ASTM International, West Conshohocken, USA.

Appendix 1 Sampling, codes and batch numbers

Janka hardness test Titan Wood
Sample overview

	Accoya™ wood Acetylated Radiata Pine			Reference Radiata Pine
	Batch LG118	**Batch LG122**	**Batch LG123**	**References**
1	LG118 RP2	LG122 RP1	LG123 RP2	REF - LG122 RP1
2	LG118 RP4	LG122 RP3	LG123 RP3	REF - LG122 RP3
3	LG118 RP5	LG122 RP5	LG123 RP4	REF - LG122 RP5
4	LG118 RP6	LG122 RP6	LG123 RP5	REF - LG122 RP6
5	LG118 RP7	LG122 RP8	LG123 RP6	REF - LG122 RP9
6	LG118 RP9	LG122 RP9	LG123 RP9	REF - LG122 RP10
7	LG118 RP11	LG122 RP10	LG123 RP10	REF - LG122 RP11
8	LG118 RP13	LG122 RP11	LG123 RP11	REF - LG122 RP13
9	LG118 RP14	LG122 RP13	LG123 RP12	REF - LG122 RP15
10	LG118 RP15	LG122 RP14	LG123 RP14	REF - LG122 RP16
11	LG118 RP16	LG122 RP15	LG123 RP15	REF - LG122 RP17
12	LG118 RP17	LG122 RP16	LG123 RP16	REF - LG122 RP20
13	LG118 RP20	LG122 RP17	LG123 RP18a	REF - LG122 RP21
14	LG118 RP21	LG122 RP20	LG123 RP18b	REF - LG122 RP22
15	LG118 RP22	LG122 RP21	LG123 RP19	REF - LG122 RP23

Appendix 2 Detailed test results

	Dimensions			Janka hardness ASTM D143			65% RH; 20 °C	
Board	Length	Width	Height	Radial	Tangential	End grain	Density	Moisture content
[-]	[mm]	[mm]	[mm]	[N]	[N]	[N]	[kg/m^3]	[%]
LG118 RP2	150,26	50,47	50,48	4593	3937	6430	541	4,2
LG118 RP4	149,86	50,41	50,40	3596	4467	6634	515	4,2
LG118 RP5	150,20	50,45	50,43	4554	4317	7488	534	4,1
LG118 RP6	150,13	50,42	50,34	4466	4579	6947	572	4,1
LG118 RP7	150,22	50,45	50,51	3880	4416	7031	528	4,0
LG118 RP9	150,10	50,41	50,45	4384	4832	7184	537	4,1
LG118 RP11	150,11	50,35	50,44	5131	4616	7191	551	4,1
LG118 RP13	149,97	50,49	50,52	4494	5616	7275	565	4,0
LG118 RP14	150,23	50,38	50,40	3642	3267	5346	484	4,3
LG118 RP15	150,18	50,41	50,46	3499	4599	5663	513	4,3
LG118 RP16	150,07	50,38	50,42	4438	5213	6996	560	4,1
LG118 RP17	149,65	50,40	50,39	2873	4613	6589	544	4,2
LG118 RP20	149,81	50,39	50,40	4137	4208	6123	527	4,3
LG118 RP21	150,05	50,40	50,43	4153	4439	6513	524	4,4
LG118 RP22	150,28	50,43	50,41	3699	3282	5901	491	4,7
			Avg	***4103***	***4427***	***6621***	***532***	***4,2***
			Stdev	***570***	***614***	***632***	***25***	***0,2***

	Dimensions			Janka hardness ASTM D143			65% RH; 20 °C	
Board	Length	Width	Height	Radial	Tangential	End grain	Density	Moisture content
[-]	[mm]	[mm]	[mm]	[N]	[N]	[N]	[kg/m3]	[%]
LG122 RP1	150,16	50,46	50,43	5104	4576	8028	590	3,9
LG122 RP3	149,86	50,43	50,60	4606	4802	7471	545	3,9
LG122 RP5	150,07	50,49	50,42	4842	4278	6871	529	4,1
LG122 RP6	149,94	50,41	50,43	4123	4064	6318	499	4,3
LG122 RP8	150,18	50,29	50,38	4047	4012	6514	508	4,0
LG122 RP9	150,11	50,39	50,41	3885	4633	6461	530	4,2
LG122 RP10	150,10	50,47	50,41	4643	4194	7548	555	4,2
LG122 RP11	150,00	50,24	50,37	3467	3334	6642	500	5,0
LG122 RP13	150,15	50,46	50,46	3688	3623	6466	484	4,1
LG122 RP14	150,07	50,37	50,46	3923	4014	7229	550	4,2
LG122 RP15	150,11	50,35	50,45	4333	3796	6023	546	4,1
LG122 RP16	150,10	50,43	50,38	4904	4586	7156	544	4,1
LG122 RP17	150,11	50,43	50,40	5417	3848	6874	518	4,3
LG122 RP20	150,33	50,36	50,43	4763	3546	6290	530	4,1
LG122 RP21	150,11	50,37	50,31	3668	3876	7208	539	3,7
			Avg	***4308***	***4043***	***6791***	***527***	***4,2***
			Stdev	***569***	***425***	***474***	***22***	***0,3***

	Dimensions			Janka hardness ASTM D143			65% RH; 20 °C	
Board	Length	Width	Height	Radial	Tangential	End grain	Density	Moisture content
[-]	[mm]	[mm]	[mm]	[N]	[N]	[N]	[kg/m3]	[%]
LG123 RP2	150,09	50,39	50,43	2951	3669	5812	458	3,9
LG123 RP3	150,15	50,40	50,44	3794	5073	6691	520	4,2
LG123 RP4	150,10	50,34	50,36	4945	3563	7685	531	4,3
LG123 RP5	150,08	50,40	50,48	4182	3767	6802	548	4,1
LG123 RP6	150,14	50,27	50,39	4649	5199	5638	520	3,7
LG123 RP9	150,04	50,41	50,38	3423	3307	5427	492	4,2
LG123 RP10	150,16	50,35	50,42	2991	4435	5919	474	4,2
LG123 RP11	150,12	50,35	50,46	3233	4116	5582	490	3,9
LG123 RP12	150,15	50,42	50,45	2855	3147	6273	454	4,0
LG123 RP14	150,30	50,39	50,44	3876	4273	6547	516	4,2
LG123 RP15	150,16	50,26	50,37	3152	4496	5701	460	4,1
LG123 RP16	150,19	50,40	50,45	3175	4106	5896	475	4,1
LG123 RP18a	150,08	50,40	50,46	3606	3827	7325	536	4,4
LG123 RP18b	150,19	50,32	50,39	4827	4082	7820	550	4,0
LG123 RP19	150,10	50,36	50,38	3463	3873	5916	483	3,9
			Avg	***3727***	***4090***	***6373***	***503***	***4,1***
			Stdev	***687***	***589***	***794***	***32***	***0,2***

	Dimensions			Janka hardness ASTM D143			65% RH; 20 °C	
Board	Length	Width	Height	Radial	Tangential	End grain	Density	Moisture content
[-]	[mm]	[mm]	[mm]	[N]	[N]	[N]	[kg/m3]	[%]
REF - LG122 RP1	150,07	50,66	50,66	2956	3111	3843	491	12,1
REF - LG122 RP3	149,98	50,38	50,55	3112	2996	3797	477	12,6
REF - LG122 RP5	150,02	50,28	50,38	2423	1990	2809	447	12,3
REF - LG122 RP6	150,08	49,53	50,50	3912	2827	4221	538	12,2
REF - LG122 RP9	150,06	50,49	50,57	3124	3968	4358	501	11,9
REF - LG122 RP10	149,80	50,36	50,41	3184	3022	4331	509	11,9
REF - LG122 RP11	150,16	50,28	50,33	1928	1854	3173	436	12,0
REF - LG122 RP13	150,03	50,53	50,61	2121	1961	3438	441	11,5
REF - LG122 RP15	150,05	50,57	50,63	3036	2242	3718	505	12,2
REF - LG122 RP16	150,08	50,52	49,22	2897	3298	3853	495	11,9
REF - LG122 RP17	149,97	50,50	50,62	2138	2675	3119	464	11,6
REF - LG122 RP20	150,01	50,46	50,71	2708	3110	3732	499	12,9
REF - LG122 RP21	149,98	50,49	50,68	2580	2336	3256	468	12,8
REF - LG122 RP22	149,91	50,31	50,31	2176	2391	3224	441	12,3
REF - LG122 RP23	150,02	50,34	50,58	2952	3445	3678	475	11,8
			Avg	***2750***	***2748***	***3637***	***479***	***12,1***
			Stdev	***528***	***611***	***463***	***30***	***0,4***