Understanding Properties of Commercial OSB Products

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Oriented strandboard (OSB) has gained increased market acceptance as a construction material in almost all geographical areas of Canada and United States. With its growing market, more and more research has been focused on the product’s manufacturing and performance. Commercial OSB products in U.S. and Canada are produced from different manufacturers with different process techniques, which result in different physical properties. The common physical and mechanical properties of OSB include MOR/MOE, Internal Bond (IB), Density and Thickness Swell (TS).

A comparative study was conducted to investigate mechanical and physical properties among OSB manufacturers. Commercial oriented strandboards from 14 mills were procured either directly from the mill or from the local market (Table 1). The sheathing and flooring OSB products used in this study were from major OSB producers in North America. Species included aspen, pine and other hardwood. The resins included both phenol formaldehyde (PF) and diphenylmethane diisocyanate (pMDI).

Table 1. Test OSB specifications.

Testing Board No.	Normal Thickness (in)	Species	Resin	
			Face	Core
1	7/16	Pine	PF	MDI
2	7/16	Pine	PF	MDI
3	7/16	Hardwood mixture	PF	PF
4	7/16	Hardwood mixture	PF	PF
5	7/16	Hardwood mixture	PF	MDI
6	7/16	Aspen	PF	MDI
7	7/16	Aspen	PF	MDI
8	7/16	Aspen	PF	PF
9	7/16	Aspen	PF	PF
10	7/16	Aspen	PF	PF
11	7/16	Aspen	PF	PF
12	7/16	Pine	PF	PF
13	7/16	Pine	PF	PF
14	23/32	Pine	PF	MDI
15	23/32	Pine	PF	PF
16	23/32	Pine	MDI	MDI
17	23/32	Pine	PF	MDI
18	23/32	Hardwood mixture	PF	MDI
19	2332	Aspen	PF	MDI
20	23/32	Aspen	PF	PF
21	23/32	Aspen	PF	MDI
22	23/32	Pine	PF	PF
23	23/32	Pine	PF	PF
24	5/8	Pine	PF	MDI

MOR, MOE and IB values of commercial 23/32” OSB are shown in Table 2. The aspen group has the highest MOR and MOE values in parallel direction (35.2 Mpa and 7066.6 Mpa, respectively) among the three species, and the ratios of parallel to perpendicular MOR and MOE were the highest, too (2.02 and 2.73 respectively). This is likely because of the excellent strand shape and orientation in the aspen OSB panels. The hardwood OSB panel had the similar ratios but very low MOR/MOE values, which demonstrated that strand shape and orientation in the hardwood panel was also good, but the panel density was too low. The ratios for pine MOR and MOE were the lowest (1.77 and 2.44 respectively). Mechanical properties for pine OSB panels varied significantly from manufacturer to manufacturer. As it is shown in Table 2, Nos. 16 and 17 panels had much higher MOR/MOE and IB than Panel No. 14. High core density panel, as it is of No. 17, gave much higher IB values than low core density panel No. 14. This was also demonstrated in the aspen group. Panel No. 20 had higher IB value than No.21 because of its higher core density (Figure 1). However, the relation between IB and core density might also be affected by the difference between the face and core density. As shown in Table 2 and Figure 1, No. 19 had the lowest IB value but not the lowest core density. The core density values for Nos.19 and 21 were similar, with No. 21 a slightly lower. However, the difference between the face and core density for the two panels were significantly different. No.19 showed a higher density difference than No.21. It can be concluded that the difference of OSB panels in mechanical performance is partly the result of different vertical density profiles that are developed by different manufacturing mechanisms.

Table 2. The mechanical properties of commercial 23/32” OSB testing panels arranged by panel species.

TestBoard	Density (lbs/ft^3)	MOR (Mpa)			MOE (Mpa)			IB (Mpa)
No.	Values	Perpendicular	Parallel	Para/Perp	Perpendicular	Parallel	Para/Perp	Values
				Pine Group				
14	39.3	152	17.8	1.17	2463.8	3731.4	1.51	0.15
15	41.3	162	34.0	2.10	2206.8	5856.4	2.65	0.48
16	40.6	21.5	46.0	2.14	3059.0	7025.4	2.30	0.62
17	42.0	20.4	41.9	2.05	2908.1	7569.2	2.60	0.76
22	35.3	17.5	26.6	1.52	2142.7	5517.1	2.57	0.47
23	37.6	14.7	24.2	1.65	1720.9	5194.7	3.02	0.43
Average	***39.3***	***17.6***	***31.8***	***1.77***	***2417***	***5816***	***2.44***	***0.486***
				Aspen Group				
19	36.1	14.8	33.2	2.24	2600.0	7100.0	2.73	0.412
20	42.2	15.7	32.9	2.19	2700.0	6700.0	2.40	0.524
21	35.0	16.9	39.5	2.34	2500.0	7400.0	2.96	0.491
Average	***37.7***	***15.8***	***35.2***	***2.02***	***2600***	***7067***	***2.73***	***0.469***
				Hardwood Group				
18	40.6	113	22.8	2.01	1935	5123	2.65	0.311
CSA 0437 Standard		**12.1**	**29**		**1500**	**5500**		**0.345**

Overall, as expected, Panel Nos. 17 and 21 had the best mechanical performance within the pine and aspen groups, respectively. They had relatively more uniform density profiles for both face and core regions, and the peak density was very close to the surfaces comparing to other panels in each group.

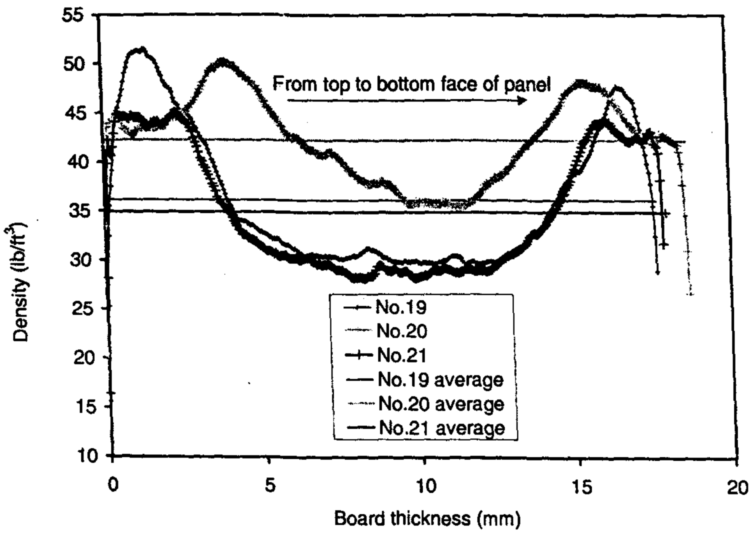

Figure 1. Vertical density profiles (VDP) for three aspen OSB 23/32”-thick panels (Source: Gu et. al 2004).

For the 7/16” thick OSB panels, average panel density for the hardwood panels was 42.6 lb/ft^3, significantly higher than one for both the aspen and pine panels. The aspen panel No. 7 shows a very nice and steep density profile (high density faces relative to the lower density core). The narrow density peaks of the surface layers are located very near the panel surface and at the same time there was relative high core density. There are no significant differences of density profiles between the pine and hardwood panels. The highest average MOR and MOE in the parallel direction was 32.6 Mpa and 5915 MPa for the 7/16” hardwood panels, respectively. The hardwood panels also had the highest paral1el/perpendicular ratio for both MOR and MOE, likely due to the excellent strand shape and orientation.

In conclusion, there are large differences of physical and mechanical properties between OSB products made by individual manufacturer. Manipulating the vertical density profile could be a useful method to improve product performance.

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