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Study on the Issue of Veneer Cracking in the Kitchen Cabinet and Furniture Industry

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Summary

Veneer cracking is a recurrent problem that results in significant annual losses for manufacturers of kitchen cabinets and furniture. The exact cause of cracking has never been clearly identified, leading to a great deal of speculation and discussion among manufacturers of veneer, finishes and adhesives. To our knowledge, no research group in Canada has addressed this problem, other than some private companies. As such, no concrete, accurate information is currently available on the cause of veneer cracking. Identifying the conditions and causes of cracking would certainly have a positive impact on reducing the costs of complaints received by manufacturers of kitchen cabinets and furniture.

The main objective of the project is to identify the factors involved in veneer cracking to minimize impacts on product quality. The specific objectives are as follows: 1) identify the humidity conditions that cause veneer surface cracks when veneer is being glued to the substrate, and 2) evaluate the impact of aqueous finishes on crack formation.

A literature review in the subject field and a review of the practical cases submitted to FPInnovations industry advisors helped us identify several parameters that may explain the formation of veneer surface cracks. Among other things, these parameters relate to veneer shrinkage due to a loss of humidity, inappropriate component storage, gluing process and glue type, wood type, substrate type, veneer handling, veneer and log quality, peeling method and veneer orientation.

Laboratory tests were conducted as part of the project, with a focus on 1) the impact of humidity differences between veneers and substrates at the gluing stage, and 2) the effect of aqueous finishes on the formation of veneer surface cracks. Tests were conducted with 21 scenarios involving the conditioning and gluing of maple veneer onto three types of substrates. The results showed the negative effects of gluing humid veneer (conditioned to 80% RH) to substrates. They also showed that the finish selected (water vs. solvent) does not impact the formation of surface cracks. However, the application of a surface finish to veneer does attenuate the formation of cracks through changes in weather conditions. The test results also showed the positive effect of using particleboard rather than plywood on reducing the number of surface cracks. The use of a Mende board (fibreboard) substrate with veneer that is not too humid (less than 80% RH) also tends to yield fewer surface cracks. Finally, the results showed a difference in performance between the two adhesives used to assemble veneer on particleboard, the veneer glued with UF adhesive showing more cracks.

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- Pierre Walsh LeBel, Director, Engineering, R&D, Perfecta Plywood Ltée,
- Gérald Roy, President, Spécialités MGH inc.,
- Yves-Marc Pelletier, Director, Technical Services, Masonite, Industries manufacturières Mégantic.

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1 Introduction

Veneer cracking is a recurrent problem that results in significant annual losses for manufacturers of kitchen cabinets and furniture. These losses are costly because cracks are generally found after the finish has been applied. Significant costs are also associated with complaints from clients regarding cracked products. The exact cause of cracking has never been identified, leading to a great deal of speculation and discussion among manufacturers of veneer, finishes and adhesives. To our knowledge, no research group in Canada has addressed this problem, other than some private companies. In the United States, a research project on the cause of cracking in maple veneer was undertaken in fall 2010 by two professors at Oregon State University. The purpose of this project is to identify the parameters leading to the formation of cracks from among the numerous variables associated with the veneer itself, the type of panel construction and the finish. The first project results are expected in 2012. No concrete, accurate information is currently available on the cause of veneer cracking. It is therefore important for the industry to update its knowledge on the problem, which is costly and difficult to prevent. Identifying the conditions and causes of cracking would certainly have a positive impact on reducing the costs of complaints received by manufacturers of kitchen cabinets and furniture.

Figure 1 Cracked veneer

Figure 2 Cracked veneer

2 Objectives

The main objective is to identify the factors involved in veneer cracking, such as weather conditions and material manufacturing processes, to minimize impacts on product quality. The specific objectives are to:

- Identify the humidity conditions that cause veneer surface cracks when veneer is being glued to the substrate.
- Evaluate the impact of aqueous finishes on crack formation.

3 Technical team

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4 Materials and methods

The project was carried out as follows: first, a Web literature review was performed to identify the main causes of veneer cracking. Discussion forums were consulted. The review also covered previous cases submitted to the Value-Added Products department at FPInnovations. Occasionally, the department's industry advisors receive complaints regarding cracks in veneered components. Examinations were then performed to identify probable causes and solution elements. Industry partners were consulted to validate the information collected on the Web, and to provide their own explanations of the causes of veneer surface cracking. The following industry partners were consulted: Perfecta Plywood and Spécialités MGH, veneered wood product manufacturers, peeling mill Masonite International Corporation, Megantic Manufacturing division, and the Canadian Hardwood Plywood and Veneer Association (CHPVA).

Following the Web research, the review of previous cases submitted to FPInnovations and our meetings with project partners, we decided to focus our laboratory tests on two parameters that may account for a large proportion of veneer surface cracks:

- humidity differences between veneers and substrates at the gluing stage
- use of aqueous finishes

Tests involving initial conditioning of the material in chambers, gluing of veneer to different substrates and conditioning with and without component finishes were defined using the protocol set out in Table 1. The protocol uses 21 scenarios involving:

- particleboard, plywood and Mende board (fibreboard) initially conditioned to 20% and 50% relative humidity (RH) before being glued to veneer (Figure 3),
- maple veneer conditioned to 20%, 50% and 80% before gluing (Figure 4), and
- use of two types of glue (PVA and UF).

Table 1 Scenarios for conditioning and gluing laboratory tests

Substrate	Veneer	Glue
Particleboard, 20%	20%	PVA
	50%	PVA
	80%	PVA
Particleboard, 50%	20%	PVA
	50%	PVA
	80%	PVA
	20%	UF
	50%	UF
	80%	UF
Plywood, 20%	20%	PVA
	50%	PVA
	80%	PVA
Plywood, 50%	20%	PVA
	50%	PVA
	80%	PVA
Mende board, 20%	20%	PVA
	50%	PVA
	80%	PVA
Mende board, 50%	20%	PVA
	50%	PVA
	80%	PVA

Figure 3 Conditioning of substrates prior to gluing to veneer

Figure 4 Conditioning of maple veneer prior to gluing to substrates

All components glued in laboratory tests following conditioning were 56 x 56 cm. The particleboard was 1.59 cm (5/8 in.) thick, and the plywood was 1.75 cm (11/16 in.) thick. The Mende board was 0.475 cm (3/16 in.) thick. The veneer was sugar maple. It came from two suppliers and was 1/36 in. (0.71 mm) thick. For each gluing scenario in Table 1, five panels were used to glue veneer to both the front and back. The proportions of the veneer from each supplier were equal for each scenario. PVA glue (Dural G2424) was used for 18 of the 21 scenarios in Table 1. The gluing parameters were as follows:

- Temperature: 102-104^{o}C
- Specific pressure (panel): 100 psi
- Press time: 105 sec
- Application: 118 g/m^2

UF glue (MDF302 TS2) was used to glue veneer conditioned to 20%, 50% and 80% to particleboard conditioned to 50%. The gluing parameters were as follows:

- Temperature: 120^{o}C
- Specific pressure (panel): 100 psi
- Press time: 120 sec
- Application: 118 g/m^2

Figure 5 Veneer gluing

All panels prepared in accordance with the scenarios in Table 1 were stored in a chamber at 20°C and 50% after veneer gluing to condition the material. Once a balance was reached, all material was carefully examined for surface cracks. The panels were then cut into three pieces: two 28 x 28 cm and one 28 x 56 cm (Figure 6). The two 28 x 28 cm pieces of each panel received a solvent-based finish and the other a water-based finish.

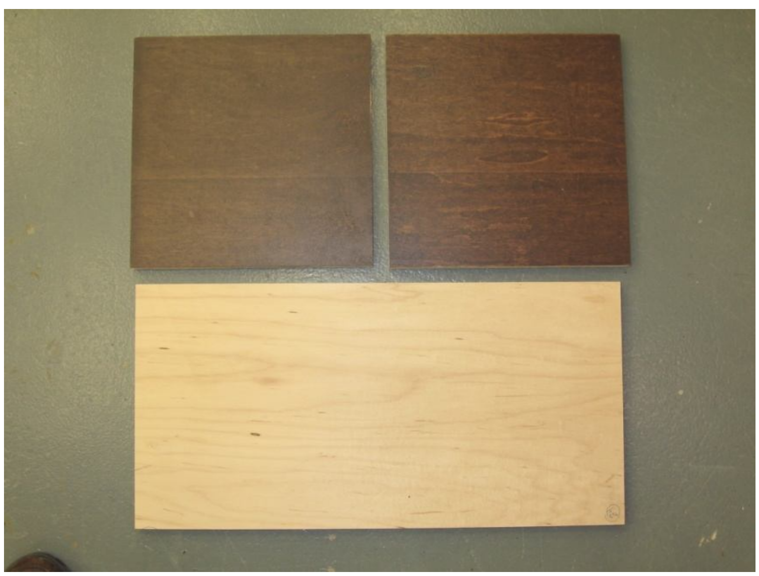

Figure 6 Three pieces of a panel

All 28 x 28 cm pieces with a water-based finish and those with a solvent-based finished, as well as the 28 x 56 cm pieces without a finish, were stored in a chamber at 20°C and 20% until a balance was reached. A second visual examination was performed on all material to find and note any veneer surface cracks. Following this examination, all material was stored in a chamber at 20°C and 80% until a balance was reached, then placed in the chamber again at 20°C and 20% for a final examination.

The purpose of preparing the materials in accordance with Table 1, with water- and solvent-based finishes, was to quantify the maximum possible differences in humidity between the veneer and the substrates at the gluing stage, with no previous formation of surface cracks caused by changes in size during post-gluing conditioning. The purpose of using two types of finishes was to test the effect of using a water-based finish on crack formation versus the effect of using a solvent-based finish.

5 Results and discussion

5.1 Review of crack formation literature

5.1.1 Web and literature review

The Web review of the main causes of veneer cracking enabled us to identify several potential sources. The Forintek Canada Corp. Veneer Cutting Manual (Feihl 1986) was also consulted. Below is a list of possible causes identified:

1. Loss of veneer humidity following gluing. A loss of veneer humidity results in shrinkage, causing tensile stresses that lead to cracking.
2. Incorrect storage of veneer before gluing, in high-humidity conditions, resulting in the problem described in item 1.
3. PVA glue used (high water content): this type of glue must be applied to the substrate, not the veneer, before gluing to prevent the veneer from swelling after absorbing the humidity in the glue (cracking problem related to item 1).
4. The use of contact glue is not recommended because it is too flexible. It does not hold the veneer sufficiently in the event of shrinkage. This type of glue does not help prevent cracks in case of loss of veneer humidity.
5. Wood type: porous wood, such as oak, and dense wood, such as maple, is most prone to cracking.
6. Substrate type: gluing veneer onto a stable particleboard substrate does not prevent cracking. Veneer reacts more to variations in humidity than substrate does.
7. Substrate humidity level must be balanced during the veneer gluing stage.
8. Hot press: use of a hot press may do more to prevent cracking than a cold press, because more humidity may be retained in the veneer with a hot press than with a cold one.
9. Poor handling of veneer (crumpling) before gluing.
10. Wavy veneer can also be a source of cracking.
11. Quality of logs at peeling stage: cracked or dry logs are problematic, as is reaction wood. A temperature that is poorly adapted to the log at the peeling stage may also cause cracks (Feihl 1986).
12. Peeling process: bar pressure too low, blade angle too high, logs too cold or too dry (Feihl 1986).
13. The orientation of veneer (open or closed face in relation to the blade) glued to substrate may have an impact on cracking (Cassens and Leng 2003).

The review also included practical cases submitted to the FPInnovations technical personnel. The following section summarizes the two cases analyzed.

5.1.2 Review of two practical cases submitted to FPInnovations

Case I: Cracking of curved panels
This practical case submitted to the Value-Added Products department of FPInnovations deals with the observation of cracks on the convex part of curved panels. The cracks appeared shortly after the components were installed.

The main points of the case are as follows:

- Observation of cracks on the convex side of curved panels
- Cracks running with the wood grain
- Raised edges of cracks
- No finish inside the cracks
- Average depth of cracks greater than the thickness of the surface finish
- 4-ply construction substrate made of three different types of wood

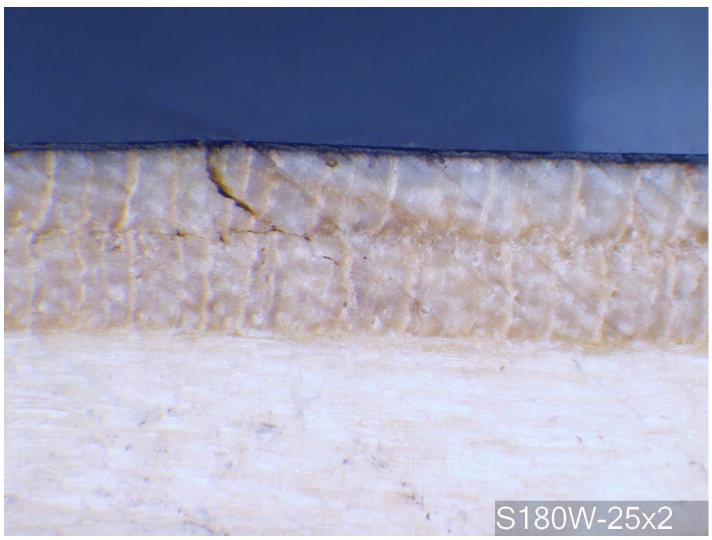

Figure 7 Surface crack on a curved panel

Various examinations and laboratory tests led to the hypothesis that the cracking was caused by high humidity in certain components (plies) of the plywood when the components were manufactured and finished.

Case II: Cracking of maple veneer glued to 0.25-inch-thick particleboard

For this practical case submitted to FPInnovations, a visual examination of several problematic panels showed two types of surface cracks. The first type of crack was characterized by the following points:

- Cracks are isolated, with a limited number on the panel
- Cracks can reach a length of 10 cm
- Edges of cracks are more or less raised
- Finish is present in the cracks
- Good adherence between the veneer and the substrate near the cracks (Figure 9)

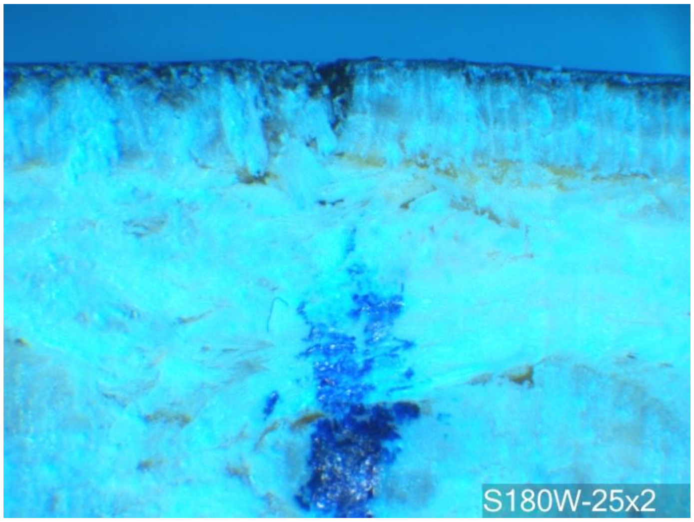

Figure 8 ***Cross-section of a type 1 crack***

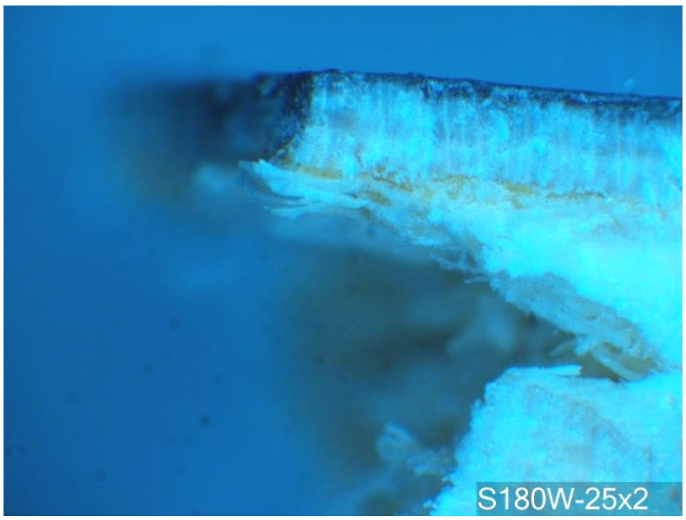

Figure 9 ***Cross-section of a test panel after the panel was broken in two***

The first type is characterized by isolated, relatively long cracks in the surface of the component. These cracks may be explained by poor handling of the veneer before gluing, or by the handling of components with veneer glued to thin substrates. It is recommended that the client handle veneer and components with care to avoid curving.

Figures 10 and 11 illustrate the second type of crack found on the panels from the same client. These cracks were characterized by the following points:

- Cracks 1 to 3 cm long with non-raised edges
- Cracks mainly present in mineral striations
- Finish present in cracks
- Good adherence between the veneer and the substrate near the cracks

Figure 10 Sanded surface of a component with striations on the veneer surface

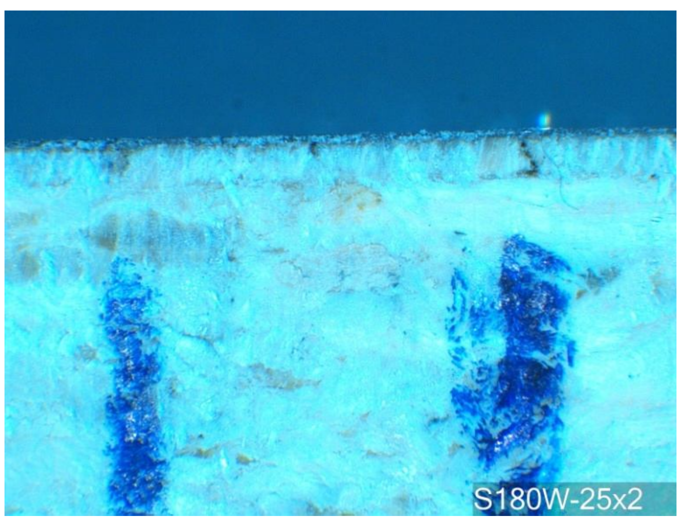

Figure 11 Cross-section of type II cracks

The second type of crack is characterized by its short length and its high numbers on the veneer surface (Figure 10). This type of crack can be explained by veneer shrinkage after gluing due to high initial humidity content. It is recommended that the client control the humidity content of the veneer before gluing. Veneer with mineral striations is very prone to surface cracks and should be avoided.

In light of the results of the literature review, the analysis of practical cases and the discussion with industrial partners, we decided to focus the laboratory tests on studying the effects of the following parameters:

- humidity differences between veneers and substrates at the gluing stage
- the effect of aqueous finishes on veneer surface cracking.

5.2 Results of chamber conditioning tests

Table 2 shows inspection results for unfinished panels for the 21 conditioning and gluing scenarios included in the project. Five 28 x 56 cm panels were prepared for each scenario, with veneer glued to both sides of each panel. Specifically, Table 2 shows, for each scenario, the number of cracks (N) observed and the total length of the cracks (L) in mm for a 1 m^2 surface of the veneer. A + sign in the L column (total length of cracks) indicates that more than 30 cracks were present on a single panel, making it difficult to calculate the total length of cracks. Only the number of cracks (N) was counted in these cases. Finally, a + sign in the N column (number of cracks) indicates that more than 40 cracks were present on at least one of the five panels in the group.

The unfinished panels were inspected three times after they were glued to various substrates:

Inspection period A:	after 9 weeks of storage at 20°C – 50%.
Inspection period B:	after 9 weeks of storage at 20°C – 50% and 3 weeks at 20°C – 20%.
Inspection period C:	after 9 weeks of storage at 20°C – 50%, 3 weeks at 20°C – 20%, 3 weeks at 20°C – 80% and 3 weeks at 20°C – 20%.

Table 2 Evaluation of panels with no surface finish

Substrate	Veneer	Inspection Period					
		A		B		C	
		N	L (mm/m^2)	N	L (mm/m^2)	N	L (mm/m^2)
Particleboard, 20%	20%	0.6	18.9	1.6	85.0	3.8	214.7
	50%	0	0	0	0	2.2	81.8
	80%	0	0	60.3	+	+	+
Particleboard, 50%	20%	0	0	0.6	6.5	1.6	50.0
	50%	0	0	0.6	10.8	2.2	36.6
	80%	0	0	1.1	46.3	12.4	240.5
	20%*	0.6	5.9	0.6	5.9	2.7	42.0
	50%*	1.1	74.3	0.6	75.3	8.6	157.1
	80%*	3.8	39.8	29.6	389.5	86.1	+
Plywood, 20%	20%	1.1	49.5	38.8	+	65.1	+
	50%	0	0	37.1	1523.1	90.9	+
	80%	2.2	130.8	144.7	+	+	+
Plywood, 50%	20%	0	0	6.5	305.6	18.3	860.8
	50%	0	0	39.8	+	53.8	+
	80%	1.1	29.6	104.9	+	+	+
Mende board, 20%	20%	0	0	0	0	2.7	110.8
	50%	0.6	6.5	0.6	8.1	1.6	78.5
	80%	0	0	17.2	349.2	49.5	+
Mende board, 50%	20%	0.6	35.5	0.6	49.0	0.6	57.0
	50%	0	0	4.3	198.0	4.3	283.0
	80%	0.6	75.3	44.7	+	+	+

*: veneer glued with UF glue

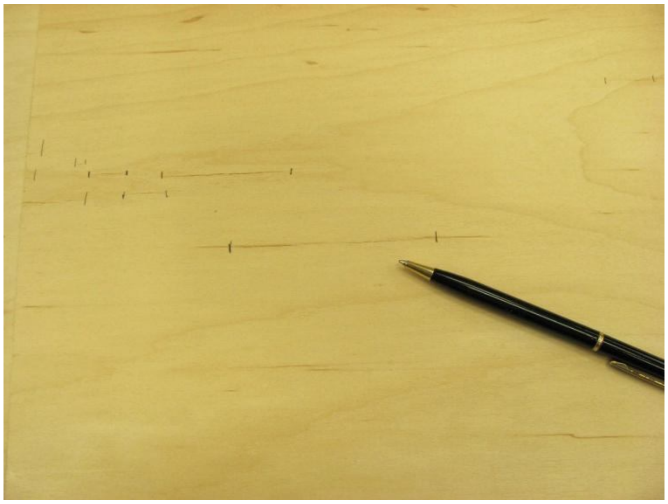

Figure 12 Cracks observed on unfinished veneer

To facilitate the evaluation of the respective results of each conditioning and gluing scenario for the veneer observed, Table 3 shows a compilation of the scenarios in decreasing order of the number of cracks observed on the surface in inspection period C, with the worst scenario first. If an equal number of cracks was observed in two different scenarios, the scenario with a lower total length of cracks was favoured.

Table 3 gives a general overview of the negative effect of gluing humid veneer (80%) to a drier substrate. This combination is conducive to crack formation due to shrinkage of the veneer during balancing after the gluing stage. The results also show the positive effect of using particleboard, rather than plywood, on reducing the number of surface cracks. The poor performance of plywood may be explained by the fact that veneer is glued in the same direction as the surface plies of the plywood. Because the veneer material (maple) is different from the plywood material (aspen), shrinkage and swelling is different, causing cracking. Gluing the veneer perpendicular to the plies may limit the formation of cracks. Finally, the results show a difference in performance between the two adhesives used to assemble veneer and particleboard at 50%. Veneer glued with UF adhesive showed more cracks.

Table 3 Compilation of scenarios involving unfinished materials in decreasing order of the number of cracks

	Substrate	Veneer
N > 100 cracks/m^2	Plywood, 20%	80%
	Plywood, 50%	80%
	Particleboard, 20%	80%
	Mende board, 50%	80%
N = 50 to 100 cracks/m^2	Plywood, 20%	50%
	Particleboard, 50%	80%*
	Plywood, 20%	20%
	Plywood, 50%	50%
	Mende board, 20%	80%
N = 4 to 50 cracks/m^2	Plywood, 50%	20%
	Particleboard, 50%	80%
	Particleboard, 50%	50%*
	Mende board, 50%	50%
N = 2 to 4 cracks/m^2	Particleboard, 20%	20%
	Mende board, 20%	20%
	Particleboard, 50%	20%*
	Particleboard, 20%	50%
	Particleboard, 50%	50%
N = 0.5 - 2 cracks/m^2	Mende board, 20%	50%
	Particleboard, 50%	20%
	Mende board, 50%	20%

*: veneer glued with UF glue

Table 4 shows inspection results for panels with a water-based finish and those with a solvent-based finish for 21 conditioning and gluing scenarios. For each finish, five 28 x 28 cm panels were prepared for each scenario, with veneer glued to both sides. Like Table 2, Table 4 shows, for each scenario, the number of cracks (N) observed and the total length of the cracks (L) in mm for a 1 m^2 surface of the veneer.

An initial inspection of the panels balanced over nine weeks at 20°C and 50% was performed to ensure that there were no cracks present before the finish was applied. Following the surface application of water-based and solvent-based finishes, the panels were inspected twice:

Inspection period D: after 3 weeks of storage at 20°C – 20%
Inspection period E: after 3 weeks of storage at 20°C – 20%, 3 weeks of storage at 20°C – 80% and 3 weeks of storage at 20°C – 20%.

Table 4 Evaluation of panels with surface finish

Substrate	Veneer	Inspection Period							
		D				E			
		Water-based finish		Solvent-based finish		Water-based finish		Solvent-based finish	
		N	L (mm/m²)	N	L (mm/m²)	N	L (mm/m²)	N	L (mm/m²)
Particleboard, 20%	20%	0	0	0	0	0	0	2.2	49.5
	50%	1.1	14.0	0	0	1.1	17.2	2.2	71.0
	80%	0	0	0	0	5.4	162.5	0	0
Particleboard, 50%	20%	1.1	11.9	0	0	1.1	31.2	0	0
	50%	1.1	125.9	0	0	1.1	9.7	0	0
	80%	0	0	0	0	0	0	1.1	12.9
	20%*	0	0	0	0	0	0	0	0
	50%*	0	0	1.1	34.5	0	0	2.2	58.1
	80%*	7.6	117.3	5.4	89.3	78.6	1098.6	65.7	963.0
Plywood, 20%	20%	5.4	43.1	5.4	34.5	9.7	535.9	8.6	353.0
	50%	4.3	184.0	8.6	599.4	19.4	1433.3	23.7	1337.5
	80%	25.8	614.4	23.7	944.8	43.1	1065.3	58.1	2664.2
Plywood, 50%	20%	2.2	51.7	1.1	12.9	2.2	57.1	4.3	70.0
	50%	12.9	838.2	14.0	875.9	22.6	1475.2	32.3	1974.5
	80%	23.7	1171.8	50.6	2526.5	74.3	3073.1	91.5	4481.6
Mende board, 20%	20%	0	0	0	0	0	0	1.1	87.2
	50%	0	0	0	0	1.1	9.7	0	0
	80%	2.2	51.7	0	0	4.3	68.9	6.5	101.2
Mende board, 50%	20%	0	0	0	0	0	0	0	0
	50%	3.3	91.5	0	0	2.2	56.0	1.1	10.8
	80%	3.3	78.6	0	0	5.4	159.3	4.3	169.0

*: veneer glued with UF glue

Figure 13 Cracks observed on finished veneer

Like Table 3, Table 5 shows a compilation of the scenarios in decreasing order of the number of cracks observed on the surface of panels finished with water-based finish and with solvent-based finish in inspection period E, with the worst scenario first. If an equal number of cracks was observed in two different scenarios, the scenario with a lower total length of cracks was favoured.

Table 5 shows the negative effect of using humid veneer (80%) on particleboard and plywood substrates. The shrinkage of veneer during conditioning after the gluing stage leads to surface cracking. The results also show that the choice of finish (water-based versus solvent-based) has no effect on surface cracking. The results of the 12 scenarios showed no surface cracks ($N = 0$ cracks/m^2), and both types of finish were used. The results also show the positive effect of using particleboard, rather than plywood, on reducing the number of surface cracks. Again, the fibreboard was better for limiting the development of surface cracks in the veneer. The use of a Mende board substrate with veneer that is not too humid (less than 80%) tends to result in a low proportion of surface cracks. Finally, the use of UF glue versus PVA glue had a significant impact on the cracks in the surface of assemblies involving veneer at 80% only: a higher number of cracks was observed with UF glue.

Table 5 Compilation of scenarios involving finished materials in decreasing order of the number of cracks observed

	Substrate	Veneer	Finish
N > 50 cracks/m^2	Plywood, 50%	80%	solvent
	Particleboard, 50%	80%*	water
	Plywood, 50%	80%	water
	Particleboard, 50%	80%*	solvent
	Plywood, 20%	80%	solvent
N = 8 to 50 cracks/m^2	Plywood, 20%	80%	water
	Plywood, 50%	50%	solvent
	Plywood, 20%	50%	solvent
	Plywood, 50%	50%	water
	Plywood, 20%	50%	water
	Plywood, 20%	20%	water
	Plywood, 20%	20%	solvent
N = 2 to 8 cracks/m^2	Mende board, 20%	80%	solvent
	Particleboard, 20%	80%	water
	Mende board, 50%	80%	water
	Mende board, 50%	80%	solvent
	Plywood, 50%	20%	solvent
	Mende board, 20%	80%	water
	Particleboard, 20%	50%	solvent
	Particleboard, 50%	50%*	solvent
	Plywood, 50%	20%	water
	Mende board, 50%	50%	water
	Particleboard, 20%	20%	solvent
N = 1 to 2 cracks/m^2	Mende board, 20%	20%	solvent
	Particleboard, 50%	20%	water
	Particleboard, 20%	50%	water
	Particleboard, 50%	80%	solvent
	Mende board, 50%	50%	solvent
	Particleboard, 50%	50%	water
	Mende board, 20%	50%	water

	Substrate	Veneer	Finish
N = 0 cracks/m^2	Particleboard, 20%	20%	water
	Particleboard, 20%	80%	solvent
	Particleboard, 50%	20%	solvent
	Particleboard, 50%	50%	solvent
	Particleboard, 50%	80%	water
	Particleboard, 50%	20%*	water
	Particleboard, 50%	20%*	solvent
	Particleboard, 50%	50%*	water
	Mende board, 20%	20%	water
	Mende board, 20%	50%	solvent
	Mende board, 50%	20%	water
	Mende board, 50%	20%	solvent

*: veneer glued with UF glue

The results in tables 2 and 4 show the positive effect of applying surface finish to veneer on preventing crack formation. All panels were conditioned for nine weeks at 20°C and 50% after the veneer was glued to various substrates. Water-based and solvent-based finishes were applied to components cut after this conditioning period. All components, finished and unfinished, were then conditioned at 20°C and 20% for three weeks. For each scenario, a comparison of the results (number of cracks, N, and length, L) in inspection periods B (Table 2) and D (Table 4) show a lower number of cracks in components with water-based and solvent-based finishes than those with no finish. The same result was found upon final inspection of the components that were conditioned for an additional three weeks at 80% and three weeks at 20%. The results in inspection periods C (Table 2) and E (Table 4) show a lower number of cracks in finished components.

6 Conclusions

The overall objective of the project was to identify the factors involved in veneer cracking. A literature review in the subject field helped identify several parameters that may explain the formation of veneer surface cracks. Among other things, these parameters relate to veneer shrinkage due to a loss of humidity, inappropriate component storage, gluing process and glue type, wood type, substrate type, veneer handling, veneer and log quality, peeling method and veneer orientation.

A review of the practical cases submitted to FPInnovations industry advisors helped us confirm some of the parameters set out above as being responsible for veneer surface cracks.

Laboratory tests were conducted as part of the project, with a focus on 1) the impact of humidity differences between veneers and substrates at the gluing stage, and 2) the effect of aqueous finishes on the formation of veneer surface cracks. Tests were conducted with 21 scenarios involving the conditioning and gluing of maple veneer onto three types of substrates.

The results showed the negative effect of gluing humid veneer (conditioned to 80%) to the substrate. Shrinkage of the veneer during conditioning after gluing leads to the formation of surface cracks. The results also showed that the choice of finish (water-based versus solvent-based) has no effect on the formation of surface cracks. However, in both cases, the application of a surface finish did significantly mitigate the formation of veneer surface cracks when the components were exposed to various conditions in the laboratory. The results also showed the positive effect of using particleboard, rather than plywood, on reducing the number of surface cracks. The use of a Mende board substrate with veneer that is not too humid (less than 80%) also tends to result in a low proportion of surface cracks. Finally, the laboratory tests showed that the use of UF glue versus PVA glue could have an impact on veneer surface cracking: a higher number of cracks was observed with UF glue.

7 Recommendations

The literature review carried out as part of the project helped identify other parameters than those taken into account in the laboratory tests (difference in component MC, water-based finish system) that may explain the formation of veneer surface cracks. We recommend that other parameters be studied, such as veneer thickness, glue type, veneer orientation and the presence of heartwood. The veneer used in this project was produced by peeling; it would be worthwhile to consider the impact of the cutting process. Finally, it would be appropriate to update the information available on log preparation and the parameters of the peeling process.

In this project, cracks were not inspected through a microscope due to a lack of time. It would be useful to analyze the crack characteristics according to the veneer-substrate combinations used in this study.

8 Bibliographical references

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