Industria y Comercio
SUPERINTENDENCIA

Prosperidad para todos

SUPERINTENDENCIA DE INDUSTRIA Y COMERCIO	
RAD: 13-89758- -5	**FECHA**: 2014-04-04 19:31:37
DEP: 2020 DIRECCION DE NUEVAS CREACIONES	**EVE:** 379 FASE NACIONAL INCLUIDO CAPITULO II
TRA: 11 PCT-PATENTE DE INVENCION CAPITULOS I Y II	**FOLIOS**: 9
ACT: 519 PRESENTACION	

DIRECCIÓN DE NUEVAS CREACIONES

2020
Bogotá, D.C.,

Abogado(a)/Señor(a)
JUAN CARLOS URIBE RESTREPO

Asunto: Radicación: 13-89758- -5
Trámite: 11
Evento: 379
Actuación: 519
Oficio: 4413
Folios: 9

Patente de Invención	X			Patente de Modelo de Utilidad	
Vía Nacional					
Vía PCT (Fase Nacional)	X	Capítulo I		Capítulo II	X
No. Solicitud Internacional	PCT/CA2010/001353				
Fecha de Presentación Internacional	07/09/2010				

Como resultado del Examen de Fondo realizado, con fundamento en el Artículo 45 de la Decisión 486 de la Comisión de la Comunidad Andina, se comunica:

1. Documentos estudiados

Descripción:	Rad. Nº 13-089758-00000-0000	05/Abril/2013
Reivindicaciones:	Rad. Nº 13-089758-00001-0000	05/Abril/2013
Dibujos:	Rad. Nº 13-089758-00000-0000	05/Abril/2013

2. Análisis de la Prioridad

Se acepta la reivindicación de Prioridad porque esta solicitud fue presentada dentro del plazo establecido (Art. 9 D 486) y su contenido técnico corresponde con el de la prioridad reivindicada.

3. Objeto de la invención

De acuerdo con lo establecido en el numeral 1.2.2.2 del Capítulo Primero del Título X de la Circular Única para efectos del examen de patentabilidad, se tendrá en cuenta la tasa pagada por el solicitante al momento de comenzar el examen para las reivindicaciones adicionales; esto es que cuando la solicitud contenga más de diez (10) reivindicaciones y no se haya pagado la tasa complementaria, sólo se estudiarán las cubiertas por la tasa pagada. Por lo tanto, se estudiaran las reivindicaciones 1 a 14.

Título de la solicitud: “Método para formar un producto de celulosa resistente al fuego, y aparato asociado” (Pág. 1, radicado N° 13-089758-00000-0000).

El problema planteado en esta solicitud consiste en la necesidad de suministrar paneles o tableros de material renovable y de desecho resistentes al fuego.

Para resolver este problema técnico, la solicitud en estudio proporciona un método y aparato para la producción de paneles o tableros a base de desechos de celulosa o celulosa virgen molida, mezclados con agentes de unión y agentes retardantes de ignición.

El objeto de la presente Solicitud se relaciona con la Clasificación Internacional de Patentes (CIP) B27N 3/12, B32B 39/02, C08J 3/20, C08K 3/00, C08L 1/02, 75/04, C09K 21/14, D21F 11/00, D21H 27/30.

4. De la Solicitud de Patente

Reivindicaciones (Art 30 D 486, Art 22 PCT)

La reivindicación 1 no es clara porque hace referencia a un método, pero presenta características técnicas de un producto mediante el uso de la expresión *“el miembro de placa de fibra de celulosa tiene superficies”* y las reivindicaciones 11 a 14 no son claras porque hacen referencia a un aparato, pero presentan características técnicas de un método, lo cual no es permitido. Al respecto no debe olvidarse que las reivindicaciones de producto y de procedimiento son diferentes y, por ello, deben redactarse de manera independiente en el pliego reivindicatorio. Sobre las mismas, el Tribunal Andino de Justica ha dicho lo siguiente:

> “El objeto de la invención de producto está constituido por un cuerpo cierto destinado a llenar una necesidad industrial que el estado de la técnica aún no ha satisfecho. En cambio, el objeto de la invención de procedimiento se encuentra conformado por “una serie o sucesión de operaciones que inciden sobre una materia (solida, liquida o gaseosa) que se encamina a la obtención de una cosa o un resultado”.[1]

Las reivindicaciones 1 a 6 y 8 a 14 no son claras porque porque las expresiones *“elemento de accionamiento”, “agente de unión”, “se configura” y “sustancialmente”* son generales, por lo cual no permite distinguir la invención del estado de la técnica. Se sugiere sustituirlas por un término preciso o un rango concreto.

Las reivindicaciones 3, 5 y 10 no son claras porque las expresiones *“aproximadamente”* y *“por lo menos”* son imprecisas, ya que en este caso el alcance de la protección de las reivindicaciones deja de ser precisa y no permite distinguir la invención del estado de la técnica. Se sugiere sustituirlas por un término preciso o un rango concreto.

Las reivindicaciones dependientes 3 a 7 y 10 no son claras porque hacen referencia a dos reivindicaciones independientes lo que no está permitido. Se sugiere incluir de forma separada reivindicaciones dependientes para cada reivindicación independiente.

Las reivindicaciones 1, 2 y 8 a 10 no son claras porque las expresiones *“el elemento de accionamiento se configura…con el fin de facilitar la cohesión de las fibras”, “para formar”, “para exponer”, “para acoplar”, “para refinar”, “para recibir” y “para secar”*, son resultados a alcanzar, lo que no está permitido, no define al producto y/o método porque la invención no queda definida por el resultado a alcanzar, puesto que la reivindicación incluiría no sólo la solución propuesta por el solicitante, sino todas las alternativas presentes o futuras que lleguen a ese resultado.

[1] Otero Lastres, José Manuel. Ob. Cit. Proceso 129alPa2007.

La reivindicación independiente 9 no es clara porque presenta las mismas características estructurales del aparato de la reivindicación 8. Se sugiere realizar una única reivindicación independiente relacionada al aparato para la producción de paneles a base de celulosa.

La reivindicación 7 no es clara porque presenta una falsa dependencia al indicar compuestos que no están mencionados en la reivindicación 1.Se sugiere realizar la corrección necesaria.

5. Determinación del Estado de la Técnica

El estado de la técnica se determinó con base en la fecha de presentación internacional de la solicitud, es decir, el 7 de septiembre de 2010.

Consultadas las fuentes de información con que se cuenta, se encontraron los siguientes documentos que anticipan el objeto de esta solicitud.

Item	Documento	Título	Fecha de Publicación
D1	WO 02/102926	"Aqueous fire retardant"	27/Diciembre/2002
D2	US 2002/0162298	"Fire-resistant material and method of manufacture"	7/Noviembre/2002
D3	Art 1[2]	"Laminating composite panels"	2007

El documento D1[3] divulga una solución de retardante al fuego que se aplica a un material celulósico antes de la formación del panel (Pág. 4, línea 12 a línea 26, Pág. 5, línea 19 a Pág. 6, línea 2).

El documento D2[4] divulga un método para la formación de un panel con capacidad de resistencia al fuego basado en paja de arroz como remplazo al material celulósico (Pág. 1, Párr. 12).

El documento D3[4] divulga equipos continuos para laminación de paneles (Pág. 21, Col. 2, Párr. 2 a Pág. 22, Col. 1, Párr. 1).

6. Examen de Patentabilidad (Art 14 D486)

Nivel inventivo (Art 18 D486)

La reivindicación 1 consiste en "*Un método para formar un producto de cartón de celulosa resistente al fuego, dicho método caracterizado porque comprende:…*" (Ver Pág. 8 del Rad. N° 13-089758-00001-0000).

Comparación de las características técnicas **esenciales**, con las del Estado de la Técnica:

Características **esenciales**	D1	D2
Un método para formar un producto de cartón de celulosa resistente al fuego, dicho método caracterizado porque comprende:	Método para la formación de un panel con capacidad de resistencia al fuego basado en material celulósico (Págs. 8 y 9, reivindicaciones 9 a 11).	Método para la formación de un panel con capacidad de resistencia al fuego basado en paja de arroz como remplazo al material celulósico (Pág. 1, Párr. 12).
Formar una mezcla de fibra de celulosa que consiste principalmente de fibras de celulosas refinadas que tienen una solución ignífuga y un agente de unión distribuidos uniforme allí con respecto a las fibras de celulosa	Se tiene una solución acuosa de compuestos retardantes de llama que se aplican antes o después de la adición de agente de unión al material celulósico (Pág. 4, línea 12 a 26, Págs. 5 y 6, línea 19 y 2 respectivamente.	No se menciona

[2] Composite panel association. Technical bulletin. 2007. Págs. 1 a 27.
[3] http://www.google.es/patents/WO2002102926A1?cl=en
[4] http://www.freepatentsonline.com/y2002/0162298.html

La solución ignífuga comprende uno de un compuesto de boro, un borato, un hidrato inorgánico, un compuesto de bromo, hidróxido de aluminio, hidróxido de magnesio, hidromagnesita, trióxido de antimonio, una sal de fosfonio, fosfato de amonio, fosfato de diamonio, y combinaciones de los mismos;	La solución tiene borato y fosfato (Pág. 4, línea 12 a línea 26).	No se menciona
Exponer la mezcla de fibra de celulosa a un elemento de accionamiento, el elemento de accionamiento se configura para accionar el agente de unión y formar la mezcla de fibra de celulosa en un miembro de placa de fibra de celulosa	Las fibras se someten a una presión en caliente (Pág. 6, línea 2).	Se somete la mezcla seca a un curado por presión y calor para que se realice el entrecruzamiento (Pág. 3, Párr. 29).
Acoplar un miembro de hoja de celulosa con cada una de las superficies principales del miembro de placa de fibra de celulosa, de modo tal que cada miembro de hoja de celulosa cubre la respectiva superficie principal.	No se menciona	Se colocan láminas para cubrir el panel resultado de las etapas anteriores que pueden ser del mismo material u otro que es resistente al fuego (Pág. 3, Párr. 31, Pág. 4, Párr. 32).

Los documentos D1 y D2 se consideran el estado de la técnica más cercano a la invención definida en la reivindicación 1, porque divulgan métodos para la formación de tableros o paneles resistentes al fuego a partir de material celulósico.

La diferencia entre la invención, definida en la reivindicación 1 y el método del documento D1 consiste en que D1 no menciona el acoplamiento de hojas de celulosa sobre el panel formado inicialmente.

La diferencia entre la invención, definida en la reivindicación 1 y el método del documento D2 consiste en que D2 no menciona que se forma una mezcla de fibras de celulosa con una solución de agente ignífugo.

El efecto que logra el acoplar un miembro de hoja de celulosa con cada una de las superficies principales del miembro de placa de fibra de celulosa es que permite lograr una placa con un mejor terminado/presentación y mayor resistencia al fuego de forma más eficiente.

Por lo tanto, el problema técnico objetivo que pretende resolver esta invención se puede formular así “¿cómo modificar el método de D1 para que se lleve a cabo la obtención de una placa con un mejor terminado/presentación y mayor resistencia al fuego de forma más eficiente?”.

Sin embargo, el acoplamiento de hojas de celulosa a cada una de las superficies principales del miembro de placa de fibra de celulosa, ya está divulgado en el documento D2 que se refiere a un método para la formación de un panel con capacidad de resistencia al fuego basado en paja de arroz como remplazo al material celulósico, en donde se colocan láminas para cubrir el panel resultado de las etapas

anteriores que pueden ser del mismo material u otro que es resistente al fuego (Pág. 1, Párr. 12, Pág. 3, Párr. 31, Pág. 4, Párr. 32).

En consecuencia, una persona normalmente versada en la materia incluiría el acoplamiento de láminas sobre el panel previamente formado de D2 en procedimiento de formación de paneles de celulosa de la anterioridad D1, esperando con certeza lograr el método, como la de la reivindicación 1 de la solicitud, lo cual es considerado obvio y, por lo tanto, sin altura inventiva.

La reivindicación 2 consiste en "*Un método para formar un producto de cartón de celulosa resistente al fuego, dicho método caracterizado porque comprende:…*" (Ver Págs. 8 y 9 del Rad. N° 13-089758-00001-0000).

Comparación de las características técnicas **esenciales**, con las del Estado de la Técnica:

Características **esenciales**	**D1**	**D2**
Un método para formar un producto de cartón de celulosa resistente al fuego, dicho método caracterizado porque comprende:	Método para la formación de un panel con capacidad de resistencia al fuego basado en material celulósico (Págs. 8 y 9, reivindicaciones 9 a 11).	Método para la formación de un panel con capacidad de resistencia al fuego basado en paja de arroz como remplazo al material celulósico (Pág. 1, Párr. 12).
Formar una mezcla de fibra de celulosa sin yeso en donde la mezcla consiste en fibras de celulosas refinadas que tienen una solución ignífuga y un agente de unión distribuidos uniforme allí con respecto a las fibras de celulosa	Se tiene una solución acuosa de compuestos retardantes de llama que se aplican antes o después de la adición de agente de unión al material celulósico (Pág. 4, línea 12 a línea 26, Pág. 5, línea 19 a Pág. 6, línea 2).	No se menciona
La solución ignífuga comprende uno de un compuesto de boro, un borato, un hidrato inorgánico diferente a yeso, un compuesto de bromo, hidróxido de aluminio, hidróxido de magnesio, hidromagnesita, trióxido de antimonio, una sal de fosfonio, fosfato de amonio, fosfato de diamonio, y combinaciones de los mismos;	La solución tiene borato y fosfato (Pág. 4, línea 12 a línea 26).	No se menciona
Exponer la mezcla de fibra de celulosa a un elemento de accionamiento, el elemento de accionamiento se configura para accionar el agente de unión y formar la mezcla de fibra de celulosa en un miembro de placa de fibra de celulosa	Las fibras se someten a una presión en caliente (Pág. 6, línea 2).	Se somete la mezcla seca a un curado por presión y calor para que se realice el entrecruzamiento (Pág. 3, Párr. 29).
Acoplar un miembro de hoja de celulosa con cada una de las superficies principales del miembro de placa de fibra de celulosa, de modo tal que cada miembro de hoja de celulosa cubre la respectiva superficie principal.	No se menciona	Se colocan láminas para cubrir el panel resultado de las etapas anteriores que pueden ser del mismo material u otro que es resistente al fuego (Pág. 3, Párr. 31, Pág. 4, Párr. 32).

Los documentos D1 y D2 se consideran el estado de la técnica más cercano a la invención definida en la reivindicación 2, porque divulgan métodos para la formación de

tableros o paneles resistentes al fuego a partir de material celulósico.

La diferencia entre la invención, definida en la reivindicación 2 y el método del documento D1 consiste en que D1 no menciona el acoplamiento de hojas de celulosa sobre el panel formado inicialmente.

La diferencia entre la invención, definida en la reivindicación 2 y el método del documento D2 consiste en que D2 no menciona que se forma una mezcla de fibras de celulosa con una solución de agente ignífugo.

El efecto que logra el acoplar un miembro de hoja de celulosa con cada una de las superficies principales del miembro de placa de fibra de celulosa es que permite lograr una placa con un mejor terminado/presentación y mayor resistencia al fuego de forma más eficiente.

Por lo tanto, el problema técnico objetivo que pretende resolver esta invención se puede formular así "¿cómo modificar el método de D1 para que se lleve a cabo la obtención de una placa con un mejor terminado/presentación y mayor resistencia al fuego de forma más eficiente?".

Sin embargo, el acoplamiento de hojas de celulosa a cada una de las superficies principales del miembro de placa de fibra de celulosa, ya está divulgado en el documento D2 que se refiere a un método para la formación de un panel con capacidad de resistencia al fuego basado en paja de arroz como remplazo al material celulósico, en donde se colocan láminas para cubrir el panel resultado de las etapas anteriores que pueden ser del mismo material u otro que es resistente al fuego (Pág. 1, Párr. 12, Pág. 3, Párr. 31, Pág. 4, Párr. 32).

En consecuencia, una persona normalmente versada en la materia incluiría el acoplamiento de láminas sobre el panel previamente formado de D2 en procedimiento de formación de paneles de celulosa de la anterioridad D1, esperando con certeza lograr el método, como la de la reivindicación 2 de la solicitud, lo cual es considerado obvio y, por lo tanto, sin altura inventiva.

Asimismo, el documento D1 divulga las características de las reivindicaciones dependientes así:

Reivindicación 3: se trabajan las fibras en seco por lo que antes del accionamiento no se requiere un secado (Pág. 4, líneas 9 a 11).

Reivindicación 4: la solución ignifuga es líquida que no permite la generación de gases tóxicos en caso de fuego y en donde definir un pH de la solución ignifuga a aplicar depende de un estudio de optimización en busca de lograr una mejor impregnación, optimización que realiza el técnico que trabaje realizando paneles de celulosa (Pág. 1, línea 30, Pág. 2, línea 6, Pág. 4, líneas 20 a 29).

Reivindicación 5: la mezcla tiene una concentración de ignífero entre el 9 al 18% (Pág. 6, líneas 3 a 5).

Reivindicación 7: se adicionan otras sustancias para evitar que los insectos se puedan propagar en los tableros o paneles que se adicionan en cualquier etapa antes o después del curado (Pág. 3, líneas 11 a 21).

Asimismo, el documento D2 divulga las características de las reivindicaciones dependientes así:

Reivindicación 3: se tiene la mezcla seca antes del accionamiento con una forma predeterminada, en donde se pueden incluir fibras molidas de diverso origen (Pág. 1, Párr. 4, Pág. 1, Párr. 12).

Reivindicación 4: a las fibras se les adiciona agente de unión MDI entre un 2 al 10% o cera (Pág. 3, Párr. 27 MDI, Pág. 3, Párr. 28).

Reivindicación 5: la mezcla tiene del 2 al 20% de agente ignífero MDI y del 2 al 10% de agente de unión MDI (Pág. 3, Párr. 27, Pág. 4, reivindicación 9).

Reivindicación 7: se agregan en la mezcla otras sustancias para darles características deseadas (Pág. 3, Párr. 28).

Por otra parte la reivindicación 6 es afectada con el conocimiento del técnico, "*el experto medio deberá poseer experiencia y contar con un saber general en la materia y con una serie de conocimientos en el campo específico de la invención*"[5], el cual conoce que: sobre la superficie del tablero pueden ir láminas, en donde se tienen diferentes tipos de láminas resistentes al fuego como por ejemplo los MDF (tableros de media densidad), que pueden ser unidas por resina o adhesivos[6].

Puesto que las reivindicaciones dependientes 3 a 7 no mencionan características adicionales que hagan inventiva la solicitud, se considera que tales reivindicaciones tampoco tienen nivel inventivo.

La reivindicación 8 consiste en "*Un aparato para formar un producto de cartón de celulosa resistente al fuego, dicho aparato caracterizado porque comprende:…*" (Ver Págs. 11 y 12 del Rad. N° 13-089758-00001-0000).

Comparación de las características técnicas **esenciales**, con las del Estado de la Técnica:

Características **esenciales**	**D2**	**D3**
Un aparato para formar un producto de cartón de celulosa resistente al fuego, dicho aparato caracterizado porque comprende:	Equipos en serie que permiten la fabricación de paneles de material celulósico (Pág. 4, reivindicación 11, Pág. 3, Párr. 29).	No se menciona
Un dispositivo de mezclado	Se tiene un mezclador para realizar la mezcla entre el agente de unión, el material de paja de arroz y el agente de resistencia al fuego (Pág. 4, reivindicación11).	No se menciona
Un primer dispositivo de procesamiento que expone la mezcla al elemento de accionamiento	Se tiene una prensa que se calienta y realiza el curado (Pág. 3, Párr. 29).	No se menciona
El elemento de accionamiento		No se menciona
Un segundo dispositivo de procesamiento que une las hojas de celulosa sobre la superficie de la placa de fibra de celulosa	No se menciona	Se tiene una laminadora con rodillos para posicionar láminas sobre un sustrato (Pág. 21, Col. 2, Párr. 2 a Pág. 22, Col. 1, Párr. 1).

Los documentos D2 y D3 se consideran el estado de la técnica más cercano a la invención definida en la reivindicación 8, porque divulgan aparatos para la formación de tableros o paneles resistentes al fuego a partir de material celulósico.

[5] Proceso 43-IP-2002, publicado en la G.O.A.C. Nº 870, de 9 de diciembre de 2002, caso: formulaciones de péptidos hidrosolubles de liberación retardada.
[6] Composite panel association. Laminating composite panels. Technical bulletin. 2007. Págs. 1 a 27. Pág. 6, col. 2, Párr. 4, Pág. 7, col. 1, Párr 1. Pág. 8, col. 1, Párr. 4.

La diferencia entre la invención, definida en la reivindicación 8 y el aparato del documento D2 consiste en que D2 no menciona un segundo dispositivo para unir láminas u hojas de celulosa sobre la superficie de un panel formado de celulosa.

La diferencia entre la invención, definida en la reivindicación 8 y el aparato del documento D3 consiste en que D3 no menciona el dispositivo que forma el panel de celulosa.

El efecto que logra el incluir un dispositivo para unir láminas u hojas de celulosa sobre la superficie de un panel formado de celulosa es que permite producir paneles laminados de forma más eficiente.

Por lo tanto, el problema técnico objetivo que pretende resolver esta invención se puede formular así "¿cómo modificar el aparato de D2 para que se lleve a cabo la laminación de paneles de celulosa de forma más eficiente?".

Sin embargo, equipos para laminar continuamente paneles o sustratos con láminas u hojas de diversos materiales, ya está divulgado en el documento D3 que se refiere a equipos y estrategias para laminación de paneles (Pág. 21, Col. 2, Párr. 2 a Pág. 22, Col. 1, Párr. 1).

En consecuencia, una persona normalmente versada en la materia incluiría los equipos de laminación de D3 como dispositivo para laminar en el equipo de la anterioridad D2, esperando con certeza lograr el aparato, como la de la reivindicación 1 de la solicitud, lo cual es considerado obvio y, por lo tanto, sin altura inventiva.

La reivindicación independiente 9 presenta las mismas características estructurales del aparato de la reivindicación 8 ya que lo que hace la diferencia son características de un método las cuales no se toman en cuenta en el análisis de u producto, por lo tanto la reivindicación 9 se ve afectada por nivel inventivo con los documentos D2 y D3.

Asimismo, el documento D2 divulga las características de las reivindicaciones dependientes así:

> Reivindicación 10: se tiene un dispositivo de secado, un dispositivo para darle forma al tablero, un dispositivo de refinamiento o molienda (Pág. 2, Párr. 20, Pág. 3, Párr. 26 y Párr. 29).

Puesto que la reivindicación dependiente 10 no menciona características adicionales que hagan inventiva la solicitud, se considera que tal reivindicación tampoco tiene nivel inventivo.

Adicionalmente se indica que las reivindicaciones 11 a 14 fueron afectadas por el art. 30 al encontrarse mal caracterizadas porque hacen referencia a un aparato, pero presentan características técnicas de un método.

7. Conclusión

Los requisitos de Patentabilidad de la presente Solicitud están afectados así:

Item	Documento	Reivindicaciones afectadas	Requisito que afecta
D1	WO 02/102926	1 a 7	Nivel inventivo
D2	US 2002/0162298	1 a 10	Nivel inventivo
D3	Art 1	8 y 9	Nivel inventivo

En cumplimiento del artículo 45 de la Decisión 486 de la Comisión de la Comunidad Andina, se le indica que debe dar respuesta dentro del término de sesenta (60) días contados a partir del día siguiente de la fecha de notificación de la presente comunicación. En caso de no dar respuesta al presente requerimiento, o si a pesar de la respuesta subsistieran los impedimentos para la concesión, se denegará la patente.

Se invita al solicitante se sirva indicar, si así lo considera, su renuncia al término faltante de sesenta (60) días para dar respuesta a este requerimiento y presentarla por escrito.

Finalmente, se le recuerda al solicitante que si como respuesta a este requerimiento llegara a modificar el capítulo reivindicatorio y éste contenga más de diez (10) reivindicaciones, no pagará la tasa de modificación voluntaria pero sí la correspondiente al pago por reivindicación adicional.

Notifíquese el presente oficio conforme a lo dispuesto en el numeral 5.2, literal e), del capítulo quinto del título primero de la Circular Única No. 10 de 2001.

JOSÉ LUIS SALAZAR LÓPEZ
Director de Nuevas Creaciones (c)

El anterior requerimiento fue notificado por fijación en lista, de fecha 2014-04-08

Elaboró: Jorge Eduardo Cortazar Gomez
Revisó: Olga Ximena Benavides Salazar

COMPOSITE PANEL ASSOCIATION℠

Laminating Composite Panels

technical

BULLETIN

INTRODUCTION

Over the past several decades, industrial grade particleboard, medium density fiberboard (MDF) and hardboard have been recognized throughout the wood industry as ideal substrates for laminated panel constructions, utilizing various types of decorative overlay surfacing materials. This publication discusses the major types of decorative overlays in detail and provides recommendations to the laminator on suggested lamination strategies, along with technical and performance considerations.

Particleboard has been favored by laminators because of its uniform density, thickness tolerance and surface smoothness. Other board properties such as dimensional stability, strength, stiffness, flatness, screw holding strength and workability contribute significantly to the ease of fabrication and ultimate performance of the laminated end product. High-pressure laminates, thermally fused laminates and resin-saturated decorative papers, vinyl films, foils and wood veneers are the most common types of overlay materials applied to particleboard substrates.

MDF has become a premier substrate for wood veneers, vinyl films, light and intermediate basis weight decorative papers, resin-saturated decorative papers and foils. Of the many properties that make MDF desirable as a substrate for laminates and overlays, the most important are its face and edge qualities. As veneers and papers have diminished in thickness, substrate quality has become more important. MDF's smooth surface, superior edge-finishing qualities, dimensional stability, flatness, close tolerances, dent-resistance, lower glue usage requirements and absence of board grain telegraphing have contributed to its wide acceptance. Good bond strength, screw holding strength and resistance to compression and warp also make MDF an ideal substrate for lamination with various laminating materials.

The most common lamination processes apply overlay material to the substrate by cold or hot pressing with either flat (platen) or continuous (roll or double belt) laminating presses. Because each type of overlay material has unique properties and lamination requirements, the choice of laminating material introduces variables that affect the laminating process and influence the performance of the finished product.

TABLE OF CONTENTS

INTRODUCTION **1**

DEFINITIONS **4**

- **UNITS OF MEASURE** **4**
- **OVERLAY MATERIALS** **4**
  - DECORATIVE FOILS 4
  - HIGH-PRESSURE LAMINATES 5
  - LIGHT BASIS WEIGHT PAPERS 5
  - THERMALLY FUSED PAPERS 5
  - VINYL FILMS 6
  - WOOD VENEERS 6
- **SUBSTRATES** **6**
  - HARDBOARD 6
  - MEDIUM DENSITY FIBERBOARD (MDF) 7
  - PARTICLEBOARD 7
- **REFERENCES** **7**

LAMINATING OVERLAYS **7**

- **DECORATIVE FOILS & LIGHT BASIS WEIGHT PAPERS** **7**
  - INTRODUCTION 7
  - SUBSTRATE REQUIREMENTS 7
  - PROCESS PARAMETERS 8
  - ADHESIVES 8
  - TROUBLESHOOTING 8
    - Telegraphing or Irregular Surface 8
    - Poor Adhesion or Delamination 8
- **HIGH-PRESSURE LAMINATES** **8**
  - INTRODUCTION 8
    - Types of High-Pressure Laminates 9
    - Properties of High-Pressure Laminates 10
  - SUBSTRATE REQUIREMENTS 11
  - PROCESS PARAMETERS 11
    - Conditioning Materials 11
    - Lamination 11
  - ADHESIVES 12
    - Thermosetting Adhesives 12
    - Thermoplastic Adhesives 13
    - Contact Adhesives 13
  - TROUBLESHOOTING 13
    - Warp 13
    - Delamination 14
- **THERMALLY FUSED PAPERS** **15**
  - INTRODUCTION 15
    - Production of the Thermally Fused Decorative Papers 15
    - Laminated Panel 16
  - SUBSTRATE REQUIREMENTS 16
  - PROCESS PARAMETERS 16
    - Laminating Press 16
    - Conditioning Materials 17
    - Substrate 17
    - Pressing Parameters 17

ADHESIVES 17
TROUBLESHOOTING 18
Warp 18
Mottling 18
Precure 19
Starvation 19
VENEERS 19
INTRODUCTION 19
SUBSTRATE REQUIREMENTS 20
PROCESS PARAMETERS 20
Conditioning Materials 20
Hot Pressing 20
Cold Pressing 20
ADHESIVES 21
TROUBLESHOOTING 21
Warp 21
Delamination 21
VINYL LAMINATION 21
INTRODUCTION 21
Cold Laminating System 21
Hot Laminating System 22
SUBSTRATE REQUIREMENTS 22
PROCESS PARAMETERS 22
Conditioning Materials 22
Pressing Parameters 22
ADHESIVES 22
Cold Laminating 22
Hot Laminating 22
VINYL - THERMOFORMING 23
INTRODUCTION 23
Vacuum Forming 23
Membrane Pressing 23
SUBSTRATE REQUIREMENTS 23
PROCESS PARAMETERS 23
Vacuum Forming 23
Membrane Pressing 23
ADHESIVES 24
Vacuum Forming 24
Membrane Pressing 24
TROUBLESHOOTING 24
Membrane Pressing 24

APPENDIX I - GLOSSARY OF TERMS 25

DEFINITIONS

Units of Measure

Imperial units of measure have been used throughout this document, with the equivalent value in metric units of measure given in parentheses. One exception is the value for the weight per unit area of decorative and other types of papers used in the laminating industry, which is expressed in metric units of measure.

The imperial unit used by the decorative paper industry in the beginnings of the high-pressure industry was BASIS WEIGHT expressed in pounds per ream of décor paper, or *lbs/3000 square feet*. The equivalent metric unit is GRAMMAGE, expressed in grams per square meter or *gsm*. Due to globalization in the décor and specialty paper industry, as well as the spread in the use of metric units in North America, the use of the metric unit of measure has significantly increased in the laminating industry over the last decade or two. The metric unit of measure is also easier to visualize and was thus chosen as the preferred unit to define the weight of décor paper per unit area, in this document.

Conversion of a GRAMMAGE value to a BASIS WEIGHT value can be accomplished by multiplying the GRAMMAGE value by 0.6154. Conversely, a GRAMMAGE value can be obtained by multiplying a BASIS WEIGHT value by 1.6248.

Overlay Materials

Decorative Foils

Decorative foils are alpha-cellulose papers with grammages ranging between 40 and 200 grams/ m^2. These overlays are also referred to as impregnated papers. Because of substrate surface advancements, the use and performance of decorative foils has increased. Common applications of decorative foils include cabinets, store fixtures, closet systems, ready-to-assemble (RTA) and home office furniture, profile wrappings and point-of-purchase (POP) displays.

Decorative foils are impregnated with a blend of resins; the type of resin used is dependent on the final application of the laminated panels. The impregnation will add between 20% and 50% to the weight of the decorative paper, depending on the type and process of impregnation. Foils are classified as unimpregnated, pre-impregnated or post-impregnated:

UNIMPREGNATED FOILS – no resin is added during paper manufacturing.

PRE-IMPREGNATED FOILS – these papers are impregnated during the paper-making process with a resin system such as melamine and/or acrylic. This impregnation normally takes place on the paper machine; however, some or all of the resins can be added to the cellulose before calendering.

POST-IMPREGNATED FOILS – are impregnated with resin after the paper-making process is completed. The impregnation is accomplished with a blend of melamine and acrylic resins. Due to the high percentage of resins in the paper, acrylic is normally necessary to retain flexibility after curing.

Quantity, method and type of impregnation, along with the type of adhesive system and substrate used, will have a direct effect on the internal bond strength and surface porosity of the finished product. These qualities will be demonstrated in cutting and machining performance. Laminated foils have good fidelity of print or solid color, and provide a finished panel with good resistance to stain, chemicals, abrasion, and impact. In most cases, foils can be used for single-side laminated panels to provide a more cost-effective construction.

The resins in pre-impregnated and post-impregnated decorative foils are fully cured in the foil manufacturing process and do not have residual bonding properties. Therefore, impregnated as well as unimpregnated decorative foils require an adhesive system for bonding to the substrate. Depending on the laminating equipment to be used, foils may be supplied by the overlay manufacturer with a pre-applied hot melt adhesive. Additionally, a variety of in-line laminating adhesives may be used. The most common of these adhesives is polyvinyl acetate (PVA). Other systems such as urea formaldehyde, acrylic based- or hot melt adhesives can be applied in-line. The type of adhesive system used and its method of application can affect the performance of the finished panel.

Impregnated papers do not require a topcoat to be considered a foil, however, depending on the application, a finished topcoat will normally be added. The finish is the reason the product is referred to as a "Finished Foil" in Europe. This nomenclature is rarely used in North America.

High-Pressure Laminates

High-pressure laminates (HPL) are also known as plastic laminates. In its LD 3-2005 standard publication, entitled "High-Pressure Decorative Laminates" the National Electrical Manufacturers Association (NEMA) defines a high-pressure laminate as a sheet "*which consists of papers, fabrics, or other core materials that have been laminated at pressures of more than 5.0 MPa*[1] *using thermosetting condensation resins as binders.*" The most common resins used are phenol-formaldehyde and melamine-formaldehyde thermoset resins.

The great majority of high-pressure laminates used as overlays on wood substrates are produced by stacking an optional alpha-cellulose sheet and a decorative paper sheet, both impregnated with melamine resin, over multiple Kraft paper sheets impregnated with phenolic resin, and fusing the sheets together in a press, at temperatures exceeding 265°F (130°C) and pressures as high as 1,200 psi (8274 MPa). The optional alpha-cellulose sheet, popular in laminate flooring products, becomes transparent during the pressing process; it is used mainly with print patterns to add additional wear resistance to the surface. The final thickness of the laminate is determined by the number of layers of Kraft paper, the amount of resin absorbed by the paper and the pressure used in the press. The surface finish (i.e., texture and gloss level) is imparted to the surface of the laminate while the laminate is being pressed, by a textured steel caul plate or an embossed release paper sheet. HP laminates are available in a multitude of solid colors, printed patterns and textures, in sheets of different dimensions. HP laminate is a thin, stiff, strong, hard and abrasion-resistant material that has excellent aesthetic appeal and durability. It is overlaid on particleboard or MDF substrates for both vertical and horizontal end use applications, such as tabletops, countertops, sink tops, furniture, cabinetry and case goods.

Light Basis Weight Papers

Light basis weight papers range in grammage from 23 to 50 grams/m^2. Resin may be added during the paper making process to improve the internal bond strength of the paper. Acrylic, polyester and other resins are most commonly used. The paper is then printed and generally coated with a polyurethane, urea, polyester, acrylic or melamine resin, or a combination thereof, for increased durability and performance. These very thin papers can be printed with excellent quality, high fidelity wood grain patterns. Light basis weight papers have long been popular with higher levels of value engineering and are widely used in cabinets, store fixtures, shelving, closet systems, ready-to-assemble (RTA) and home furniture.

Light basis weight papers are usually divided into two categories, depending on the amount of resin present in the base paper. Light basis weight papers containing a lower amount of resin offer an economical laminate for use on low wear surfaces, such as wall paneling. Papers having a higher resin content are characterized by a greater internal bond strength.

Light basis weight papers may be supplied pre-coated with hot melt adhesive ready for hot roll laminating, or uncoated, requiring application of an adhesive during lamination to the board substrate. Light basis weight papers are normally supplied with a topcoat to provide surface durability; however, they may also be supplied without this topcoat and "finished" after lamination.

Thermally Fused Papers

The papers in this overlay category are referred to by many names, including saturated papers, low pressure papers, direct pressure or simply melamine overlays, and are used in low-pressure/ thermofusing lamination. Sub-categories include polyesters and decorative phenolics. These decorative papers generally have grammages between 60 and 130 grams/m^2, and their paper formation is similar to the formation of the decorative sheets used for HPL. They are saturated with reactive resins, which are then partially cured by the manufacturer, to aid in storage and handling of the paper. Full curing is achieved in the laminating hot press, when the resins form hard, permanent, thermoset bonds between the paper and the substrate.

Thermally fused papers are self-bonding, i.e., the resin in the paper flows into the board during lamination to create a permanent bond between the decorative surface and the board substrate. Thus, no additional adhesive system is necessary. The three most common thermoset resin systems used in the production of saturated papers for low-pressure/thermofusing lamination are melamine-formaldehyde, polyester and decorative phenolic resins. When double-stage impregnation equipment is available, saturating urea-formaldehyde resin may be used to extend the melamine resin in the core of the saturated sheet.

Common end-use applications of thermally fused papers include laminate flooring, kitchen cabinets and countertops, shelving, store fixtures and home office furniture.

[1] 725 lb/in^2

Vinyl Films

Vinyl films are made from polyvinyl chloride and can be used in a multitude of applications. They come in a variety of thicknesses, from 0.002 to 0.045 inches (0.051 to 0.11 mm), and different grades of flexibility. These types of overlays are typically extruded or calendered and are divided into six categories:

2 Mil (0.051mm) Reverse-Printed Rigid Film – The print design and base coat are printed on the back of a transparent film, in reverse order (i.e. the print is applied first followed by the base coat). These films are used for wall paneling (mostly in recreational vehicles), kitchen cabinets, furniture and manufactured housing.

Semi-Rigid Clear Film – These films are reverse-printed. They are frequently embossed and can be coated with scuff resistant coatings. They range from 4 to 8 mils (0.10 to 0.20 mm) in thickness. Some can be miter-folded.

Sandwich Film – These are semi-rigid, two-ply overlays. The opaque base film is top-printed and a clear overlay is laminated on top of the printed film. These films are designed for miter-folding and flat sheet lamination, and range from 5.5 to 8 mils (0.14 to 0.20 mm) in thickness. Some are available with scuff-resistant top coating.

Solid Color Film – These are semi-rigid films. The film is integrally colored and can be top-printed and/or embossed. Top-printed films are used extensively in manufactured housing, recreational vehicles, commercial paneling and movable walls. Plain solids are used in furniture, kitchen cabinets, fixtures and displays, and in office furniture applications. They range in thickness from 3.5 to 8.0 mils (0.089 to 0.20 mm). Some films are available with scuff-resistant top coatings.

Thermoformed Overlay Film – These films have a single-ply or two-ply construction. Gauges range from 0.010 to 0.030 inches (0.25 to 0.76 mm), and the films may be printed with a wood grain or decorative pattern. They may also be embossed and/or coated with scuff and stain-resistant coatings. Primers to promote adhesion are available. These films are designed for thermoforming with heat and pressure in a membrane press or vacuum forming process. Decorative effects can be achieved with two-ply films when a router is used to expose a different color in the bottom ply of the film. The films may also be flat laminated or miter-folded. Raised panel cabinet doors and free-formed furniture components are the most popular applications for this type of film.

Wrapping Films – These are rigid vinyl films in gauges ranging from 0.005 to 0.010 inches (0.13 to 0.25 mm). The films may be printed with a wood grain or decorative pattern, may be embossed and/or may be coated with scratch- and stain-resistant coatings. These films are designed for wrapping profiles, like picture frames and furniture molding, and also can be flat laminated and miter-folded.

Wood Veneers

The veneers used in the lamination industry include real wood veneers that are rotary cut, flat cut, rift cut or quarter cut from a variety of wood species, both domestic and imported. The veneers are sliced or peeled to a thickness between 1/25 to 1/50 inch (1.0 to 0.50 mm) and are available with a paper or fleece backing, providing varying degrees of flexibility. The backers also provide stability and strength to the veneer and minimize splintering, cracking and checking.

Veneers can be overlaid either with heat-activated resins or by cold pressing. The main resin used in hot-pressing systems is a urea-based adhesive, due to its ability to make the panel more rigid, its faster processing parameters and lower cost base. Cold press systems typically use polyvinyl acetate, casein and contact adhesives. These systems are used for smaller production quantities and may be less rigid than heat-activated adhesive systems.

Veneered composite panel constructions are used in many applications, including high quality furniture, case goods, store fixtures and cabinetry. Some veneers are used for profile wrapping, typically over MDF, for high-end millwork applications.

Substrates

Hardboard

Hardboard is a composite panel manufactured primarily from inter-felted ligno-cellulosic fibers consolidated under heat and pressure. Other materials may be added during the manufacturing process to improve certain properties, such as resistance to abrasion and moisture, and increased strength and durability. Hardboard has a uniform thickness, density and appearance, and has no grain. It resists marring, scuffing and abrasion. It can be laminated with paper overlays, plastic laminates and veneers.

Medium Density Fiberboard (MDF)

MDF is a composite panel product typically consisting of cellulosic fibers combined with a synthetic resin or other suitable bonding system and joined together under heat and pressure. Additives may be introduced during manufacturing to impart additional characteristics. The surface of MDF is flat, smooth, uniform, and dense, and has a homogeneous edge profile, free of knots and grain patterns.

Particleboard

Particleboard is a composite panel product consisting of cellulosic particles of various sizes that are bonded together with a synthetic resin or binder, under heat and pressure. Particle geometry, resin levels, board density and manufacturing processes may be modified to produce products suitable for specific end uses. At the time of manufacture, additives can be incorporated to provide greater dimensional stability, better fire and moisture resistance or to impart additional characteristics.

References

- NEMA LD 3-2005, "High-Pressure Decorative Laminates", NEMA Standard Publication, National Electrical Manufacturers Association, Copyright 2005.
- "Particleboard from Start to Finish", Composite Panel Association, Copyright 1996.
- "Glossary of Terms", Laminating Materials Association, Copyright 1991.
- "2005 Buyers & Specifiers Guide to Particleboard and MDF", Composite Panel Association, Copyright 2005.

LAMINATING OVERLAYS

Decorative Foils & Light Basis Weight Papers

Introduction

Decorative foils and light basis weight papers are decorative overlays that are either roll laminated or pressed in "quick stamping" platen presses. Foils are thicker and have a higher basis weight than light basis weight papers. Decorative foils are available in printed patterns or in solid colors. Foils are classified as unimpregnated, pre-impregnated or post-impregnated:

- Unimpregnated foils do not contain resin, i.e., no resin is added during the paper manufacturing process.
- Pre-impregnated foils are impregnated during the paper-making process with a resin system such as melamine and/or acrylic. This impregnation normally takes place on the paper machine; however, some or all of the resins can be added to the cellulose before calendering. The calendering process provides a good printable surface that takes topcoating easily. The product can be embossed either chemically or mechanically. The foil will remain flexible, even after the resins are fully cured.
- Post-impregnated foils are impregnated with resin after the paper-making process is completed. The impregnation is accomplished with a blend of melamine and acrylic resins. Due to the high percentage of resins added, acrylic is normally added to retain the flexibility of the foil after the resins are cured. The resin mixture encapsulates the paper fibers and fills voids in the base paper. The papers may be printed and topcoated. Chemical and mechanical embossing is also possible.

The resins in pre-impregnated and post-impregnated decorative foils are fully cured in the foil manufacturing process and do not have residual bonding properties. Therefore, these foils require an adhesive system for bonding to the substrate. The adhesive can be pre-applied to the foil as hot melt or a wet application can be performed in-line, when laminating the foil to the substrate. A number of vendors supply press equipment and there are several methods of bonding the foil to the substrate, either in a one-side or a two-side application.

Substrate Requirements

Industrial grade MDF and particleboard are good substrates for decorative foils and light basis weight papers because they have uniform and smooth sanded surfaces. As the basis weight of the paper is diminished, the quality of the substrate surface becomes more important. The best substrate surfaces are achieved through the use of finer grit belts and cross belt sanders.

Substrate surfaces need to be clean and the boards need to be flat. Thickness control is critical within the board and between boards, especially on roll laminating lines. Both MDF and particleboard have shown that they process very well, due to precise thickness control. Surface strength, surface porosity, and surface wettability are also important

factors in running the lines smoothly, achieving excellent paper adhesion and displaying superior aesthetics.

Process Parameters

Since so many different approaches are used, it is hard to give specific parameter recommendations. Uniform application of adhesives and catalysts, if used, are critical. These materials may be applied to the panel, to the paper, or both, depending on the equipment. Successful lamination also is dependent on the paper uniformity and its bonding properties.

The surface temperature of the materials (substrate, adhesive, catalyst and paper) can affect the cure speed and the penetration of the bonding ingredients. Control of the substrate temperature lies with the laminator, through the use of warehouse HVAC systems or processing line configuration. Time between glue application or activation and application of pressure for lamination, as well as adhesive application rates, must be carefully controlled. Adequate and uniform press or nip pressure is essential for good lamination.

Adhesives

Various adhesive systems are used with decorative foils and light basis weight papers. The most common are polyvinyl acetate (PVA), urea formaldehyde and acrylic-based systems. Hot melt adhesives are used also, either pre-applied or applied in-line. The choice of adhesive system can affect the performance of the finished panel.

When applying waterborne adhesives such as PVAs, EVAs (ethylene/vinyl acetate) and urea-formaldehydes to the substrate surface, rapid flashing-off of the water is essential to prevent fiber swell. The adhesive supplier's recommendations should be closely followed to achieve adequate curing of the adhesive and obtain good paper adhesion. The type of adhesive selected is dependent upon factors such as the type of overlay, the substrate and the laminating equipment used. The equipment manufacturer or adhesive manufacturer should be contacted in selecting the correct adhesive for a particular application. The above comments also apply to catalysts.

Troubleshooting

Telegraphing or Irregular Surface

Telegraphing and/or irregular surface on the laminated panel surface may be due to:

- Improper functioning of the substrate cleaning equipment, i.e., cleaning brushes at the feed end of the line.
- Contamination in the adhesive or catalyst systems.
- Improper substrate storing conditions. Extended or improper storage of the substrate can lead to fiber pop or grain raise, especially on the top and bottom boards in a unit; controlling the inventory cycle is important.
- Surface defects present on the substrate prior to lamination. This can be determined by applying crayon to the surface of a board sample from the same unit as the defective panel or by using a flashlight to view its surface at a low angle.
- Prolonged time between glue application, and application of the laminating roll or plate. This may cause fiber pop on the line, due to extended contact between the catalyst and/or adhesive and the substrate surface, prior to lamination.

Poor Adhesion or Delamination

Adhesion problems may be due to:

- Application of incorrect levels of catalyst and/or adhesive.
- Insufficient wetting of the substrate and/or paper surfaces by the catalyst and/or adhesive.
- Incorrect equipment settings such as temperature, pressure, or press roll or line speeds.
- Improper curing of the adhesive system.
- Incorrect substrate target thickness or inadequate thickness tolerance.
- Incorrect surface temperatures of the mating materials (substrate, resin, paper, catalyst).

High-Pressure Laminates

Introduction

High-pressure laminates (HPL) are produced by fusing together under heat and pressure, multiple layers of Kraft paper saturated with phenolic resin, a layer of decorative paper saturated with melamine resin and, optionally, a very thin top sheet of alpha-cellulose paper heavily saturated with melamine resin. The resulting laminate is a thin, stiff, strong, hard and abrasion-resistant sheet with excellent aesthetic

appeal and durability. High-pressure laminates are most often manufactured using a multi-opening press, with several laminates being pressed simultaneously in each press opening. A relatively new development in HPL technology is the continuous press, which uses rolls of resin-saturated papers instead of sheets, to produce laminates in a continuous fashion; only thin laminates can be produced with this process. The laminates are rolled or cut to the desired length as they exit the continuous press. The thinner continuous HP laminates can be applied to the substrate using a roll press.

High-pressure laminates are available in a wide range of solid colors, wood grain prints, patterns, textures and finishes. They are overlaid on particleboard or MDF substrates for both vertical and horizontal end use applications such as tabletops, countertops, sink tops, furniture, cabinetry, and case goods. The type and properties of the high-pressure laminate selected will depend on the desired performance of the end product.

In addition to the aesthetic attributes, the lamination of particleboard or MDF with HP laminates can improve the physical performance of the substrate. The bending strength and stiffness of particleboard or MDF can increase significantly with the addition of HP overlays on each side. For example, standard ¾-inch industrial grade particleboard (ANSI A208.1, M-2) has a Modulus of Elasticity (MOE, bending stiffness) of about 326,300 psi and a Modulus of Rupture (MOR, breaking strength) of about 2,100 psi. After laminating with a 0.062–inch HPL face and a 0.030–inch backer, strength in the forming direction increases as reflected by an MOE of 850,000 psi and an MOR of 6,500 psi for the laminated panel. In an application-oriented example, a shelf of ¾–inch industrial (M-2) particleboard that is 24 inches long will carry 45 lbs per square foot of uniform loading with a 0.133–inch deflection. If laminated as described in the preceding example, it can carry 85 lbs per square foot before reaching the same deflection.

Types of High-Pressure Laminates

Different types of high-pressure laminate materials designed to meet specific requirements are available from suppliers, in various sheet sizes and thicknesses. Based on their use, they are broadly identified as general purpose, postforming and backer laminates. Special purpose laminates are also produced that possess very specific properties for particular applications.

General Purpose - General Purpose laminates are the most widely used, because they are suitable for almost any horizontal or vertical surface applications. Typical thickness ranges from 0.028 to 0.048 inch (0.71 to 1.22 mm).

Postforming - Postforming laminates are laminates that can be formed around curved edges by application of heat and restraint, followed by cooling. Their maximum thickness is about 0.038 inch (0.97 mm); these laminates can normally be formed or soft roll-formed to radii as small as 3/8 inch (9.5 mm) or less. Typical uses are cupboard door edges and counter bullnoses and cove bends.

Backer - Backer laminates are laminates produced without a decorative face that are used on the back of panel assemblies to protect the substrate from changes in humidity and to balance the panel construction. There are two major types of HP backers: standard and regrinds. Non-HP backers are also being produced by several manufacturers.

Standard Phenolic Backers

These are the most common type of backers used and they are manufactured specifically for this purpose. They are usually slightly thinner than decorative HPL sheets and do not have a melamine top sheet, so their physical properties are slightly different than those of decorative HP laminates.

Regrinds

These are produced from decorative HP laminates that have been rejected due to some surface flaw or defect. The rejected decorative laminates are made into backers by sanding off their decorative face. This is the best type of backer for HP laminates, because it has essentially the same thickness and properties as the decorative laminate. It therefore provides the best balanced panel construction.

Non-HP Backers

These backers are paper products manufactured through a process other than high-pressure lamination. They are used as substitutes for standard HP backers, in an effort to reduce laminated panel production costs. As a group, they have different properties than HP laminates and may not provide balanced panel construction.

Other Types of High-Pressure Laminates - Special purpose high-pressure laminates include cabinet liners, high-wear, fire-rated, electrostatic dissipative and chemical resistant laminates; they are purchased by fabricators to meet specific end product requirements.

Properties of High-Pressure Laminates

Physical Properties

In addition to aesthetic attributes, the lamination of particleboard or MDF with HPL can improve the physical performance of the substrate. High-pressure laminates are considerably stronger and stiffer per unit thickness than particleboard or MDF. For example, the tensile strength of HPL is anywhere from 10 to 35 times greater than that of particleboard. This means that HP laminates have enough strength to affect the particleboard or MDF substrate when they expand and contract in response to changes in ambient humidity conditions.

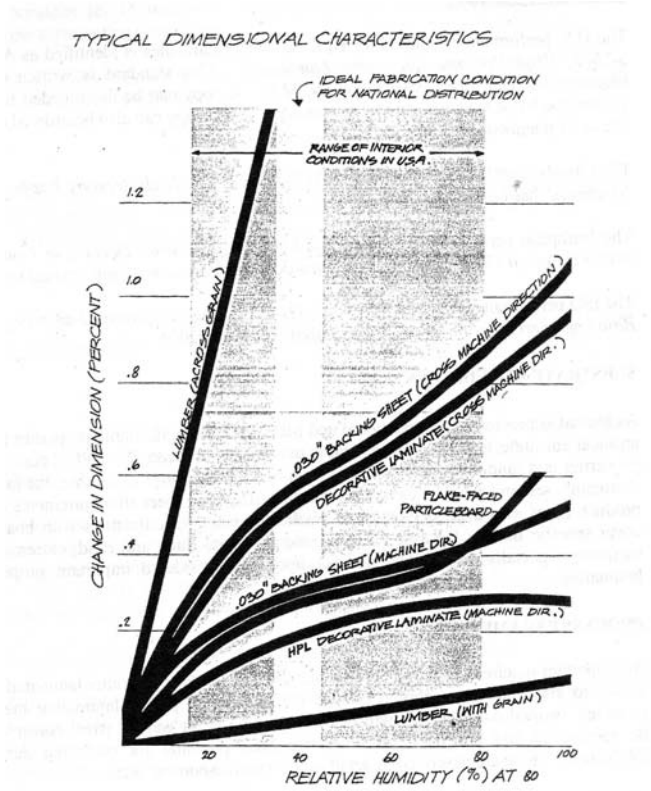
Particleboard and MDF panels are isotropic materials. Their physical properties are independent of direction, as shown by the fact that, for example, the modulus of rupture will be the same, whether the sample used in the measurement was cut parallel to the width of the board or parallel to its length. On the other hand, HP laminates are anisotropic or unidirectional materials, i.e., they have different characteristics in different directions. This is due the fact that the anisotropic properties of the paper sheets used in the manufacturing of HP laminates are retained in the laminate. Anisotropic properties are typical of paper products. They are usually much stiffer, stronger, and more dimensionally stable in the machine direction (parallel to the paper-forming direction). This carries over to the physical properties of HP laminates. HPL machine direction is generally parallel to the sander markings on the back of the sheet, although there are exceptions. The best way to determine machine direction is to flex the laminate: the direction parallel to the machine direction is always stiffer. Identification of the machine direction of the laminate is important for the production of laminated panel constructions with optimal performance.

Dimensional Stability

High-pressure laminates do not respond to changes in moisture content in the same manner as particleboard and MDF. Linear expansion and contraction in the machine direction is less than particleboard or MDF and approximately twice as much as particleboard in the cross-machine direction (perpendicular to the machine direction).

Standard HPL backer sheets often show even greater differences in dimensional stability than decorative HPL sheets, with movement in the cross-machine direction up to four or five times as much as in the machine direction. Standard backer sheets also may pick up and lose moisture more rapidly than the thicker decorative HPL sheets.

The properties of HPL will vary from one manufacturer to another. Thus, laminates from different manufacturers should not be mixed on the same panel construction, unless they are known to have the same behavior pattern.



Performance Standards

The U.S. performance standard for HPL decorative laminates is identified as ANSI/NEMA LD 3-2005, "*High-Pressure Decorative Laminates.*" This standard is written by the National Electrical Manufacturers Association (NEMA). A copy can be downloaded free of charge by visiting the NEMA website at www.nema.org. A hard copy can also be ordered on the same web site or by telephone at 1-800-854-7179.

The Canadian performance standard, CAN3-A172-79M, *"High-Pressure Paper Base Decorative Laminates"* has been withdrawn.

The European performance standard EN 438, *"High-Pressure Decorative Laminates (HPL) – Sheets Based on Thermosetting Resins (usually called laminates)"* was revised in July 2005.

The ISO performance standard, ISO 4586, *"High-Pressure Decorative Laminates (HPL) – Sheets Based on Thermosetting Resins"* was revised in October 2004.

Substrate Requirements

As indicated previously, particleboard and MDF have many desirable properties that make them an ideal substrate for panel constructions overlaid with decorative HPL faces. Because board properties and sanding quality can vary from one manufacturer to another, the fabricator should thoroughly test and evaluate candidates until satisfied they meet all requirements for the finished product. It is also a good practice to establish written specifications with board suppliers to cover specific needs. Because HPL is generally quite thick and rigid, extremely fine-sanded surfaces, especially with MDF, are not normally considered important properties by HPL laminators.

Process Parameters

An important requirement for tabletops, countertops, sink tops and other laminated panels is their ability to stay flat under normal service conditions. If proper laminating methods are not observed, warped constructions will result. The causes for warped panel constructions need to be recognized and understood to minimize their potential for occurring during and after fabrication. These are described in detail in the Troubleshooting section.

Conditioning Materials

It is essential to bring the HP laminate sheets (face and backer sheets) and the intended substrate (particleboard or MDF panels) to equilibrium at the same relative humidity and temperature before lamination. A conditioning period of at least one week, but preferably two weeks, between 35% and 45% relative humidity and at a temperature around 70F (21C) is recommended. The longer period is preferred because both the substrate and the HP laminate require at least seven days to reach equilibrium.

If laminated panels are fabricated from component materials conditioned at radically different temperatures or humidity levels, warp will surely occur when all of the materials come to equilibrium with the surrounding atmosphere.

Additional information about conditioning is available in CPA's technical bulletin[2], "*Storage and Handling of Particleboard and MDF.*"

Lamination

Regardless of the laminating process employed, the adhesive manufacturer's recommendations for storage, method of application, and use of the adhesive should be closely followed. The main areas of concern for producing quality HP laminated panel constructions are:

Substrate

Substrate surfaces should be clean and free of any loose particles or contaminants that could interfere with adhesive application or affect appearance of the finished laminate by telegraphing.

Glue Spread

Adhesive should be spread to a uniform thickness over the entire substrate surface. Globs, ridges, lines, and starved areas that could telegraph through the HPL face or cause poor or spotty bonds should be avoided.

Care should be taken not to use any more adhesive than required to achieve good transfer between mating materials. Excessive glue usage adds more moisture to the board surface that could promote surface roughening and affect the appearance of the finished laminates. Costs are also increased. Glue spreads should be verified often with a film thickness gauge or in accordance with the formulas given below, to ensure adequate glue spread.

Formulas for Determining Glue Spread or Glue Requirement (Single Glue-Line)

The following formulas may be used to determine glue spread, **G, in pounds of glue per 1000 square feet** of laminating surface area, **for a single glue line.**

When weighing in **grams**:

$$\text{Glue Spread} = \frac{(W_g - W_s)}{453.6 \text{ g/lb}} \times 1000 \text{ sq. ft.}$$

where:

W_s is the weight of 1 square foot of substrate, in grams;

W_g is the weight of 1 square foot of substrate with glue applied, in grams.

When weighing in **ounces**:

$$\text{Glue Spread} = \frac{(W_g - W_s)}{16 \text{ oz/lb}} \times 1000 \text{ sq. ft.}$$

where:

W_s is the weight of 1 square foot of substrate, in ounces;

W_g is the weight of 1 square foot of substrate with glue applied, in ounces.

[2] "Storage and handling of Particleboard and MDF", Composite Panel Association, Copyright 2000.

The following formulas may be used to determine the weight of glue required per square foot of laminating surface area to obtain a desired glue spread.

Grams of glue required/sq. ft. **=** $\frac{G \times 453.6g/lb}{1000 \text{ sq. ft.}}$

where:

G is the glue spread in pounds per 1000 square feet.

Ounces of glue required/sq. ft. **=** $\frac{G \times 16oz/lb}{1000 \text{ sq. ft.}}$

where:

G is the glue spread in pounds per 1000 square feet.

Contamination

Possible sources of contamination of the adhesive and surfaces to be glued should be eliminated. Basic housecleaning practices can practically eliminate the possibility of foreign matter being trapped in the laminate layup. Adhesive coating equipment, caul plates and press or nip rolls should be kept clean.

Pressure

Adequate pressure is mandatory to ensure good transfer of adhesive to uncoated surfaces and to hold components in close contact while the adhesive sets. Most adhesives contract as they set and have limited ability to bridge voids or gaps, so mating surfaces must be forced together tightly to obtain uniform bonds.

Liquid adhesives should be pressed between 20 and 50 psi (138 and 345 kPa) or until a small bead of adhesive has squeezed out around the panel edges. With contact adhesives, nip roll pressures of 50 to 75 psi (345 to 517 kPa) for steel or 50 to 80 durometer rubber rolls are recommended. Laminating pressure can be calculated using the formula shown below.

Formula for Calculating Laminating Pressure

$$\mathbf{SP = \frac{R \times N \times P}{A}}$$

where:

SP is the panel surface pressure, in psi;
R is the ram area cross section, in square inches; $R = 0.785xD^2$ where D = diameter of the ram in inches;
N is the number of rams;
P is the gauge pressure, in psi;
A is the total panel area, in square inches.

Temperature and Moisture Content

When cold gluing, the temperature of the materials should be maintained at 70°F (21°C), until the adhesive is set. Moisture content will not be a factor if the materials have been conditioned before laminating, as recommended.

Layup

When stack gluing, panels should be laid up face-to-face and back-to-back, for smoother finished surfaces.

Adhesives

A variety of adhesives has been found satisfactory for bonding HPL to particleboard and MDF substrates. The type of adhesive selected will depend upon the desired end product and the fabricator's capabilities. The most commonly used adhesive categories are thermosetting, thermoplastic and contact adhesives. Their properties are described below.

Thermosetting Adhesives

These adhesives cure at room temperature or in a hot press by chemical reaction, to form a network of rigid bonds (crosslinks) that are not re-softened by subsequent exposure to heat. The most commonly used are:

- Urea-Formaldehyde Adhesives: these are good for most applications and provide a poor to fair resistance to moisture.
- Resorcinol and Phenol-Resorcinol Adhesives: these are used where waterproof bonds and good heat resistance are required.
- Casein Adhesives: these are used in applications where moisture resistance is not critical.
- Epoxy Adhesives: these are good for bonding to impervious substrates such as metal, but also perform well on almost all substrates. Epoxies have good gap-filling properties.

Thermoplastic Adhesives

These adhesives harden at room temperature through loss of water or solvent and re-soften upon subsequent exposure to heat. The most commonly used are:

- Polyvinyl Acetate Adhesives (White Glue): these are good for bonding HPL to wood substrates, but have poor moisture and heat resistance; they are not recommended for sink tops.
- Catalyzed Polyvinyl Acetate Adhesives: these are good for most applications; they yield moisture-resistant or waterproof bonds, depending upon the formulation used.

Contact Adhesives

Contact adhesives can be water- or solvent-based and are suitable for bonding HPL to most substrates. They must be applied to both mating surfaces and dried before bonding. Laminating can be accomplished at room temperature. High-strength, water-resistant bonds are developed almost immediately upon contact between both coated surfaces. The glue line remains flexible, allowing the HP laminate to expand and contract independently of the substrate, which minimizes the tendency of the finished panel to warp (particularly for one-sided constructions).

Troubleshooting

Warp

The causes for warped panel constructions need to be recognized and understood to minimize their potential for occurring during and after fabrication. These are described in detail below.

Unbalanced Two-Sided Construction

The basic cause of warp is an unbalanced panel construction, i.e. the individual components of a laminated panel do not respond equally to changes in moisture content. When one considers that decorative HPL faces, substrates and backer sheets typically expand and contract differently in response to changes in relative humidity, it is easy to understand why a laminated panel can become distorted. Bonding these dissimilar materials rigidly together causes internal stresses each time the components attempt to change dimensions with changes in ambient humidity. Warp results when these stresses are not counterbalanced within the laminated panel construction. Unbalanced constructions may arise from:

- Different Expansion Properties - Warp will occur when the HPL face and backer sheet do not expand and contract equally with changes in moisture content. As thin as they are, these materials are strong enough and different enough in response to ambient humidity changes to profoundly affect flatness of the laminated panel.
- Cross Orientation of HPL Sheets - The HPL face and backer sheets must be laid up with their machine direction parallel to each other. If machine directions are crossed, "saddle-shape" warp will occur, due to the anisotropic characteristics of the HP laminates.
- Improper Conditioning - Improper conditioning of the component materials is a major cause for warp in HPL panel constructions. Warp can occur when the different materials are not conditioned at the same relative humidity before they are bonded together. As a result, the components expand and contract unequally in response to changes in ambient humidity, causing warp. It is unlikely that panels warped from improper conditioning will regain their flatness. If it is not practical to condition the components because of time restrictions, it is probably best to have the decorative HPL face drier than the backer sheet at the time of layup. If warp does occur, it will be convex toward the face and may be less objectionable than a concave warp.
- Thin Backer Sheet - Insufficient conditioning can aggravate warp when thin backer sheets are used. Thin backers condition more rapidly than decorative faces and can cause warp if they are laid up with partially conditioned HPL faces.

In summary, a balanced panel construction is one that will not warp when subjected to forces induced by uniformly distributed moisture changes. The key factors for obtaining a balanced panel construction are:

- Proper conditioning of the component materials before lamination.
- Selection of HPL faces and backers with similar linear expansion properties.
- Laying up of the HPL faces and backers with their machine direction parallel to each other.
- Always using an HPL backer with the HP laminate, when hot pressing.

Well-balanced, properly constructed laminated composite panels can exhibit temporary warp due to the fact that the HPL face will usually take

longer to reach equilibrium with the ambient humidity levels than a standard HP backer sheet. This will result in stresses that can cause warp. However, as soon as the decorative HPL face has reached equilibrium, the stresses are relieved and the panel will regain its flatness. It is this ability to equalize and regain its flatness at any level of ambient humidity that is the most important benefit of a balanced panel construction.

One-Sided Construction

Applying a decorative HPL face to only one side of a particleboard or MDF substrate obviously creates an unbalanced construction. Although conditioning the components to the same humidity level before laminating is important, it will assure flatness of the finished laminate only at that humidity level. Warp may occur at higher or lower ambient humidity because of the difference in linear expansion properties between the HP laminate and the particleboard or MDF substrate. Failure to condition components prior to layup may cause the laminated end product to warp at all levels of ambient humidity.

Rubber-based contact adhesives may reduce warp of one-sided constructions by providing a flexible glue line that allows the HPL face and substrate a certain amount of independent movement. Thick, stiff particleboard or MDF substrates will also minimize warp. One-sided constructions are best suited for applications such as countertops where the panel is restrained with mechanical fasteners.

The Architectural Woodwork Institute (AWI)[3] Quality Standard 400 restricts the amount of one-sided panel surface area used in architectural cabinets.

Warped Substrate

Warped board should not be used as a substrate for laminating high-pressure laminates because the ultimate performance of the laminated panel will be unpredictable. Warp in particleboard or MDF is frequently due to unequal moisture pick-up in the top board of a stack or unit. Placing a cover board on top of the stack whenever the production line is shut down for more than a few hours can control this. Panels already warped should be removed from the stack and stored on edge to equalize for a day or so, until they regain their original flatness, before laminating.

Temperature

HP laminate and particleboard or MDF react differently when exposed to elevated temperatures. Particleboard or MDF will contract, whereas high-pressure laminate will expand. If thermosetting adhesives are used to bond an HPL sheet to particleboard or MDF in the hot press, extremely cupped laminates will result because the plastic HPL is expanding while the adhesive is setting. After the panels are removed from the press, the HPL cools and contracts, resulting in cupped or concave finished laminated panels. A high-pressure backer sheet should always be used when hot pressing.

Cupping can also occur when contact adhesives are used on one-sided constructions. Some fabricators employ flash-off ovens to dry the contact adhesive on both the HPL and substrate. The HPL will expand when exposed to the oven heat and if the components are not allowed to cool properly prior to lamination, cupping will result.

Delamination

Although not as common as warp, delamination problems, i.e., partial or, more rarely, total failure of the bonding between the laminate and the substrate can sometimes occur. Delamination may be due to one or more of the following factors:

Adhesive

- An insufficient amount of the adhesive was applied to the HP laminate, the substrate or both.
- The adhesive was not applied uniformly, which created areas where an insufficient amount of adhesive was coated.
- The adhesive on the mating surfaces was too dry or not dry enough. The manufacturer's instructions on allowable optimum tack range should be closely followed.
- The adhesive was not stirred thoroughly before being applied to the mating surfaces.

Bonding Conditions

- The bonding pressure was too low. Sufficient pressure should be applied to the assembly to ensure intimate contact between the mating surfaces, until the adhesive has set. However, care should be taken not to submit the assembly to a pressure that is high enough to affect the integrity of the substrate.
- The materials to be bonded were too cold. Most adhesive manufacturers recommend a minimum temperature of 70°F (21°C).

[3] Architectural Woodwork Institute, 1952 Isaac Newton Square West, Reston, VA 20190, www.awinet.org

- High humidity (> 80% RH) may also interfere with proper bonding, if the temperature is below 70F (21C), because moisture may condense on the surfaces during drying.
- Contamination of the surfaces to be bonded may cause delamination, depending on the extent and the nature of the contamination. The mating surfaces should be clean, dry and free of oily materials, dust, etc.

Thermally Fused Papers

Introduction

Decorative papers saturated with melamine-formaldehyde, polyester or a mixture of urea-formaldehyde and melamine-formaldehyde resins have gained wide acceptance as surfacing materials for industrial-grade particleboard and MDF substrates. Their performance characteristics have greatly improved over the past several decades and thermofused laminates are well suited for many end use applications such as case goods, institutional and hospitality furniture, office furniture, store fixtures, cabinetry and many others.

Industrial grade particleboard and MDF are the most common substrates used for the production of Low-Pressure Laminate/thermofused melamine laminate (TFM) because of their uniform density, surface smoothness and good thickness tolerance. With a well-sanded surface and proper moisture control, MDF shows almost no telegraphing of wood particles. The smooth, hard surface supports and adheres evenly to the decorative paper and resists dents, damage and compression during the laminating process.

TFM panels are manufactured by fusing a printed or solid color decorative paper saturated with a thermoset resin to a wood substrate, under heat and pressure. This is usually accomplished in a single opening hot press, but continuous double-belt presses are also available. During the pressing process, the resin in the paper softens, flows and sets into the substrate creating a permanent bond between the decorative paper and the substrate. The resin on the decorative side of the paper, which is against the textured plate also softens, flows and sets, to become a transparent layer of cured resin, creating the resin-rich surface that gives TFM its performance characteristics. The physical properties of TFM panels will vary with the manufacturer, percentage of resin impregnated in the saturated paper, weight and quality of the decorative paper and the laminating conditions.

Production of the Thermally Fused Decorative Papers

The type of resin, amount of resin impregnation in the paper and the laminating process will determine wear, stain resistance, cleanability, and many other properties of the finished product.

Decorative Paper

Decorative papers are alpha-cellulose papers produced with the specifications required for use in the production of decorative laminates. The same printed papers can be used in both the HPL and the TFM processes; however, a solid color paper is usually designed for optimized performance in either the HPL or the TFM process and thus usually cannot be used interchangeably in both processes. The papers used by most laminators today range from 70 to 115 grams/m^2, although decorative papers having grammages as low as 60 grams/m^2 and as high as 140 grams/m^2 have been used. Once they have been impregnated with resin, the overall weight of the saturated decorative papers will typically range from 175 to 320 grams/m^2; they can be supplied in rolls or in sheets, depending on user specifications.

Impregnating Resins

The resins are introduced into the paper during an impregnation operation. The paper is first impregnated with a solution of the resin and then dried and partially cured (b-staged) in the curing ovens that are an integral component of the impregnation equipment (treater).

MELAMINE – Cured melamine-formaldehyde resin is noted for its hardness, scratch resistance and color stability; it is the most commonly used resin in the production of TFM laminates. In the last two decades, the introduction of two-stage impregnating equipment has allowed producers of saturated papers to extend the melamine resin with a saturating grade urea-formaldehyde resin. In this instance, the decorative paper is impregnated by saturating the core of the paper with the extended or mixed resin, followed by coating of the partially dried decorative paper with a coat of 100% melamine resin, to completely seal the mixed resin in the core of the paper, away from its surface.

POLYESTER – Decorative papers are sometimes impregnated with polyester resins; cure times can be adjusted through the use of different peroxide initiators. The saturated papers obtained are less brittle

and less demanding in processing than melamine papers. In general, the polyester papers are similar in performance to melamine papers. The finished polyester laminate may exhibit lower scratch resistance than a thermofused melamine panel. However, polyester resins are noted for their stain, water, chemical, and impact resistance, as well as their good color clarity and machinability.

PHENOLIC – Phenolic resins are also used for specialized decorative applications, such as exterior applications, where toughness and weather resistance are required. Phenolic resins are also noted for their chemical, stain and impact resistance. However, phenolics are less colorfast and are limited in color range.

Impregnation of the Paper

The amount of saturation is most often expressed by the thermally fused paper suppliers as resin content[4], and normally ranges between 50% and 65% of the weight of the impregnated paper. An important part of the impregnation process is the proper staging of the resin, i.e. drying and cross-linking of the resin to a point that will allow ease in handling of the paper prior to laminating and good performance in the laminating press. The proper staging is designated as the b-stage. Under-staging may result in the impregnated sheets sticking together, a problem known in the industry as blocking. Over-staging will cause flow problems during lamination. The amount of resin (given as resin content or resin pick-up) and the degree of volatiles present in the paper are two characteristics that must be specified by the laminator, in consultation with the impregnator. Other specifications such as final dimensions of the impregnated paper sheets or rolls and packaging requirements should also be communicated to the impregnator.

Laminated Panel

Strength

The strength and stiffness of particleboard or MDF surfaced on both sides with thermofused overlays may increase slightly, but not as dramatically as board surfaced with HP overlays.

Product Performance Standard

A performance standard for Thermoset Decorative Composite Panels was developed in the mid-1980s by the American Laminators Association (ALA-1985). However, this association ceased to exist in the early 1990s. The only North American Performance Standard in existence is the voluntary standard available from CPA and entitled: "*Voluntary Product Standards and Typical Physical Properties of Decorative Overlays.*"

Substrate Requirements

Because thermally fused overlays are thinner (0.004 – 0.007 inch or 0.10 – 0.18 mm) and thus, have different masking properties than HPL (0.020 – 0.048 inch or 0.51 – 1.22 mm), the board substrate should be selected with greater care. Impregnated thermally fused paper on the lower end of the weight scale (impregnated weight between 175 grams/m^2 and 220 grams/m^2) will not cover or mask the smaller imperfections in the surface of the substrate like an HP laminate will. The factory-sanded surface quality, surface smoothness, density uniformity, thickness tolerance as well as the integrity of the surface layer will influence the visual appearance and quality of the finished TFM panel. Large flakes or particles may not only telegraph through the overlay but could also affect machining quality. The surface quality of the substrate becomes slightly less critical as the total weight of the impregnated thermally fused paper increases.

Fabricators should test and evaluate substrate candidates and finished laminates thoroughly until satisfied with their appearance and performance. It is also a good practice to establish specifications with substrate and thermally fused paper suppliers, particularly when specific requirements are being requested by the customer.

Process Parameters

Laminating Press

The press should ideally be located in an enclosed temperature- and humidity-controlled atmosphere to avoid sudden changes in humidity, contamination from airborne dirt and particulate and other factors that could affect the laminating process and the quality of the finished laminate.

Textured caul plates are most often used to impart texture to the TFM panel. Caul plates may be

[4]The amount of resin present in the paper can also be expressed as resin pickup, which is defined as the weight of resin as a percentage of the weight of the unsaturated paper. The conversion between resin content (RC) and resin pickup (PU) is as follows: %PU = %RC ÷ (100 – %RC); %RC = %PU ÷ (100 + %PU).

manufactured from different metals, the most common being steel and brass sheets; if the surface of the plate is to come into direct contact with the laminate, that surface is usually chrome-plated. In the continuous press, texture and heat transfer is achieved by the use of textured belts that revolve around heated steel drums. Caul plates/belts can influence cure, appearance, handling and quality of the finished laminate. Caul plate/belt temperature, finish, and cleanliness are key factors for good laminating results. Heavy, embossed release papers are also available and eliminate the need for texture on the caul plates or belts.

Conditioning Materials

For best laminating results, the board substrate and saturated paper should both be brought to equilibrium at 35% to 45% relative humidity and 70°F (21°C).

Saturated Paper

Saturated melamine papers should be stored in a controlled atmosphere to prevent an increase or decrease in their volatiles content, which will affect laminating performance. High humidity could also lead to blocking, while low humidity can dry out the paper and make it brittle. Polyester papers are not affected by humidity and have a longer shelf life. Extremes in temperatures should be avoided for all types of impregnated papers.

Substrate

Resin-impregnated papers are good vapor barriers, allowing very little moisture to escape through the surfaces of the substrate during pressing. Conversely, they provide resistance to moisture entering the panel after pressing. Hence, high moisture content of the substrate should be avoided as this may contribute to bond-degradation within the substrate, steam blows, warp and poor bonding between the substrate and the décor paper. Substrate moisture content should not exceed 6-8%; thus, shipping and storage conditions are important. Attempting to laminate on raw board that is either too hot or too cold also can negatively affect laminating performance and the quality of the panels produced.

Substrate

Consideration of the substrate is important when establishing pressing conditions, in order to avoid bond degradation in the board, blows, warp or substrate compression. This is particularly important when high temperatures, pressures and/or long pressing times (press cycles) are used. With higher press temperatures, faster press cycles are desirable to minimize the amount of heat absorbed by the board substrate. Because heat is only required at the substrate surface to cure the resin in the paper, deep penetration of heat into the substrate should be avoided. High temperatures can also cause precure of the resin in the paper; this phenomenon is described in the Troubleshooting section.

Pressing Parameters

Some typical laminating pressing conditions for thermofusing saturated decorative papers to particleboard or MDF in a single-opening press are given below:

Melamine

Temperature:	300° to 400°F (150° to 205°C)
Cycle:	15 to 40 seconds, not including press closing and decompression time.
Pressure:	300 to 400 psi (2067 to 2756 kPa)

Polyester (Range)

Temperature:	275° to 350°F (135° to 177°C)
Time:	30 to 90 seconds, not including press closing and decompression time.
Pressure:	175 to 200 psi (1206 to 1378 kPa)

Polyester (Ideal)

Temperature:	300° to 310°F (149° to 160°C)
Time:	30 to 90 seconds, not including press closing and decompression time.
Pressure:	185 to 200 psi (1275 to 1378 kPa)

Phenolic

Temperature:	275° to 350°F (135° to 177°C)
Time:	60 to 300 seconds, not including press closing and decompression time.
Pressure:	175 to 350 psi (1206 to 2411kPa)

The preceding conditions apply when similar papers are pressed on both sides of the substrate. If different papers are applied, the slower curing paper will determine the pressing conditions. Hence, difficulties may occur when different face and back papers are used.

Adhesives

As mentioned above, under heat and pressure, the

resin in the décor paper softens, flows and sets into the substrate, creating a permanent bond between the décor paper and the substrate, without need for an adhesive applied to the décor paper or the substrate, in a separate step.

Troubleshooting

Warp

One of the most important requirements for most decorative panel constructions is their ability to remain flat under normal service conditions. The following recommendations should promote the production of flat laminated panels:

Conditioning

- Materials should be stored, handled and conditioned as recommended.
- Extremes in temperature and humidity should be avoided.

Substrate

- Warped particleboard or MDF substrates should not be used.
- Substrate should be stored under reasonable, uniform, protected warehouse conditions; extremes in temperature and humidity should be avoided.

Saturated Paper

- An adequate volatiles content should be retained in the paper.
- The paper should not be over-aged or dried-out.
- The grain and machine direction of the top and bottom paper should be parallel.

Balanced Construction

- Whenever possible, a balanced construction should be used. Proper balancing may be achieved by using top and bottom sheets of similar type, weight, etc.
- The rate of curing of the top and bottom papers should be similar.

Pressing Parameters

- The press should be loaded and brought to full pressure as quickly as possible.
- Pressed panels should be unloaded from the hot press immediately after opening of the press, to avoid prolonged contact of the bottom of the panel with the hot caul plate.
- Bottom caul plates should be cool, if used for panel insertion.
- Pressing temperatures and cycles should not be hotter or longer than necessary; the hottest temperatures possible should be used to minimize the amount of time the panels will be exposed to heat in the hot press (shorter cycles).
- When using different sheets on the top and bottom, special attention should be paid to the pressing parameters to ensure proper cure on both sides of the panel.
- Hot pressed panels should be stacked flat and be well supported while cooling in small, covered bundles: if available, conveyor cooling should be used with all panels exposed on both sides for faster, uniform cooling.
- Pressed panels should be allowed to cool to 120F or below, before machining.

Warping may be caused by many factors in addition to those mentioned above. For example, the linear expansion of resin-saturated papers is often greater than that of particleboard under the same conditions. For more information on preventing warp in laminated panels, see CPA's Technical Bulletin entitled "Minimizing Warp in Laminated Particleboard and MDF."

Mottling

Mottling is defined as the presence of whitish areas on the surface of the pressed panel. Mottling is easier to observe on dark solid colors or dark printed patterns. Mottling is usually due to improper or uneven flow of the resin in the décor sheet, during the pressing process. The most common cause is low flow of the resin, which may be related to:

- Over-staging of the resin in the resin-impregnation process.
- Aging of the saturated paper, due to poor stock rotation or other reason.
- Premature aging of the saturated paper due to exposure to high heat during transportation or storage.
- Low volatile content of the saturated paper. This may occur during the impregnation process or because of exposure to dry ambient conditions during transportation or storage, due to poor packaging.
- Low resin content of the saturated paper. Papers that are prone to mottling, such as black and other deep, intense solid colors or some dark prints are typically produced with a higher resin content than most other papers.
- Pressing temperature is too high, not allowing the resin to flow before it sets.

When mottling occurs, the following changes in pressing parameters can often alleviate the problem:

- A reduction in pressing temperature, most often accompanied by an increase in pressing cycle to ensure that proper curing is achieved.
- An increase in pressing pressure, as long as this does not lead to a deterioration in the substrate integrity.
- The use of cushions between the caul plates and the press platens to avoid hot spots on the caul plates.
- Pressing the same lot of impregnated paper on a different lot of substrate to determine if the mottled appearance is due to irregularities on the surface of the substrate.

Precure

Precure is usually characterized by the presence of shiny lines on the bottom decorative surface of the pressed panels. Precure will occur when the resin is allowed to start setting (cross-linking) under low or no applied pressure. Minimizing exposure of the impregnated paper to heat before full pressure is achieved is thus the best way to avoid precure, as described below:

- The press should be loaded and brought to full pressure as quickly as possible.
- When pressing in a multi-opening press, using as few openings as possible may decrease the occurrence of precure, which is related to slow press closing times.

Starvation

Although much less common than mottling or precure, starvation can sometimes occur when the resin content of the saturated paper is too low, or the surface of the substrate is too open. This leads to an insufficient amount of resin remaining on the surface of the décor paper preventing complete sealing of the paper surface by the resin; this can result in open pores in the surface of the TFM that can cause poor water and dirt resistance. Starvation is easily eliminated by increasing the resin content specification of the saturated paper.

VENEERS

Introduction

Composite panels, such as particleboard and MDF, are the preferred substrate for veneers, due to their superior surface qualities, such as their surface smoothness and integrity and the absence of knots and grain patterns. In addition, their uniform thickness and properties, their dimensional stability, strength properties and cost advantages, their ease of layup and good machineability, as well as their tendency to stay flat, make them ideal substrate materials. Veneered particleboard and MDF constructions are used in many applications including high-quality furniture, case goods, store fixtures and cabinetry.

In most instances, thin veneers are bonded directly to substrate surfaces without the need for cross-banding, and show-through is virtually eliminated. Cross banding may be used in certain applications as determined and specified by the fabricator or end user. Fabricators need to evaluate boards thoroughly if they intend to omit cross-banding.

The main advantages of using particleboard or medium density fiberboard instead of other substrates for these high-quality industrial panel constructions include:

- PB and MDF substrates are characterized by consistent quality core that promotes good bonding, homogeneous glue absorption and resistance to compression.
- In most cases, particleboard and MDF display better flatness than veneer core plywood.
- Decreased glue usage, which leads to higher labor productivity and a decrease in the possibility of bleed-through.
- Shorter press times are required due to reduced glue spreads, uniform substrate thickness and no inside glue lines.
- Fewer rejects from layup problems, sand-through, core overlaps, trimming problems, and grain telegraphing.
- More uniform thickness and moisture content of the finished panel.
- Thinner veneers may be used without the need for cross-banding, with less sand-through and less bleed-through, due to lighter glue spreads.
- Good screw holding properties with advanced fasteners.
- MDF has the added advantage that its edges can be machine-profiled and finished when appropriate for the application.
- Improved routability and edge finishing.

Depending upon veneer thickness, the strength of veneer panel constructions laminated in the hot press can increase compared to the strength of the unlaminated substrate, and can approach the stiffness and Modulus of Rupture (MOR) of solid wood. Cold press adhesives, such as polyvinyl acetates and contact adhesives, are too flexible to bring much improvement in panel strength. Only panels constructed with hot-pressed rigid (thermosetting) resins in conjunction with HPL or veneers provide this extra strength.

Hardwood veneer, with particleboard or MDF substrate, may be finished utilizing many of the same techniques employed to finish solid wood. Most species accept stains and dyes very well, or the panels may be painted, if so desired. The finishing materials suppliers should be contacted for advice on finishing hardwood veneer.

Substrate Requirements

Because thin veneers will not cover or mask the smaller imperfections in the surface of the substrate like an HP laminate will, the board substrate should be selected with greater care, as large flakes or particles may telegraph through the veneer. The factory-sanded surface quality, surface smoothness, density uniformity, thickness tolerance as well as the integrity of the surface layer will influence the visual appearance and quality of the finished veneer laminate. The surface quality of the substrate becomes slightly less critical as the thickness of the veneer increases.

Fabricators should test and evaluate substrate candidates and finished veneer laminates thoroughly until satisfied with their appearance and performance. It is also a good practice to establish specifications with substrate and veneer suppliers, particularly when specific requirements are being requested by the customer.

Process Parameters

Conditioning Materials

The wood veneers and board substrates should be brought to equilibrium at the same temperature and relative humidity. Ideally, the moisture content of the materials to be pressed should be between 6%-9%, with no component exceeding 12%.

Hot Pressing

Wood veneers are typically laminated to board substrates in a hot press. The main resin used in the hot pressing of veneers is a urea-formaldehyde adhesive system, due to its ability to make the panel more rigid, its fast processing parameters and its lower cost base. The manufacturer's recommendations for storage, handling and application of the adhesive should be followed. The gluing practices described in the High-Pressure section of this bulletin should be followed for the production of good veneer laminates. The glue spread and laminating pressure can be calculated using the formulas given in the High-Pressure section.

As with HP laminates, balanced panel construction is essential to minimize warp. The same thickness veneer should be used on both sides. If different species are used, the unbalanced nature of the construction could lead to warp, unless they have similar dimensional expansion behaviors in the same ambient conditions.

Typical process parameters for laminating hardwood and decorative veneers with a urea-formaldehyde adhesive are shown below:

Glue Spread:	60-70 lb/1000 ft^2 (0.29-3.4 kg/m^2) of double glue line
Press Temperature:	240-250°F (115°-120° C)
Press Time:	2-1/2 to 3 minutes
Pressure:	150 to 175 psi (1030 to 1200 kPa)
Board Moisture Content:	6%-9%

This should yield a well-bonded, virtually flat panel if properly balanced and stored, before and after pressing. The finished panel is usually very stable, and checking of face veneers after layup is almost non-existent. Long and/or hot pressing conditions are detrimental to the substrate panels when laminating with veneers. The time required to cure the applied glue lines is all that is necessary.

Cold Pressing

Wood veneers can also be laminated to board substrates in a cold press with contact adhesives, polyvinyl acetate or casein adhesives. These adhesives may be less rigid than heat-activated resin systems. Cold pressing is generally conducted in small batches. Clamp times will vary depending on the type of adhesive used. Times as low as 5 to 10 minutes are possible, but set times under pressure are usually longer because of slower moisture evaporation. Water-based

adhesives may induce checking in the wood veneers. It is important to allow adequate set times before machining.

Adhesives

The most common adhesives used in hot pressing are urea-formaldehyde systems. The adhesives most commonly used in cold pressing are contact adhesives, polyvinyl acetate and casein systems. Cross-linked isocyanate resins have also been used successfully in cold pressing.

Troubleshooting

Warp

Warp is seldom a problem with balanced panel constructions. The most common causes of warped veneered panels are listed below.

Veneer

- Use of a very thin substrate with thick veneer faces.
- Different moisture contents, species, density or thickness of the face veneers that lead to an unbalanced construction.
- Stress areas in the veneers (tension wood, burls, cross grain, etc).
- Non-uniform sanding.
- Veneers on top and bottom do not have parallel grain (one veneer perpendicular to the other)

Adhesive

- Application of too much or too little adhesive.
- Use of a low solids content adhesive.
- Unbalanced glue spreads between one side of the substrate and the other.
- Inadequate cure of the adhesive in the hot press.
- Over-drying of the adhesive in the press before, during or after pressing.

Process

- Loading and/or unloading the hot press too slowly.
- Poor stacking of the panels before and/or after pressing.
- Uneven heating of the platens.
- Pressing of two thin panels in the same opening.
- Unstacking the panels or machining them before they are properly cooled.
- Unbalanced sanding.

Delamination

Delamination may occur when:

- Too much water is present due to a high adhesive coverage or to the use of an adhesive with too low of a solids content.
- A high internal steam pressure develops because the press cycle time is too long or the platen temperature is too high.
- The surface of the substrate is porous and absorbs too much moisture.

VINYL LAMINATION

Introduction

Lamination of vinyl films on flat substrates is accomplished with either a "quick stamp" flat press line or a roller continuous press line. Flat presses typically have a longer dwell time that provides increased wetting (resin penetration into the substrate). Roller presses are more compact physically, are faster and can accommodate a variety of substrate lengths.

The machines that comprise a continuous film, roll laminating production line are a combination of automatic assembly devices, with interconnecting conveyors that apply and bond the laminating film to one or both sides of the board substrate. They can be very basic cold laminating lines or very sophisticated hot laminating lines, depending upon the end product requirements, production volume, and the fabricator's capabilities.

Cold Laminating System

A cold or wet laminating line is a rather simple, straightforward laminating system used for the application of some vinyl films. A typical line would automatically clean both sides of the substrate, apply a uniform coat of adhesive over the board's surface with a direct roll coater and laminate the film to the substrate with roll pressure. The adhesive can be applied to the vinyl films also, as it is let off the feeding roll. In most instances, no substrate sanding is required and no energy is needed to dry or reactivate the adhesive.

In this process, open time (time elapsed between adhesive application or activation and application of laminating pressure) is critical. In addition, the laminated panels must be stacked under pressure for 24 to 48 hours to allow the adhesive to cure completely before any subsequent processing can be conducted.

Hot Laminating System

The hot laminating system used to laminate films that do not have a pre-applied adhesive is more complex than the cold laminating system, but offers more capabilities. A typical production line would include a material infeed, sander, substrate cleaner, direct roll coater, drying oven, second roll coater, second drying oven, adhesive heat reactivator, film roll stand, heated laminating roll, cut-off knife to slit loose film between panels, embosser (if required), foil edge and end trimmer, and a laminated board stacker.

Two coats of thermoplastic adhesives are generally applied to the board's surface: the first coat seals the board and the second coat provides the layer needed to achieve the required bond between the film and the board substrate. After exiting the second drying oven, the dry adhesive on the board substrate is reactivated with heat just before the film is applied, using a heated elastomeric nip roll. After lamination, the surface can be tic-embossed to enhance a wood grain pattern and machined in-line. Finished laminates can be shipped almost immediately after processing.

Hot lamination is more labor and energy intensive than cold lamination, but offers a larger lamination capacity.

Substrate Requirements

The surface quality of the board has a significant influence on the surface appearance of the finished laminate. Thinner decorative overlays do not have good masking properties and any imperfections in the substrate surface can telegraph through the film. Surface color, smoothness, sanding, face layer integrity as well as uniform thickness tolerance are essential. For some film applications, the board surface may have to be filled or sanded with a 150 or 180-grit belt to provide a tighter, smoother surface.

Process Parameters

Conditioning Materials

The vinyl film manufacturer's recommendations for storage and conditioning prior to lamination should be followed closely. Storage conditions can be especially critical for materials with a pre-coated adhesive and topcoat.

The substrate should be conditioned to ensure a moisture content in the range of 6-8%. The conditioning time should be long enough to achieve uniform moisture content throughout the thickness of the substrate.

Pressing Parameters

It is difficult to give general guidelines on temperatures, pressures, drying ovens, etc., for roll lamination of films to board surfaces, because there are so many variables in materials, adhesive systems, laminating lines, and fabricators' capabilities. However, the recommended gluing practices described in the HPL section are key factors in producing attractive, well-bonded laminates.

In most instances the processing information needed can be obtained from the suppliers of the vinyl film, adhesives and laminating machinery. It is essential to work with those suppliers and with the substrate manufacturer to determine the process parameters that will yield the desired appearance and performance of the finished laminated product. A most important and often overlooked requirement for quality lamination is correct and uniform temperature of the substrate before the first press.

Adhesives

Several different adhesive systems are used for bonding vinyl films to board substrates. In most instances, they are applied by a direct roll coater. The adhesive manufacturer's instructions for storage, handling, and application should be followed closely. During winter, the temperature around the glue tank should not dip below 68°F (20°C).

Cold Laminating

Vinyl films may be laminated with two-part epoxy adhesives or water-based adhesives such as ethylene/vinyl acetates, acrylics or vinyl chloride/ vinylidenes. The water-based systems should be evaluated closely, due to their tendency to raise board surface particles and fibers that could telegraph through the vinyl film surface. A one-part urethane adhesive system that cures by absorbing moisture from the air and/or the substrate is also used by some fabricators.

Hot Laminating

Solvent-based adhesives such as urethanes, polyesters, vinyl/urethanes, polyester/urethanes and epoxy/urethanes have been found suitable for bonding vinyl films to board substrates. All are two-part systems that must be combined prior to use. They all require forced air-drying to dissipate solvents and need heat reactivation before the film is laminated. Full bond strengths are obtained within 12 to 24 hours.

VINYL – THERMOFORMING

Introduction

Thermoforming encompasses a number of processes. Two of these processes, vacuum forming and membrane pressing, involve laminating vinyl overlays onto a substrate. Both processes are used to create three-dimensional pieces in which the vinyl conforms to the profile on all sides as well as any routed areas in the center of the piece. Vinyl films require an adhesive for bonding to the board substrate. As the name implies, the thermoforming process uses heat to soften the vinyl film and then form the film tightly to the profile. Typical profiles consist of medium density fiberboard or high density fiberboard (MDF or HDF) shaped and routed into cabinet doors, decorative moldings and contoured tops.

The use of these techniques is expected to continue to grow due to the design flexibility that thermoforming offers and increasing environmental pressures from various state regulations and the revised 1990 Clean Air Act, to reduce emission of volatile organic compounds (VOCs).

Vacuum Forming

Vacuum forming has been used with vinyl films for decades. A variety of finished products can be produced for the furniture and consumer electronics market using this process, including speaker baffles, rounded tops, drawer fronts and handles.

Membrane Pressing

Membrane pressing was used exclusively for laminating wood veneers until the 1980s, when the technology was expanded to vinyl films. Membrane presses have the capability of laminating more complex profiles and providing better heat resistance, but require heavy gauge rigid films.

Membrane presses form the film by pulling with vacuum from below and pushing the film into the profile with a pressurized silicone membrane from the top. The film is forced into the profiles by the pressure differential between the membrane above and the vacuum below the film and routed part. Membraneless presses use the film as the membrane to separate pressure on top and vacuum below. Thermoforming equipment can be purchased in a number of configurations from several different manufacturers.

Substrate Requirements

MDF and HDF (high-density fiberboard) are the most commonly used substrates in thermoforming, with the density of the substrate depending on the application. The fine core of these substrates allows routed parts to be glued and laminated with minimal telegraphing. Other porous substrates are sometimes used in vacuum forming. The surface of the substrate must be smooth and void of chatter, sanding marks, router marks or other board defects that will telegraph through the vinyl film. The routed areas present a more open surface and tend to absorb water-based adhesives more readily, which may lead to some fiber pop in those areas.

Process Parameters

Vacuum Forming

Vacuum forming machines form the heat-softened vinyl to the substrate by vacuum application under the board and film. Vinyl films for vacuum forming are usually plasticized to make them more flexible and range in gauge (thickness) from 0.005 inch (0.13 mm) all the way up to 0.060 inch (1.5 mm).

Membrane Pressing

The membrane press process requires careful planning for the laminated panels to meet the quality requirements. Several key factors to consider include:

<u>Membrane</u>

The selection of the proper membrane is critical to successful vinyl film pressing. Only properly formulated, 100% silicone rubber membranes should be used with vinyl films. Non-compatible natural rubber membranes commonly used to press wood veneer will impart the vinyl film with a yellow discoloration. Membrane suppliers should be able to offer technical assistance in determining compatibility between the vinyl and the membrane.

<u>Vinyl Film Gauge</u>

Membrane press films are usually rigid films. The film gauge ranges from 0.010 to 0.020 inch (0.25 to 0.50 mm), with some films as thick as 0.040 inch (1.0 mm) being used in special applications. The selection of the vinyl film gauge depends on the radius of the draw and the shape of the profile.

Tests should be conducted to determine which thermoforming vinyl film gauge meets the needs of the shape to be pressed.

Pressing Parameters

Successful pressing requires consistent processing conditions. The temperature, pressure, preheat time and pressing time all must be optimized. Enough heat is required to soften the vinyl for forming and to activate the adhesive. Pressing cycles range between 1½ and 4 minutes. A typical cycle includes preheating for 30 to 60 seconds, followed by pressing for 1 to 3 minutes. Heat settings during pressing are different from press to press, but generally the vinyl and glue line are heated to a minimum of 160°F (71°C), typically around 195°F (90°C). Pressures usually range from 2.5 to 5 bars (36 to 72 psi).

Adhesives

The application of the adhesive is critical to a smooth even surface. Uneven adhesive application can show through the film surface and result in uneven adhesion.

Vacuum Forming

The most common adhesives used in vacuum forming are polyurethanes, which are sometimes catalyzed.

Membrane Pressing

An adhesion promoting primer is usually applied to the back of the film. The predominant adhesive type is a cross-linkable water-based polyurethane spray (PUD) applied to the substrate prior to pressing. In certain applications, a non-crosslinking hot melt adhesive is pre-applied to the film, followed by re-rolling of the film.

Troubleshooting

Membrane Pressing

- Too little heat can tear the film and result in poor adhesion.
- Too much heat can result in embossing loss and sticking of the film to the membrane.
- Too little pressure can lead to poor forming and poorly sealed edges.
- Too much pressure can tear the film, increase strike-through and lead to premature wearing of the membranes.

Lengthening the cycle allows lower temperatures and pressures to be used, but will slow down production.

REFERENCES

- William Herschberger, "The Anatomy of High-Pressure Decorative Laminates", Wood and Wood Products, June 1985.
- Bill Bair, "A Look at Decorative Paper Laminating", Wood and Wood Products, June 1985.
- Robert F. Snider, "Using Adhesive with Core Materials", Wood and Wood Products, June 1985.
- B.G. Heebink, "Importance of Balanced Construction in Plastic-Face Wood Panels", U.S. Forest Service Research Note Fpl-021, 1963.
- B.G. Heebink, "Reaction to Unbalance Panel Constructions to Slow and Rapid Changes in Relative Humidity", U.S. Forest Service Research Note Fpl-0166, 1996.
- B.G. Heebink, H.H. Haskell, "Effect of Heat and Humidity on the Properties of High Pressure Laminates", Forest Products Journal, XII (11): 542, 1962.
- "Particleboard from Start to Finish," Composite Panel Association, Gaithersburg, Maryland, 1996.
- "MDF from Start to Finish", Composite Panel Association, Gaithersburg, Maryland, 1991.
- Bob Martin, "Continuous Film Laminating Systems", Furniture Production, November 1970.
- Donald Jones, "Tips on Cold Press Particleboard Laminating", Wood and Wood Products, November 1969.
- Miriam Feinseth, "Dry Printing Decorative Techniques and Applications for Wood Products", Furniture Manufacturing Management, December 1980.
- NEMA LD3-2005 standard, "Performance, Application, Fabrication and Installation of High-Pressure Decorative Laminates", National Electrical Manufacturers Association, 2005.

APPENDIX I – GLOSSARY OF TERMS

ADHESIVE

A substance capable of holding materials together by surface attachment. The term is used to cover the bonding of sheet material and is synonymous with glue.

BACKER

A non-decorative overlay used on the back of composite panel constructions to protect the substrate from changes in humidity and to balance the panel construction.

BALANCED CONSTRUCTION

A laminated composite panel construction that typically has a similar overlay on both surfaces, which reduces or eliminates warp when subjected to uniformly distributed moisture changes.

BASIS WEIGHT

Most often used to characterize paper products, in the decorative laminates industry. The basis weight is defined as the weight in pounds of a ream (3000 square feet) of paper.

BLOCKING

When referring to saturated papers, sticking of the sheets or layers of the roll together without any means of separating them without inflicting permanent damage to the sheets or roll.

BLOW

A localized delamination caused by steam pressure build-up during the hot pressing process. Blows may result from excessive moisture, excessive or poor resin distribution or high press temperatures.

CALENDERED

For polymers, passing of the film through heated rolls, moving at varying rates, to reduce the film thickness.

CHECKING

Ruptures along the grain that develop during seasoning either because of a difference in radial or tangential shrinkage or because of uneven shrinkage of the tissue in adjacent portions of the wood.

CUP

Deviation, flat-wise from a straight line stretched across the width of the panel.

DELAMINATION

An actual separation of a laminate from a substrate.

EMBOSSING

A process by which the surface of the panel product is given a relief effect. This can be accomplished with a pressure roll or a patterned caul plate in a hot press.

EPOXY

A two-component thermosetting adhesive typically used for laminating medium and heavy gauge vinyls. Epoxy adhesives are generally blended 1:1 (resin to hardener) by volume and are roll-coated either to the backside of the vinyl web or to the board surface.

FIBER RAISE

Face fibers that are raised above the surrounding surface appearing as a rough surface. Usually caused by excessive absorption of moisture.

GRAMMAGE

Most often used to characterize paper products, in the decorative laminates industry the grammage is defined as the weight in grams of one square meter of paper (gsm).

GRIT SIZE

Refers to coarseness of an abrasive material on a sanding belt. The lower the grit label, the coarser the abrasive material.

HOT MELT

A thermoplastic adhesive that is 100% solids and is applied molten to form a bond upon cooling. Hot melts differ from conventional liquid adhesives because they set by cooling rather than by absorption or evaporation of water or solvent.

LINEAR EXPANSION

A measure of growth along the length and/or width of a material when exposed to conditions from low to high humidity, stated as a percentage of the original dimensions.

MACHINE DIRECTION

The orientation that corresponds with the direction in which the product moved through the machine that manufactured it.

MIL

A thickness measurement typically used for vinyls and papers. One mill equals one-thousandth of an inch or 0.001 inch.

MODULUS OF ELASTICITY (MOE)

A measure of the board's resistance to deflection or sagging when loaded as a simple beam. Value stated in pounds per square inch (psi) or Newtons per square millimeter (N/mm^2).

MODULUS OF RUPTURE (MOR)

An index of the maximum breaking strength of the board when loaded as a simple beam. Value stated in pounds per square inch (psi) or Newtons per square millimeter (N/mm^2).

MOISTURE CONTENT

The amount of water in wood and expressed as a percentage of dry weight.

MOTTLING

Irregular visual appearance in an area or entire surface of a finished panel.

PRECURE

Curing of a resin before pressing.

POLYURETHANE DISPERSIONS

Polyurethane dispersions are used for the membrane pressing of vinyl films and veneers to a MDF core. They can be used in conjunction with a hardener for higher heat resistance if required. The hardener level is usually 5% by weight and should be added with very good agitation. Polyurethane dispersions are typically spray-applied to the MDF and then air-dried before mating with the vinyl film or veneer in the press.

RELATIVE HUMIDITY

Ratio of the amount of water vapor present in air to that which the air would hold at saturation at the same temperature.

RESIN CONTENT

In the decorative overlay industry, the resin content is the percentage of resin in the saturated paper in relation to the total weight of the saturated paper.

RESIN PICKUP

In the decorative laminates industry, the resin pick-up is the percentage of resin in the saturated paper in relation to the weight of the paper before impregnation.

SAND-THROUGH

A condition where the face layer has been sanded off, exposing the core.

SOLVENT-BORNE ADHESIVE

An adhesive containing polymeric materials dissolved in volatile organic solvents, to which a small percentage of cross-linker is added to obtain certain desired performance properties, such as higher heat resistance. This type of adhesive is typically used on a "hot line" laminator where it is applied to the board or film surface, dried and then heat activated prior to a hot roll laminating station. They are non-grain raising and exhibit good coatability, high heat resistance and excellent bond strengths.

SCREW-HOLDING

A measure of the force required to withdraw a screw directly from the face or edge of a board, stated in pounds (lbs) or Newtons (N).

SUBSTRATE

A material that provides the surface onto which an adhesive or coating is spread.

TACK

Viscosity or degree of "stickiness" of an adhesive, which reflects its state of dryness or advancement of cure, prior to bonding.

TELEGRAPHING

Transfer of substrate surface defects through the thickness of the overlay material.

THERMOPLASTIC ADHESIVE

Resins or adhesives that harden at room temperature and re-soften upon exposure to heat.

THERMOSETTING ADHESIVE

Resins or adhesives that cure at room temperature or in the hot press by chemical reaction to form rigid bonds that are not re-softened by exposure to heat (cross-links).

UNBALANCED CONSTRUCTION

When individual components or layers of a laminate do not respond equally to changes in moisture, thus causing warp.

VOLATILES CONTENT

Weight loss of a saturated paper when heated to bone-dry, expressed as a percentage of the weight of the saturated paper.

WATERBORNE ADHESIVE

Water-based adhesives are formulated synthetic polymers (usually vinyl acetate or ethylene vinyl acetate polymers). These products are generally used for paper laminating, where the adhesive is applied to the web and/or board surface and tacks up through one or more heated rolls that combine paper to board.

WARP

Deviation of a panel from a flat plane due to unbalanced construction, excessive moisture pickup, wetting or other unfavorable exposures.

REFERENCES

- "MDF from Start to Finish", Composite Panel Association, Copyright 1991.
- "Glossary of Terms", Laminating Materials Association Inc., Copyright 2001.
- A.J. Panshin & C. De Zeeuw, Textbook of Wood Technology, Vol. 1, 1964.
- "Storage and Handling of Particleboard and MDF," Composite Panel Association, Gaithersburg, Maryland, 2000.

The information in this document is believed to be reliable. However, the determination of suitability of this information for any use or application remains the sole responsibility of the user.

No guarantees, representations or express or implied warranties are made regarding the accuracy and completeness of this information, and the Composite Panel Association (CPA) assumes no responsibility or liability for any loss or damage through reliance upon it.

Composite Panel Association

The Composite Panel Association (CPA), founded in 1960, represents the North American composite panel industry on technical, regulatory, quality assurance and product acceptance issues. CPA General Members include 39 of the leading manufacturers of particleboard, medium density fiberboard and hardboard. Together they represent nearly 95% of the total manufacturing capacity throughout North America. CPA also brings together the complete value chain affiliated with the composite panel industry. CPA's 200 members worldwide, primarily in the US and Canada, are committed to product advancement and industry competitiveness. Associate Members include manufacturers of furniture, cabinets, decorative surfaces and equipment, as well as laminators and distributors.

CPA is a vital resource for both producers and users of industry products. As an accredited standards developer, CPA writes and publishes industry product standards. It also participates in the standards development work of ANSI, ASTM and others, sponsors product acceptance activities and works with federal and state agencies and model building code bodies. In addition, CPA conducts product testing and third-party certification programs, while helping manufacturers create in-plant quality control programs. CPA offers the first ANSI accredited Environmentally Preferable Product (EPP) certification program, which certifies composite panel products that are 100 percent recycled and low emitting. Downstream manufacturers who use EPP certified substrates will also be able to market their products as environmentally preferable through this program, which offers an alternative to "for profit" green certification programs. Outreach and education are also focal points of the CPA. The Association publishes industry performance data, produces a series of technical bulletins and develops publications to inform key audiences about the attributes of industry products.

Composite Panel Association

Main Office
18922 Premiere Court
Gaithersburg, Maryland 20879-1574
301-670-0604 ▪ Fax 301-840-1252

99 Bank Street, Suite 701
Ottawa, Ontario K1P 6B9
613-232-6782 ▪ Fax 613-232-8386

Toll Free 1-866-4COMPOSITES
www.pbmdf.com

Copyright © 2007 Composite Panel Association. All rights reserved. Any reproduction of this document in whole or in part by any means is expressly prohibited unless specific written authorization is obtained from the Composite Panel Association.