

TKH-Technical Briefing Note 6

Profile Wrapping

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1. Introduction

Profile wrapping is one of the standard procedures in wood finishing and furniture manufacturing. Commonly, furniture elements, door and window profiles, panels for wall and ceiling linings, finishing strips and other similar elements are manufactured with profile wrapping. During this process, a three-dimensionally shaped core of any type of material is covered by a flexible film so that film and core are permanently bonded on all contact points. The profile core used, in most cases not very decorative, inexpensive or not meeting the requirements for the intended application, is covered with a film which gives the wrapped element a high-quality look and/or high resilience. The profile core can either be covered completely or partial wrappings are possible.

To bond core material and film, usually hot melt adhesives are used.

The objective of this technical information sheet is to convey to manufacturers of profile wrapped elements the basics for use of hot melt adhesives in profile wrapping.

2. Definitions and Terms

2.1 Materials used

- For profile wrapping, three-dimensionally shaped cores are used as profiles. These cores can be manufactured from solid wood, wood-based materials such as chipboards, MDF, composite materials made from wood and thermoplastics also called WPC (Wood-Plastic Composites), plastics, metals such as aluminum or steel and any combination of these materials. To improve bonding, the profiles are treated with adhesion promoters if required or prepared with special physical processes such as flaming, Corona or plasma treatment.
- The films to be used shall be matched to the later range of use of the resulting element, e.g. weather or light resistance etc. Among the materials used are, among others: raw or fleece-backed veneers, resinated papers, CPL, thermoplastic films. Ideally, the film should be flexible enough to closely attach to all points of the profile core during the wrapping process. If necessary, the required flexibility must be achieved during profile wrapping by appropriate process management. In order to achieve a good bond between adhesive and film, films may be equipped with adhesion promoters.
- DIN EN 923 defines a hot melt adhesive as a thermoplastic material applied in molten form which solidifies on cooling and then develops cohesion (inner strength). Detailed information regarding hot melt adhesives for furniture manufacturing, their composition and their physical and chemical properties in general are summarized in Technical Information Sheet "Hot Melt Adhesives" of the Technical Technische Kommission Holzklebstoffe (TKH) (Technical Committee on Wood Adhesives). For profile wrapping, specialized profile wrapping hot melt adhesives with a specific chemical composition and special physical properties are used. The hot melt adhesive must be matched to the processed material as well as to machine parameters.

2.2 Process

During profile wrapping, above mentioned materials, i.e. hot melt adhesive, film and profile core, are formed into a work piece in a continuous process. In a first step, the film is coated with the liquid hot melt adhesive, applied either with a nozzle or a profiled roller. Next, the coated film is pressed onto the profile core using pressure elements, either rollers or pressure shoes which are arranged in a pressure zone adapted to the profile core. The hot melt adhesive cools during the pressing process, solidifies and thus bonds

film and profile core. After film and profile core have passed through the pressure zone, a firm bond is established between the two. Strength between film and profile core is high enough to allow further processing of the wrapped work piece.

3. Processing Criteria for Hot Melt Adhesives for Wrapping

3.1 Preparation Premelting

Hot melt adhesives are normally delivered in the form of free-flowing granules. The granules may be surface-coated to prevent caking. For processing, the granules must be dry and free of contaminations.

PUR-hot melt adhesives are normally delivered as blocks.

All wrapping hot melt adhesives can be melted in drum melters, quick melters and extruders. Feed via gear pumps or heated hoses is possible. In order to ensure adequate feed quantities, inner diameter of hoses should not be smaller than 10 mm. Before start of work, the melters must be clean and free of combustion residue; residue of other hot melt adhesives must be removed completely.

PUR-hot melt adhesives are melted in special, coated melters. In addition, it is recommended to protect these adhesives from humidity in the melters by introducing nitrogen or dry air to prevent premature reactions.

3.2 Temperature Settings

The recommended temperature in drum melters shall be approx. 10% lower than the targeted processing temperature; the correct temperature setting shall be checked by measurements inside drum melter.

There may be different recommendations for PUR-hot melt adhesives, since various melting technologies can be used. All processing recommendations given by the adhesive manufacturer shall always be complied with.

For quick melters, temperatures at the hot plate exceeding processing temperature by 25% are admissible, since dwell time of hot melt adhesive on hot plate is rather short. However, this requires a continuous granule feed; in the event of interruptions, temperature must be lowered or hot plate must be switched off.

Extruders generate the required temperature for melting by friction and pressure built-up of granules fed to extruder. The obtained temperature corresponds to melting temperature

of the hot melt adhesive used and may vary between approx. 120 °C and approx. 180 °C. The melting process is started via heating collars on the extruder. In the next step, the granules are heated by the generated friction to an extent that the melting process can continue. The melting temperature marks the transition from granules to liquid form and is significantly lower than the processing temperature of the hot melt adhesive.

Note: Quick melt devices and extruders do not generate the processing temperature; they only melt the granules. When using these pre-melting devices, the processing temperature must be generated by downstream devices or in the application units.

3.3 Melting Rate

Melting rate in the pre-melting device mainly depends on the following factors:

- The higher the softening point of the adhesive, the slower it melts.
- From experience, more energy is needed for the melting of unfilled adhesives than for filled adhesives.
- Type and construction of the pre-melting device, in particular contact surface and heat transfer.
- Increase of temperature settings result in increased thermal stress and consequently, in some cases, in faster burning (formation of crackings).
- Crackings on the contact surfaces impede heat transfer and consequently the melting process.
- Electric heat output of melting drum or melting plates.
- For extruders, screw geometry and driving power have an effect on melting rate.

3.4 Application temperature

Application temperature is the temperature at which the hot melt adhesive is applied to the film. Set application temperature according to recommended values indicated in technical datasheet of the respective hot melt adhesive.

Perform a control measurement with penetration probe in melt or with infra-red thermometer (when measurement is taken on roller).

The recommended application temperature mostly allows tolerances of 15 to 20 °C. This tolerance can be used as follows:

- Lower temperature:
 - higher viscosity
 - less heat energy
 - reduces open time

- use with high room/material temperature
- Higher temperature:
 - lower viscosity
 - more heat energy
 - extends open time
 - use with low room/material temperature

When applying adhesive with roller, ensure that recommended processing temperature is attained at roller, since roller can not be heated.

A temperature check is recommended after approx. 30 minutes of processing. By changing the application temperature, usually application quantity is changed as well.

Typical signs for improper temperature settings:

- Too low: Adhesive film has a mat finish. Roller structure visible on adhesive film.
- Too high: Strong smoke formation, adhesive turns brown.

Application using a nozzle is mostly stable regarding temperature setting and application quantity since nozzle is heated.

However, make sure that adequate energy is provided to reach the required application temperature with high extrusion rates.

If necessary, increase temperature in pre-melting device/hose (see note/temperature settings pre-melting).

Typical signs for improper temperature settings:

- Too low: Adhesive film has a scaly structure over entire surface or in parts. The adhesive film tears at high speed.
- Too high: Smoke formation, adhesive turns brown.

3.5 Application Quantity

Please refer to the technical datasheets of the adhesive manufacturer for reference values for the individual products.

In general, application quantities are defined by the materials used:

- Porous materials, e.g. chipboards, veneer: higher application quantities
- Thick wrapping materials, e.g. CPL, laminate: higher application quantities

- Dense / smooth materials, e.g. MDF, HDF, PVC: smaller application quantities
- Thin films, e.g. 60 to 100 g – paper PVC film: smaller application quantities

Some reference values:*

• Veneer on MDF	max. 150 g/m ²
• Veneer, raw	180–250 g/m ²
• Veneer, fleece-backed	80 - 150 g/m ²
• CPL, laminate	80–150 g/m ²
• 120 g paper	60–100 g/m ²
• 60 g paper	40–60 g/m ²
• Thermoplastics	40–80 g/m ²

If necessary, perform tests with different application quantities; starting with the mean reference value, variations with more or less adhesive are possible depending on the result.

Measuring of the application quantity is performed using scales (reading accuracy 0.01 g) and test areas as large as possible (100 or 200 cm²). Machine presettings of application quantity shall be checked and adapted to modified production conditions.

***Note:** the lower reference values normally only apply to unfilled adhesives, upper reference values to filled adhesives. In any event, machine speed must be taken into consideration.

3.6 Processing Viscosity

Viscosity (identical to resilience) is the degree of resistance of a liquid when exposed to an external force. The higher the value, the more viscous the liquid. For melted liquid adhesives, the following rule applies:

The higher the temperature of the melt, the lower the viscosity.

The viscosity of the hot melt adhesive at processing temperature is indicated in the technical datasheet of the adhesive manufacturer.

Generally, the following applies:

- The thinner the films, hot melt adhesives with the lowest viscosity must be selected.
- When increasing the temperature, the viscosity of the adhesive decreases (also see 3.4.).
- With increasing viscosity of the adhesive, application quantity at the given temperature increases.

General designations:

Low viscosity = approx. 5.000 to 10.000 mPa's
 Medium viscosity = approx. 10.000 to 35.000 mPa's
 High viscosity = starting with 35.000 mPa's
 at processing temperature.

Slot nozzles work best with low to medium viscosities; smallest application quantities can be achieved.

Rollers are best suited for medium to high viscosity filled and unfilled products; roller structure must be adapted to viscosity. Hot melt adhesives with high viscosity normally do not allow small dosages.

Generally, roller as well as nozzle systems must be matched to the adhesive systems used. Always observe the instructions of the adhesive and machine manufacturers.

3.7 Open Time

Open time is defined as the maximum time span between application of the adhesive and the joining of the two substrates to be bonded. After open time is exceeded, the opposite side can not be wetted entirely and consequently, optimum bonding is not ensured.

The open time of profile wrapping adhesives is roughly divided into the following groups:

- OT short
- OT medium
- OT long

Fundamentally, it is to be expected that adhesives with long open times can also be processed with little feed. Open time of a hot met adhesive depends on the processing conditions such as adhesive temperature, temperature of the substrates, quantity of adhesive applied, drafts etc. If these parameters change significantly, it is recommended to adjust application temperature.

4. Characteristics of Hot Melt Adhesives for Wrapping

4.1 PUR

Polyurethane hot melt adhesive
 Reactive hot melt adhesive on polyurethane basis, also called RHM – reactive hot melt

Characteristics:

- For application purposes, PUR hot melt adhesives and nonreactive hot melt adhesives show similar properties. After application,

humidity induces a reaction resulting in a three-dimensional cross-linking.

- PUR-hot melt adhesives can be processed at lower application temperatures than non-reactive hot met adhesives. The initial strength of the bond is sufficient for standard further processing of the manufactured components.

Application:

- High resistance to heat, cold and humidity
- Very high shear, torsional and peel strength
- Very good aging resistance

Special requirements:

- Special packaging; moisture protection!
- Special processing equipment required

Labeling:

- Request and observe safety datasheet

4.2 PO

Polyolefin hot melt adhesive

Characteristics:

- Thermoplastic hot melt adhesive
- Filled and unfilled products are used.
- Product viscosities in low to medium range.

Application:

- High heat resistance
- PO-hot melt adhesives have good thermoplastic properties: softening only starts in the upper operating range;
- Sufficient joint strength in the 100 °C range.

Labeling:

- No mandatory labeling according to the German Gefahrstoffverordnung (GefStoffV) (Ordinance on Hazardous Substances) and related EU guidelines

4.3 EVA

Polyethylene-vinyl acetate hot melt

Characteristics:

- Thermoplastic hot melt adhesive
- Product viscosity ranges between 5.000 to 100.000 mPas.
- Filled and unfilled products are used.

Application:

- Low to medium heat resistance

Labeling:

No mandatory labeling according to the German Gefahrstoffverordnung (GefStoffV) (Ordinance on Hazardous Substances) and related EU guidelines

4.4 PA

Polyamide hot melt adhesive

Characteristics:

- Thermoplastic hot melt adhesive
- Filled and unfilled products are used

Application:

- High cohesion strength;
- High heat resistance
- Strong glue joint

Restriction:

- Short open time

Labeling:

No mandatory labeling according to the German Gefahrstoffverordnung (GefStoffV) (Ordinance on Hazardous Substances) and related EU guidelines

Feature Profile of Hot Melt Adhesives for Profile Wrapping				
Basis	EVA	PUR	Polyamide	PO
Adhesion	good	very good	good	good
Heat resistance [°C]	Up to 80°C	> 150°C	Up to 120°C	Up to 120°C
Water resistance	satisfactory	very high	satisfactory	satisfactory
Processing	standard	very high	high	standard

Selection Diagram per Application for Different Substrates							
Profile core Wrapping material		1 Chipboard	2 MDF	3 Solid wood	4 Aluminum chromated or primed	5 PVC-window profile primed	6 WPW (on PO basis)
1	Raw veneer	EVA PO PUR PA	EVA PO PUR PA	EVA PO PUR PA	PUR	not common	PO
2	Veneer, fleece- backed	EVA PO PUR PA	EVA PO PUR PA	EVA PO PUR PA	PUR	PUR	PO
3	Thin paper film (<60 g/m ²)	EVA unfilled PO PO unfilled PUR PA	EVA unfilled PO PO unfilled PUR PA	EVA unfilled PO PO unfilled PUR PA	PUR	not common	PO
4	Standard paper film (>60 g/m ²)	EVA PO PUR PA	EVA PO PUR PA	EVA PO PUR PA	PUR	not common	not common
5	CPL film	PO PO unfilled PUR PA	PO PO unfilled PUR PA	PO PO unfilled PUR PA	PUR	not common	not common
6	Thermo- plastic film	EVA PO PUR	EVA PO PUR	EVA PO PUR	PUR	not common	not common
7	PVC film	EVA PUR	EVA PUR	EVA PUR	PUR	PUR	PO

6. Literature

- DIN EN 923, Adhesives – Terms and Definitions
- TKH-4 Technical Briefing Note Hot Melt Adhesives

The information and specifications in this technical briefing note reflect to the best of our knowledge the current state of technology. They are only intended for information purposes and as a nonbinding guideline. As a result, they cannot be used as a basis for deriving any warranty claims.