

TKH Briefing Note 6

Version: September 2024

Profile Wrapping

Prepared by the Technical Working Group on Wood Adhesives
(TKH) of
Industrieverband Klebstoffe e.V., Düsseldorf

Table of Contents

1	Introduction	2
2	Definitions and terms	2
2.1	Materials used.....	2
2.2	Process	3
3	Processing criteria for hot melt coating adhesives	3
3.1	Melting process.....	3
3.2	Temperature setting.....	3
3.3	Melting capacity	3
3.4	Application temperature.....	4
3.5	Application quantity	4
3.6	Processing viscosity	4
3.7	Open time	5
4	Characteristics of the hot melt adhesives for profile wrapping.....	5
4.1	PUR.....	5
4.2	PO	5
4.3	EVA.....	5
4.4	PA.....	6
4.5	Comparison of the property profile of hot melt adhesives for profile wrapping	6
5	Selection scheme for different substrates	6
6.	Literature	6

1 Introduction

Profile wrapping is an established and one of the most widely used processes in wood and furniture production. Profile wrapping is generally used for finishing furniture components, door and window profiles, panels for wall and ceiling cladding, skirting boards and other similarly designed elements. The profiles to be wrapped can be made from a vast range of different materials. The wrapping material usually consists of a flexible foil or veneer. It is important that the wrapping material can form a permanent bond with the profile at all contact points during the wrapping process.

The purpose of profile wrapping is generally to improve both the aesthetic and the technical-functional properties of the material, ensuring that the final product better meets the requirements of its intended use compared to an unwrapped profile. The profile core may be wrapped fully, but partial wrapping is also possible.

Today, hot melt adhesives are used to bond the profile to the foil.

The purpose of this technical briefing note is to provide manufacturers of wrapped profiles with some fundamental information on the use of hot melt adhesives in wrapping processes.

2 Definitions and terms

2.1 Materials used

- Profiles: These are the carrier materials. They have the shape of a bar and have the same cross-section over their entire length. Profiles can be made of solid wood, wood-based materials such as chipboard, MDF, composites of wood and thermoplastic materials, also known as WPC (wood-plastic composites), plastic materials, metals, such as aluminum or steel, or any combination of these. To improve the adhesion of the adhesive, the profiles may be coated with adhesion promoters (so-called primers) in advance. Depending on the type of profile, processes such as flame treatment or plasma treatment may also be used.
- Foils: These are the coating materials in the wrapping process. They are offered on reels for industrial production. In order to achieve the best possible results, they must be adapted to the requirements of the subsequent use of the component. For outdoor use, for example, they must be resistant to weathering and sunlight. In addition to resin-impregnated papers, CPL and thermoplastic foils, raw and fleece-laminated veneers are also used (these can also appear as sheet material). Depending on the material, the foil may be supplied by the manufacturer with a pre-

applied primer coating or a corona treatment. For the wrapping process, the foils must be flexible enough to be applied to the entire surface of the profile during the wrapping process. If necessary, the required flexibility must be created during the profile wrapping process by means of suitable process control.

- According to DIN EN 923, a hot melt adhesive is defined as a thermally fusible adhesive system that develops cohesion (internal strength) after cooling. Detailed information on hot melt adhesives for furniture production, their composition, physical and chemical properties in general, is summarized in the hot melt adhesives technical briefing note published by TK Holzklebstoffe.
- Special hot melt adhesives with specific chemical compositions and physical properties are used in profile wrapping. In addition to the bonding requirements, the hot melt adhesive must be selected according to the materials to be processed and the technical machine conditions.

2.2 Process

In profile wrapping process, the before mentioned materials hot melt adhesive, foil and profile core are processed into one workpiece in a continuous process. The foil is first coated with the liquefied hot melt adhesive. The adhesive is either applied via a slot nozzle or a roller. The coated foil is then pressed against the profile core using pressure elements, such as rollers or shoes arranged in a pressure zone corresponding to the profile core. During the pressing process, the hot melt adhesive cools down, solidifies and bonds the foil to the profile core. After leaving the pressure zone, a firm bond is formed between the foil and the profile core. The strength of the bond is usually so high that the coated workpiece can be processed immediately.

3 Processing criteria for hot melt coating adhesives

3.1 Melting process

Thermoplastic hot melt adhesives are usually supplied in the form of free-flowing granules. The granulate must be dry and free of impurities during processing.

PUR hot melt adhesives are usually supplied in block form.

All coating hot melt adhesives can be melted in tank melters, quick-melt units, hotplate melters or extruders. The melt can then be easily transported to the application units via gear pumps and heated hoses.

For PUR hot melt adhesives, the melting units must have a special non-stick coating and be airtight. In the case of tank melters, nitrogen or dry air is blown into

the tank space above the melt to prevent a premature chemical reaction.

As a general rule, the melting equipment used must be clean before starting work. Any burnt residues must be removed. Residues of other hot melt adhesives must also be completely removed.

3.2 Temperature setting

The most suitable melting temperature for each adhesive type for tank melters, quick-melt units, hot-plate melters or extruders is specified by the adhesive manufacturer in the technical data sheets. It must be followed in order to ensure the best possible bonding performance of the adhesive and to avoid thermal damage. This is particularly important for tank melters. Due to their design, larger quantities of adhesive are melted and held at higher temperatures for longer periods of time.

The same applies to melting devices downstream of heated buffer tanks as to melting devices.

Extruders occupy a special position among the melting devices. They generate the temperature for melting by pressurizing and friction of the continuously flowing granulate. As a rule, the melting process is only started with the heating sleeves on the extruder. As the process continues, the pellets are then heated by friction to such an extent that the melting process continues independently. The temperature generated here is usually only slightly above the softening temperature of the pellets and therefore significantly lower than the melting temperature of tank melters, quick-melt devices or hot plate melters, which is already in the range of the application temperature. Appropriate equipment is therefore required to reach the application temperature.

3.3 Melting capacity

The melting capacity in the melting unit essentially depends on the following factors:

- The type and heating capacity of the melting unit, in particular the available contact surface and the heat transfer. In extruders, for example, the screw geometry and speed have a particular influence on the melting capacity.
- Softening point of the adhesive: The higher the softening point, the slower the adhesive melts.
- Filler content: Experience has shown that unfilled adhesives require more energy to melt than filled adhesives.
- Melting temperature setting: The higher the setting, the greater the thermal load on the hot melt adhesive. To avoid damage, the exposure time should be kept as short as possible.

- Burnt adhesive residues on the contact surfaces reduce the heat transfer and slow down the melting process

3.4 Application temperature

The application temperature is the temperature at which the hot melt adhesive is applied to the foil. It must be ensured in accordance with the specifications in the technical data sheet for the hot melt adhesive.

A control measurement is carried out using immersion thermometers in the melt or infrared thermometers (when measuring on a roller or slot nozzle).

The application temperature is usually specified as a temperature range and has the following effects with roller or slot nozzle application:

- Lower temperature:
 - higher viscosity
 - less heat energy
 - shorter open time
 - applicable at higher room/material temperature
- Higher temperature:
 - lower viscosity
 - more heat energy
 - longer open time
 - e.g. applicable at low room/material temperature

Changing the application temperature usually also changes the application quantity.

If processors apply the adhesive at a temperature outside of the range specified by the adhesive manufacturer, this can lead to unsatisfactory bonding results.

If this is unavoidable in individual cases, it must be clarified in advance with the adhesive manufacturer.

3.5 Application quantity

Standard values for the respective hot melt adhesives can be found in the technical data sheets of the adhesive manufacturers.

The application quantity is often specified as an application quantity range. In general, the respective application quantity depends on the surface quality of the carrier profile and the wrapping material. Some examples:

- Veneer on chipboard:
Application quantity in the upper range
- CPL on chipboard:
Application quantity in the upper range

- Plastic foil on PVC profile:
Application quantity located in the lower area
- Decor paper on MDF profile:
Application quantity in the lower range

Due to the large number of possible material combinations, preliminary tests with different application quantities are always necessary for an optimum bonding result, both from a technical and an economic point of view.

The application quantity is checked using a scale (display accuracy 0.01 g) and the largest possible test area (100 or 200 cm²). Machine settings for the application quantity on the processing system must always be checked and continuously monitored.

3.6 Processing viscosity

Viscosity (also known as toughness) is the measure of the resistance of a liquid to the action of an external force. The higher the value, the 'tougher' the liquid flows.

The viscosity of the hot melt adhesive at processing temperature is specified in the adhesive manufacturer's technical data sheet.

The following generally applies:

- The thinner the foils, the lower the viscosity of the hot melt adhesive to be used.
- Increasing the temperature reduces the viscosity of the adhesive (see also 3.4).
- The application quantity increases as the viscosity of the adhesive increases.

With regard to the viscosity of hot melt adhesives at processing temperature, the following rough classification applies:

Low viscosity	=	5,000 to 10,000 mPa.s
Medium viscosity	=	10,000 to 35,000 mPa.s
Higher viscosity	=	35,000 to 60,000 mPa.s
High viscosity	=	from 60,000 mPa.s

Slot nozzles usually work with low to medium viscosity. With suitable pumps, however, higher viscosity and high viscosity hot melt adhesives can also be processed. Preferably unfilled products are used here. With slot nozzles, even the smallest application quantities can be applied very precisely and homogeneously over the entire surface. They represent the state of the art for coating materials that are processed from a roll.

Rollers are suitable for medium to high viscosity filled and unfilled products; the roller structure must be adapted to the viscosity. High-viscosity hot melt adhesives usually do not allow a low dosage.

In general, both rollers and nozzle systems must be matched to the adhesive systems used. The instructions of the adhesive manufacturer and the machine manufacturer must be taken into account.

3.7 Open time

The open time is the maximum time that may elapse between the application of adhesive and the joining of the two substrates to be bonded under pressure. If the open time is exceeded, complete wetting of the opposite side with adhesive is not achieved and therefore optimum bonding is no longer guaranteed.

Attention: Hot melt adhesives do not have an open time in the usual sense. Due to potentially undesirable cooling effects between application and bonding, the temperature of the materials to be bonded and that of the environment have an eminent influence on the bonding result. Drafts acting on freshly applied hot melt adhesive should generally be avoided. With this in mind, the relevant information in the adhesive manufacturer's technical data sheets must be strictly observed and taken into account accordingly during the application process.

The open time of hot melt adhesives is roughly categorized into the following groups:

- OT short = up to 5 seconds
- OT medium = up to 10 seconds
- OT long = longer than 10 seconds

4 Characteristics of the hot melt adhesives for profile wrapping

4.1 PUR

Reactive hot melt adhesive based on polyurethane

Properties:

- In terms of adhesive application, PUR hot melt adhesives behave in a similar way to chemically nonreactive hot melt adhesives. After application, moisture from the ambient air triggers a chemical reaction that leads to three-dimensional crosslinking inside the adhesive.
- PUR hot melt adhesives can usually be processed at a lower application temperature than non-reactive hot melt adhesives.

Application:

- High resistance to heat, cold and moisture
- Very high shear, torsion and peel strength
- Very good ageing resistance
- Special requirements:
- Special processing equipment required (protection against moisture ingress)

Labelling:

- Request and observe safety data sheet

4.2 PO

Polyolefin hot melt adhesive

Properties:

- Thermoplastic hot melt adhesive
- Filled and unfilled products in use
- Application:
- High heat resistance

Labelling:

- Not subject to labeling according to GefStoffV (German ordinance on hazardous substances) and EU directives

4.3 EVA

Poly-ethylene-vinyl-acetate hot melt adhesive

Properties:

- Thermoplastic hot melt adhesive
- Filled and unfilled products in use

Application:

- Low to medium heat resistance

Labelling:

- Not subject to labelling according to GefStoffV (German ordinance on hazardous substances) and EU directives

4.4 PA

Polyamide hot melt adhesive

Properties:

- Thermoplastic hot melt adhesive
- Filled and unfilled products in use

Application:

- High cohesive strength;
- High heat resistance
- Hard adhesive joint
- Limitation:
- Short open time

Labeling:

- Not subject to labeling according to GefStoffV (German ordinance on hazardous substances) and EU directives

4.5 Comparison of the property 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	up to 150 °C	up to 120 °C	up to 120 °C
Moisture resistance	satisfactory	very high	satisfactory	satisfactory
Process complexity	low	high	increased	low

5 Selection scheme for different substrates

Profile core		1 Chipboard	2 MDF/HDF	3 Solid wood	4 Aluminum profile pre-treated with primer	5 PVC window profile pre- treated with primer	6 WPC (on PO basis)
1	Raw veneer	EVA PO PUR PA	EVA PO PUR PA	EVA PO PUR PA	PUR	not common	PO (PUR after adequate pre-treatment)
2	Veneer, fleece-backed	EVA PO PUR PA	EVA PO PUR PA	EVA PO PUR PA	PUR	PUR	PO (PUR after adequate pre-treatment)
3	Thin paper foil (<60 g/m²)	EVA unfilled PO unfilled PUR PA	EVA unfilled PO unfilled PUR PA	EVA unfilled PO unfilled PUR PA	PUR	not common	PO (PUR after adequate pre-treatment)
4	Paper foil (>60 g/m²)	EVA PO PUR PA	EVA PO PUR PA	EVA PO PUR PA	PUR	not common	PO (PUR after adequate pre-treatment)
5	CPL	PO PUR PA	PO PUR PA	PO PUR PA	PUR	not common	not common
6	Thermo-plastic foil	PUR	PUR	PUR	PUR	PUR	PO (PUR after adequate pre-treatment)

6. Literature

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

All available leaflets of the
Technical Committee Wood Adhesives (TK)
of the Industrieverband Klebstoffe e.V.
can be found in the currently valid version at

**www.
klebstoffe
.com**

The information platform on the internet.