VESTOPLAST® 206

Silane-modified Poly-α-olefin

34.13.069e / 12.04

General Description

VESTOPLAST 206 is a reactive adhesive raw material which is characterized by its excellent adhesion to a very wide range of plastics (e.g. polypropylene, polyester and polyamide), to wood and such 'hard-to-adhere-to' polar substrates as glass, ceramics and metals.

Use

By combining VESTOPLAST 206 with the typical components used in the adhesives industry, completely new types of glues and adhesives can be formulated.

The properties of these hot melt adhesive systems widen considerably the range of applications in which amorphous polyolefins are used:

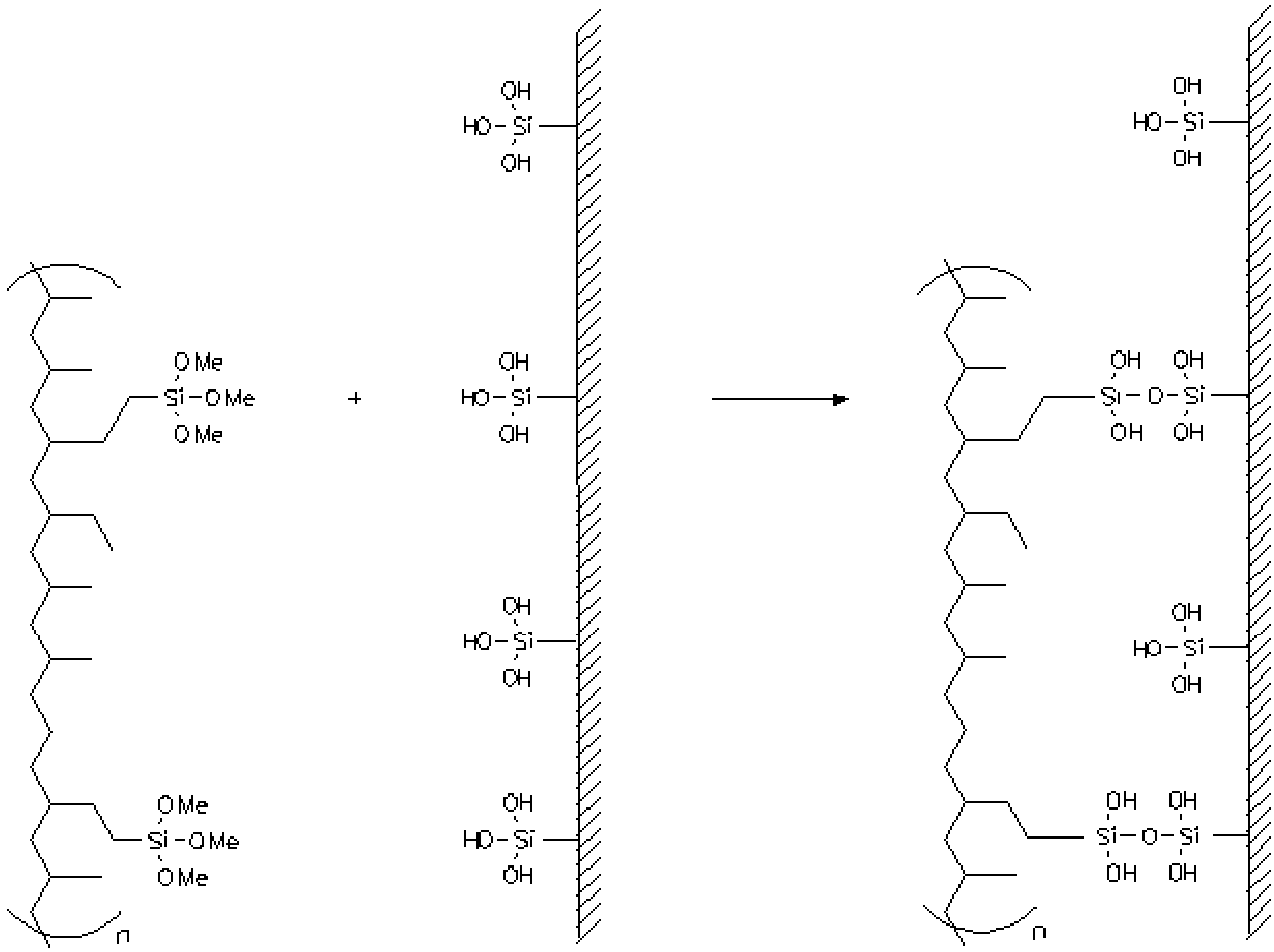
- Bonding two types of plastics (e.g. PP/PP, PE/PA or PE/polyester)
- Bonding various combinations of glass, metal and ceramics in the construction and automotive industries
- Wood adhesives for which a high degree of thermal stability is required
- Manufacture of sealants with a high filler content and in which there is efficient bonding to the fillers used.

Mode of action

The silane-modified Poly-α-olefin VESTOPLAST 206 is a reactive adhesive raw material.

Once the low viscosity melted material has been applied, the silane functionality in VESTOPLAST 206 can undergo strong chemical bonding, linking the polymer chains of the adhesive layers to OH groups on the surface of the substrate. Once the melted material has been applied, the adhesion to substrates such as glass or ceramic increases significantly.

Furthermore, the polar character of this adhesive raw material also improves adhesion to plastics such as polyesters and polyamides, i.e. to substrates that are normally difficult to bond using amorphous Poly-α-olefins. The chemical bonding underlying the enhanced adhesion to the substrate is shown schematically in Figure 1.

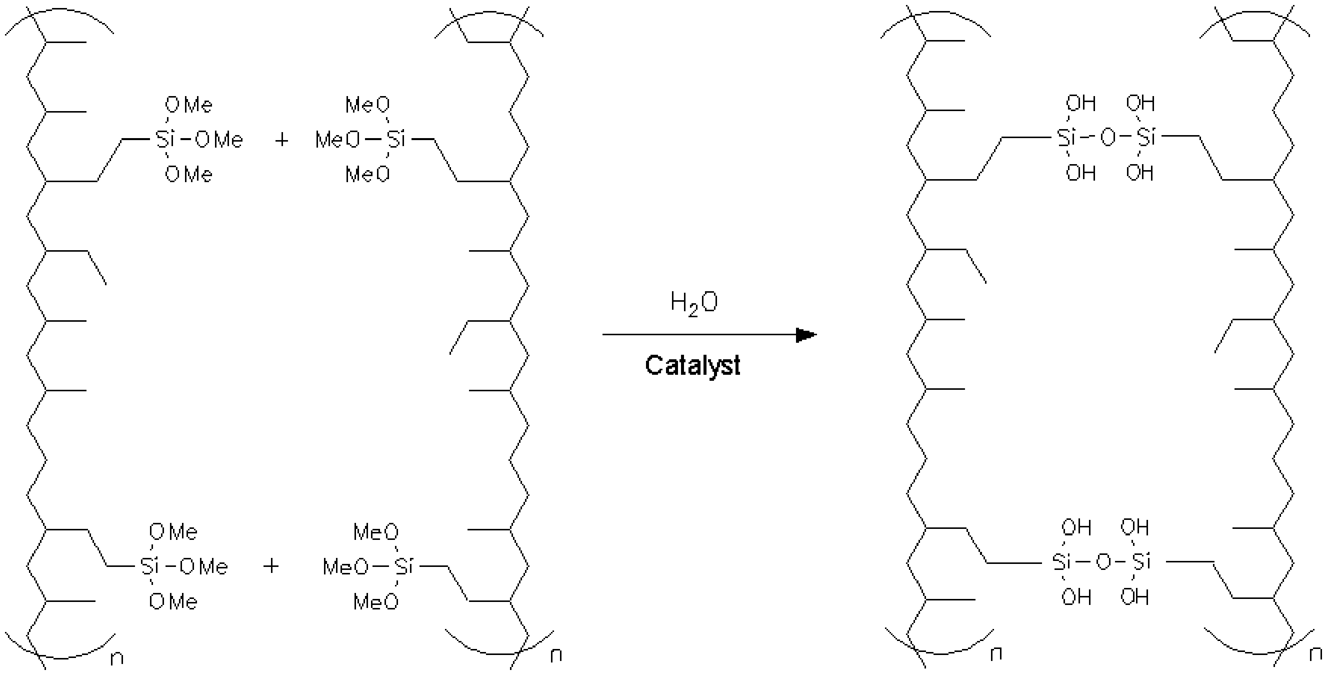


VESTOPLAST 206 | glass surface | VESTOPLAST 206 bonded to a glass surface

Fig. 1: Bonding of a silane-modified Poly-α-olefin (VESTOPLAST 206) to a glass surface

Once the film has been applied, the polymer chains also crosslink with one another under the influence of moisture as evidenced by the strong increase in the film's cohesion and its viscosity. These changes are not accompanied by an increase in the brittleness of the material; the elongation at break of approximately 800 % is retained.

The crosslinking reaction which causes the increase in cohesion is illustrated schematically in Figure 2.



VESTOPLAST 206 VESTOPLAST 206 cured VESTOPLAST 206

Fig. 2: Crosslinking of polymer chains in the silane-modified Poly-α-olefin (VESTOPLAST 206)

Curing (crosslinking) begins immediately after application of the adhesive to the substrate and, in the case of thick layers stored in air at 23 °C, reaches completion within 8 weeks. In thinner layers, curing proceeds significantly faster. The time required for curing depends upon the availability of moisture within the bonding joint and this is, in turn, dependent on the rate of diffusion of moisture from the exterior and on the water content of the substrate.

Adhesion is considerably greater therefore in the case of water-containing substrates such as wood or those with ‘dangling’ OH groups such as glass or ceramics, due to the formation of covalent bonds with the silane groups.

The curing rate can be increased substantially by the addition of a promoter such as dibutyl tin dilaurate (DBTL), or by increasing temperature and moisture content. By varying the quantity of promoter added, the curing time can be adjusted to meet a customer’s specific demands. Typically, quantities of up to 0.1 % DBTL prove expedient. Amounts of DBTL of between 0.02 and 0.1 %, premixed with an inert ingredient such as a conventional VESTOPLAST grade, a hydrocarbon resin or a PE wax have proved particularly easy to handle. How the fraction of promoter influences the rate of cure is illustrated in Figure 3 and 4.

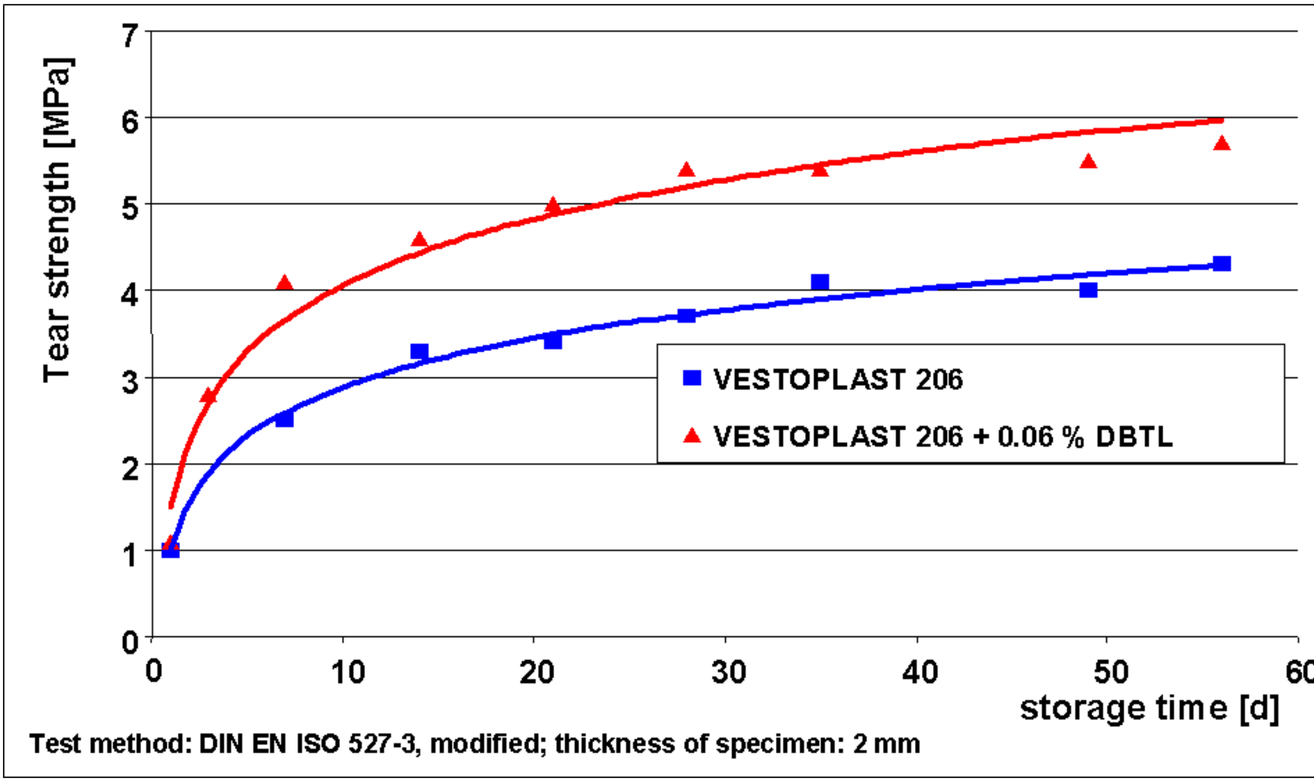


Fig. 3: Cohesion of VESTOPLAST 206: tear strength vs. time with and without curing accelerator DBTL

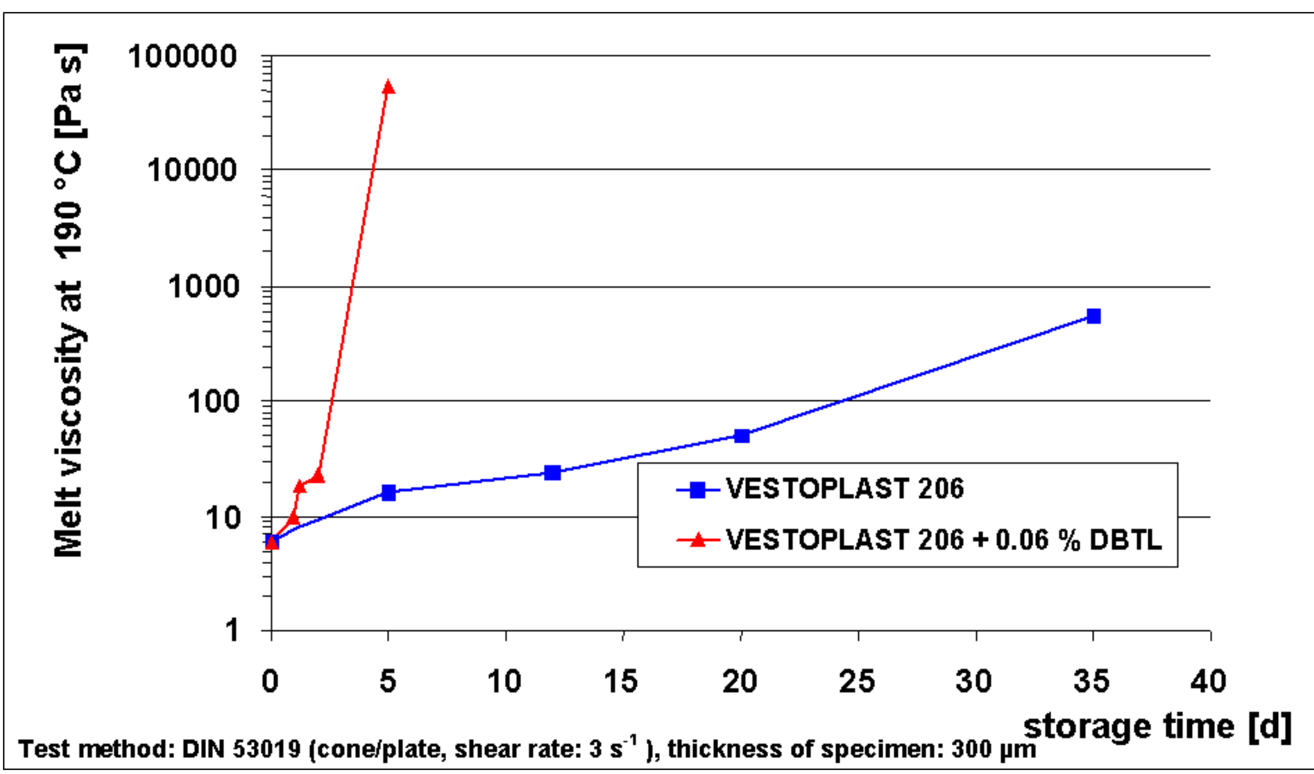


Fig. 4: Curing of thin layers of VESTOPLAST 206: Influence of the curing accelerator DBTL

Crosslinking within the adhesive layer increases the thermal stability of the bond. For example, the thermal stability of wood/wood bonds formed by VESTOPLAST 206 with 0.06 % DBTL after 14 days of storage at 20°C and at a relative humidity of 65 % increases from under 110°C to more than 180 °C (test method employed is analogous to WPS 68 but uses a 1 kg load). The moisture required for curing can be supplied by the ambient atmosphere, by hot water or steam treatment or can be drawn from the surface of the substrate. When moisture can only diffuse in to the bonding joint with difficulty (e.g. when bonding metals), the time required for curing may be longer.

The cooling of VESTOPLAST 206 during curing means that, once applied, the material rapidly achieves a sufficiently high initial strength. This enables assembly to continue whilst the bond is still curing and means that there is no need to clamp the joint and that no time is lost due to curing delays.

By adding further substances to VESTOPLAST 206 such as adhesive resins, waxes, other polymers (polyolefins, rubbers etc.), fillers, plasticizers and stabilizers, the compounder can create formulations with the required degree of adhesive strength, initial bond strength, viscosity, hardness, elasticity, thermal stability and resistance to oxidation. It is important to realize that water that may be present in these additives can increase the curing rate.

The most important properties of VESTOPLAST 206 at a glance

Property	**VESTOPLAST 206**	**Unit**	**Test procedure**
Melt viscosity at 190 °C	5,000 ± 1,000	mPa s	based on DIN 53 019 (rate of shear: 30.5 s^{-1})
Softening point (ring and ball method)	98 ± 4	°C	based on DIN EN 1427
Needle penetration (100/25/5)	19 ± 3	0.1 mm	based on DIN EN 1426
Molecular mass M_n M_w Polydispersity	10,600 38,000 2.6	g/mol	GPC based on DIN 55 672
Open time	approx. 20	s	In-house SOP AA-CO-RE-AA-TS2-05
Setting time	approx. 6	s	In-house SOP AA-CO-RE-AA-TS2-29
Glass transition temperature T_g	-28	°C	DTA analysis based on DIN 53 765, in-house SOP AN-SAA-0663
Density at 23°C	0.870	g/cm^3	DIN 53 479

Property		VESTOPLAST 206	Unit	Test procedure
Adhesive tensile shear strength	wood	2.3	MPa	In-house SOP QS-AA GB 2.3 AT 15-13, based on DIN EN 1465, storage period[1]: 14 d
	polypropylene	2.0		
	polyamide 6	1.7		
	fiberglass-reinforced polyester	1.6		
	PVC	1.2		
	PBT	1.8		
	leather	1.8		

[1] The substrates were bonded to one another and stored at 20 °C and at a relative humidity of 65%

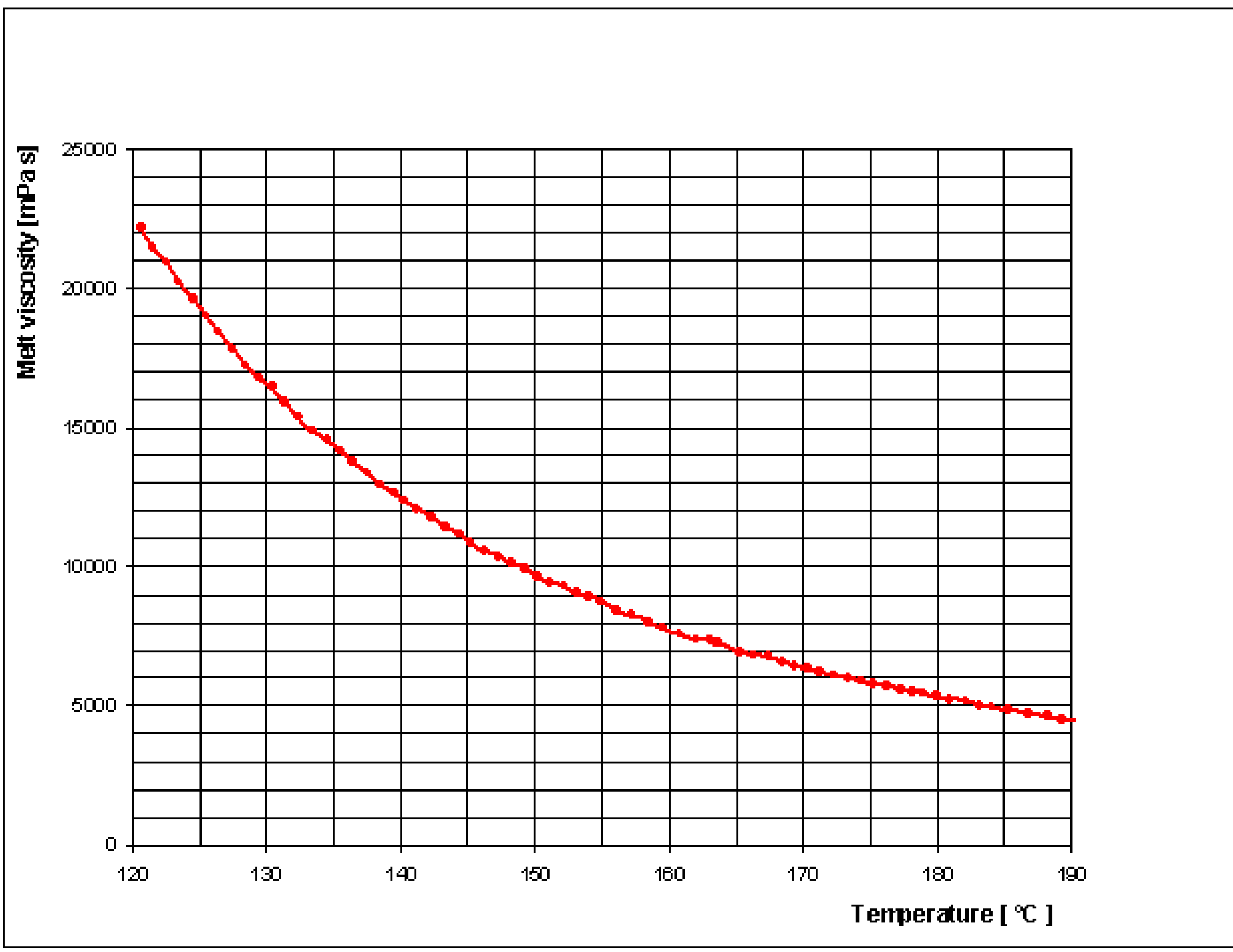


Fig. 5: Melt viscosity (plate/plate) of VESTOPLAST 206 as a function of temperature

Instructions for use

a) Use without a promoter (VESTOPLAST 206 only):

VESTOPLAST 206 is melted in a drying cabinet in a moisture-free N_2 atmosphere for 1-2 hours at 150 -180 °C. The product is then homogenized by stirring it intensely for 10 minutes at 150 - 170 °C. In the tests that we performed, we generally worked with an application temperature of around 170 °C, though temperatures up to 180 °C can also be used.

b) Use with a promoter (VESTOPLAST 206 and DBTL):

VESTOPLAST 206 is melted in a drying cabinet in a moisture-free N_2 atmosphere for 1-2 hours at 150 -180 °C. The product is then homogenized by stirring it intensely for 10 minutes at 150 - 170 °C.

Up to 0.1 % w/w of DBTL are then added. Incorporation of the promoter is facilitated by premixing it with an inert formulation component such as a hydrocarbon resin, a wax or a conventional VESTOPLAST grade. After stirring the mixture for a further 10 minutes at 150 - 180 °C, the product should then be applied. The pot life, i.e. the period in which the adhesive can be applied (as measured from the moment the DBTL promoter is added), depends upon the water-content of the other components added to the formulation and must be determined using a small test sample.

In the tests that we performed, we generally worked with an application temperature of around 170 °C, though temperatures up to 180 °C can also be used.

Safety and handling information

VESTOPLAST 206 is a moisture cure adhesive raw material. To avoid premature curing, water in whatever form should be kept away from the product until it is ready to be applied. For this reason, please:

- handle the melted material under an inert gaseous blanket,
- do not expose the melted material to air or, if unavoidable, please ensure that the exposure time is kept to an absolute minimum,
- handle the melted material at the lowest possible temperature,
- ensure that, wherever possible, the other components added to the formulation are moisture- or water-free,
- keep all samples in closed containers, storing them if necessary with a dessicant.

If the product has been used on machines with hard-to-access parts (e.g. narrow bore capillary tubing), these parts should be thoroughly rinsed with a melted polyolefin (e.g. VESTOPLAST 708) or a suitable solvent in order to free them of any cured VESTOPLAST 206 residues, which could cause blockages.

VESTOPLAST 206 may contain volatile components. The melted material should therefore only be used where there is adequate ventilation. Please read and comply with the information provided in the safety data sheet. We would be happy to send you the current version of the safety data sheet on request.

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