

PLASTIC ADDITIVES  
**BONDING AGENTS**





The unique advantage:

## Expertise of a strong partner

With decades of experience and customers spread across the globe, LANXESS is already one of the world's major chemical manufacturers. LANXESS was formed in 2004 through the carve-out of major portions of the chemical activities of the Bayer Group and parts of its polymer operations, which means it has many years of experience to look back on, with roots going all the way back to the founding of Bayer in 1863. This is the basis on which LANXESS now develops, produces and markets a portfolio consisting of basic and fine chemicals, color pigments, plastics, fibers, special-purpose rubbers, rubber chemicals, material protection and water treatment products and chemicals for the production of leather, textiles and paper. In so doing, LANXESS provides reliable solutions worldwide for a wide range of different applications.

LANXESS has the experience and sound market knowledge of an established global player, combined with the commitment of a new, young enterprise. This is a combination that makes LANXESS strong and active. We are ready to break new ground, when and wherever our customers ask us to go.

You want the very best - so do we. Together we can build on this common ground, because LANXESS offers you the best conditions for a continued and successful partnership. Our claim is to provide our partners with all-important stimulus through innovative concepts and a customer-focused and solution-oriented approach that allows you to develop unique products.

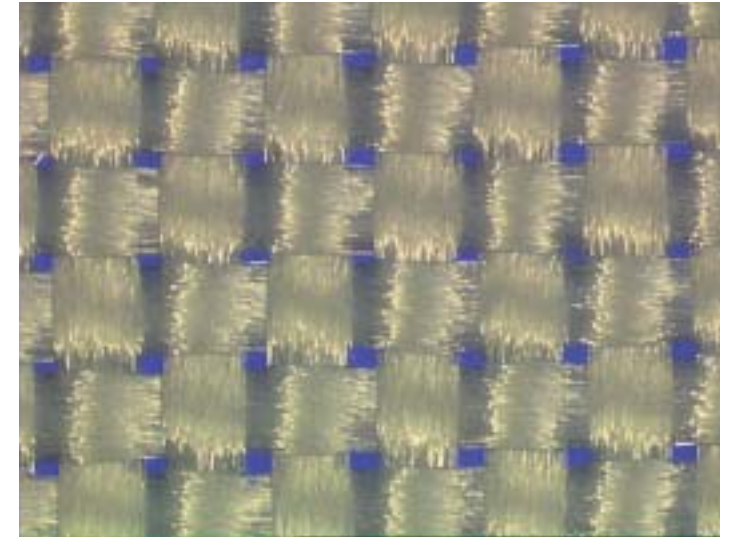
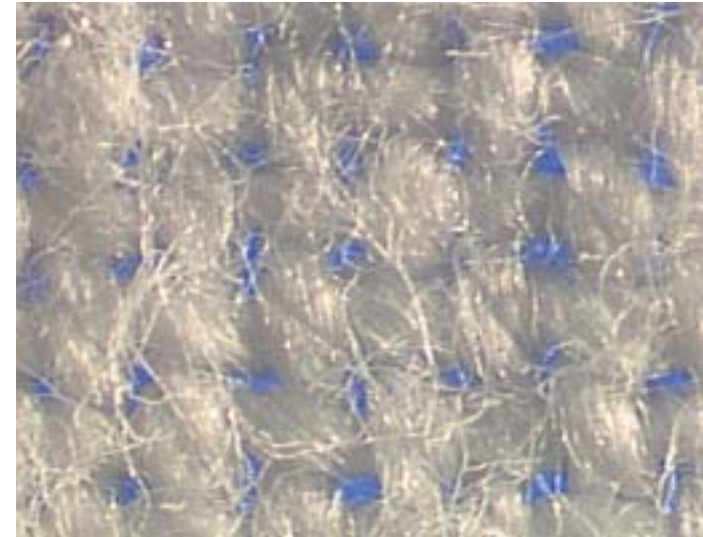
In the area of plastic additives this involves, above all, a consistent strategy to meet the market's commercial, technical and chemical demands, alongside a wide range of products. LANXESS taps extensive expertise and application-related experience for the development of modifiers, plasticizers, bonding agents and blowing agents, and as a customer you benefit from this. From the development of formulations and

individual customization to meet specific product requirements through to process optimization, knowledge from each individual area of application is used consistently to enable optimization in all related areas. In addition, LANXESS has a network of research and testing departments that ensures worldwide proximity to customers and an ability to respond quickly.

And last but not least, in all our activities, we focus on one thing, namely maintaining the ecological equilibrium by taking special safety measures and remaining aware of our responsibilities in the future. After all, LANXESS's solutions involve much more than just supplying raw materials. They are always the end product of well thought out, forward-looking development, adapted to meet your requirements.

A firm bond between the PVC coating and its reinforcement material made from artificial fibers is essential for ensuring that PVC tarpaulins and films can withstand high stresses and have a long service life. Unlike with, say, cotton fabrics, which can offer sufficient support to almost any polymer thanks to their fine, fibrous structure, the use of polyamide and polyester fibers that are far stronger and hence indispensable for many technical applications creates problems in this regard. These are too smooth and provide the applied polymer with only a comparatively small surface area for permanent anchorage.

The consequence of this is that the adhesion of simple PVC plastisols to artificial fibers is just not good enough for many applications without the appropriate chemical additives. The minimal support that the smooth artificial fiber filaments offer a simple PVC coating will, at least in long-term use, cause problems. Even in conditions of comparatively low dynamic stress, the coating may detach itself from the fabric, initially just at points that are subject to the effects of force, and later over a larger area. The result may be a total breakdown of the material - with immeasurable consequences for the user, who always needs to be able to rely on the impermeability of the coated - fabric and not just for tents, dinghies or protective clothing but in other applications too. Here LANXESS bonding agents ensure long-lasting support.



Taking a look under the microscope shows us: smooth artificial fibers (right) offer much less support than a cotton fiber (left). This is why it is essential to use bonding agents when applying PVC coatings to smooth fabrics of this type.



Reliable hold for smooth fibers:

**Bonding for  
long-lasting success**

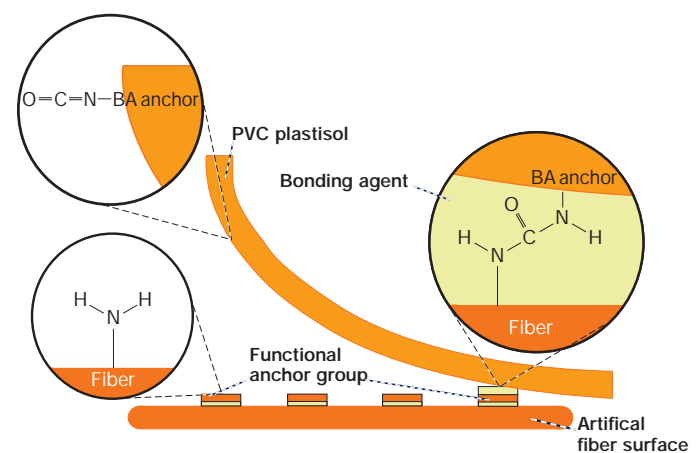
Problem-free bonding agents:

# Small quantity, big impact



Bonding agents do not act like a conventional adhesive. Instead, they are reactive chemical compounds that are able to form solid chemical bonds with certain "anchor groups" on the surface of the fiber (-OH, -NH<sub>2</sub> groups). In doing so they anchor the PVC firmly to the fiber - more firmly than would be possible if the fiber netting was merely penetrated mechanically by the PVC plastisol. Bonding agents increase the adhesion of a PVC adhesive coat to many industrially important fibers by several hundred percent.

The application of a bonding agent is extremely simple: it is sufficient to stir a few percent of this additive into the plastisol adhesive coat which can then be processed as usual. LANXESS bonding agents are compatible with most other PVC additives, which means that in many cases the same basic formula - PVC, stabilizer, plasticizer, filler, pigments - can be used for both anchor and top coats. Nevertheless, the best formula should be determined in each individual case by means of preliminary investigations and simple tests. Every fiber is different, and depending on the plastisol formulation, the resulting adhesion may frequently be optimized further through a shrewd selection of appropriate bonding agents.



The reactive bonding agents anchor the PVC polymer firmly to the fiber surface by means of actual chemical bonds with a long-lasting effect.

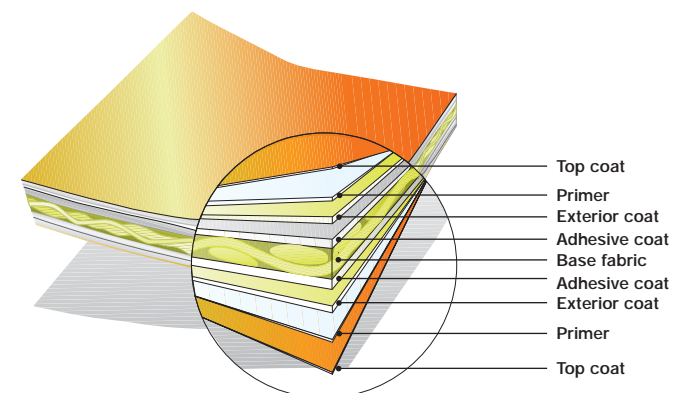
LANXESS's bonding agent systems are available as one-component and two-component technologies, which means that they can easily be individually adapted to standard production processes. Even the easy-to-handle one-component systems improve the properties of the products created and therefore provide our partners with valuable benefits in the bottom line.

If there are particular requirements to be fulfilled, for example if non-yellowing coatings are needed for background-illuminated advertising boards, then the use of specific systems is recommended. Here too, LANXESS has the right response to every challenge.

Since bonding agents have such a critical significance when it comes to achieving a long working life in quality tarpaulins that take a lot of stress, it is natural that particularly high quality

standards must be applied during their selection. Through the use of high-quality products, many sources of error can be eradicated in the early stages. For example, the purity of the bonding agent's active ingredient has a significant influence on its potlife or the adhesion achievable. Our effective quality assurance procedures and state-of-the-art production ensure that the product quality of LANXESS is always of a consistently high standard.

Through the constant optimization of LANXESS bonding agent systems the user also has confidence that he is working with additives that meet the requirements of modern PVC tarpaulin production and that offer the ideal cost-effective solution even when it comes to difficult tasks.



Layer construction of a high-quality PVC tarpaulin: the adhesive coat is responsible for the good cohesion of the product.

For a long time now PVC films with fabric reinforcement have become indispensable in many areas of our daily lives. For them to be used successfully it is essential that the polymer layers that are applied to the fabric remain bonded to one another even in the toughest conditions, therefore minimizing the risk of separation.

The requirements that the coated films must fulfill can be very different, however. For use in elegantly curved marquee roofs, for example, large expanses of PVC must withstand high tensile stress and withstand sun, frost and rain over several years - while still retaining their attractive appearance. With vehicle tarpaulins it is above all excellent weather and aging resistance that are required, furthermore the side curtains of trucks must not be sensitive to damage from sliding load parts and, even in cold weather, display high flexibility. It is here that bonding agents have to fulfill good long-term performance, even if the coating material has a high plasticizer content.

To be suitable for large areas of open-air advertising, large PVC tarpaulins must be printable and colorfast, as well as having good tear resistance at low weight; on fast-moving conveyor belts, the fabric and coating must primarily demonstrate high tensile strength and dynamic strength over long periods of use, and also have long-lasting resistance to oils and greases.

There may be additional requirements in other areas of application: for example, sacks and folding containers made from PVC-coated fabrics need to have outstanding resistance to chemicals such as oils and fuels. Safety-related articles such as protective suits or lifeboats must always be at peak performance - even after a long period of storage or, as may be the case, after having been folded to save space, they must not show any separation of the fabric.

These are the significant challenges facing the manufacturer of a comprehensive range of bonding agents.

LANXESS bonding agents have proved their worth in all these areas of application. They ensure optimum adhesion even under harsh conditions of use and can still be processed easily. LANXESS's range of bonding agents contains durable solutions for all coating tasks in the PVC industry. These range from easily dosable one-component bonding agents for all standard tasks to the coordinated two-component system for specific applications.

And the results speak for themselves: even after long-term use under adverse conditions, the products still live up to their requirements.



Total resilience:

**A wide range of products for diverse adhesive applications**

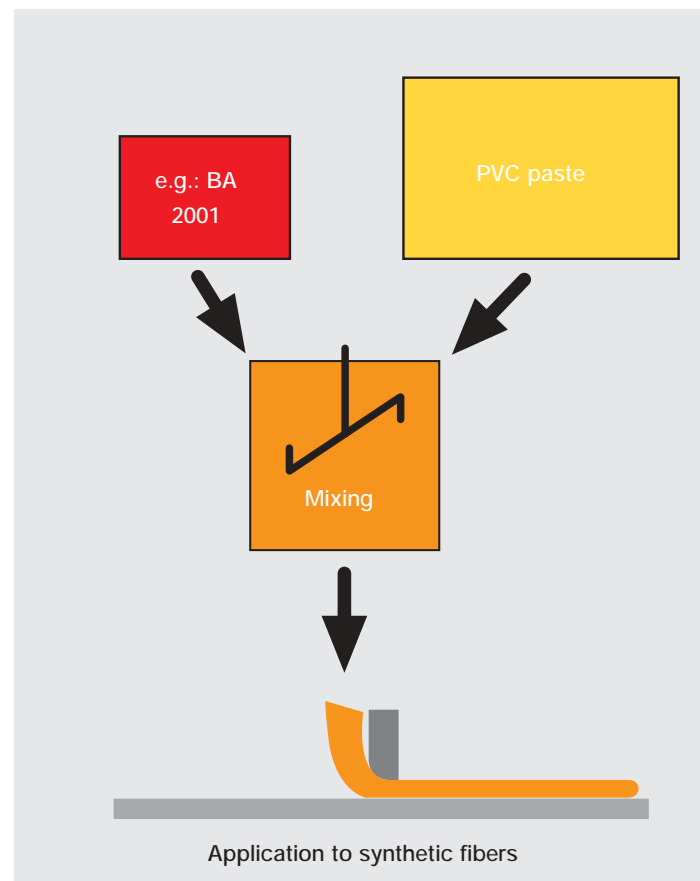
Reaching the goal quickly:

# One-component bonding agents



Every coating task is different. That's why LANXESS offers a variety of bonding agent systems that allow optimum adhesion for every situation - from the standard product as a durable solution for the majority of everyday assignments to a flexible bonding agent module with which the user where - necessary in cooperation with LANXESS experts - can also confront complex challenges.

The liquid one-component LANXESS bonding agents are stirred into the PVC plastisol until a homogeneous mixture is obtained, without time-consuming preparation work. The additives can be obtained in both a solvent-free plasticizer formulation (Bonding Agents 2001 and 2007) and in a low-viscosity, solvent-containing form (Bonding Agent 2005). The solvent-containing grades guarantee particularly easy incorporation, while the solvent-free grades ensure that the viscosity of the basic plastisol essentially remains constant during the mixing in of the bonding agent. The recommended bonding agent addition lies between two and eight percent depending on formula.



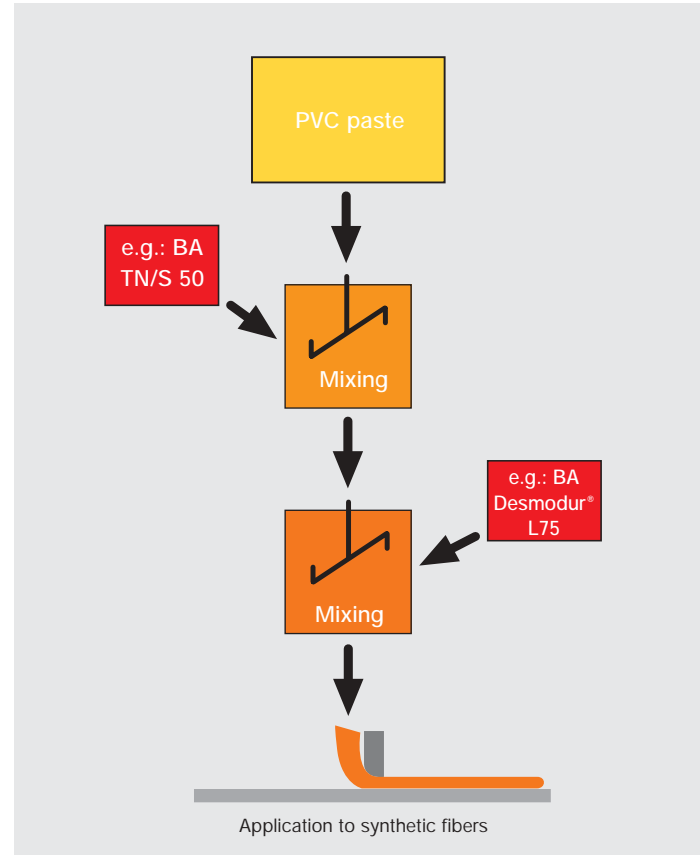
One-component bonding agent system

## One-component bonding agents

Product	Composition at 23°C [mPa•s]	Viscosity	Remarks
Bonding Agent 2001	Aromatic polyisocyanurate in DBP	10,000	Solvent-free product with wide range of applications
Bonding Agent 2005	Aromatic polyisocyanurate in n-butylacetate	85	Concentrated, low viscosity
Bonding Agent 2007	Aromatic polyisocyanurate in DOP	12,500	highly heat-resistant, solvent-free, low volatility
Bonding Agent Trial Product 51021	Aromatic polyisocyanurate in DINP	approx. 6,000 – 10,000	Solvent-free, very low volatility, lower viscosity

The two-component bonding agents that are also supplied in liquid form are specific building blocks with special properties that, for example, give a particular lightfastness to white or translucent PVC films - this allows maximum flexibility for drawing up elegant solutions for specific adhesion problems. To "engineer" a tailor-made bonding agent, the bonding agents TN/S 50 and TN/N and the associated Desmodur® crosslinking agents are mixed in pre-determined proportions (for example for polyester fabric: 3-6%, Desmodur® 2.7-5.4%) individually and subsequently homogeneously into the PVC paste.

The crosslinking agent building block Desmodur® L75 offers particularly high reactivity and is therefore suitable for particularly "fast" adhesive coats. For longer reaction times, though, its processing window can easily be enlarged by adding Potlife Enhancer 9142.



Two-component bonding agent system

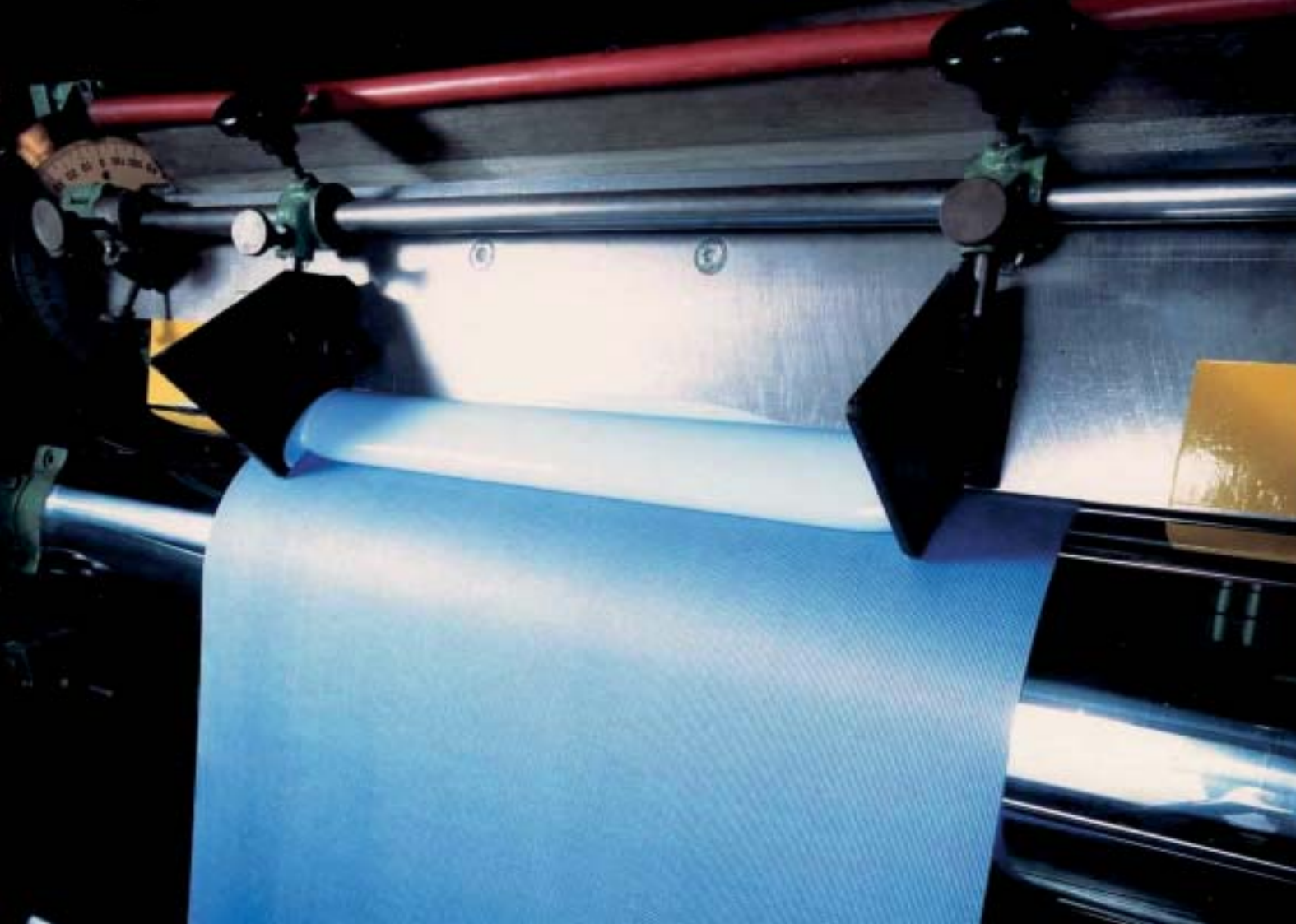
### Two component systems

Product	Composition at 23°C [mPa]	Viscosity at 23°C [mPa · s]	Remarks
Bonding Agent TN/S 50	Hydroxyl group-containing polyester (50 % OH) in BBP	860	Solvent-free
Bonding Agent TN/N	Hydroxyl group-containing polyester (70% OH) in ethyl acetate	170	Low viscosity
Desmodur® N 75	Aliphatic polyisocyanate in xylene/ethylbenzene/2-methoxy-1-methylacetate	225	Lightfast, low volatility
Desmodur® N 100	Aliphatic polyisocyanate	9,000	Lightfast, solvent-free
Desmodur® L 75	Aromatic polyisocyanate in ethyl acetate	1,600	Highly reactive
Potlife Enhancer 9142	Organic acid chloride in DINP	-	Extends the potlife, Solvent-free



Tailor made and flexible:

# Two-component bonding agents



What you should bear in mind:

## Ways to achieve optimum adhesion

LANXESS's bonding agent systems offer the best pre-conditions for the manufacture of plastisols with good adhesion. In the course of the production process there are, however, several factors in addition to the grade and quantity of the bonding agent added that are responsible for obtaining flawless adhesive properties:

- type of fabric to be coated and PVC grade
- processing temperature
- ambient air humidity
- plasticizers added
- stabilizers added
- fusion time, speed and temperature
- temperature profile of the fusion oven

These influencing factors should be investigated in the test laboratory and compensated for before each new application. In this regard, LANXESS is there to help its partners with technical assistance where required.

In general it should be borne in mind that the bonding agent should not be mixed in at too high a temperature, otherwise it is possible that the reactive chemicals will react with other components of the PVC paste and then are no longer available to bond to the artificial fiber filaments. Contact with water should also be avoided for the same reason - no air should therefore be introduced into the mixture during the stirring in; finally it must be ensured that the fabric to be coated is dry and the air humidity is not too high. Ideally, the bonding agent should not be stirred into the plastisol until just before processing.

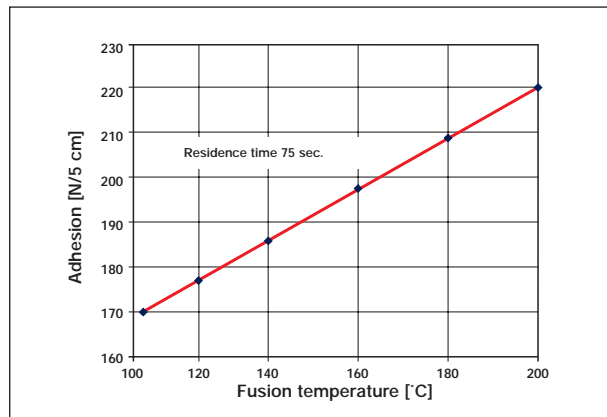
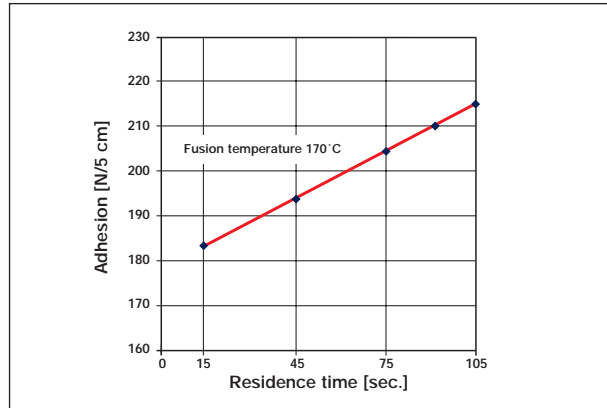


Photos: Vestolit GmbH

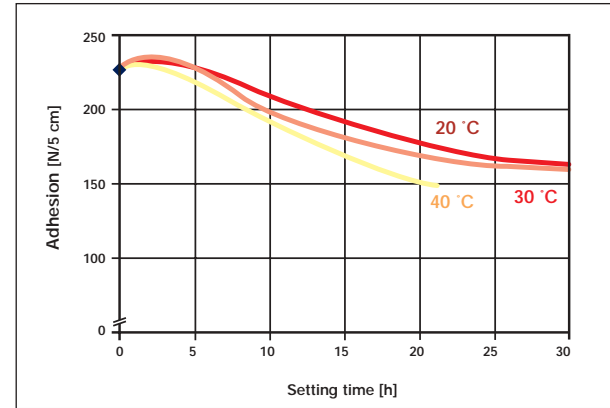
Concentrations of the bonding agent that are too high may cause the PVC to become rigid. The most suitable concentration must be determined for each individual scenario. In general, this will be between four and six percent. If sufficient adhesive strengths cannot be achieved despite ideal ambient conditions, this may be due to the use of some rarely used stabilizers that can sometimes significantly reduce the potlife of the bonding agent and thereby the adhesion of the additive-containing adhesive coat. To ensure optimum adhesion of the PVC coating to the fabric, the adhesive coat is applied in such a way that all the fabric fibers are completely covered. The quantity required for this generally lies at approx.  $100 \text{ g/m}^2 \pm 20$ ; however, it may vary according to the type of plastisol.

After having been applied by a blade, the basic coat should be pre-fused at approx.  $140 \text{ }^\circ\text{C}$  and then be given the top coat. The subsequent fusion should occur at about  $180 \text{ }^\circ\text{C}$ .

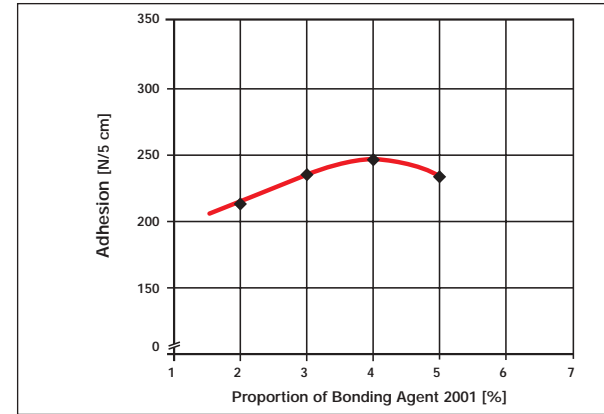
This approach ensures that the bonding agent can fully form its bonds with the artificial fiber surface and that the top coat adheres fully to the adhesive coat. Use of bonding agents is not, incidentally, limited to use on polyamide or polyester fabrics: in some cases they can also be used to advantage on other fabrics. LANXESS's application technologists will be pleased to assist in the development of new techniques for coating unusual fabrics.



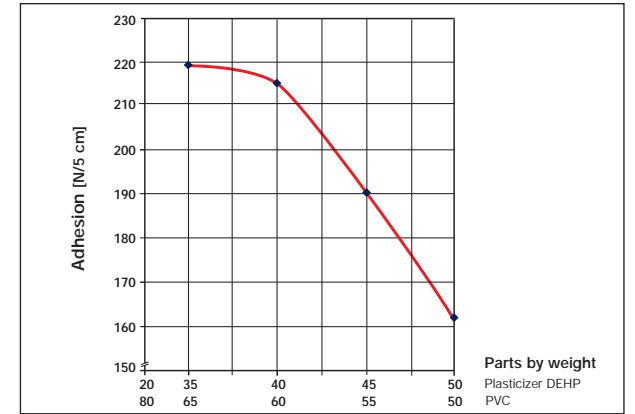
The correct temperature and residence time in the fusion oven have a significant effect on the adhesion of the adhesive coat to an artificial fiber fabric.\*



Influence of temperature and setting time on the adhesion of a PVC adhesive coat paste.\*



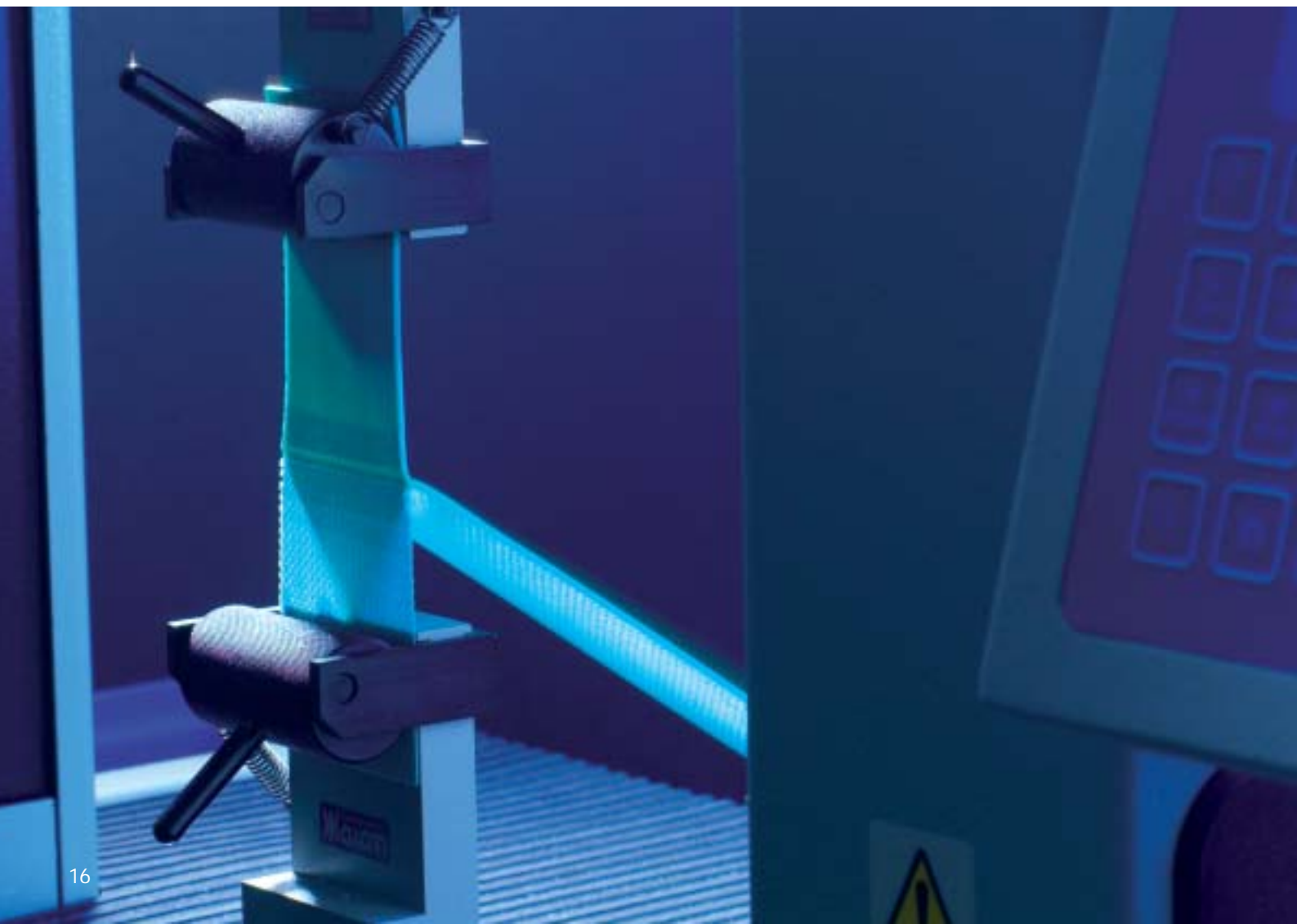
Adhesion of PVC paste to a polyester fabric.\*



Factors affecting the adhesive strength of a PVC coating include, for example, the proportion of plasticizer.\*

\* Typical measurement values: measurements of other plastisol/fabric systems give other values but display a similar trend.

Tensile testing machine



Don't get any nasty surprises:

**Make sure you test what is going to bond forever.**

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#### **Forward-looking statements**

This brochure contains forward-looking statements based on current assumptions and forecasts made by LANXESS Deutschland GmbH management. Various known and unknown risks, uncertainties and other factors could lead to material differences between the actual future consolidated

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