

Adhesives for the manufacture of filter media for vehicle component assembly

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In the manufacture of air filters, user-friendly, intelligent adhesives are a crucial factor for process efficiency and make air filter systems resistant and reliable.

The product range for air filters is not only huge but also covers all kinds of special variations. Even when considering only the limited spectrum of air filters for vehicles, this still refers to a product range where structural forms, sizes and material choices are almost unlimited. Air filters are manufactured in fast production processes with specifically tailored adhesives which have to fulfil all the challenges during production as well as in the utilisation of these high-tech filter systems later on.

Adhesives are responsible for the optimum connection of the most diverse structural components and material combinations – for flat surface bonds of the filter medium, for the strength of small surfaces in pleating, and for the flexibility of the frame assembly. Specially formulated adhesives facilitate high-speed manufacturing cycles, a problem-free engineering and application technology, and an accurate production with the highest quality for each intermediate product that undergoes further processing, up to the final step.

1. Flat surface compound of filter media with activated charcoal

During the laminating process and for the end product of activated charcoal filter media, modern adhesives like the thermoplastic Jowat-Toptherm and the reactive PUR adhesive system Jowatherm-Reaktant ensure quality and efficiency.

Quality, because the performance of the activated charcoal filter is substantially determined by the adsorption capacity of its filter medium. The new Jowat laminating adhesives reach good strength levels of the activated charcoal medium in the laminating process, even when the adhesive grammages are low. This ensures that the open surface of the activated charcoal remains as large as possible with only minimal reduction of adsorption and air permeability – even when the filter media consist of several layers. When bonding the activated charcoal onto the carrier material a low adhesive grammage is crucial for maintaining the actual function of a filter - the filtration and constant supply of clean air – to a superior extent.

Efficiency, because the new adhesives based on polyurethane or polyolefin have good spraying properties, and the high green strength allows fast downline steps, thereby supporting the manufacturing processes. The open time of the adhesives (see table 1) is adapted to the individual manufacturing methods when the filter fleece materials are coated with activated charcoal. Even when the adhesive bond is subject to downline stress resulting from operations like reeling and unreeling, cutting and pleating of the coated fleeces, the excellent flexibility of the Jowat adhesives will also withstand these mechanical stress factors.

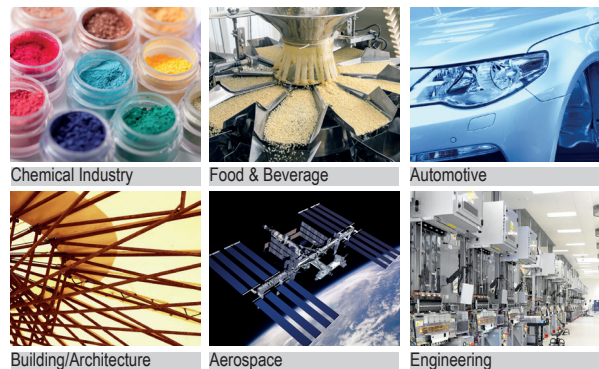
The selection of the appropriate adhesive system must be made under consideration of the manufacturing process and the characteristics required from the end product when in actual use. The table below shows a comparison of the relevant process parameters of both adhesive systems.

Following the basic choice of either thermoplastic or reactive system, the specific adhesive is selected according to the requirements of the manufacturing processes and the performance criteria of the filter media which have to be met.

When comparing a purely thermoplastic to a reactive adhesive, the reactive system is exhibiting a much better performance, with an outstanding flexibility, very long open time and high heat resistance. All of these are properties which the reactive adhesive achieves due to the chemical crosslinking reaction that takes place after application.

Bonds with either Jowat-Toptherm or Jowatherm-Reaktant permit a high functionality of the filter medium due to the formulation ingredients which are low in VOCs; both adhesives also have no recognizable odour in the finished product. Characteristics which are expected especially when they are used for the manufacture

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Table 1: Relevant process parameters and characteristics by comparison (source: Jowat)

	Thermoplastic adhesive	Reactive system
Sprayability	✓	✓
Flexibility	✓	✓
High green strength	✓	limited
Long open time >40 s		✓
Short open time <40 s		✓
Heat resistance	limited	✓
Low fogging	✓	✓
Processing temperature	High processing temperature	Low processing temperature

Table 2: Processing parameters of selective Jowat adhesives for the lamination of activated charcoal filter media (source: Jowat)

	Jowat-Toptherm® 238.50	Jowat-Toptherm® 238.70	Jowatherm-Reaktant® 614.18
Polymer basis	Polyolefin	Polyolefin	Polyurethane, reactive
Viscosity at 120 °C			approx. 5,500 mPas
Viscosity at 190 °C	approx. 11.000 mPas	approx. 6.000 mPas	
Processing temperature	180-200 °C	180-200 °C	110-130 °C

Table 3: Examples for formulations with different viscosities, open times and processing temperatures (source: Jowat)

	Jowatherm® 214.86	Jowatherm® 262.20	Jowat-Hightherm® 262.90	Jowat-Hightherm® 263.05
Polymer basis	Copolyester	EVA	Polyolefine	Polyolefine
Viscosity at 200 °C	approx. 25,000 mPas			
Viscosity at 190 °C				approx. 26,000 mPas
Viscosity at 170 °C		approx. 4,200 mPas		
Viscosity at 150 °C			approx. 2,000 mPas	
Processing temperature	190-210 °C	160-180 °C	140-160 °C	180-200 °C
Open time at processing temperature	approx. 15 s	approx. 5 s	approx. 30 s	approx. 10 s

of passenger compartment filters. Beyond this, the low adhesive consumption also results in lower energy requirements, and in consequence reduced manufacturing costs.

2. Pleating and filter frame assembly

The thermoplastic Jowat filter adhesives for pleating and frame assembly have been developed for sealing and forming properties which also promote the largest possible process safety. Apart from the good adhesion to the papers and fleece materials, structural properties are also required. This means the the shape of the filters must remain unchanged over their entire life, even when the material compound is exposed to mechanical forces or high temperatures. The special adhesives for pleating and frame assembly ensure that the filter elements have a lasting product life and a high quality.

Pleating:

The diverse filter materials and manufacturing methods require adhesives for the pleating step with special processing characteristics: Jowat adhesives support fast manufacturing by an open time adapted to this necessity, while the high

green strength data are maintained, which ensures fast downline production cycles of the pleated filter media. The adhesives additionally have a wide spectrum of adhesion for safe bonding of substrates made of paper, fleece and other materials like nano-fibres. When papers impregnated with phenolic resins are used a high temperature resistance is required since curing takes place after pleating, and usually at temperatures distinctly above 150 °C.

Filter frame assembly:

The engine compartments of cars are becoming increasingly more compact, in consequence the air filter placement often permits only a filter exchange under heavy deformation (see photo 2)

This in turn demands for frame bonds with high levels of strength and excellent flexibility. The adhesive, or better the bondline, may not fail and the filter pockets may not develop leaks, respectively the performance of the filter element may not be impaired. Apart from this, the assembly inside the engine compartment also necessitates superior levels of temperature resistance - depending on the placement of the filter, the filter bond may be exposed to temperatures from 80 to 130 °C.

The processing characteristics and their impact on the process times can be tailored to the requirements of the manufacturing process (see table 3).

In order to provide adequate stability to the filter media after pleating, the adhesive is applied in bead form for the lateral bonding of the filter pockets, and to hold the folds in place. When assembled into the frame, the adhesive can also be applied with a flat slot nozzle. The necessary strength, flexibility and tightness on the frame is given by the embedding of the ends of the pleats in the adhesive layer (see photo 3). The products listed in table 3 have proven to be successful for pleating as well as for assembly into the frame.

Conclusion:

The filters used in an automobile play a non-negligible role when considering its ecological footprint. All air filters have a series of properties in common: The optimum air filter is tailored to the surrounding component architecture, it is tightly sealed and creates minimal differential pressure in spite of its superior capacities of particle removal and absorption. The filter should maintain constantly the full and highest possible performance up to the time of exchange. When the adhesive is perfectly matched to the substrates used and their surface properties, to the production processes and the future wear in actual operation of the filters, major savings in processing costs are possible without loss of quality of the end product. Jowat filter adhesives meet the stringent heat resistance demands by the car manufacturers, and allow the manufacture of vehicle compartment cell filters and engine intake air filters in OEM quality. Using modern adhesives with special formulations which have no detrimental impact on the performance of the filter is therefore an absolute must, from the ecological as well as from the economical perspective.

To take full advantage of all positive characteristics of a modern adhesive, Jowat provides competent technical consultation to all customers in all phases of use of the products. From the provision of samples over the test phase to taking-in-to-operation of the machines, Jowat engineers are ready to supply help and advice.



Fig. 1: Activated charcoal filter media pleated (source: Jowat)

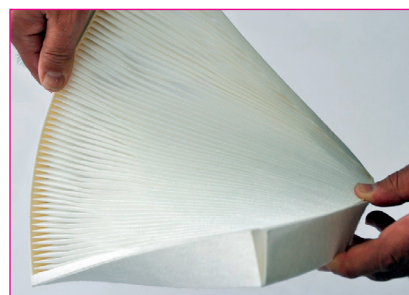


Fig. 2: Adhesives for pleating and frame assembly, major quality factors for the filter performance. (source: Jowat)

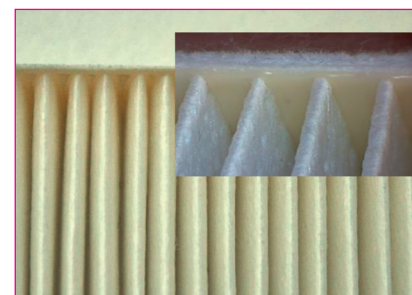


Fig. 3: Examples for embedding of the filter pleats into the layer of adhesive on the frame (source: Jowat)