

“Cellulose” filter  
media portfolio  
Filter papers –  
relic or gem?

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1000 research & development specialists, continuous growth and more than 24 filter elements produced per second - for 75 years MANN+HUMMEL has displayed an impressive track record. Quality, service and innovations make the MANN+HUMMEL Group a distinguished development partner and original equipment supplier to the international automotive and mechanical engineering industries.

The use of cellulose-based materials for filtration in the automotive and mechanical engineering industry appears at first glance to be a relic from the past. Filter papers, produced from naturally grown fibres, with an apparently unalterable structure, whose growth is dependent on climate conditions, are not initially suspected of playing a role in technologically high-quality products.

### Filter paper made from pure cellulose

However, the reality of the fact is that the overwhelming majority – worldwide – of filter media at the filter specialist MANN+HUMMEL is composed of cellulose, and filter elements with a filter medium made from cellulose, i.e. paper, are present in almost every vehicle. For instance, impregnated filter paper made from pure cellulose is used for 90 % of the full range of engine air filters, from mopeds to large agricultural machinery. In the largest instances, up to 36 square metres are pleated and built in per filter element. From a technical standpoint, cellulose media often even suitable for many applications in the engine oil circuit, despite the much greater requirements on chemical and mechanical resistance to a very wide range of engine oils. When manufacturing such oil filter papers, a defined quantity of synthetic fibres is added to the headbox of cellulose fibres to increase the stability and strength of the paper in the finished composite.

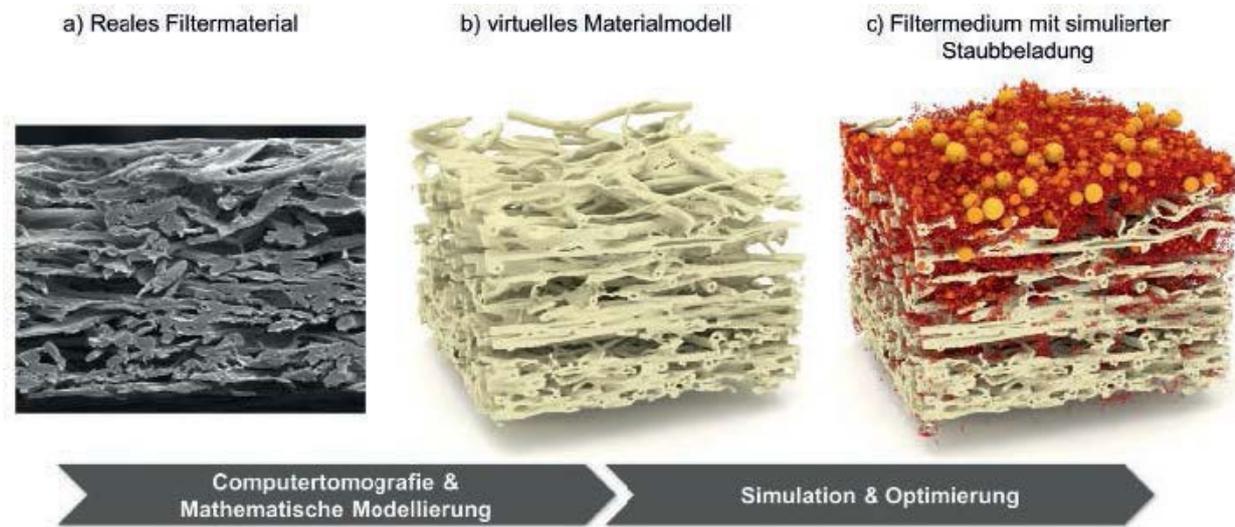
In fuel filtration, on the other hand, the main focus lies on the separation efficiency of the finest particles, which can be achieved both via the use of a denser media structure as well

as by using special cellulose fibres. The addition of micro glass fibres can further increase efficiency in these applications. These "little helpers", often used in the USA, however, are viewed much more critically in injection systems in the European market. For this reason, their use is coordinated with the customer on a project-by-project basis and, where applicable, protective layers are fitted, which can prevent glass fibre migration

### Multilayer media

Filtration performance can also be increased significantly even without the use of glass fibres. Various filter layers, in combination with a basic cellulose media, are often the medium of choice for these applications. The developed Multigrade technology is used in high-resistance fuel filters and can now be found in almost every motor vehicle with a diesel engine. These combinations of meltblown fine fibre layers with very dense filter papers provide for outstanding performance data.

In air filtration, media coated with nanofibres are among the frontrunners in filter efficiency. A paper base is covered with ultra fine fibres using an electrospinning process, a technology performed by MANN+HUMMEL as part of its own manufacturing process. These fibres, which are only visible with electron microscopes and have a mean diameter of just 150 nanometres, ensure that even the finest particles of dust, with separation efficiency of up to 99.98 %, are reliably captured in the finished element.



Simulation of cellulose material with subsequent simulated loading (© MANN+HUMMEL)

### Filter media, made to measure

In the industrial filter segment, too, filter media based on cellulose are used in a very wide range of applications, such as in electrical discharge machining (EDM), which mostly takes place in an aqueous medium or in the cabin of a forestry worker's harvester. The cabin air filters used here are fitted with highly efficient filter media, which also prevent carcinogenic particulate matter from getting into the cabin.

Modern filter papers are thus technically high-quality products that have been optimised at all levels with regard to their fields of application. Improvements are continually strived for, starting with the selection of the fibres as well as the mixtures of various fibre types, to the pre-treatment of the fibres, for instance, mercerisation, milling and drying, through to plant technology for filter paper manufacturing, which can have an influence on the depositing structure of the fibres. New types of filter media are thus brought to series production hand in hand with the suppliers, always with a focus on the customer requirements. Whether it concerns a flame-retardant finish for air filter papers or there is a need for a hydrophilic or hydrophobic additive, a requirement for greater water stability or further additional chemical functions need to be taken on by the filter paper –

cellulose-based papers allow various applications to be covered – and at a good price-quality ratio, too.

### A focus on sustainability

The activities of MANN+HUMMEL with regard to the controlled sustainability of the basic raw material cellulose demonstrates the multilateral approach undertaken by the company, whereby not only the useful properties are taken into account, but also its environmental impact. The fibres used to manufacture filter papers come from the timber industry and must be acquired from fresh wood. Through certification of numerous suppliers and production facilities according to the strict guidelines of the Forest Stewardship Council (FSC), it is possible to follow the entire production chain for a filter element bearing the FSC label – from the forest to retail. The starting point are thus forests and forest enterprises that fulfil high ecological and social standards. Standards, with complete transparency for the end customer. In order to seek the optimum version of this material in an even more efficient and sustainable way, many years of combined experience in the development of cellulose-based filter media are increasingly being complemented with

virtual development methods. For a specific filtration application, a detailed understanding of the processes involved in dirt collection inside the fibre material is always crucial for the development and improvement of successful filter elements.

### High performance through simulation

The development of a new filter medium is based on a material that already exists, whose structure is recorded using computed tomography and converted into a three-dimensional computer geometry. Using this image, characteristic features such as its diameter, orientation and density of the fibres can be determined using statistical analyses.

In the following step, based on these parameters, a mathematical model is created that passes on these characteristics of the real filter material. In contrast to a real material sample, the properties of the virtual fibre structure can be

easily adapted in a very targeted manner. Simulation tools can be used to calculate perfusion and the transporting of dirt particles inside the filter medium, which provides information about the filtration performance of the virtual material. Through alternating "fine-tuning" of the material parameters and calculation of the filtration properties, it is possible to gradually create a filter material that is "made to measure" for its respective application. In close collaboration with the suppliers, the knowledge gained with computer-aided simulation methods opens up the doors to the filter paper of tomorrow.

In this regard the "cellulose" filter media portfolio is continuously growing today and covers an enormously wide spectrum of applications and modifications, effectively shifting established standards to innovative high-performance media.



Flammability testing of an air filter paper in accordance with DIN 53 438-3 (© MANN+HUMMEL)