

1. Example of a confined packaging envelope available for installation of a suction filter system

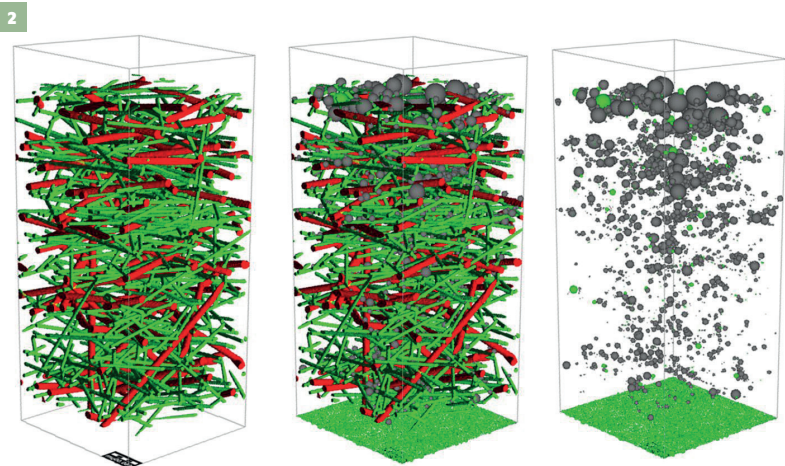
# Filter media

## Development of alternative filter media enables increased oil flow performance and filtration efficiency in next-generation automatic transmission applications

Over the years there has been a continuous, gradual change in requirements for transmission oil filtration solutions. In general, filtration efficiency requirements have increased, especially toward the smaller particle sizes. This is to a large extent due to higher oil cleanliness requirements from, for instance, more sensitive shift control valves. These valves are currently operating at much lower clearances than they used to in order to reduce leak flow. The proper functioning of these valves is paramount in achieving the shift quality required for an automatic transmission. Over the years, shift quality has become an increasingly important factor in the acceptance of transmissions.

As well as the increased level of requirements regarding filtration efficiency, another trend has become apparent. Due to the steady

2. Examples from numerical study results on a particular fiber blend and its effect on filter media performance, showing a variety of different fiber sizes in a small cube for evaluating permeability, particle capture behavior, dirt holding capacity, etc

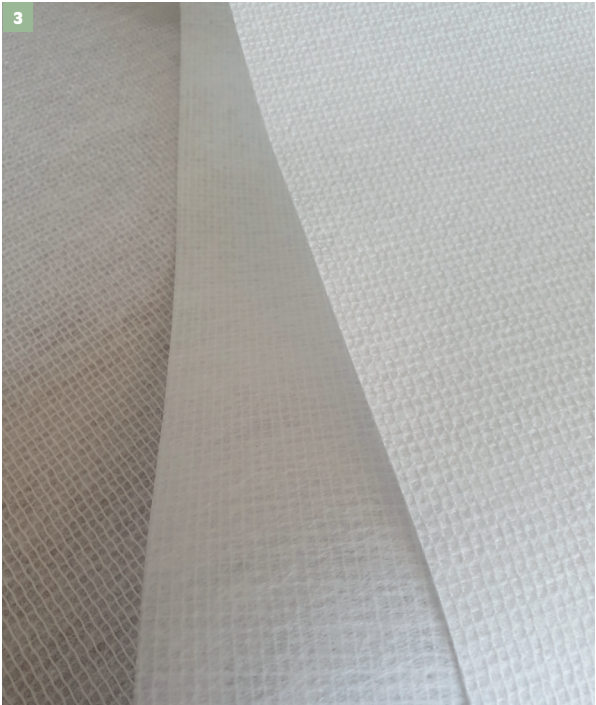


increase of components in modern vehicles and the increased complexity of transmissions, packaging envelopes available for filter installation have decreased and become more irregular. Maximum oil flow requirements, in general, have remained at high levels.

The combination of increased filtration efficiency requirements and limited installation space calls for a filter concept that supports a relatively high oil flow (in relation to its size) together with high filtration efficiency. The problem is that normally a trade-off exists between air permeability and filtration efficiency; if a higher efficiency media is produced by increasing the media surface area or weight, or by reducing fiber dimensions, this will generally lead to lower air permeability and consequently a higher pressure drop at a given oil flow.

The combination of the phenomena described above has sometimes led to the necessity to install an overmolded, pleated filter element in order to achieve a larger filter surface area. In this case, the larger filter area is key to achieving an acceptable flow performance. However, filter products – just like any other automotive component – are strongly cost-driven and therefore more and more turn into commodity products. An overmolded, pleated element installed in a suction filter will be more costly than a simple sheet or bag filter media element and therefore is not always a preferred solution.

An alternative way forward would be to simply select an existing filter media that has a more favorable flow performance to filtration efficiency ratio. However, none of IBS Filtran's current filter media suppliers had such media readily available in their filter media product portfolios. It became clear that to increase flow performance and filtration efficiency at the same time, innovation was required. For that reason, IBS Filtran decided to initiate development of a new type of suction filter media. This new media, especially suitable for application in the latest



3. HFT-330 filter media including multifilament support netting

4. Overview of existing and newly developed HFT-330 suction filter media characteristics. Image shows the relative position of different types of filter media currently used in series production. The trade-off between air permeability and filtration efficiency can be seen from the MFT-XX and the TF-XX materials. The arrow shows the direction in which the new development needed to progress: higher permeability together with higher filtration efficiency. The green crossed circle illustrates where the new HFT-330 media has landed in relation to the existing media types; this clearly highlights the desired trend break

generation of automotive transmissions, better caters to the aforementioned challenges as well as having comparable or lower cost than the existing solutions.

### PRODUCT INNOVATION

For this development project, IBS Filtran decided to join forces with one of its existing media suppliers. The manufacturer in question is open to innovation and as such also to the development of new products. It contributed use of its production hardware for nonwoven media and its extensive knowledge of the production of nonwoven materials. Furthermore, it used its network to source the raw materials best suited for the media under development in the most economical way. IBS Filtran, meanwhile, focused on the filter aspects by defining not only the filtration performance related requirements, but also the textile requirements needed to withstand the brutal conditions to which suction filter media is exposed in automatic transmissions.

Having established an initial set of requirements, IBS Filtran started actual development work by carrying out an investigation using numerical tools. With the help of these tools the company was able to predict the influence of polyester fiber sizes, blend ratios, fiber distribution, fiber orientation and the weight per surface area of the fibers. The evaluation carried out was based on fibers that were easily available as raw materials and which fitted the specified pricing requirements.

From this preparative study, a theoretically suitable fiber composition was determined. With a base recipe available from the numerical studies, a first trials round was carried out on the nonwoven production equipment. The IBS Filtran

team ensured that the base media recipe was indeed a feasible one to run on this particular production line and to produce a first base material.

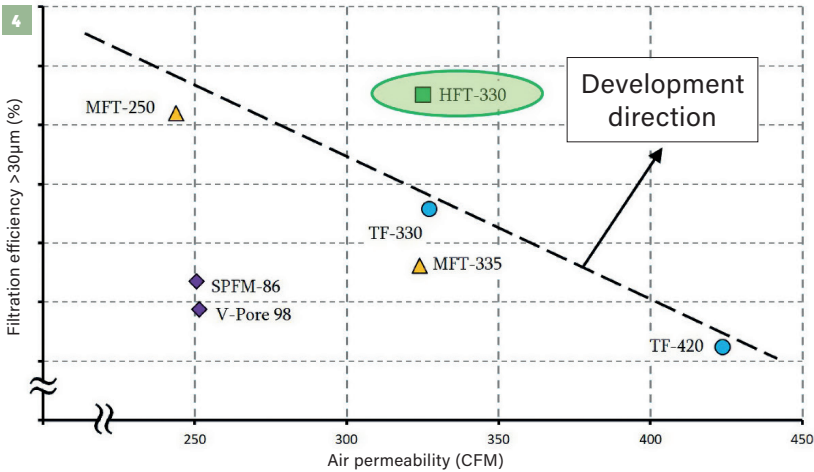
During the first production trial, a process parameter study was carried out during which all relevant production line parameters were varied. For each of the parameter variations, media samples were produced for evaluation in the IBS Filtran laboratory, which is specifically equipped for testing automotive filtration products. The tests carried out can basically be divided into filtration-specific and textile-specific tests.

### MEDIA TESTING

The textile-specific tests showed that, due to the nature of the fiber blend chosen and the weight per surface area required to obtain the proper air permeability, the tensile strength and e-module of the media were not up to par with the textile-specific requirements. The most feasible way to move forward was to introduce a multifilament support netting. This particular netting has already been applied in other types of filter media used by IBS Filtran. As such, it has already proved itself in other filter applications that are currently in series production.

The data gathered on filtration performance showed that the desired requirements had been reached with the new product, the HFT-330. Of course, alternative versions of the HFT-330 with different air permeability, and consequently different filtration efficiencies, are possible.

During the HFT-330 suction filter media's approval process, a new filter development project turned out to be an ideal candidate for its application due to limited build space and demanding requirements. This particular filter is already in the final stages of approval and undergoing extensive testing in transmissions in order to ready it for series production. ☺



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