

Keeping
pollen out

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Author

» Dr.-Ing. David Keerl is a development engineer with MANN+HUMMEL Innenraumfilter GmbH & Co KG in Himmelkron.

Modern cabin filters offer a high level of comfort and occupant protection. With MANN+HUMMEL's innovative biofunctional coating, natural polyphenols and a biostatic product combine to provide additional anti-allergen and anti-microbial protection, inactivating and inhibiting more than 95 % of health-relevant allergens and germs respectively.

According to the World Health Organization, allergies are now the fourth most common chronic illnesses worldwide¹. They are also exacerbated by various particulate matter and harmful gases in the air, which are at their highest levels in larger cities and industrial locations. In general, it is clear that the proportion of people who suffer from allergies is particularly high in populous, highly industrialized regions. Thus in South Korea, 59 % of the population are treated for allergy symptoms, in Japan that figure is 44 %, in the USA 28 % and in Europe 20 %. In Germany, 35 to 40 % of residents suffer from allergy-related illnesses, whereby 86 % of allergy sufferers suffer from pollen-related allergies, while 40 % are allergic to pets and 14 % to mold spores – those figures continue

to rise^{1,2,3}. In particular, the number of those allergic to pollen is rising worldwide. The cost of treating these patients amounts to approximately Euro 240 million annually in Germany alone⁴. If pollen, bacteria, mold spores and other tiny particles make their way into the interior of a vehicle through the ventilation ducts, they can provoke allergic reactions⁵. The protection of vehicle occupants is therefore increasingly a focal point for developers: while the first cabin filters aimed to protect the components of an air-conditioning system against contamination, modern variants protect the passengers against harmful allergens and germs in the ambient air.

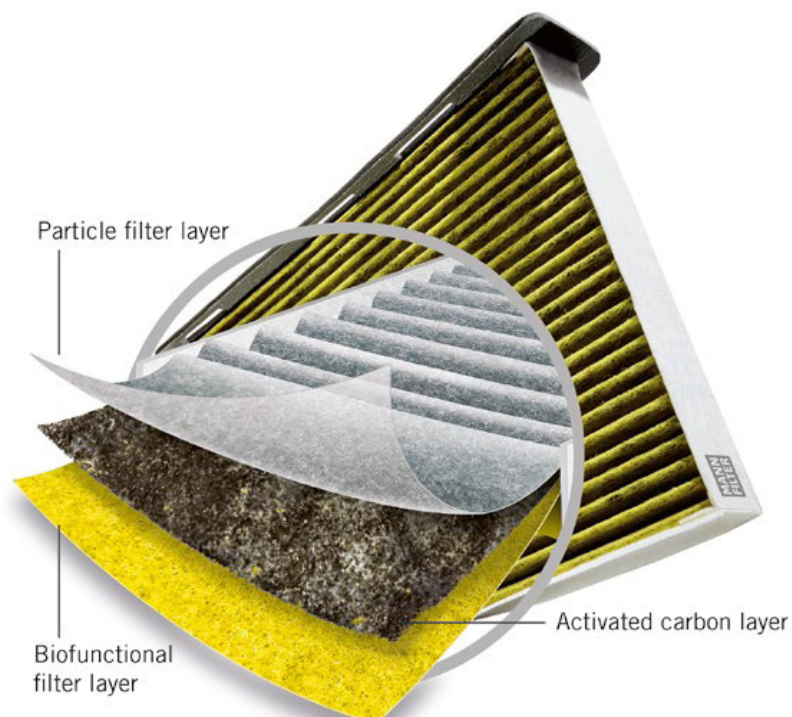


FIGURE 1: Structure of a FreciousPlus filter (© MANN+HUMMEL)

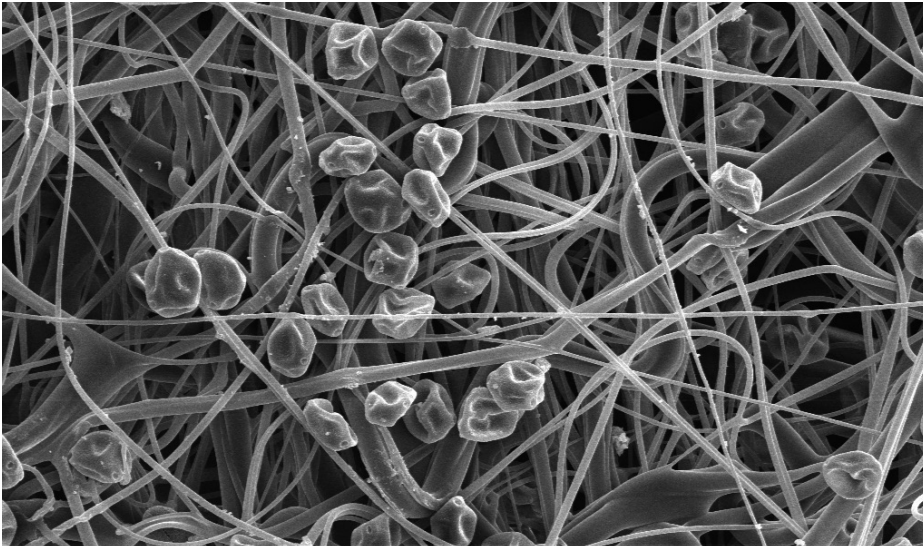


FIGURE 2: Pollen
(© MANN+HUMMEL)

Filter Structure

The new FreciousPlus cabin filter from MANN+HUMMEL is tackling this issue head on. The FreciousPlus filter is constructed of multiple layers of filter medium, FIGURE 1, which in addition to the particle filter layer and the activated carbon layer, also features a specially developed biofunctional filter layer that has both anti-allergen and antimicrobial properties and thus offers consumers additional health protection against micro-organisms such as mold spores and allergens, FIGURE 2.

The activated carbon layer absorbs harmful gases such as sulfur dioxide (SO₂) and nitrogen oxide (NO_x), but also aromatic hydrocarbons and other harmful molecules and volatile organic compounds (VOCs) from exhaust gases. Moreover, odorous substances from agriculture are absorbed, whereby combined filters, in addition to protecting the health of vehicle occupants, also contributes to further enhancing their comfort. While the existing cabin filters in the MANN+HUMMEL product range already have a highly efficient particle filter layer, which in addition to large particles like pollen (5 to 100 µm in diameter, whereby most pollen grains are between 10 and 30 µm large) also filters out smaller particles and soot. However, the allergy-triggering particles relevant for the health of vehicle occupants that are inside the pollen are frequently significantly smaller (in the nm range), so they can even pass through this layer and, in

traditional cabin filters, can pass through into the interior of the vehicle, FIGURE 3. In addition, it has been observed that pollen can release dangerous allergens when it comes into contact with the filter media surface or with other particles, and also through external influences such as moisture, heat or cold⁴. Multiple studies performed over the last 15 years prove that interactions with particulate matter and diesel particles are not unusual and even lead to the greater release of allergens and to greater exposure for allergy sufferers^{5,7}. The released allergens can additionally settle on particulate matter and thus be transported over great distances. Both the presence of allergens on starch granules measuring from 0.5 to 2.5 µm and the binding of pollen allergens on diesel soot particles have been verified experimentally⁶. Scanning electron micrographs of fibers of a cabin filter, which was used under real-life conditions in a vehicle, provide information about the typical dust particles separated from the air. These small particles can penetrate deep into the alveoli of the lungs and increase the risk of respiratory illnesses⁷.

Efficacy of FreciousPlus

The anti-allergen features of the FreciousPlus cabin filter mean that the activity of released allergens and thus their potential to trigger allergies can be verifiably reduced. The anti-allergen effect of the biofunctional layer is due to the



FIGURE 3: Particles can spread in the vehicle interior (schematic representation) (© MANN+HUMMEL)

polyphenol coating. Polyphenols are natural phytonutrients, which occur, for example, in many plants such as green tea, apples and grapes. Health-promoting effects are attributed to polyphenols and they are therefore frequently also used as a nutritional supplement – for example in wine and beer⁸. Furthermore, polyphenols interact with proteins, which is why they can for example bind with and thus inactivate allergens that are separated out onto the fibers of the cabin filter. Immuno-chemical investigations (ELISA test) have proven that allergens are effectively inactivated due to the polyphenol coating. Under the chosen test conditions, the allergens of grass pollen, for example, can be more than 95 % deactivated.

As a result of the additional antimicrobial coating, PreciousPlus also prevents allergy-triggering and, at times unpleasant-smelling, bacteria and molds from forming and proliferating on the cabin filter. As a result, more than 98 % of mold spores and bacteria are verifiably prevented from multiplying and growing. Furthermore, the antimicrobial

coating acts like a protective shield for the natural polyphenols, because these as natural products can be decayed by microorganisms present.

Summary and Outlook

The significant reduction of allergy-triggering pollen and particulate matter (diesel particulate) in the vehicle interior and the improvement in occupant comfort are and will remain the primary focus of future developments in the area of cabin filters. Filtration efficiency will be continuously improved, in order to increase the separation of particularly dangerous particulate matter (particles < 1 µm). The aim is to create a structure which permits the greatest possible air permeability and with that low pressure loss, but also enables excellent dust storage capacity and thus a long life for the filter. Further developments aim to enhance the adsorption capacity of activated carbon, the use of other adsorbent

materials to combat certain odorous substances and a reliable protection of dustladen filters against microbiological growth. Due to the multiple tasks a cabin filter must perform, it is recommended that it be replaced at least once a year or every 30,000 km, so that it continues to work properly and afford effective protection, FIGURE 4.

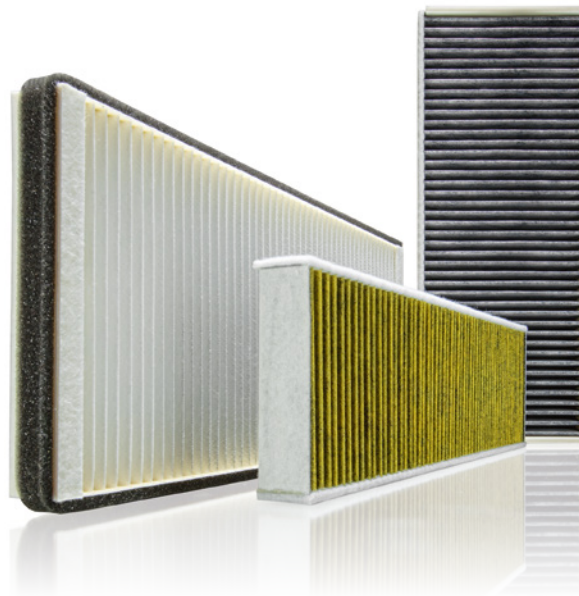


FIGURE 4: MANN+HUMMEL filters in different sizes
(© MANN+HUMMEL)

References

- 1 WHO Air quality guidelines – global update 2005
- 2 <http://www.aaaai.org/about-aaaai/newsroom/allergy-statistics>
- 3 <http://dgg.de/gesundheits/allergie-haut/allergien/situation-in-deutschland.html>
- 4 Renz, H.; Kaminski, A.; Pfefferle, P.I.: Allergieforschung in Deutschland. Deutsche Gesellschaft für Allergologie und klinische Immunologie (DGAKI, ed.), 2008 [Allergy research in Germany. German Society for Allergology and Clinical Immunology]
- 5 <http://www.faz.net/aktuell/rhein-main/pollen-allergie-immunsystem-hat-langeweile-14170254.html>
- 6 Grote, M. et al.: Release of allergen-bearing cytoplasm from hydrated pollen: A mechanism common to a variety of grass (Poaceae) species revealed by electron microscopy. *J. Allergy Clin. Immunol.* (2001) 108, p. 109-115.
- 7 <http://www.euro.who.int/de/media-centre/events/events/2010/03/fifth-ministerialconference-on-environment-and-health/sections/news/2010/03/einer-von-2000-sauglingen-in-der-europaischen-region-stirbt-an-atemwegserkrankungen>
- 8 Goldberg, I.: *Functional Foods*. Springer, 2012
- 9 Grotewold, E.: *The Science of Flavonoids*, Springer Science and Business Media, 2006