

Market Demands in Cabin Air Filters

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Abstract

Talking about market demands means more than taking a merely product related approach. In order to act successfully, markets and their needs must be known and the own position in the market must be properly defined. Information on this as given for the cabin air filter segments OEM, OES and IAM. Product related specialties as against other products in the automotive industry are described.

The need for reality related results from filter measurements for development engineers, marketing people and passengers in a car are outlined at the example of results with different test aerosols in particle filtration and results of olfactometric measurements.

Key words:

Cabin Air Filter, Market, Odour, Olfactometry

Introduction

Technically oriented people think while talking about market demands quite often especially on technical performance needed by products and how to reach the goals defined e.g. in specifications and standards. Marketing people on the other hand think of customer needs, markets, their segmentation and growth, the behaviour of the market participants as well as distribution, communication and last not least pricing. As the results of the work of both groups are necessary to meet the customer benefit the analyses and actions of both groups must be regarded to act successfully on the market.

An appropriate market definition is crucial for success as it determines the customer and his demands as well as the needs of the supplier. In the case of cabin air filters the demands of the passenger in the car must be covered. This makes the product different from other products for the automotive industry. Another characteristic feature can be seen in the fact that it has to be changed regularly, independently on its technical performance.

In this environment we define ourselves as suppliers of cabin air filter elements, providing all necessary products and services worldwide and we define the market segments we want to cover as OEM (Original Equipment Manufacturers) and Aftermarket, with the two segments OES (Original Equipment Service) and IAM (Independent Aftermarket).

The OEM Market

The OEM market consists of the vehicle manufacturers installing cabin air filter into their air handling systems and thus creating the market. Additionally, as cabin air filters are frequently installed in HVAC systems, the HVAC system manufacturers play an important role; they must care for the product as it influences the performance of their systems.

Figure 1 shows the OEM installation rate of cabin air filters and their expected growth.

	OEM Inst. Rate 2004 %	Car production Mio. cars/year	Expected growth
Europe	>90	15,3	→
North America	30	16,0	↑
Latin America	50	1,8	↑
South Korea	60	2,3	↑
Japan	60	7,7	↑

* incl. Light commercial vehicles and pick-up trucks

Figure 1: Installation rate of cabin air filters

It can be seen, that cabin air filters are in different stage of their life cycle in the major car producing regions of the world. In the Americas and Asia the installation rate will increase in the future, growth is assumed with the exception of Europe where an installation rate > 90% for passenger cars is reached. The assumption of future growth of the OEM market outside Europe is based on sociocultural trends like the rising health awareness of people, increasing comfort demands and the continuing growth of allergies.

Demands in this segment are created independently from the product by mega-trends of the automotive industry, like

- the well known concentration process of the vehicle manufacturers; but there is also a trend towards concentration on the level of the first tier suppliers. Today there are only six major HVAC manufacturers left working worldwide.
- the strategy of the most important vehicle manufacturers to act on global scale and to react on local demands of markets at the same time (sometimes called glocal behaviour) and the platform strategy enabling them to do so.

The biggest platform equipped with cabin air filters is the PQ35 / PQ46 platform of the Volkswagen Group. It comprises cars of VW, Audi, Seat and Skoda. It started in 2003 with a need of 0,5 mio. filters/year. This number is scheduled to rise to 2,5 mio. filters/year in Europe in 2007, when all platform cars will be built. There was a tremendous price fight in this project. The vehicle manufacturers and the first tier suppliers used their purchase power to put pressure on the filter manufacturers.

- the need for “local content”, enhanced by the platform-strategy for the reasons of security of supply but also due to political reasons. That’s why it is of advantage, if filters can be produced in countries where the platform cars are produced.
- the shortening of development cycles leading to shortened reaction times and
- the demand for continuous improvement of the supply chain management.

All these demands have to be seen in context with actions of the purchase departments like “global sourcing” and “reverse auctions”.

Figure 2 is a result of an analysis performed at OEMs. It was asked for the most important criteria a supplier has to fulfil.

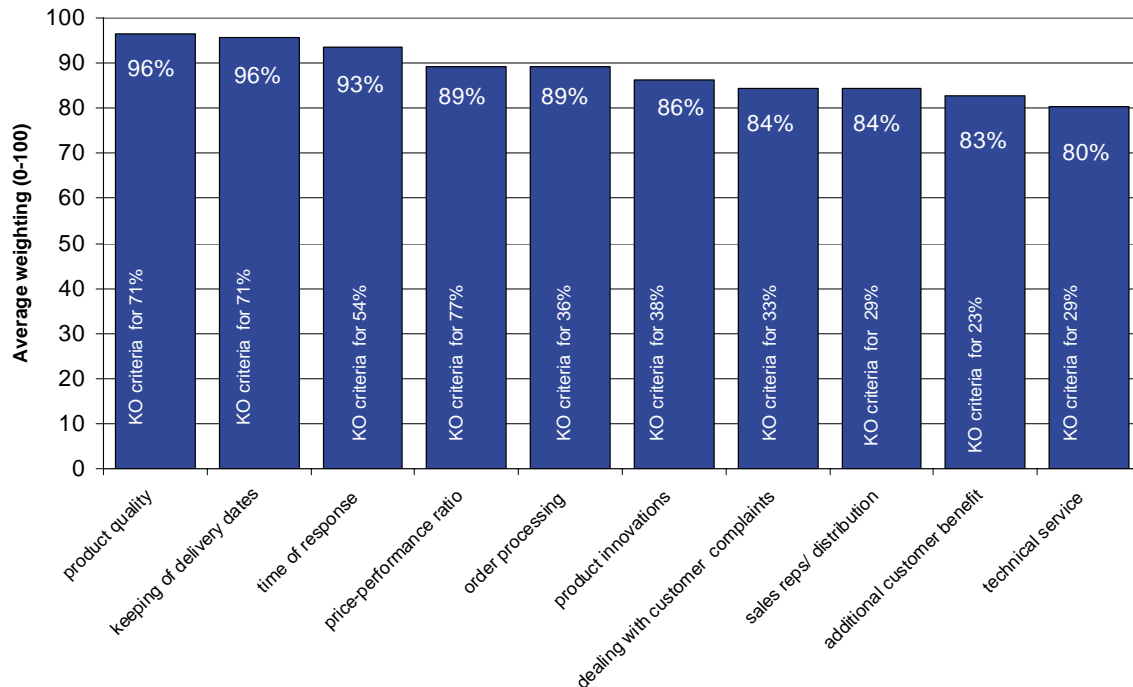


Figure 2: Most important criteria for suppliers in OEM

As can be seen in the figure, every item asked for is important to a high degree (>80%), with emphasis put on product quality, keeping of delivery dates and time of response in more than 90% of all answers given. The importance of product innovations rises, when talking to development and marketing people alone.

The Aftermarket

In Europe about 14 mio. cars per year are equipped with a cabin air filter, since 1989 about 115 mio. cars have been equipped. The actual car park amounts to about 70 mio. cars with a cabin air filter installed.

In a settled filtration market like engine filters more than 80-90% of the whole market volume comes from the aftermarket. This number is not yet reached by cabin air filters, but with the increasing car park and the raising average age of cars in Europe (e.g. in Germany from 6,3 years in 1992 to 7,6 years in 2004) more cars remain longer an available aftermarket potential even if the service intervals for cars are constantly increasing.

The aim for the exchange of cabin air filters was an interval of 15.000 km at the beginning of the nineties. Today 30.000 - 40.000 km are reached and we face demands up to 60.000 km.

This demand is understandable from the overall strategy of the OEMs but it may lead to life times of a cabin air filter of more than 3 - 4 years.

A VDI working group recommended, that due to hygienic reasons a service time of 2 years should not be exceeded /1/.

The aftermarket consists of all distribution channels utilized to supply the service parts to the end users (car-drivers). It includes service centres of the vehicle manufacturers (OES) and distribution channels acting independently from the vehicle manufactures (IAM). Distribution via internet does not play a major role at the moment. The structure of the European aftermarket for service parts can be taken from figure 3.

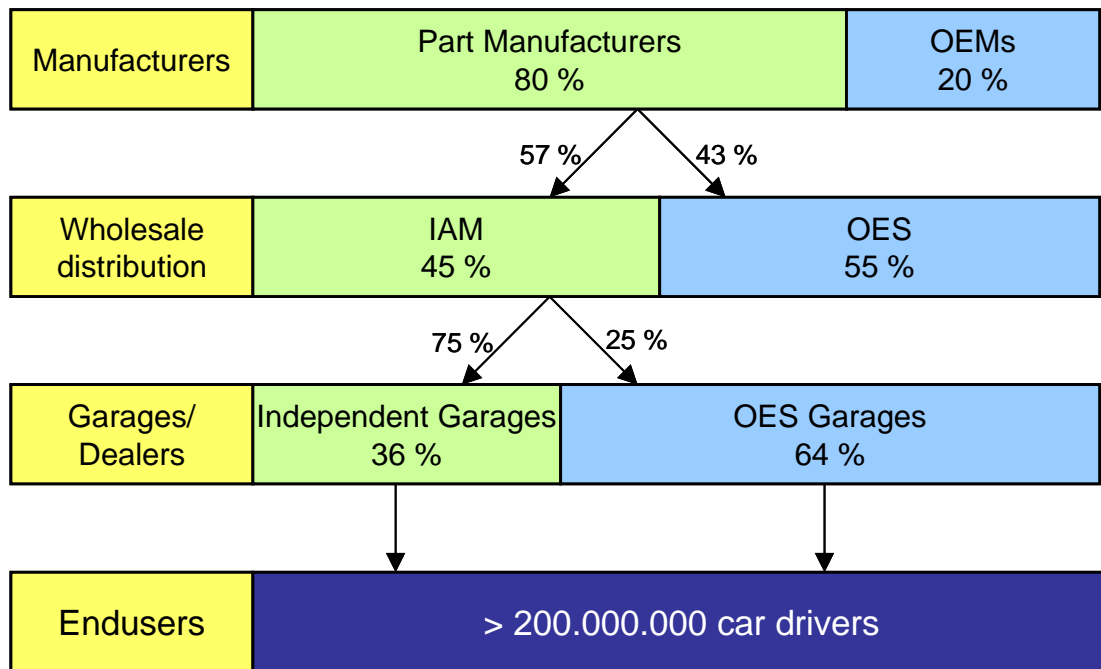


Figure 3: Structure of the European Aftermarket

Whereas OES organizations market the service parts of their respective OEM and thus are closely linked to this organization, IAM organizations market a defined product range of several OEMs, partly under own label.

Like OEM/OES, IAM undergoes a concentration process Europe-wide. The main purpose for this concentration process is the centralisation of marketing and sales actions in order to strengthen market- and purchasing power. The IAM in Europe is determined by its regional diversification in attitude and structure. Specific national and local characteristics must be taken into account. Filter manufacturers of engine filters with well established distribution networks play an important role in this market segment.

With the revised “Block Exemption Rules”/2/, aiming at the deregulation of the automotive market, the competition between OES and IAM has intensified. The vehicle manufacturers enlarge warranty periods, they improve their service (qualified training of personnel, equipment), they introduce logistical systems to bind dealers and they improve bonus systems. The increased use of electronics in cars with the decreased serviceability without special equipment is regarded as a powerful additional means to keep and extend the own position.

The most important criteria a supplier has to fulfil in OES can be found in figure 4, taken from an analysis performed there.

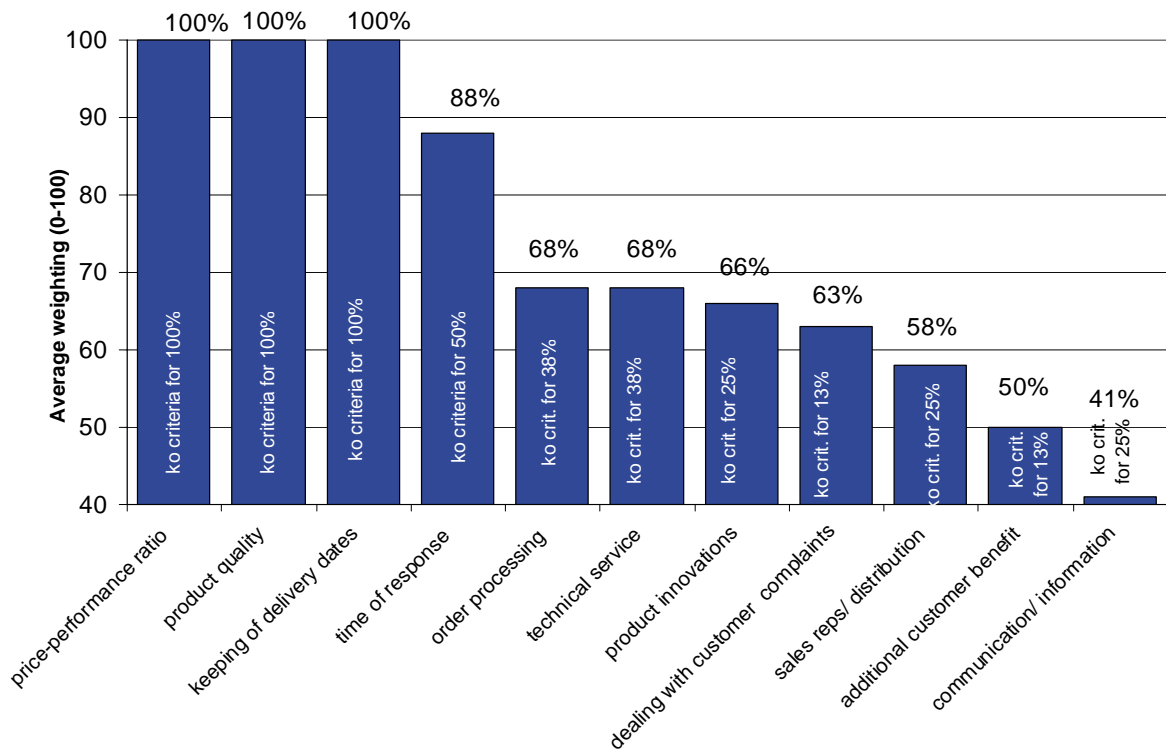


Figure 4: Most important criteria for suppliers in OES

Knock-out criteria are price-performance ratio, product quality and the keeping of delivery dates. Other criteria do not play an equally important role like in OEM. Product innovations are important for 2 out of 3 people asked.

This may be an option for the installation of specifically designed filters for specific groups, like allergy sufferers who may be interested to get filters with increased particle filtration efficiency at the cost of decreased adsorption efficiency and lifetime of the filter compared to the “standard filter” installed by the OEM.

Performance Setting and Control

The performance of a cabin air filter is defined by every vehicle manufacturer individually in specifications for filter media and the filter element for a defined project. There is no “legal prescription” what so ever for the requested performance of a cabin air filter as it is not a security item. The test standards for assessing the particle filter performance and the adsorption performance specify a test method but not a performance needed. That’s why we can find filters especially in the IAM with very poor filtration efficiency.

The world-wide existing standards are not identical. In Europe, cabin air filters are tested in most cases according to DIN 71460 part 1 /3/ and part 2 /4/ respectively, in USA according to ISO /TS 11 155 /5/ and in Japan with test aerosols according to JIS Z 8901 /6/ for particle filters and DIN 71460 part 2 for combination filters. At the moment a test rig according to

DIN 71460 part 1 and 2 is being built up at a test centre in Korea, which will act as a reliability centre for cabin air filters.

All these test methods are suited for standardized comparison of filter performance only. They can be regarded as a first means to differ between different qualities of filters under standardized laboratory conditions. They are necessary to be performed, but they do not reflect the filter performance under realistic conditions i.e. they are not suitable to test the filter according to the ability to improve comfort and wellness in the passenger cabin. That's why additional tests should be carried out evaluating the filter under real-life conditions.

Real-Life Conditions

In Europe the total concentration of man-made particles in the air expressed by the PM10 value has diminished. On the other hand the number of fine particles in the air (expressed by the PM 2,5 value) has increased though dust removal in industry has been greatly improved over the years and the EEC directives for engines resulted in less emission per car. The naturally occurring particles (pollen, microorganisms, dusts from soil a.s.o.) can be regarded as unchanged. In the field of gaseous components a decrease of VOCs and SO₂ emission is reported with increases in NO_x and periodical increases in ozone.

Development in Filter Testing

Filter testing of cabin air filters must be developed towards the aim to give more assistance to development engineers, to marketing people and to the end users when choosing a filter. This means on the particle filter side that dusts with particle sizes relevant for health should be used for testing. Standardized tests methods should still be applied to analyze and optimize the adsorption of any particular gaseous component like NO_x, VOC and others. Additionally gaseous substances should be tested in "real-life" environments like concentration in the low ppm or ppb range as this is necessary to get answers on questions like breakthrough and desorption behaviour as well as life time in reality.

A new tool for testing cabin air filters is the use of olfactometric measurements following DIN 13725 /7/ and VDI 3882, part 1 /8/. Using these methods an objective picture of subjective odour perception can be achieved. It gives additional end-user related information and can be regarded as a means to get objective results on comfort and wellness for a passenger in a car. It can be combined with the evaluation of samples from the laboratory and from the field and can be applied for the solution of many reality-related problems such as

- odour removal efficiency against different odours and odour mixtures
- desorption of odours
- evaluation of different adsorbents and equipment against odours

Particle Collection Efficiency Results with different Test Aerosols

Figure 5 shows the fractional collection efficiency with different test aerosols measured with the same filter element under comparable conditions. It can clearly be seen, that a big difference exists depending on the test aerosols used. This result provides important information as a part of these particles stay for a longer time in the lungs and can even enter the blood circulation. As a consequence carcinogenic and a inflammatory reactions such as asthma may arise.

Therefore it is necessary to use filters with a high fractional efficiency in this particle range.

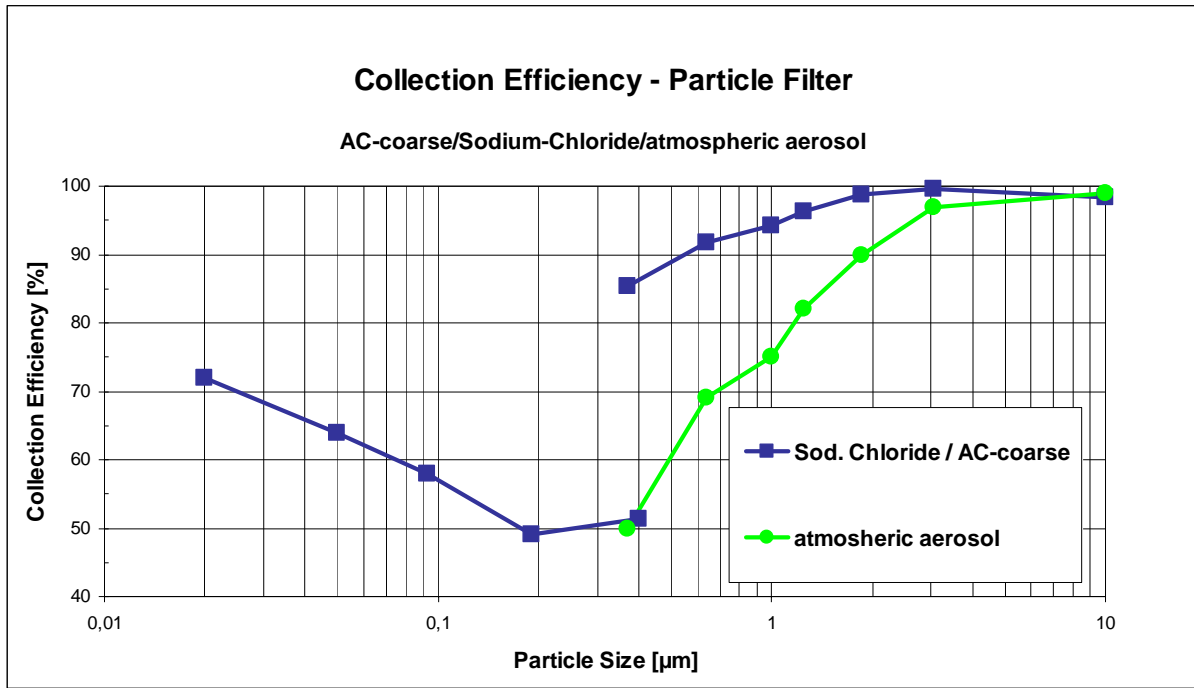


Figure 5: Particle collection efficiency results with different test aerosols

Olfactometric Results of Odour Removal Efficiency Measurements

There are air purifiers on the market using active air treatment processes such as UV irradiation or UV photocatalysis for the reduction of odours. In two olfactometric measurement series the initial efficiency and the long-time efficiency of a commercially available photocatalytic air purifier consisting of a HEPA filter and a UV irradiation plus TiO₂ catalyst was tested and compared to a standard MicronAir combifilter.

The test was performed in a 1m³ test chamber with cigarette smoke as test aerosol. The results are shown in figure 6. In order to evaluate the initial performance one cigarette was burned down, samples of the air were taken afterwards in certain intervals and given to an olfactometric test panel, consisting of 4 persons. They determined the odour perceived at every sample taken. The results for this “raw cigarette smoke” measurement are plotted in graph 1 in figure 6, expressed as “relative odour level”.

The relative odour level compares the odour perceived at the beginning of the test with the odour perceived at the time the sample was taken. As there is a logarithmic scale behind, a decrease to 40% (80%) means a decline of odour achieved by the element under test to 12% (30%) of the odour perceived when compared to the situation without odour reducing element.

The perception of the odour of the “raw cigarette smoke” stayed almost constant for all samples taken during the whole 60 minutes of the test.

Nearly the same odour reduction in magnitude and decline could be found for the photocatalytic air purifier (graph 2) and the combination filter (graph 3). Both reached a relative odour level of 0.41-0.43 for samples taken 60 min after the cigarette was burned down.

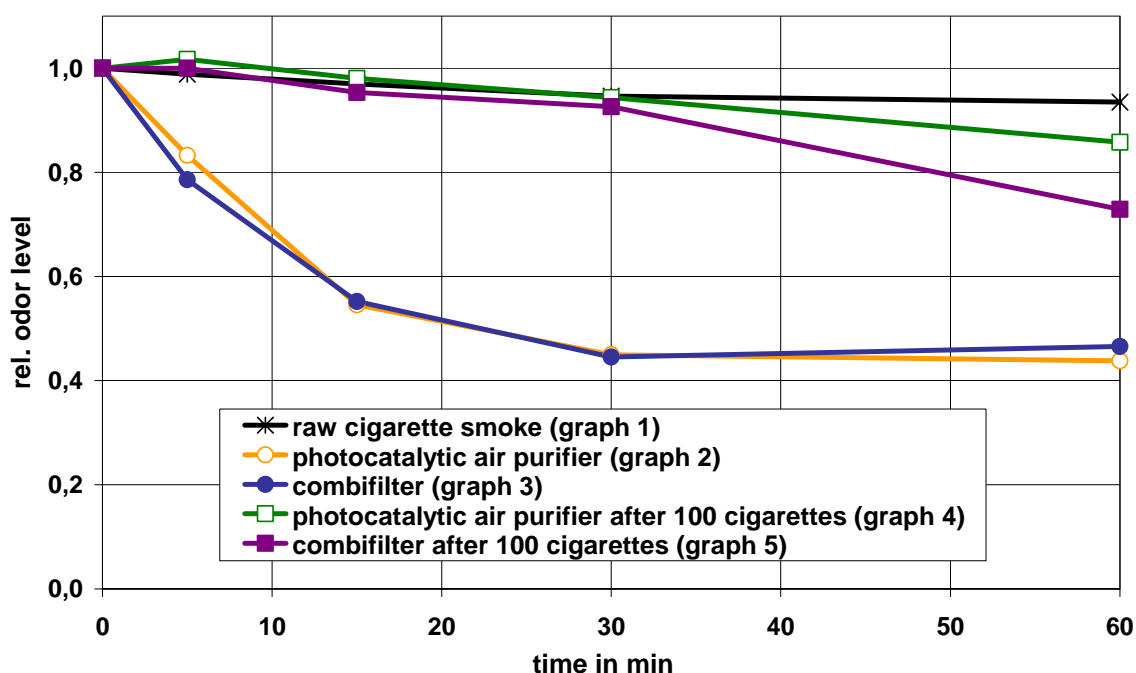


Figure 6: Initial and long-time odour removal efficiency of different equipment

In order to evaluate the long-time efficiency of both options at first 100 cigarettes were burned down with the combifilter respectively the photocatalytic unit installed in the test chamber and air sucked through the system. Then the chamber was cleaned and again one cigarette was burned down and the measurement procedure was repeated like before.

The results are shown as graphs 4 and 5 in figure 6. With the samples taken after 30 minutes and earlier, only a minor odour reduction could be detected, whereas after 60 minutes better values were found for the odour reduction of the combination filter compared to the photocatalytic unit. Additionally, the long-time efficiency has diminished when compared with the initial efficiency in both cases.

The initial efficiency of a second module which was tested in the same way is shown in figure 7. This module was a less sophisticated prototype containing only UV irradiation and less efficient filter elements. It can be seen that UV irradiation alone and together with the use of the particle filter installed could not efficiently reduce the cigarette smoke odour. A fair efficiency is achieved with the combination filter plus UV irradiation.

Analyzing the results of figure 6 and figure 7 and comparing the results of both figures and taking into account the results of other measurements performed /9, 10/ it can be said that olfactometry is a valuable tool to demonstrate differences in odour reduction of different equipment available on the market and to achieve reality-related results for the evaluation of the performance of air handling equipment against odours.

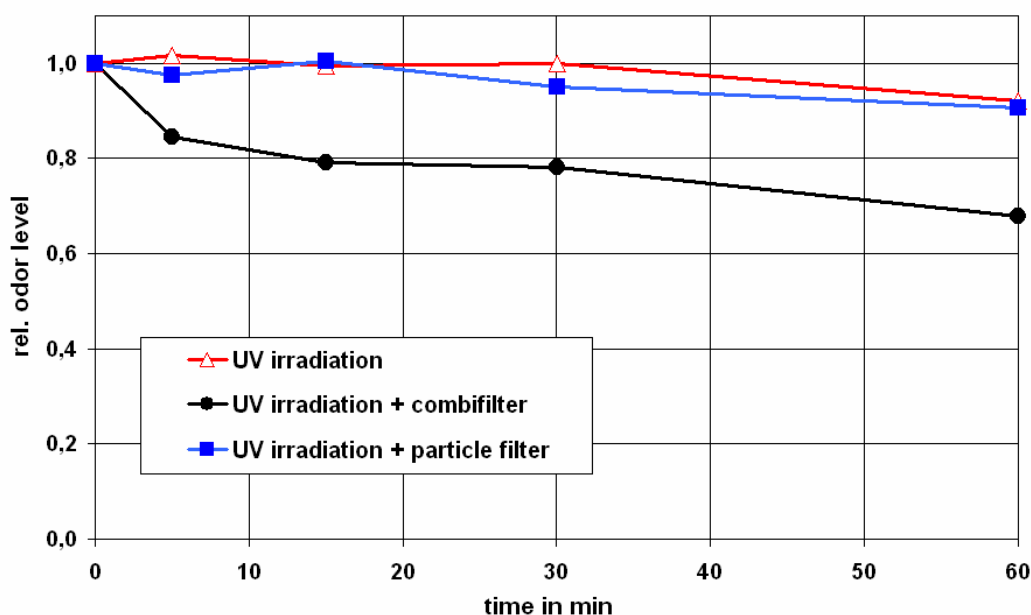


Figure 7: Odour removal efficiency of an air purifier for re-circulated air.

Summary and Conclusion

In cabin air filtration the car passenger is finally the customer. He must be given reality related information, which he can use and understand.

The benefit he can expect from the installation of a cabin air filter in his car has to be communicated via development engineers and marketing people in the OEM and aftermarket organizations.

Today standardized test methods are used to evaluate cabin air filters. Additionally, methods providing easily understandable information for the passenger, easily to communicate for marketing people, must be introduced.

Results of olfactometric tests are a useful tool to create such informations. The benefit for the passenger can be proven, he can experience the benefit. This tool therefore should be used systematically for the evaluation of the performance of cabin air filters.

The figures given are mean values with tolerances entailed by the customary production fluctuations. Our explicit written confirmation is always required for the correctness and applicability of the information involved in any particular case.

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