



# OUR PLUS FOR THE ENVIRONMENT

**Cleaner mobility**

**Cleaner air**

**Cleaner water**



## Bring this brochure to life



**1. Search** for QR codes in the brochure



**2. Scan** the QR codes with your smartphone

# SETTING POSITIVE EXAMPLES FOR TODAY AND TOMORROW

## **Welcome to the filtration experts**

We live in a time in which it is no longer enough for a company to rely solely on profitability. The world is facing radical change, but we all want it to continue being a place where we can live healthy and happy lives. Unfortunately, we can no longer take clean drinking water and clean air for granted, not to mention the challenges we now face with regards to clean mobility.

Innovative technologies are needed today that will pave the way for a better future, and one key technology for this is filtration. Separating the useful from the harmful. This is MANN+HUMMEL's mission and passion. For 80 years we have been focused on this task, and today we are the worldwide market leader for innovative

filtration solutions. We know that this gives us a great responsibility, one that we accept with pleasure. We want to help actively shape the future, so our aim is to set many positive examples today – technologically, ecologically, and from a human perspective.

**Join us and find out how less – namely fewer pollutants – can be turned into a big PLUS for us all.**



**4.2**

**BN € SALES**

**134**

**M € INVESTMENT  
IN RESEARCH & DEVELOPMENT**

**2,500**

**PATENT APPLICATIONS**

**PASSION FOR  
FILTRATION**

**in figures (2019)**



**22,000**  
**EMPLOYEES**

**80+**  
**LOCATIONS**

**26**  
**FILTERS/SECOND**

**THE PLUS FOR OUR CUSTOMERS:  
WE ARE ALWAYS NEARBY.**

We think our numbers are really impressive. The fact that we continue to grow, and have been doing so for decades, is not only good for us, but is also a real PLUS for our customers. Because with every new employee, every new location and every newly developed filter, we gain valuable experience and thus expand our unique expertise. This makes us an extraordinarily strong engineering partner. All over the world. And always near you.

# OUR GOAL:

## a cleaner world

### OUR PLUS: THE TECHNOLOGICAL LEAD

MANN+HUMMEL has long been an established name in the automotive industry. Our air and liquid filters have become indispensable in vehicles of all kinds. But as a future-oriented company, we also look beyond our own four walls to seek out new challenges. And there are plenty of them, especially in filtration.

It starts with cars, of course: The future belongs to alternative drive systems, whether they run on electricity, natural gas or hydrogen. We are already developing pioneering filtration solutions for this purpose, for example for the cathode air in fuel cells or for the coolants in high-performance batteries.

However, liquids and air are not only found in vehicles. We need them everywhere – especially for drinking and breathing. But what sounds obvious is not always available in sufficient quantity and quality. Fine dust, microplastics, multi-resistant germs and other contaminants are a major problem all over the world.

For MANN+HUMMEL it was therefore not only a logical step, but a real opportunity to make meaningful use of our existing expertise from the automotive industry in other areas as well. With our technological leadership, we make an important contribution to the worldwide protection of what we believe to be basic human rights. Free access to cleaner air and cleaner water must be guaranteed for everyone. This is our PLUS for a better quality of life – whether at home, on the road or at work.

On the following pages we will show you which innovations we have already initiated for a cleaner future.



#### HEPA FILTER NANOCUBE N

Designed for high air volumes of up to 4,000 m<sup>3</sup>/h, plus a large active media area, all in a compact, space-saving design: When it comes to separating suspended particles, the robust Nanocube N HEPA Filter delivers outstanding results.

Regardless of whether it is used in industrial ventilation systems, clean room applications or in medicine: harmful or hazardous particles are safely removed from supply and exhaust air systems. It also reliably prevents contamination through the ventilation system itself.

HEPA (High Efficiency Particulate Air) filters are used to control air pollution and are classified as H13 or H14 according to the EN 1822 standard. These classifications guarantee a separation efficiency of 99.95% (H13) or 99.995% (H14) of the particle size with the lowest separation efficiency MPPS (Most Penetrating Particle Size), typically in the size range of 0.12 µm to 0.25 µm – roughly the size of many virus types.











# CLEANER MOBILITY

## **A PLUS in securing the future**

There is enormous innovative power in the automotive industry. This can be seen in the rapid development of alternative drive systems, but also in the way conventional vehicles are generating fewer and fewer emissions. Because regardless of the drive technology, there is really only one common goal: to make mobility more sustainable.

As a sought-after development partner of the automotive industry, MANN+HUMMEL develops efficient high-performance components for all areas of vehicles. Whether compact liquid filter systems for oil and fuel, effective intake systems and cabin air filters or pioneering components for electromobility: with our technologies we make an important contribution to a cleaner change in mobility.



# COMPONENTS FOR FUEL CELLS

## Staying clean for the future

### THE CHALLENGE:

One promising concept for electric vehicles is the fuel cell. Here, the electrical energy is generated directly in the private or commercial vehicle and converted into motion. But the system is extremely sensitive: Central components react sensitively to particles, harmful gases and water in the intake air. For example, sufficient relative humidity is required for optimum operation of the fuel cell. In addition, harmful gases can irreversibly damage the platinum-coated catalytic converter.

A further challenge is the cooling of the fuel cell, because the electrochemical reaction generates heat which has to be dissipated. Harmful particles must be removed from the cooling circuit, and it must be ensured that the conductivity of the coolant remains below the permissible limit.

### A DECISIVE PLUS:

#### OUR SYSTEM COMPETENCE

MANN+HUMMEL can also draw on a wealth of experience in the development of new technologies, such as our simulation competence and our extensive know-how in component design.

The result is an integrated system from a single source with perfectly matched components. This enables our customers to reduce interfaces and simplify processes considerably.

### OUR SOLUTION:

Fuel cell technology is a complex system. The solution from MANN+HUMMEL is therefore not a single product, but rather the interaction of several optimally matched components which ensure a highly efficient supply of cleaner air to the fuel cell and an optimum cooling circuit:

- **The cathode** air filter system removes impurities from the air.
- **The broadband** muffler dampens the intake noise caused by the compressor.
- **The humidifier** protects the fuel cell membranes from drying out.
- **The cathode** water separator prevents the fuel cell from flooding or freezing.
- **The coolant particle filter** prevents blockage of the cooling channels and protects against wear.
- **The ion exchanger filter** protects the fuel cell from electrical short circuits.





#### **A HEALTHY PLUS: OPTIMUM FILTER PERFORMANCE AT EVERY STAGE**

Each filtration stage of the FrecciousSmart fulfills a specific task, adapted to a specific need: The highly effective cabin filter with biofunctional coating binds allergens, filters fine dust and prevents the spread of bacteria and mold.

The pre-filter, which can be switched on as required, also cleans the outside air of fine dust as well as pollen and harmful gases such as nitrogen dioxide.

As a third filtration stage, a HEPA filter (High Efficiency Particulate Air Filter) even binds ultra-fine particles (<0.1 µm), such as soot and brake dust. This ensures that passengers are optimally protected in every situation.

# FRECCIOUSSMART

## Your PLUS for optimum protection inside the vehicle

### **THE CHALLENGE:**

For many people, the most important consideration when deciding to purchase an electric vehicle is still the range. How long the range is depends not only on the battery capacity, but also on the consumption efficiency of the electrical devices. One of the biggest “energy guzzlers” in cars is still the air conditioning and ventilation system. The cabin filter that is used plays a significant role in the amount of energy used. After all, the filter has an important task: It has to reliably remove all the various pollutants that enter from the outside – regardless of whether you’re cruising down the highway or stuck in rush hour traffic. However, the stronger the filter, the more energy the fans need.

The ideal solution would be a filter that automatically detects the level of pollutants and adapts its response accordingly. This is exactly what the engineers at MANN+HUMMEL thought.

### **OUR SOLUTION:**

The FrecciousSmart system consists of three filter stages which can be switched on or off as required. The information required for this is provided by sensors that continuously measure the indoor and outdoor air quality. The intelligent system then decides which filter stage(s) should be switched on and how much air should be supplied from outside.

The advantages of this intelligent fresh air management: On the one hand, the air has to pass through fewer “obstacles”, i.e. the fans do less work. The fact that the filters are only used when they are really needed also extends their life. On the other hand, less fresh air from outside has to be adapted to the temperature level of the interior. Together, this results in significant energy savings and ultimately in a longer range for the vehicle. Good news for those switching to electric vehicles.



# CLEANER AIR

## A PLUS for quality of life

There's something in the air. Unfortunately that's not always a good thing. Smog caused by traffic and industry in the cities, dust in the countryside, pollution from chemicals inside our buildings: Air pollution has become a threat to our climate and our environment and is also an increasing threat to human health. A total of 92% of the world's population is affected by air pollution that exceeds the safety limits of the World Health Organization (WHO).

Research & Development at MANN+HUMMEL works each and every day on innovative solutions to reduce air pollutants. With success, as the following examples show ...





# FILTER CUBE

## The cleaner cube

### A SMART PLUS:

#### DEMAND-ORIENTED OPERATION

The Filter Cube is equipped with intelligent control electronics that enable the system to be operated based on demand. External sensors record current air and weather data as well as the pollution level of the outside air.

This data is merged and analyzed in a cloud-based solution. Depending on the ambient conditions, its operation can be adjusted automatically or manually by the user. This saves energy and maintenance costs.

### THE CHALLENGE:

Many cities around the world and the people who live in them suffer from high levels of air pollution. Particulate matter and nitrogen dioxide pose a particular threat to people with respiratory diseases, the elderly and children. But for everyone else, bad air always means a reduction in quality of life.

The highest levels of pollution are found at hotspots with heavy road traffic or with insufficient air exchange, such as in subway stations. As a political solution, driving bans are repeatedly being discussed. An alternative would be a solution that specifically relieves the hotspots without restricting life across the entire city – permanently and implemented before it is already too late. This is exactly the kind of solution that filter specialist MANN+HUMMEL has developed.

### OUR SOLUTION:

The Filter Cube is an air cleaning system that pulls in large quantities of air via a fan and then expels the cleaned air back out. A specially developed, highly effective combi-filter binds over 80% of nitrogen dioxide (NO<sub>2</sub>) and particulate matter (PM), thus ensuring cleaner ambient air.

With the modular system, up to three cubes can be assembled to form a filter column that then cleans 14,500 m<sup>3</sup> of air per hour while consuming the same amount of energy as a regular vacuum cleaner. Possible applications include playgrounds in inner cities or railway stations. If several filter columns are installed one behind the other, entire sections of road could be freed of air pollutants. We did just this in our pilot project at Stuttgart's Neckartor. With different product designs, the technology can be used in many applications with specific requirements.

## THE CHALLENGE:

Poor air quality is not only found outdoors. The air in buildings is often many times worse – even in modern office buildings. These buildings are often optimized to be energy efficient. The downside is that windows can no longer be opened, resulting in poor air circulation and greater CO<sub>2</sub> pollution. In addition, pollutants that are produced by the building itself, such as formaldehyde and other volatile organic compounds (VOCs), as well as the fine dust particles from clothing, carpets and skin, are released into the air.

All this not only harms the health and well-being of employees, it also brings measurable economic disadvantages. It has been proven that poor office air reduces performance and often leads to sick leave – also known as “sick building syndrome”. Even a 10% reduction in productivity is more expensive for the company than the total monthly rent of the respective workstation.

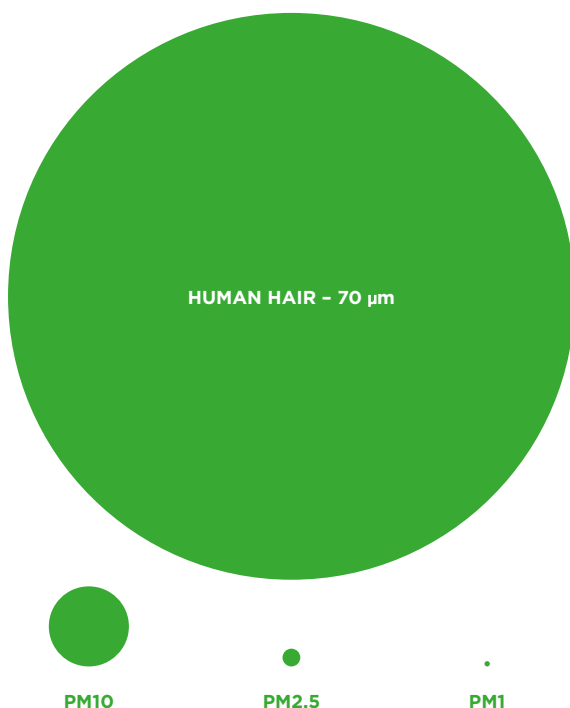
## OUR SOLUTION:

MANN+HUMMEL works closely with manufacturers of air conditioning and ventilation equipment. These devices provide the necessary air exchange in the building. Our filter systems remove the pollutants from the air flowing through. In order to find the optimal filter configuration for each building, we measure the pollutant load inside and outside the building. This way, every system can be optimized for maximum energy and cost efficiency.

# A PLUS FOR OFFICE BUILDINGS

## Air filters

### ILLUSTRATION OF PARTICLE SIZES



### AN ECONOMIC PLUS: MINIMIZED ENERGY CONSUMPTION

Did you know that the air conditioning system in an average commercial building is responsible for 50% of the building's total energy consumption? One third of this is due to the air filter system.

This means that the air filter influences approximately 15% of the total energy consumption. With our optimized solutions, operating costs can be significantly reduced.







# CLEANER WATER

## For a PLUS in resource conservation

Water is our most important resource. Nearly 8 billion people need cleaner water every day for drinking, washing, cleaning, cooking and other everyday activities, with industry and agriculture amongst the largest consumers. Did you know that over 4,000 liters of water are needed to produce a single cotton T-shirt?

The utilization of water and the treatment of waste water are therefore amongst the central challenges of our time – especially where clean fresh water is still a rare and therefore particularly valuable commodity. MANN+HUMMEL has set itself the goal of using its technologies to enable sustainable water management and efficient water treatment in industry and communities worldwide, as you will read about on the next pages.





# WASTE WATER TREATMENT WITH MICRODYN BIO-CEL<sup>®</sup> MODULES

## Problem solved

### THE CHALLENGE:

Water is a limited, non-renewable resource. At the same time, the world's population continues to grow steadily and urbanization is increasing. Together, these are typical drivers for the topic of water reuse. The ultimate goal: Never again to waste a drop of water, but to treat the used water again and again. The aim is to secure the earth's demand for fresh water in the long term and to enable the sustainable use of our resources. Different membrane technologies are thereby indispensable facilitators in the preparation and reuse of waste water.

### OUR SOLUTION:

MICRODYN BIO-CEL<sup>®</sup> MBR modules – they are already successfully used all over the world for biological waste water treatment, whether for the treatment of industrial waste water or in municipal sewage treatment plants. In combination with other technologies, they prevent bacteria and micropollutants – e.g. residues of pharmaceutical substances, which in turn promote multi-resistant germs – from entering the recycled water. In order to operate the modules optimally at all times and thus use resources efficiently and save energy, we offer STREAMETRIC – digital remote real-time monitoring of the modules.

### A LONG-LASTING PLUS: MODULES THAT “HEAL” THEMSELVES

In membrane filtration it is important that the membranes are undamaged. Because even the smallest cracks can severely impair filtration performance. MANN+HUMMEL has therefore developed a special modular design: The membrane is laminated onto a spacer fabric. The resulting pockets are welded at the edges. The clean waste water flows out through an opening in the middle.

The advantage is that the biomass present in the waste water plant can seal damage to the membrane thanks to the spacing effect. Bacteria and solids thus remain in the membrane module. Superficial damage “heals” by itself, so to speak.

# WATER TREATMENT FOR BEVERAGES

## The PLUS for manufacturers and consumers

### THE CHALLENGE:

Most beverages, such as soft drinks or beer, actually consist mainly of water. Therefore the quality of the water used has a decisive influence not only on the taste, but also on the color and consistency of the drink. Manufacturers want consistency in the look and taste of their products, and they must also comply with strict health regulations. Consistent high water quality is therefore indispensable. But this is not always easy, because water can contain many things that are undesirable in beverage production, such as suspended particles, dissolved salts, metals, organic substances or bacteria. Water must be filtered before processing to ensure that the taste and appearance of the drink is not spoiled.

### OUR SOLUTION:

Innovative membrane filtration from MANN+HUMMEL ensures optimum water quality in beverage production. Different technologies are used depending on the requirements:

- **Ultrafiltration (UF)** is used to remove particles, but also bacteria and larger molecules, from the water. It is ideal for producing soft drinks, energy drinks and bottled water.
- **Membrane elements made of cellulose acetate (CA)** for nanofiltration (NF) and reverse osmosis (RO) offer the most efficient filtration for beverage production. Our modules are certified according to NSF/ANSI Standard 61 and ensure a safe and hygienic system environment.
- **Reverse osmosis (RO)** with thin-film composite membranes (TFC) provides high-purity water with low TDS (dissolved solids). The membrane modules are available in different compositions for different requirements – from “high rejection” to “low-energy”.



### THE PLUS FOR TASTE:

#### REDUCED-ALCOHOL BEVERAGES THROUGH MEMBRANE FILTRATION

Non-alcoholic and reduced-alcohol drinks are increasingly in demand, whether for a healthier lifestyle, religious reasons or because you still have to drive. Usually, the fermentation process is interrupted during production or the dealcoholization is carried out by vacuum evaporation. However, certain substances which have an influence on the taste are also lost in the process. Membrane processes such as reverse osmosis or dialysis are better. This allows the winemaker or brewer to better influence the alcohol content of the drink and preserve the desired taste.

# WE RESEARCH SO THAT WE ALL “GET MORE”

## **THE PLUS FOR YOU: A PARTNER WHO THINKS AHEAD**

You have just learned about some of our innovations in the filtration sector. Now you may be wondering: How do we come up with all these good ideas? The simple answer is curiosity. We at MANN+HUMMEL want to understand how the world we live in works. And we want to make it better.

This is also based on very solid economics. Because we know that investments in research and development pay off. And so much so that we invest a great deal. We invest around 4% of our turnover in research and development every year. More than 1,200 experts around the world work at MANN+HUMMEL to find solutions to the major challenges of our time. This includes basic research, innovation, technology development and close cooperation with universities and scientific institutions.

And of course there is another element that comes into play: use of the latest research methods. Want an example? Then take a look at our virtual simulation methods.





# THE BEST FILTER MEDIA ARE DISCOVERED USING COMPUTERS

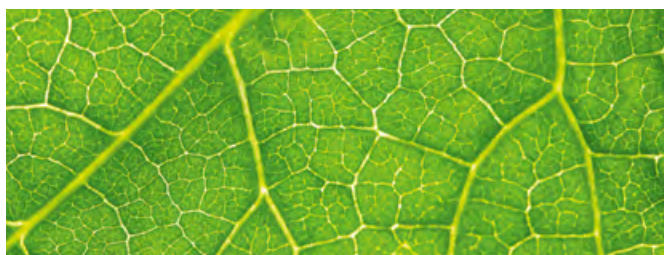
When developing new filter media, MANN+HUMMEL engineers use the latest simulation methods. First, a detailed image of the filter medium is taken with the aid of a computer tomograph. This image makes the microscopic structure of the filter material visible: structures that are thousandths of a millimeter in size that would never be visible to the naked eye.

An analysis of these structures reveals the characteristic properties of the filter material such as fiber diameter, packing density and the structure of the individual material layers. Based on these data and properties, the next step is to develop a virtual, parametric model of the filter material. The result is a virtual prototype that the developers can experiment with. This means that they can vary certain parameters and thus optimize the filter medium ever more finely.

The special feature of this procedure: up to this point, each step is done exclusively on the computer. This saves the engineers a lot of time and effort in development. Instead of experimenting in conventional pilot plants, novel material structures can be investigated in a targeted manner on the computer. The result is filter media with optimum properties for each specific application.

Filtration separates the useful from the harmful. What sounds like a factual description of our field of activity is at the same time an obligation and a benchmark for our actions as a company. We want to create something useful for the world and the people in it, and we want to remove the things that stand in the way of this. This applies equally to the products we develop, to the partnerships with our customers and suppliers, to our interactions within the company and to our involvement in the regions where we operate.

**WANT TO KNOW MORE? THEN TAKE A LOOK AT OUR 4 V'S:**



#### **VALUE ADDED**

The fundamental principle underlying the sustained development of MANN+HUMMEL is the company's value added. We act as entrepreneurs and focus on our products and cultivate our success. In addition, we aim to be results-oriented, direct and quick. This is how we strive to deliver the best performance.

Our innovative strength is a key factor in our value creation. We develop pioneering filtration technologies that promote the mobility and health of people. We adjust our company structurally to the challenges of the future. In this way, we achieve continuous growth with strong brands in different business fields.

#### **VALUE ENDURANCE**

MANN+HUMMEL manages the resources directly associated with the company's value added process responsibly. This means we do our job right from the start, avoid any kind of waste and take care of our employees.

In this context, we want to use only as much energy as we need and not harm the environment unnecessarily as a result of emissions. We protect our employees with the highest level of occupational safety and we take care of their health. Our suppliers are also an important resource. We also expect them to implement sustainable business practices. We therefore put our faith in having constant business relationships.

# SUSTAINABILITY AND RESPONSIBILITY

## The PLUS that multiplies itself



### VALUED COMMUNITIES

We value our employees and the communities in which we live. We are open-minded and open to diversity. For our employees this means: We are convinced that well-trained and motivated people are the key to success, and so we work consistently on developing ourselves and others. We show our appreciation with respectful communication, equal opportunities, professional development opportunities and attractive working conditions.

We accept responsibility for our local environment and we are good neighbors. As early as the 1950s, MANN+HUMMEL made a name for itself by establishing a company health insurance fund and carrying out housing construction projects for its employees. Today, we focus on partnerships with non-profit organizations and support our employees in their commitment to the community.

### VALUE ORIENTED

We accept responsibility for the people we deal with, for the society in which we work and for the environment. We want to build trust and trust the people with whom we work. Our Code of Conduct governs everything we say and do.

Of course being guided by these values means complying with all applicable laws. We actively combat breaches of competition law and corruption in particular. Fair working conditions are the basis for cooperation at MANN+HUMMEL. We discourage discrimination.



EN 092020 ©MANN+HUMMEL