



**Freudenberg  
Innovation Award  
2016**

**FACTS AND  
IMPRESSIONS**

# EDITORIAL

## DEAR LADIES AND GENTLEMEN,

As a global technology group, we rely on the know-how and experience of our employees in 60 countries to create leading-edge products, services and solutions – not only for Freudenberg’s future – but also for the sustainable development of the environment and society.

Innovations have been the basis of our success for 167 years. They have many facets and always originate in teams. The 2016 Freudenberg Innovation Award projects show how we live our company slogan INNOVATING TOGETHER. The Award is the Freudenberg Group’s most important accolade that honors our employees’ remarkable achievements in innovation. The Award was presented in October 2016 for the second time.

This brochure showcases the five 2016 finalist projects, with a special emphasis on this year’s winner “Levitex – Sealing Minus the Friction.” All of the projects presented demonstrated outstanding creativity and quality. The Freudenberg Innovation Award (FIA) map gives you an overview of the innovations submitted for the competition from around the globe.

We invite you to be fascinated and inspired – in words and pictures. Please use the QR codes to access videos of each finalist project.



Sincerely

A handwritten signature in blue ink that reads "Tilman Krauch". The signature is written in a cursive, flowing style.

Dr. Tilman Krauch  
Member of the Freudenberg Group  
Board of Management

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# THE JURY



**Dr. Arman Barimani**  
CTO Freudenberg Home and  
Cleaning Solutions

**Prof. Dr. Thomas Bauernhansl**  
University of Stuttgart and  
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and Fraunhofer ISI

**Hanno D. Wentzler**  
President and CEO Freudenberg  
Chemical Specialities



SELECTION CRITERIA		
Criteria	Weighting	
	1 <sup>st</sup> stage: selection 5 finalists	2 <sup>nd</sup> stage: selection awardee
Degree of innovation	30%	25%
Customer benefit	25%	25%
Economic potential - Market potential - Improvement in costs and/or time	25%	25%
Further criteria - Contribution to HSE - Image - Team work	10% 5% 5%	15%
Presentation 2 <sup>nd</sup> stage		10%
<b>Total</b>	<b>100%</b>	<b>100%</b>

# THE AWARDEE

## LEVITEX: MINIMUM FRICTION – MAXIMUM EFFICIENCY





**Dr. Tilman Krauch**  
Board of Management

“All of the projects presented were impressive – in terms of quality and creativity. With Levitex, an innovation has been rewarded which shows in an impressive way how Freudenberg can extend its customers’ handprint. Sustainability is an important issue for all of us. Reducing CO<sup>2</sup> emissions from vehicles by up to 1 gram per kilometer not only reflects our commitment to our responsibility for society and the environment, it also brings new business opportunities. For us and for our customers which, thanks to Levitex, are able to meet strict environmental standards.”



**Claus Möhlenkamp**  
CEO Freudenberg Sealing Technologies

“Sometimes it requires staying power, even when the innovation’s added value is so obvious. Being nearly frictionless, Levitex saves 0.5 to 1 gram of CO<sup>2</sup> in a car per kilometer. It was worth it. My thanks and appreciation go to all those who believed in and have driven the innovation forward in the past years. The opportunities for Levitex are many and diverse – not only in the automotive industry. There is considerable potential for growth here.”



**Karl Woll**  
Levitex Project Lead

“We are proud and happy to have received the Innovation Award. We had to fight hard and overcome many obstacles before the market accepted this technology. So many colleagues from different areas have put their heart, soul and knowledge into this project. And this is our reward.”

## LEVITEX – SEALING MINUS THE FRICTION

Levitex is the first virtually frictionless crankshaft seal. Levitex reduces friction by up to 90 percent compared to a conventional radial shaft seal. That means less fuel consumption, less wear and a longer service life. There are also environmental benefits: if every car in Germany were equipped with the Levitex technology, more than 440,000 tonnes of carbon dioxide would be saved each year.

The intersection between the engine and the transmission is one of the most important sealing points. There the crankshaft ends with a shaft seal at the crankcase. Various sealing concepts for performing this function have been developed over the decades: the “classic” version is a Simmerring with a tension spring. Radial shaft seals with a seal lip made of elastomeric material or polytetrafluoroethylene (PTFE) – i.e. the plastic commonly known as Teflon – are comparatively new. With this design the rotating crankshaft conveys and steers the oil back from the seal gap to the housing. However, direct contact between the seal lip and the crankshaft together with the shear forces acting on the oil produce friction – and that in turn reduces the engine’s efficiency.

With Levitex – a gas-lubricated mechanical face seal – the engineers at Freudenberg Sealing Technologies have succeeded in designing a sealing solution where the friction is only a fraction of that produced in conventional mechanical face seals.

Gas-lubricated seals have been around for quite some time. The basic idea came from the Freudenberg joint venture EagleBurgmann. So far, these seals have been used in steam turbines, compressors and turbochargers. Until recently, however, gas-lubricated seals were not suitable for use on crankshafts in car engines: too big and too complex. Now, though, engineers have succeeded in greatly simplifying both the seal and the manufacturing process, so that series production can start next year.

How does Levitex work? When the crankshaft rotates, a cushion of air is produced between two rings – one of which is firmly attached to the crankshaft and the other to the crankcase: one of the rings has grooves that are just a few micrometers deep. These grooves taper to a closed tip, representing a cul-de-sac for the enclosed air. Once the engine reaches a certain speed the air is trapped in the grooves – and separates crankshaft and crankcase from each other. The engine oil stays where it belongs.

What is more, the Levitex seal has proved it can function flawlessly under adverse conditions, too. Neither temperatures ranging from -40 to +150°C nor the penetration of water result in the seal’s failure. Nor does the notorious super-fine “Arizona dust” used by carmakers for their functional tests.

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### Business Group:

Freudenberg Sealing Technologies



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### More Information in the Project Video:



[www.freudenberg.com/en/innovation](http://www.freudenberg.com/en/innovation)





## The finalists

### Business Group:

Freudenberg Performance Materials



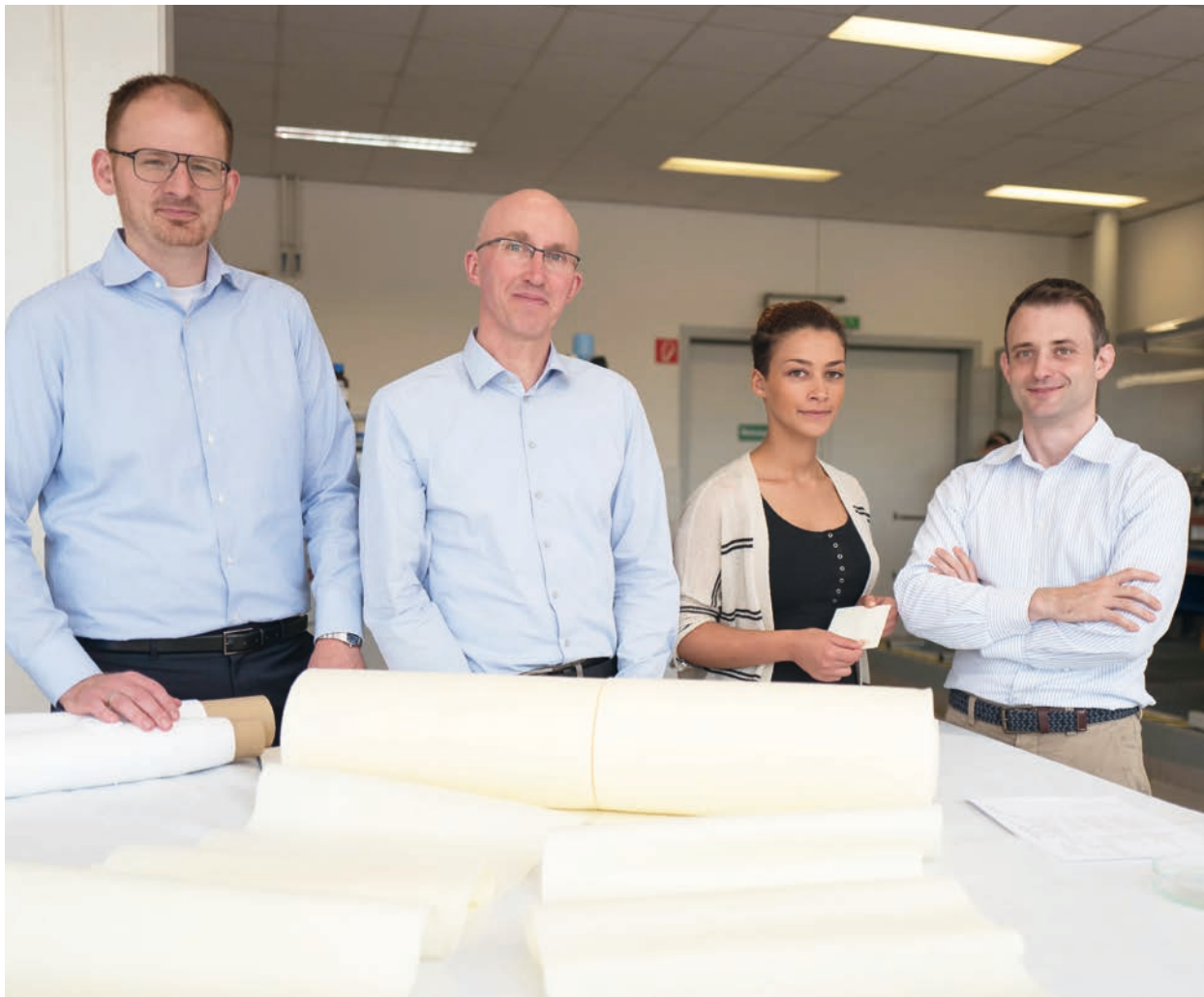
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## BETTER CARE FOR CHRONIC WOUNDS

Minor injuries or major post-operative wounds – whatever the type of the wound it needs a moist environment for an accelerated and complication-free healing process. To achieve that, wound dressings must not only be able to absorb fluids such as exudates, but must also retain their stability when moist. A gelling fiber dressing meets this challenge.

Physicians and nurses can choose from a range of different dressing materials to care for wounds – from simple plaster strips to high-performance compresses and tamponades. There is also a steady stream of new products, some of them with amazing properties that bring remarkable improvements in wound care.

One example is the gelling fiber nonwoven for Advanced Wound Care developed by Freudenberg Performance Materials in cooperation with a key customer from the medical technology sector. What is special about the dressing is that it retains the wound exudate. And that accelerates the healing process.

In order to achieve this effect, the wound dressing combines properties that until now were seemingly incompatible. The highly-absorbent fibers have superior fluid retention. The

material gels when it comes into contact with exudates. The dressing maintains its excellent stability when wet and does not leak even when the dressing is compressed. The new dressing material can absorb over 20 percent more fluid than other dressings currently available.

For both health professions and patients, though, there is a second characteristic that is perhaps even more important: thanks to its high wet tensile strength, the dressing has the benefit of one-piece removal without tearing or disintegrating, and without leaving any residue in the wound bed.

This good mechanical performance is due to the base material – a needle-punched staple fiber nonwoven where the fibers are interlocked and bonded. The material is additionally coated with silver which kills bacteria so that the dressing also delivers antimicrobial efficacy. The risk of infection is reduced. These wound dressings are manufactured in the cleanroom to meet the stringent production hygiene requirements for this highly-sensitive application.



The finalists

**Business Group:**  
Freudenberg Filtration Technologies

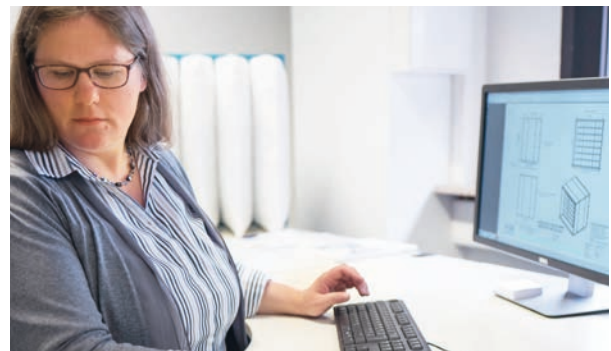
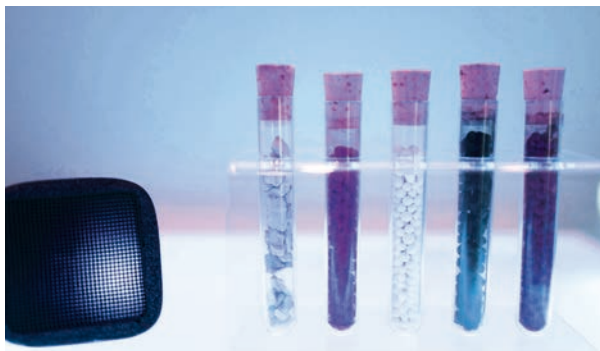


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## SAFE OPERATION OF CONTROL SYSTEMS

Acidic gases, such as sulfur, chlorine or nitrogen compounds in ambient air cause corrosion of electronic components in motor control rooms of industrial plants. This leads to increased maintenance cost, downtime and even uncontrolled shutdowns of operations. The Viledon ChemControl filtration systems protect sensitive and critical equipment and ensure safe operation of industrial plants.

The electronic control systems in pulp and paper and petrochemical plants or on oil rigs are located in production areas where corrosive gases are generated. Corrosion of sensitive control circuits can lead to downtime or even failure of machinery and whole production lines. The damage caused by the failure of just one single pump on an oil rig could quickly run into millions.

The main causes for damage of electronic equipment are chlorine, sulfur compounds and nitrogen oxides in the ambient air: they lead to the corrosion of contacts on computer and control system circuit boards. Hence, these contaminant gases must be completely removed from the air. Viledon ChemControl filtration systems offered by

Freudenberg Filtration Technologies (FFT) reliably removes corrosive substances from the air. The Viledon ChemWatch system monitors on-line the air quality to ensure corrosion-free atmosphere at all times. The device enables real-time monitoring of air quality: temperature, humidity, air pressure and corrosion status are recorded and displayed. All data can be transmitted via WLAN which makes remote maintenance of the filtration system possible. So-called media-life analysis allows FFT's service engineers to determine what quantities of contaminant gases the filters can still remove before they must be changed.

How does a ChemControl filter work? The technical term used by experts is "gas phase filtration." The heart of the system are so-called gas adsorption pellets or honeycombs. These adsorptive materials can eliminate or convert specific gases. Their composition varies depending on the contaminant gases they are designed for. Unlike conventional particle filtration, gas phase filtration is based on a chemical reaction transforming the gases into harmless substances. This process takes place in filtration units specially designed by Freudenberg Filtration Technologies.





## THE CLEAN GRASS BROOM

Traditional Indian brooms are made from natural fibers. Tiny seed pods caught in the stalks of grass detach during sweeping, creating more dust and dirt. The No-Dust-Broom – the high-tech version of this traditional broom – puts an end to that problem. Its bristles are made of polymer fibers that last much longer and are also rinsable.

Sweeping in India is a dusty undertaking: each year over half a billion brooms are bought by around 250 million households. These brooms are usually slim, elongated bundles of dried grass stalks which – unlike the brooms used in homes in the Western world – are only about a meter long. That is because on the Indian continent people prefer to sweep in the squatting position, so a longer broom would be inconvenient. There is, however, one big downside to the broom's natural bristles: the broom tends to shed tiny seed pods caught in the grass stalks during sweeping. So the traditional Indian grass broom doesn't just sweep dirt aside, it actually makes dirt of its own – at least while it is still new. And on top of that it does not last very long. That's because sweeping wears the bristles down. The grass brooms have to be replaced on average every three months. And that is not all: these natural brooms cannot be rinsed because the stalks of grass do not respond well to water.

The technicians and product developers at Freudenberg Home and Cleaning Solutions decided to see whether they could come up with an alternative that would do away with all these disadvantages. The result: the No-Dust-Broom. The new broom made by Freudenberg Gala Household Product and marketed in India under the Gala brand name features extruded polymer fibers instead of grass stalks. These fibers have flagged tips so they can sweep a larger area. Several thousand of these wear-resistant synthetic fibers are aligned in parallel and thermally fixed in a U-shaped profile. This “fiber carpet” is then wound helically round a flexible core and secured. The bristle section is firmly attached to the ergonomically designed plastic handle.

The No-Dust-Broom is a high-tech broom with a precisely-defined bristle geometry ideally suited to the “squat sweeping” typically found in India. The broom underwent endurance testing based on a specially-designed standardized test method. The results speak for themselves: the polymer fibers do not cause dust, they are extremely robust and last three times as long as the traditional grass stalks. Moreover, a dirty No-Dust-Broom can be easily rinsed in water with no negative effects.

Definitely a case of a “new broom sweeps clean”!



**Business Group:**  
Freudenberg Home and Cleaning  
Solutions

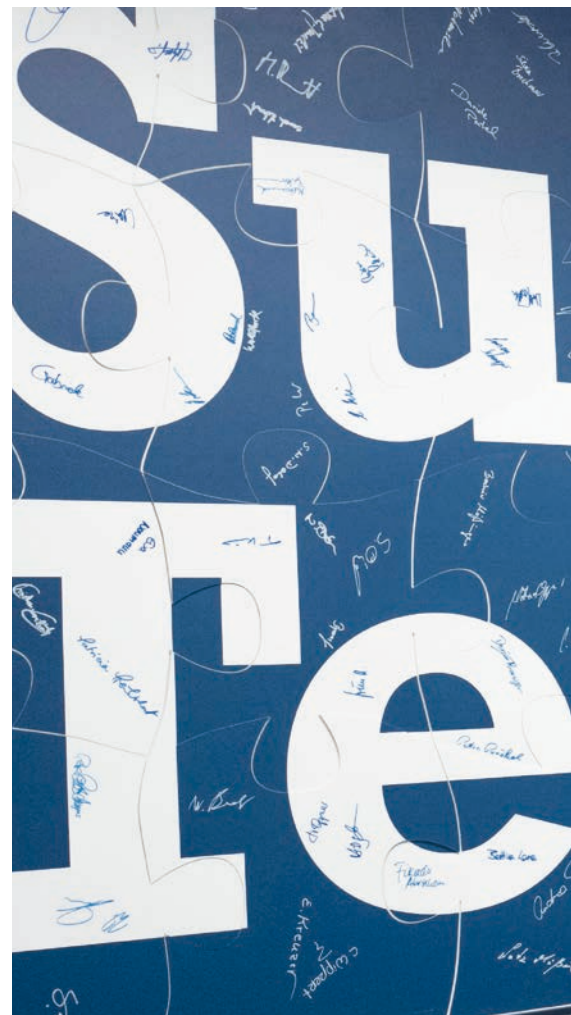


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## CHROMIUM(III) – SAFE FOR HUMANS AND THE ENVIRONMENT

Chromium-plated products and components are chic and robust. Nonetheless, chromium(VI) will vanish from the market in the medium term because working with hexavalent chromium brings serious health risks. Trivalent chromium plating, on the other hand, is completely harmless. Here is how the success story came about.

They have a silver shine and an elegant appearance: chromium-plated items are part of our everyday lives like cell phone cases, metal frames on office chairs or components fitted in top-of-the-range espresso machines. But chromium plating is not just for decoration. It also protects against corrosion and makes objects more robust, for example when it comes to aggressive cleaning

agents. So it is hardly surprising that chromium features prominently in kitchens and bathrooms – on faucets or shower fittings, for instance.

Chromium and electroplating with chromium have come in for public criticism because of the carcinogenic effects of chromium(VI) – used in the past for relatively thick wear-resistant coatings on machine parts, for example. It is not the chromium-plated part itself that is toxic – it is the aerosols which people are exposed to during the plating process. While these aerosols can be extracted and neutralized, the EU has nevertheless decided to err on the side of caution: severe restrictions on the use of chromium(VI) compounds come into effect from September 2017.





**Business Group:**  
Freudenberg Chemical Specialities



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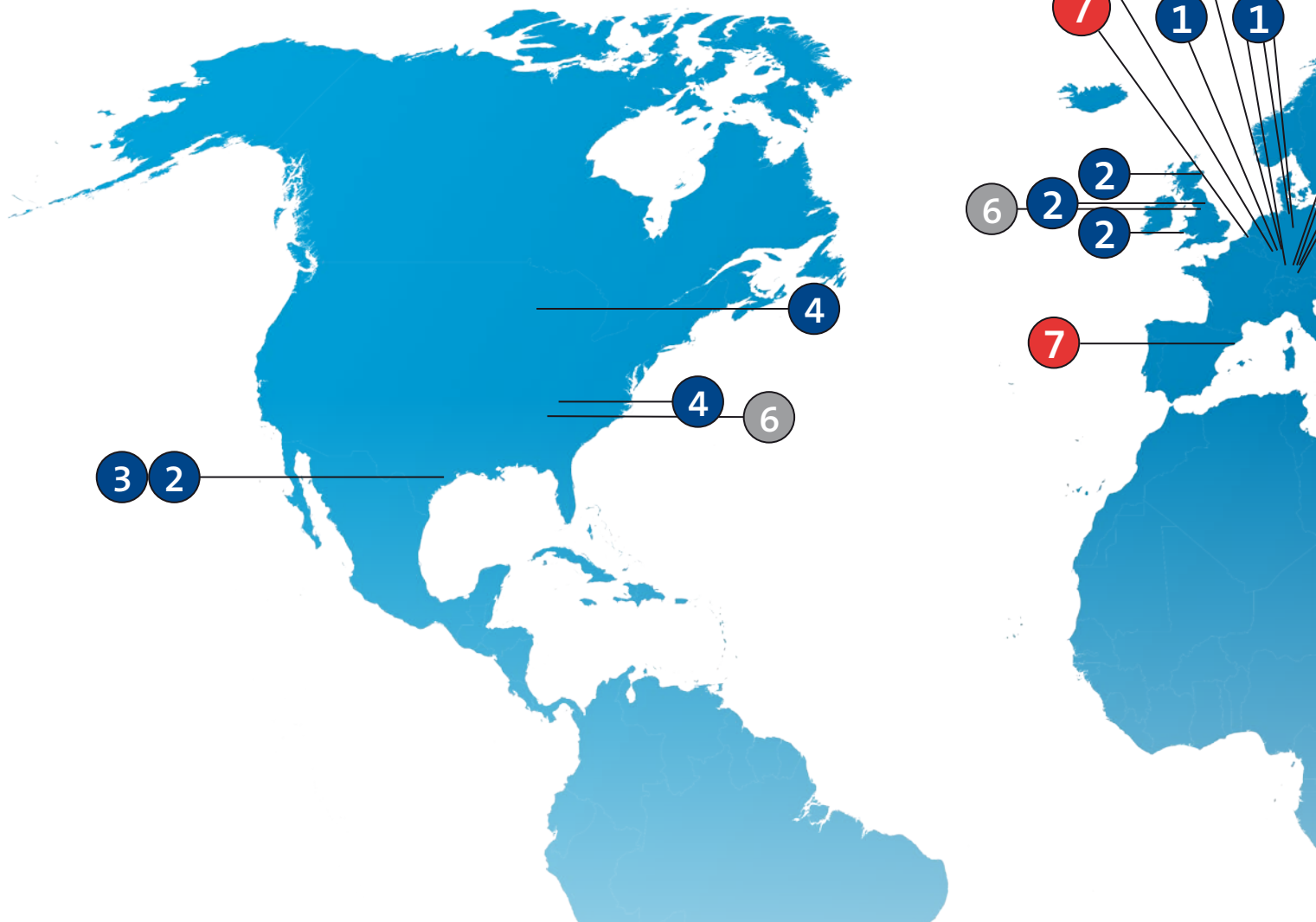


[www.freudenberg.com/en/innovation](http://www.freudenberg.com/en/innovation)

But that does not mean the end of chromium plating: researchers and technicians from the Freudenberg subsidiary SurTec in Tokyo and Zwingenberg have succeeded in scaling up chromium(III) plating processes to real-life conditions in practical plating lines. Trivalent chromium is chromium's most stable oxidation state and is found in the earth's crust. And what is particularly important in regulatory terms: chromium(III) is not affected by the EU ban.

Technical processing issues are the main reason why chromium(III) electrolytes have not been used on an industrial scale so far. Chromium(III) baths were not very stable, the coatings not very robust and the color range for chromium-plated surfaces not particularly extensive. These obstacles have now been overcome, and progress has been made in all areas. Chromium(III) plating has become state-of-the-art – partly because SurTec's chromium(III) electrolytes are completely safe for humans and the environment.

# THE FIA MAP



## SEALS AND VIBRATION CONTROL TECHNOLOGY

- 1 Freudenberg Sealing Technologies:**
  - Levitex – the Revolution in Automotive Sealing Technology
  - New Generation of Polyurethane – 94 AU 30000
  - Unique Mold Design (WebFEM)
- 2 Freudenberg Oil and Gas Technologies**
  - Statoil Polarled Pipeline Project – Development of two 36“ Optima Connectors and Ancillary Equipment
  - S and FS Seal Design and Process Development
- 3 EagleBurgmann**
  - Sealing Solution for Electric Submersible Pumps (ESP) in Subsea and Oilsand Oil Production
- 4 Freudenberg Medical**
  - FlexSeal Introducer Sheath

## NONWOVENS AND FILTRATION

- 5 Freudenberg Performance Materials**
  - Superior Nonwoven Development for Advanced Wound Treatment
  - Energy Saving TACs (Tertiary Air Channels)
  - A-Adhesive System for Interlining Applications
- 6 Freudenberg Filtration Technologies**
  - Gas Phase Filtration



**HOUSEHOLD PRODUCTS**

- 7** Freudenberg Home and Cleaning Solutions
  - No-Dust-Boom
  - SwepPro – Service Contracts
  - Actifibre – The Next Generation Microfibre

**SPECIALITIES AND OTHERS**

- 8** Freudenberg Chemical Specialities
  - Safe and Non-Toxic Decorative Chromium Plating
  - In-Process Quality Control of Homogeneity and Purity of Lubricating Greases
- 9** Freudenberg IT
  - Customer Project Ontex – Next Generation Shop Floor



## IMPRESSIONS 2016: AWARD CEREMONY





## IMPRESSIONS 2016: JURY SESSION



## Legal information

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