

Adhesives on the Ice Rink

Ice hockey is now one of the most popular team sports in Germany, and the German ice hockey league plays at a high level. Evidence of this, for example, is the silver medal that the German ice hockey team won at the 2018 Winter Olympics in South Korea. Compared to the equally popular sport of soccer, ice hockey is even faster and even more physical. Body checking within certain rules is permitted as a normal part of the game. And when this happens, the players are subjected to amazingly high g forces. For example, if a player is standing at arm's length from the plexiglass shield at the edge of the rink and an 80kg opposing player tackles them at a speed of 20km/h, the player will hit the shield with a force of 3.6g. For comparison: a car's airbag will already deploy at 2g. For that reason, having the right equipment is absolutely essential to ensure comfort and safety on the ice. It is a little known fact that adhesives provide decisive support.

Comfortable and safe from head to toe

Ice hockey equipment is divided into two kinds: protective equipment and sporting equipment. The former includes such items as the helmet and protective shields for the legs, chest, and face. The protective equipment for the legs and chest are made of an adhesively bonded combination of hard plastic and soft PE foam, making it both safe and comfortable without restricting the movements of the players.

The sporting equipment includes the skates and the hockey sticks. Adhesives are also used for these items. For example, in the production of ice hockey skates, the ankle support and the foam padding are adhesively bonded inside the shoe, and adhesives are also used to attach the sole of the shoe, to which the runners are subsequently fixed. And even the players themselves



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Various adhesives are used in the production of ice hockey skates.

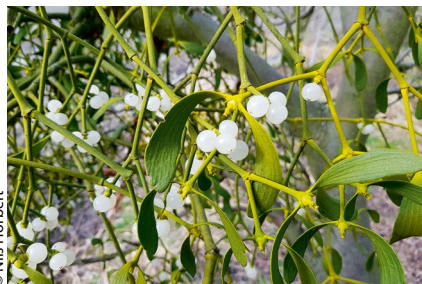
use adhesives when playing, as they like to wrap adhesive tape round their hockey sticks.

In addition to their protective and sporting equipment, the ice hockey players also wear their team jerseys, which are always a popular item among the fans. Traditionally, the names of the players and sponsors are printed or embroidered on the jersey. However, if they want to add an individual touch, for example with their own name, this can be done by flocking. The underside of the flock film is coated with a hotmelt adhesive that is activated by heat. During the application process, the flock fibers are electrostatically charged, causing them to stand up vertically. High pressure and heat are then applied to fix the fibers of the flock film – and the customized jersey is finished. One thing is certain: adhesives in ice hockey contribute to safety, functionality, and comfort – from head to toe. //

For further information, please visit: www.klebstoffe.com

Natural Adhesive from Local Mistletoe Berries

A team of researchers from the Max Planck Institute of Colloids and Interfaces (MPICI) and McGill University in Canada have discovered that white-berry mistletoe has strong adhesive properties. The flexible fibers of the mistletoe berries adhere to both skin and cartilage as well as to various synthetic materials.



© Nils Horbelt

Mistletoe berries produce a natural cellulose adhesive.

For their research, the materials scientists led by Prof. Dr. Peter Fratzl picked the mistletoe berries from the trees themselves. The director of the Department of Biomaterials can see many of the green parasitic plants from his own office window. "Mistletoe grows in large numbers everywhere, including the Max Planck Campus, and is biodegradable and renewable," says Peter Fratzl, adding: "For the first time, we are now investigating how to harness its excellent adhesive properties potentially for medical or technical uses." Each mistletoe berry can produce a sticky thread up to two meters long called viscin – a natural cellulose adhesive. This enables the seeds of the semi-parasitic plant to stick to their host plants. The researchers in the former research group led by Dr. Matthew Harrington, who has since

moved on to take up a professorship at McGill University in Canada, discovered that viscin fibers can be stretched into thin films or assembled into 3D structures by simply processing them when wet. This natural super glue could potentially find application as a wound sealant, and it also adheres to metals, glass, and plastics. What is also exciting is the fact that the adhesive properties are fully reversible under humid conditions. "Many questions remain about this very unusual material," says Nils Horbelt, first author of the present study. The next step will now be to investigate the chemistry behind this swellable, extremely sticky material in order to be able to imitate the bonding process in a second step. //

For further information, please visit: www.mpikg.mpg.de

50 Years of FEICA

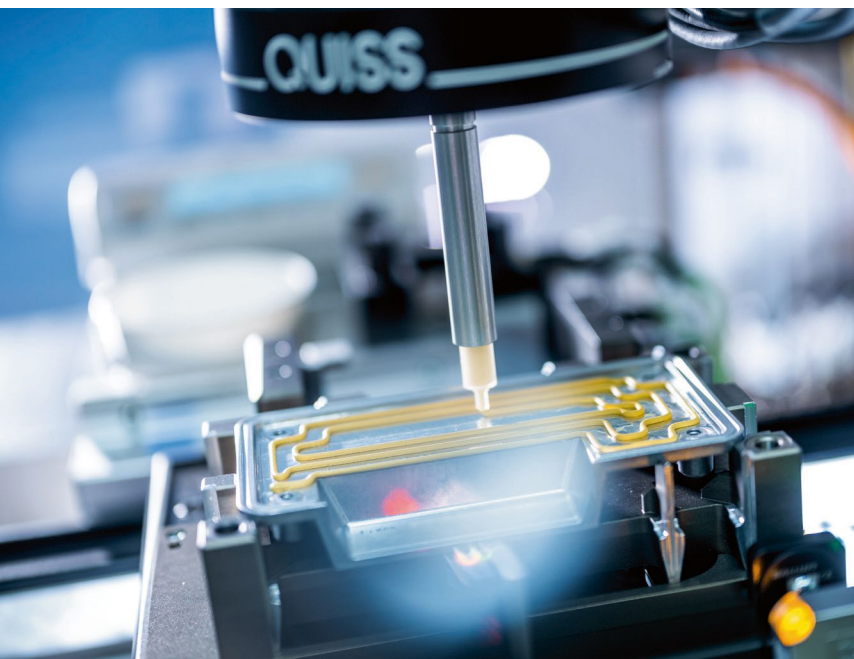
After a two-year hiatus, the 2022 FEICA Conference and Expo broke an attendance record and celebrated the association's 50th anniversary with the European and International adhesives and sealants community. This year's event was a celebration of the European adhesives and sealants industry's getting together again for the first time since 2019, as well as of FEICA's anniversary. It took place from 14 to 16 September 2022 and was held at the Grand Elysée Hotel in Hamburg, Germany. Following two postponements due to the pandemic, more than 700 industry leaders from all over the world exchanged ideas, discussed today's global challenges, and built opportunities for long-term growth. The conference and expo brought together formulators, suppliers, distributors, service providers and members of the academic community to Hamburg. The conference provided insights into key issues affecting the industry, such as sustainable growth, innovation and digitalization. This year's conference business forum, titled 'Enabling a sustainable future', explained how a viable and sustainable future will depend on a more efficient and circular use of resources, and showed how the adhesive and sealant industry is eager to contribute to solutions to meet this challenge. In addition to the business forum, parallel breakout sessions offered at-



The association celebrated its 50th anniversary at the FEICA Conference and Expo 2022.

tendees a range of focus areas, such as food packaging, sustainability, hotmelts, recycling and bio-based building blocks for adhesives and sealants. These breakout sessions gave experts an opportunity to share their knowledge and to enable delegates to attend informative sessions relevant to their own spheres of interest. The conference's presentations ranged from 'Food packaging adhesives' to 'Realizing energy efficiency'. The FEICA Seminar, open to all members, addressed 'A Business Perspective on Regulatory Challenges'. At the Expo, 50 exhibitors showcased their latest developments. Two books commemorating FEICA's 50th anniversary were distributed at the event.

The first, '50 Years FEICA', featured the history of the association and the adhesive and sealant industry with photos and stories from FEICA's archives. For the second publication, FEICA commissioned Prof. Dr Bernd Mayer and Prof. Dr Andreas Groß at the Fraunhofer IFAM to write a study titled 'Adhesive Bonding Technology in the 21st Century - Synergy of Technological and Ecological Potentials'. The 2023 FEICA Conference and Expo will be held at the PortAventura Convention Centre in Tarragona, Spain, from 13 to 15 September 2023. Registration will open at the beginning of 2023. // For further information, please visit: www.feica-conferences.com



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Gaskets for Electrolyzer Stack Plates

Freudenberg Sealing Technologies produces seals for electrolyzers relying on materials that have proven their effectiveness in sealing fuel cells. They are designed to optimize sealing performance. Freudenberg manufactures the elastomeric gaskets in a four-step process in which they are overmolded onto composite and metal electrolyzer stack plates. These plates are used to separate the cells in a stack assembly. Key components of the plates are the gaskets that prevent the leakage of gas into other parts of the electrolyzer. For this purpose, the company uses a portfolio of proprietary rubber-based gasket materials, including EPDM and FKM formulas, to address the high performance requirements and electro-chemistry of the different types of electrolyzers. To ensure that the sealing function is optimized, Freudenberg has developed material-specific bonding agents that are applied between the gasket and plate materials. Ex-

tensive material testing combined with advanced injection molding techniques enable the company to produce high-quality, electrolyzer gasket-plate units that are easily transported to customers' production sites and installed there.

High demand for electrolyzers expected

"As manufacturing industries make strides in moving toward mass green hydrogen production, our ambitious goal is to support the demand for high-capacity electrolyzer gaskets by 2023," said Robert Lidster, Technical Director, Gaskets Division, at Freudenberg Sealing Technologies. "We have been successfully sealing fuel cell systems for many years. While these do not operate at the extreme pressure and temperature conditions found in high-density electrolyzers, they have provided us with a complete understanding

of what is required to seal these aggressive environments over a very long life cycle." Most hydrogen that is produced today uses fossil fuels. The only feasible option for producing green hydrogen is electrolysis. This process uses electricity to split water molecules into oxygen and hydrogen gas ions by means of an electrolyzer system. The hydrogen ions can be used as hydrogen fuel, or can be recombined with oxygen to create oxyhydrogen gas, which is used in industrial welding and other applications.

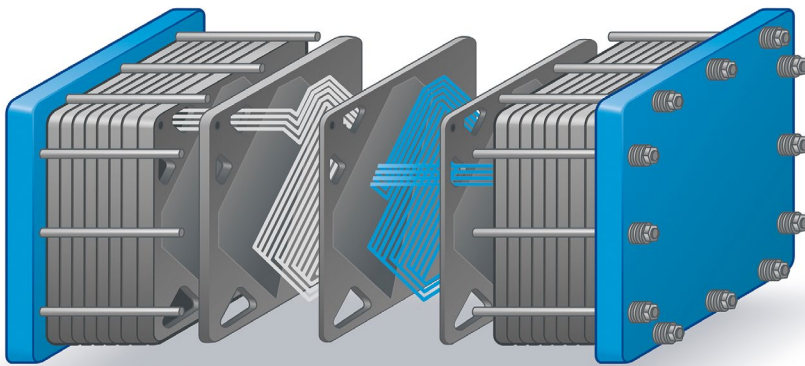
Today, green hydrogen accounts for about 1 GW of power worldwide. Driven by the urgency of climate change and commitments by countries to achieve net zero, the International Renewable Energy Agency (IRENA) estimates hydrogen to cover up to 12 % of global energy use by 2050. In addition to emission objectives, environmental regulations and investment in the production of green hydrogen are paving the way for this increase.

Even though they offer an opportunity to provide clean energy, electrolyzers are a technical challenge. For example, it is necessary to increase the power density of the stacks and at the same time to reduce the complexity and size of the overall system.

Focus on different electrolysis systems

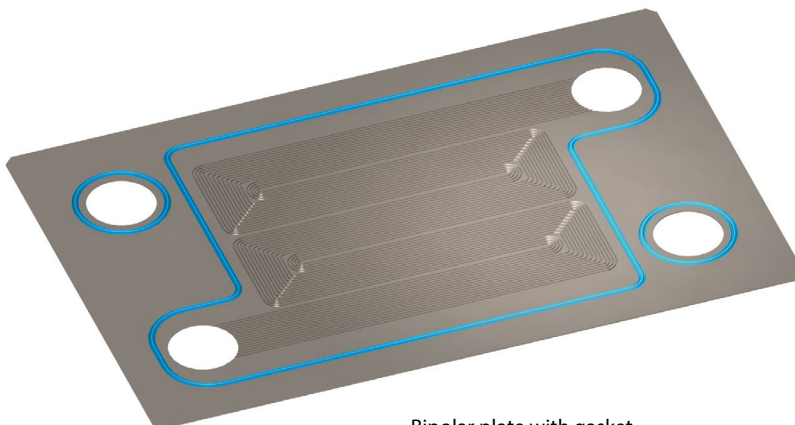
Development engineers at Freudenberg are currently working on gasket-integrated electrolyzer plates for polymer electrolyte membrane (PEM), anion exchange membrane (AEM), and alkaline (AEL) electrolyzers. Due to the differences in the electrolyte materials used in these systems, the company collaborates closely with customers to adapt the gasket materials and adhesives to ensure the optimum performance in different types of electrolyzer systems. In addition to performance measurements, the engineers also need to consider such factors as corrosion resistance, stability, material breakdown, and permeability and have to adapt these to different electrolyzer environments. //

© Freudenberg Sealing Technologies



Sketch of an electrolyzer

© Freudenberg Sealing Technologies



Bipolar plate with gasket

For further information, please visit:
www.fst.de

Printable Adhesive for Solar Modules

Producing solar modules with printing technology could speed up the energy transition while also lowering costs. A conductive and printable adhesive will help make that possible. In a joint project, researchers at Karlsruhe Institute of Technology (KIT) and Protavic International are bringing it to market. They won the transfer award in the Neuland innovation contest.

The special adhesive is expected to greatly simplify the production of photovoltaic modules while also reducing the amount of energy and materials consumed. “Thanks to this new adhesive technology, soldered connections will be a thing of the past,” says Professor Norbert Willenbacher, who developed the new method with his team at KIT’s Institute for Mechanical Process Engineering and Mechanics. “The circuitry for the solar modules will be printed onto them at low temperatures. Only in this way will it be possible to produce new cell technologies like perovskite tandem solar cells with higher efficiency.” He also sees considerable potential for other applications of the technology. “Think about the production of electronic devices like smartphones or notebooks. Our adhesive can also cut way down on raw material use there,” says Willenbacher. A complex mix of materials makes it possible to use the simple adhesive technology. A polymer and a conductive metallic powder containing silver are combined with an immiscible liquid in what is called



© Robert Fuge | KIT

KIT Vice President Prof. Thomas Hirth, Simon Malandain (Protavic International), Prof. Norbert Willenbacher and Katrin Dhyr (KIT), and Dr. Alexander Klonczynski (Robert Bosch) at the award ceremony of the Transfer Prize of the KIT competition Neuland.

a capillary suspension. It features high conductivity with low silver consumption, can be printed with common methods, and is robust and durable. //

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Supramolecular Adhesive with a Broad Usable Temperature Range

Researchers have developed a supramolecular adhesive that is recyclable and has outstanding adhesive properties across a wide range of temperatures, from liquid nitrogen (-196 °C) up to oven-hot temperatures (plus 200 °C).

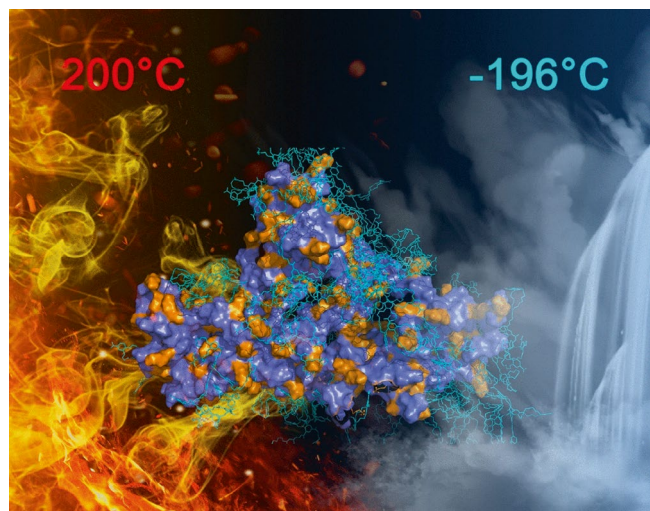
Unlike standard adhesives, supramolecular adhesives do not create adhesion by crosslinking of the molecular components. Instead, they self-assemble during the curing process like pieces of a puzzle to form a tightly knit structure. Researchers are interested in such supramolecular systems because the individual starting materials can be recovered again and their chemical behavior can be tailored. However, to date, the performance of such glues has only been satisfactory at best, and they are also highly dependent on environmental conditions.

The new supramolecular glue, which has been developed by a research team led by Kai Liu from Tsinghua University in Beijing (China), consists of two components. One is a small protein that is synthesized in bacteria that have been modified for this purpose. The other component is a crown ether – a ring-shaped molecule which can wrap snugly around another molecule, much like a crown on someone's head.

Strong adhesive effect in hot and cold conditions

The researchers observed this close interaction between the molecules in their adhesive system. If the crown ether and the protein were added together and the solution was heated, the crown ether became anchored to the surface of the protein. The team observed that the protein and crown ether were so tightly bound to each other by their opposing charges and molecular interactions that they formed a new, interlocking structure. The crown ether welded the proteins together.

The result was an extraordinarily strong adhesive effect. Steel plates glued together were able to withstand high shear forces at



The supramolecular adhesive can be used in a wide temperature range of 400 °C.

room temperature, in liquid nitrogen, and at 200 °C. The adhesive worked for different materials and even under water. Such a broad range of working conditions is rarely achieved, even with specialist adhesives, and is a first for supramolecular adhesives. The components could also be recycled. The recycled and reused adhesive lost almost none of its performance. The researchers suggest that this new adhesive could be used in the manufacture of special parts that are subject to greatly fluctuating conditions during use, such as the wide temperature ranges in space travel. //

For further information, please visit: www.gdch.de

Adhesion Innovation Award 2023

FEICA, the Association of the European Adhesive and Sealant Industry, has launched the third Award for Innovative Adhesion Science. The joint EURADH (common conference of the European adhesion societies) and FEICA Award for Innovative Adhesion

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**ADHESION
INNOVATION
AWARD 2023**

The winner of the Adhesion Innovation Award will be announced in June 2023. The award ceremony will take place at the EURADH and FEICA conferences in September 2023.

Science is a biannual event created to stimulate the interactions between industrial and scientific activities. It is also an opportunity for both EURADH and FEICA to raise awareness of the innovations in the sector, which contribute significantly towards a circular economy and the European economy. This year's focus is on sustainability, durability and industrial applications, among all other aspects of adhesive bonding and adhesion.

Applications are invited from young researchers and scientists working in adhesion science who have published outstanding work. This includes Master's students, PhD (Doctoral) students, post-docs, junior professors and researchers associated with universities, research institutes or companies. The winner of the Adhesion Innovation Award will be announced in June 2023. The award ceremony will take place at the EURADH and FEICA conferences in September 2023. //

For further information, please visit: www.adhesionaward.org

Adhesives for Metal and Lightweight Construction

Continuous developments in new materials are also leading to new and higher demands in joining technology in the field of metal processing. Designers and engineers are increasingly relying on adhesive bonding as a method of permanently joining these materials. Due to the large number of different metals and alloys that need to be joined, various adhesive systems are used. The decisive factors for the quality and durability of an adhesive bond are above all the type of material, the geometry of the surfaces being joined, and, not least, the adhesive itself. In order to ensure the best possible wetting of the surfaces with adhesive, the properties of the adhesive, such as its composition and viscosity, must be matched to the surface to be bonded. High-performance adhesives can provide high-strength and permanent bonds. The highest strengths are achieved by 2-component reactive adhesives based on epoxy resin and methyl methacrylate (MMA), which cure through a chemical reaction.

The areas of application for high-performance adhesives include, for example, structural and construction bonding in vehicle engineering and the assembly bonding of sandwich elements.

Joining metals using contact adhesives

Contact adhesives are suitable for bonding metals over large surface areas. In particular, contact adhesives based on polychloroprene (CR) have high adhesion values on metals. The advantage of contact adhesives is their high initial strength. The temperature and media resistance of contact adhesives can be significantly increased by adding a crosslinking agent. In this case, it is important to apply the adhesive on both sides, to allow the adhesive to dry, and then to join the parts by applying high pressure for a short time.

Some adhesive applications also require an elastic and anti-vibration joint which must



Contact adhesives are suitable for bonding metals over large surface areas.

perform a sealing function at the same time. The visual aspect also plays an important role if there are adhesive bonds in areas that are visible, for example in body construction, vehicle engineering, equipment construction, and ship building, as well as in air conditioning and ventilation technology. //

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Henkel Inaugurates Innovation Center

At the Inspiration Center Düsseldorf, or ICD for short, Henkel presents its portfolio and develops new solutions together with customers. The center is the largest single investment in the company's history. With an investment volume of 130 million euros, the Adhesive Technologies business sector has built a global innovation and customer center on the site of the Group's headquarters in recent years and has been gradually commissioning it since mid-2021. With a floor area of 47,000m², the ICD provides space for 30 laboratories, 4 technology centers and more than 650 experts from the company.

The laboratories are modular in design and can be adapted quickly and flexibly. In one of the laboratories, new formulations can be automatically prepared, tested and checked around the clock under data control. The technology centers include pilot production lines and equip-

ment for large-scale applications such as in the automotive industry or in structural timber engineering. Employees have access to digital platform technologies, for example a cloud-based tool for leaner, faster and strongly collaboration-based innovations. At the same time, the new building serves as a global customer center where the business sector presents its whole technology portfolio of adhesives, sealants and functional coatings and works on new solutions together with customers from over 800 industry segments. According to Henkel, the ICD marks the largest single investment in the company's history. A particular focus will be on sustainable innovations that contribute, for example, to CO₂ reduction or new solutions for a circular economy. The business sector is working on products that enable resource efficiency in production and during use across the whole life cycle and



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The Inspiration Center Düsseldorf of the Adhesive Technologies business sector

that are based on natural formulations as well as recyclates. In addition, Henkel offers a growing portfolio for the recyclability of, for example, packaging or consumer goods, and the reparability of everyday products. The company is working on new debonding solutions to drive debonding of different materials across industries to increase longevity and recyclability. // *For further information, please visit: www.henkel.com*

Call for Papers for EURADH

In September 2023, the 14th European Adhesion Conference (EURADH) will be held together with the 7th World Congress on Adhesion and Related Phenomena (WCARP) in Garmisch-Partenkirchen. Contributions can still be submitted via the conference platform until January 31, 2023.

The organizers cordially invite scientists and engineers to take advantage of this opportunity for exchange and to submit oral and poster presentations with the latest results of their work. The conference will focus on sustainability, durability and industrial applications, among all other aspects of bonding and adhesion. The full list of topics can be found on the conference website. The supporting program of the conference will also

provide an opportunity for networking with participants. The submission of articles is now possible via the Converia conference management system. Contributions can be submitted in the form of a one-page abstract as a pdf file no later than January 31, 2023. The abstract should mention the objective, new results and conclusions, or the significance of the work. A template will be provided online. Accepted abstracts will also be published in a book of abstracts for all conference participants. //

For further information, please visit: https://dechema.de/en/euradh_wcarp_2023.html

Hoffmann Mineral Prepared Life Cycle Assessment

In a further step towards more sustainability, Hoffmann Mineral has had an LCA prepared for the Aktifit AM product by TÜV Rheinland in accordance with ISO standards 14040:2021 and 14044:2021. An LCA helps to balance the environmental impact of a product and shows companies where energy and emissions can be saved. "Aktifit AM represents the entire value chain in our company and is thus an ideal starting point for deriving possible courses of action for this product and later for other products as well," explains Dr.

Mikhail Meilikhov, Member of the Management Board for R&D and Risk Management at Hoffmann Mineral. The LCA for Aktifit AM provides a detailed overview of each phase of its life cycle in terms of energy use and emissions, and shows how much energy is consumed in total for individual production steps and packaging. By preparing its LCA, Hoffmann Mineral can also support customers in their sustainability analyses. This addresses increasing regulatory requirements worldwide and the growing demand for sustainable and

optimized products. The primary energy sources for the production of Aktifit AM have an influence on the LCA results and thus on the actual emissions. Due to the changes in the conventional and renewable shares of the overall energy mix in Germany, it is necessary to regularly update and re-evaluate the results obtained from the LCA. Hoffmann Mineral plans to repeat the current review at regular intervals. //

For further information, please visit: www.hoffmann-mineral.com

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