finishextra

INSIGHTS INTO THE WÖRWAG COMPANY

Appearances

The role played by surfaces in color development

WÖRWAG

Farbe. Beschichtung. Kompetenz.

Making an appeara

Before products can sparkle and shine, developers take a close look below the surface. Which raw materials are to be coated? What will the substrates be exposed to? How will they be coated? Because this is an area in which both knowledge and practical experience come into play, the experts at Wörwag investigate every angle—iron ore mines in Ukraine, for example (photo)—Page 6. Every raw material has its own characteristics. When working with

nce

Photo: Shutterstock

titanium, steel, iron, aluminum, carbon, and plastics, what features are unique and what do they share?—Pages 8 through 21. Chrome coating—another innovation from Wörwag. For the beautiful things in life—Page 22.

Published by Karl Wörwag Lack- und Farbenfabrik, Strohgäustraße 28, 70435 Stuttgart, **Project Management, Editor-in-Chief** Daniela Renzo, **Concept** C3 Stuttgart Creative Code and Content, **Layout, Implementation, and Image Selection** Lena Nominaniuk, **Project Management** Janine Ayadi, **Editing and Text Production** C3 Stuttgart Creative Code and Content, Elmar Brümmer, Michael Thiem, **Print** RöslerDruck, **Translation** RWS Group Deutschland

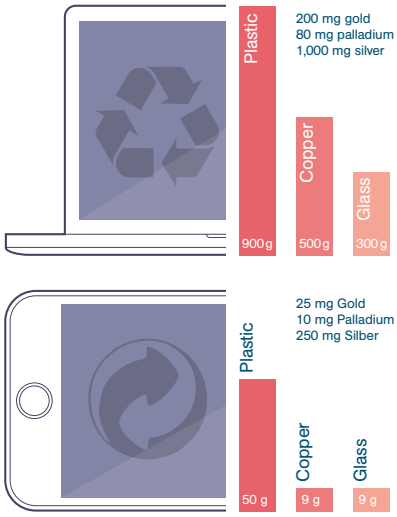
FACTS AND FIGURES

A material world

More than one-third of international trade is in natural assets. We must treat these assets responsibly if humanity is to survive. Useful knowledge and trivia about the life cycle of raw materials.

05

Up to **90** Percent



Waste not, want not

Is it trash? Far from it! By using recycled materials, we can save up to 90% of the primary raw materials that were so laboriously extracted. This is particularly true of electronic equipment such as notebooks or cellular phones. In 2014 alone, 1.3 billion smartphones were sold worldwide.

01

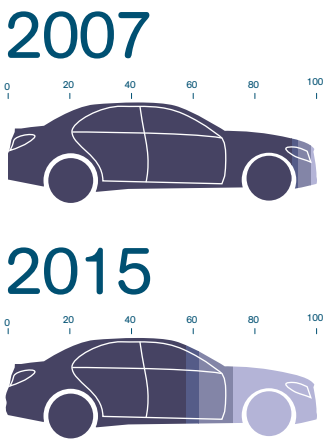
Al Aluminum

25 Percent

Bodywork "light"

74 % of the materials used in automotive engineering are metals. Plastic (12 %), elastomeres (5 %), fluids, and glass (3 % each) trail well behind.

The basic trend in selecting materials for car bodies is crystal-clear: lighter and lighter, which means better fuel economy. The mix of materials in the Mercedes C-Class is a good example of this development: the proportion of aluminum is 50 %.

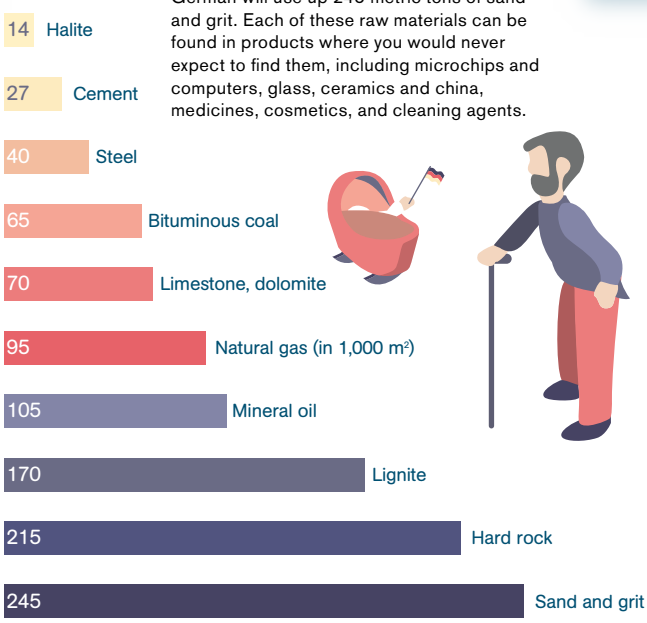


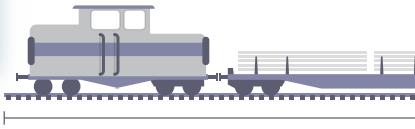
02

245 metric tons

Built on sand

During the course of their lifetime, every German will use up 245 metric tons of sand and grit. Each of these raw materials can be found in products where you would never expect to find them, including microchips and computers, glass, ceramics and china, medicines, cosmetics, and cleaning agents.

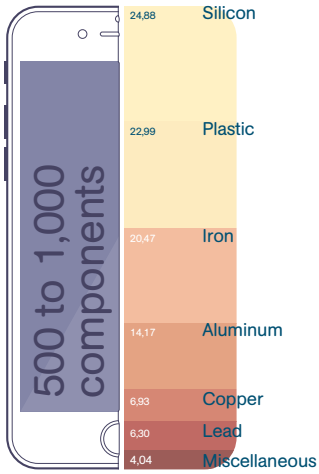




03

Si Silizium

25 Percent



Recyclables

A smartphone is made up of 500 to 1,000 components. In addition to silicon (25 %) and plastics (23 %), you'll find other recyclable materials such as iron, aluminum, copper, and lead.

04

Co cobalt

25 m tons

Bewitched

There are 25 million metric tons of known cobalt reserves. This special metal is used in high-tech products such as cell phone batteries or aircraft turbines. During the Middle Ages, cobalt compounds were used to color glass and ceramics (cobalt blue). At first, cobalt ore was mistaken for silver. However, it reeked when heated. Clearly it must have been bewitched by a kobold (a spirit or goblin) who had feasted on the precious silver. And that is the story behind the word "cobalt."

Sources: 01 Statista, Daimler AG; 02 Statista; 03 Statista; 04 Wikipedia; 05 Solenthaler Recycling AG;

Telephone graveyard

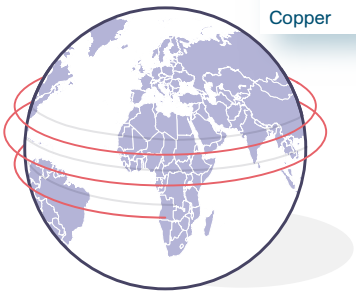
06

2,5 x

Cu

Copper

An estimated 120 million cast-off cell phones are slumbering away in German private households. A wire made from the copper in these devices would extend some 100,000 kilometers (62,137 miles) and could be wrapped two and a half times around the Earth.



The magnificent seventeen

08

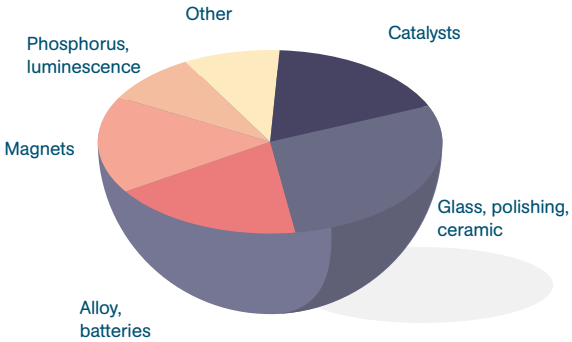
95 Percent

Tm

Thulium

Rare earths are an integral part of 21st-century technology. This umbrella term includes 17 metals that were discovered in rare minerals in the late 18th century. The metals themselves are anything but rare, however. Even the "rarest" among them—thulium and lutetium—occur two hundred times more often than gold. A good 95% of rare earths are extracted in China.

Primary uses

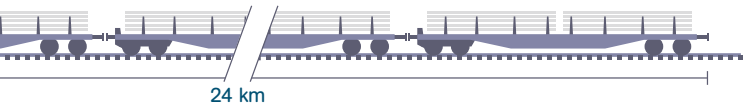


Chock-full

07

24 km

So much paper is recycled every day in the USA that you could fill a 24-kilometer-long freight train (nearly 15 miles) with it.



Continuous lighting

09

24,000 euros

Tritium is a radioactive isotope of hydrogen that is used, for example, in production of self-contained illuminated exit signs for schools, movie theaters, and other public buildings. Tritium gas in a glass tube coated with a luminescent substance will provide years of light without a power supply. One gram (0.035 oz.) of tritium costs around 24,000 euros.

Golden prospects

10

20 kg

Au

Gold

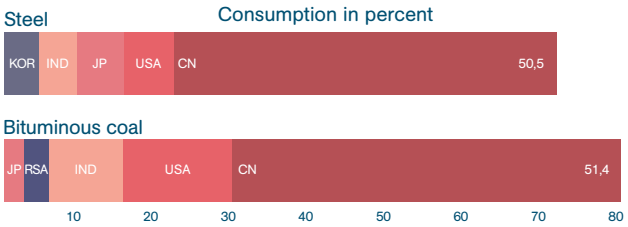
If all of the gold from the ocean floor were extracted, that would add up to around 20 kilos (44 pounds) per person. This might be of particular interest to Americans interested in tying the knot: every year, the USA uses 17 metric tons of gold for production of wedding rings alone.

In demand

11

50 Percent

Who needs which raw materials? The bar chart shows the proportion of the five largest consumer countries in terms of demand for steel and bituminous coal. China processes over half of the total for both raw materials.



Rubber tree

12

23 million

Used for manufacturing tires, among other products, every year over 26 million metric tons of rubber are harvested or synthesized and processed worldwide. Some twelve million of these tons are from a natural source—from Hevea brasiliensis, the rubber tree.

A hint of gold

13

1912

Au

Gold

It's what every Olympian hopes for, but all that glitters is not gold: the last Olympic medal actually made of gold was awarded in 1912. Today's Olympic champion receives a silver medal with gold plating.

Sources: 06 Deutsche Umwelthilfe; 07 www.interessante-fakten.de; 08 USGS (United States Geological Survey); 09 www.wissenschaft-und-frieden.de, Wikipedia; 10 www.interessante-fakten.de; 11 DERA: Deutschland – Rohstoffsituation 2010; 12 www.rubberstudy.com; 13 www.interessante-fakten.de

Scratching the surface: people who develop coating systems have to know what surfaces are made of.

The science of sticking to it

Taking care of exteriors is a part of the laboratory's daily routine. The strategists face new challenges repeatedly when new coating systems are in development, as alternative methods are often required to coat new materials or to break new ground in unfamiliar territory. A look below the surfaces.

By Michael Thiem; photos by Rafael Krötz

Titanium

is commonly found in the Earth's crust, but only bound with minerals. This element is only used in cases of highest quality requirements because it is expensive to produce.

Steel

is the most widely used metallic material in the world by far. Around 1.6 billion metric tons are produced annually. The official register of European steel lists approximately 2,500 types.

Iron

is undisputed leader in the rankings of the metals we use, with a weighting of 95 %. Its ready availability makes it relatively economical. Iron is the main component in steel.

Aluminum

takes up the geosphere's third-largest mass percentage. It is the most common metal in the Earth's crust. Raw aluminum is of growing importance to the industry.

Carbon

is a primary element in the biosphere. All living tissue consists of organic carbon compounds. Carbon takes up the second-largest share of biomass after oxygen (water). Carbon fibers are an inorganic form. They make compound materials extremely rigid and lightweight.

Plastics

have become indispensible to the industry because of their varied technical characteristics including malleability, toughness, elasticity, fracture strength, and resistance to temperature and chemicals.

The sample archive cabinet in the first floor hallway is well-filled. There are powder-coated suspension springs, a sawed-up axle support for turntables, naves, and many other components. They are covered with a wide variety of coatings and have stayed behind as silent witnesses to innovative materials research. Now and then Andreas Bäuerle (54) unlocks the door to retrieve forgotten knowledge. The technical customer advisor knows: there are many standards when developing new coating systems, but essentially no standard solutions. That's why it is often worthwhile to look at basic work that has already been done. At the same time, the most important questions never change: "Where is the coating to be applied? What is it supposed to accomplish there?", according to Bäuerle, who—along with his team—is about as close to a Wörwag motto that anyone can get: a deep understanding of surface finishing.

Bäuerle likes to cite the DIY store example: "If it were easy to paint a random surface, then anyone could buy paint off the shelf, spray it on, and that would be it." The coating systems requirements for industrial use today are as multilayered as a new car's list of extras. The coating has to act as protection, look beautiful, and fulfill additional functions on a case-by-case basis. Three criteria that can vary in multiple ways.

"Cars only have a few components anymore that are not coated in some form," says Bäuerle. That even applies to the engine. The old gray cast-iron block from which a colorful array of cables dangled has given way to visually pleasing aggregates with plastic covers sporting company logos. Even the back windows and headlight diffusers are being coated more and more often.

In general, the demands on the design become higher with each generation of cars.

The manufacturers have long since even developed color philosophies for brake disks and brake calipers. The requirements demanded of the color systems are constantly changing because new materials are continually being put to use or known materials are assigned new tasks. The development of a shade has evolved into a total work of art that sometimes entails exploiting all method and product spectrum options. "We often have to develop three or four systems for one shade," says Bäuerle. "We check on the possibilities we already have to solve the problem. If we find that we need new techniques, then it gets really exciting."

Surface experts: Silvie Mohr and Andreas Bäuerle understand the role substrate materials play in coatings development.

"If it were easy to paint a random surface, then anyone could buy paint off the shelf, spray it on, and that would be it."

Andreas Bäuerle

Ultraviolet coating makes a lot possible

Wörwag's innovative UV coating allows an electronic component made of aluminum and copper to be coated in a single work step. A prospective customer asked Bäuerle about it during a trade fair and was amazed when he shot back with the reply: "Yes, we can."

The combination of materials was new to Wörwag as well. "Two metals, which can have an intense reaction if they create a galvanic cell under damp conditions, come together in this electronic component," says Bäuerle. A prime example for the need to enable the innovative application of conventional materials using a coating solution. Even geometrically complex areas can be covered with the UV coating. The German construction machinery manufacturer Bomag, Wörwag, and the paint line producer Sturm joined forces to build a paint line that is able to coat and cure road roller drum casings in 16 minutes, thanks to the UV technology. A lamp with a diameter of 80 centimeters (31.5 in) and 400 watts output per square centimeter (0.155 sq in) was built in order to irradiate more inaccessible spots. There are many people behind success stories like this one. Andy Bender from technical customer support at the Düsseldorf-based company Henkel can verify this: "It is essential that the coating manufacturer work together with the surface's previous processor." The consumer goods giant's laboratories are testing new methods of preparing the substrates for powder coating as closely as possible to actual conditions as well as the re-coatability of seam sealants. That's the reason the experts in Zuffenhausen like to draw on the Düsseldorf company's expertise. Bender trains and advises Wörwag employees in the chemical treatment before the coating application. And so coating specialist, customer, and facility builder have grown together to form a highly effective team over the years. This "ground control" operation is especially challenged by the search for locking screws. Customers are also welcome to access this expertise. Wörwag offers seminars in Germany covering many coating and pretreatment topics several times a year (woerwag.de/seminars).

Sticking point: pretreatment

Plastic surfaces are especially tricky. Although empirical data is available for the individual substrate groups, there is no way around testing the respective substrate type for specification fulfillment with the pertinent coating, as paint adhesion is influenced by numerous factors. The adhesion of the coating itself can be manipulated by means of binding agents or solvents, and by pigments as well as the type and amount of filler. However, the type of plastic used and the pretreatment also have a considerable influence on the adhesion. "While you simply clean sheet steel before coating it, the modern thermoplastic polyolefins require additional treatment for the coating to adhere well," explains Silvie Mohr, Head of Materials Engineering at Wörwag. That primarily includes flame treatment and pretreating with plasma. The coating will then endure. "Stick-to-itiveness" is a virtue. ■

Photo: Frederik Laux

22

Ti

Titanium

Symbol: Ti

Atomic number: 22

Transition metal

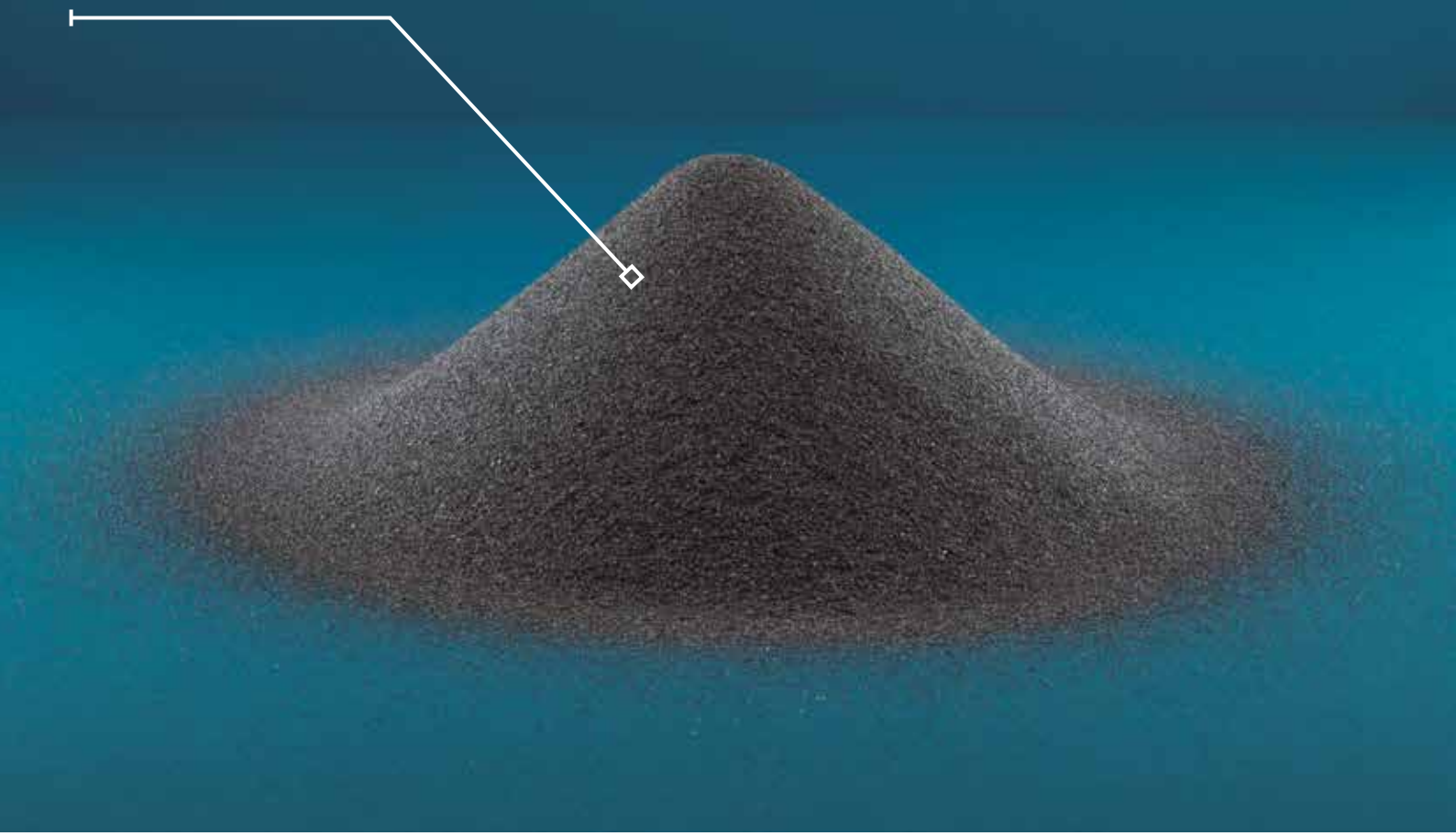
Melting point: approximately 1,668 °C (3,034 °F)

Boiling point: approximately 3,260 °C (5,900 °F)

Aggregate state under normal conditions: solid

Density: 4.50 g/cm³ at 25 °C (0.162 lb/in³ at 77 °F)

Use: microalloyed steel



Robust in terrain

The new Wörwag coating system for bicycles can do one thing above all: handle anything. It withstands even the stiffest tests.

For Thorsten Bollinger, cycling represents relaxation combined with freedom. "I decide where to go, how fast I move, and how long I'm in the saddle," says the market manager. Yet his off-road excursions on his mountain bike always have a professional element as well: Bollinger played a key role in developing a coating system that is stirring things up in the growing bicycle market. An endurance test of this sort is always a welcome opportunity. The clear coat in the system sets new standards—both in terms of curing and the brilliance that withstands even the most extreme off-road demands.

The powder coating clear coat W845 high-gloss and W847 dull matt have been used in the bicycle industry for more than 15 years. The water-based curing primer has been on the market since early 2015. The customer can choose between a water-based curing primer that can be combined with the paint systems of competitors on the market, or select a combination of powder-based primer with a liquid base coat and an acrylic powder clear top coat. Another option is the two-coat combination of powder coating W898 primer and base coat in one product, finished with a colorless acrylic powder coating top coat.

The system of primer, base coat, and clear coat protects the product like a shell. But even more than that: "In low-temperature curing, our clear coat is the market leader," emphasizes Bollinger. "While the industry standard for curing is 170 degrees Celsius (338 °F), the acrylic paints from Zuffenhausen can do with just 140 °C (284 °F; high gloss) and 150 °C (302 °F; matt). That not only saves energy, but also gives the bicycle manufacturers greater flexibility in the early application of decorative decals. The excellent coverage of the surfaces and the smooth leveling both of the primer and the base coat enable easy and bubble-free application of undercoat decals.

Like the Dutch bicycle group Accell, the Hermann Hartje company of Hoya, Lower Saxony also relies on the Wörwag system, which gives customers a choice between three primers (black, white, gray) and two clear coatings. Beyond robustness and flexibility, the product is also impressive for its universal compatibility: "Customers who use our primer can continue to use their previous base coat without any problem," assures Bollinger.

THORSTEN BOLLINGER *is convinced that the cycling boom is a lasting one. Speaking of raw titanium, which high-end bike manufacturers use primarily for hardtail (unsuspended) frames, three words spring to the market manager's mind: "light, strong—and expensive."*

The system coating is primarily used on aluminum and chromoly alloys. But it would also work with titanium, which some exclusive bicycle manufacturers use for their frames. Titanium forms a compact oxide layer on the surface that inhibits further corrosion. It is almost as strong as steel, but weighs 40 % less. Bollinger would certainly appreciate a bicycle frame made of this material on some of the steeper ascents ...

32,000

SQUARE METERS (345,445 SQUARE FEET)

is the size of the façade of the Guggenheim Museum in the northern Spanish city of Bilbao. Situated on the banks of the Nervión River and shaped to resemble a stylized ship, the building is clad in titanium tiles and limestone. To appreciate the effect of the titanium, observing the building at different times of day is advisable. Sunlight and other light reflections change the perception of the building's color from a cool gray to a warm gold tone.

The defenses are in place: the Wörwag coating system for bicycles defy mud and stones.

Photos: Lapierre, Frederik Laux

DIN EN 10020

Steel

Metallic alloy

Carbon content: under 2.06 %

Density: 7.85 to 7.87 g/cm³ (0.283 to 0.284 lb/in³)

Melting point: depending on alloy, up to 1,536 °C (2,796.8 °F)

Use: tools, machines, plants, construction

Like a mirror

It looks like chrome, but it's actually paint. Now Wörwag is offering a chrome coating in powder form that achieves unprecedented results. In combination with the equally new universal clear coat, the range of possible applications is endless.

MICHAEL FIEDLER *is Wörwag's powder coating expert. He and his team developed the chrome paint and coated a multitude of different objects with it for testing purposes. On the subject of steel, his first thought is: "I should go to the gym one of these days."*

Photos: Shutterstock, Frederik Laux

Recently, Michael Fiedler went so far as to experiment in the kitchen. Figuratively, in any case. For testing purposes, the powder coating developer coated the plastic covers of household appliances with a chrome coating. The result: "a premium appearance with a good cost/benefit ratio." You can almost use it as a mirror. This detour into the kitchen was just one of many efforts to explore the potential applications of the coating system. In recent months, Fiedler's team has coated just about everything that it could get its hands on: office implements, metal balls, bicycle frames, radiators, chair legs. The appearance outshines all else. If you want the mirror effect, this paint does the trick. Fiedler's conclusion: "There is no shinier paint than this."

The new product will presumably be used primarily in the industrial coating of steel surfaces for interior spaces. Wörwag simultaneously developed the corresponding polyester clear coat. "We anticipate that it will become the product of choice across a broad range of applications. In particular for our regular customers who use our current polyester coating, as well as with chrome paint," explains Fiedler. Compatibility with the existing product range is a key factor. Wörwag aims to launch the universal clear coat sometime this year. It would be suitable for elements like the components of high-quality office furniture such as chair or table legs—particularly in conjunction with the chrome paint.

Wörwag has tapped the full potential of the technology behind the chrome paint. Large amounts of aluminum pigments are mixed into the product. During curing, they rise to the surface and create the shiny effect. To ensure that the color tone is right, the ingredients are not mixed in powder form, but first liquefied, melted, and pressed into a plate. Once they've hardened, the plates are then ground back into powder.

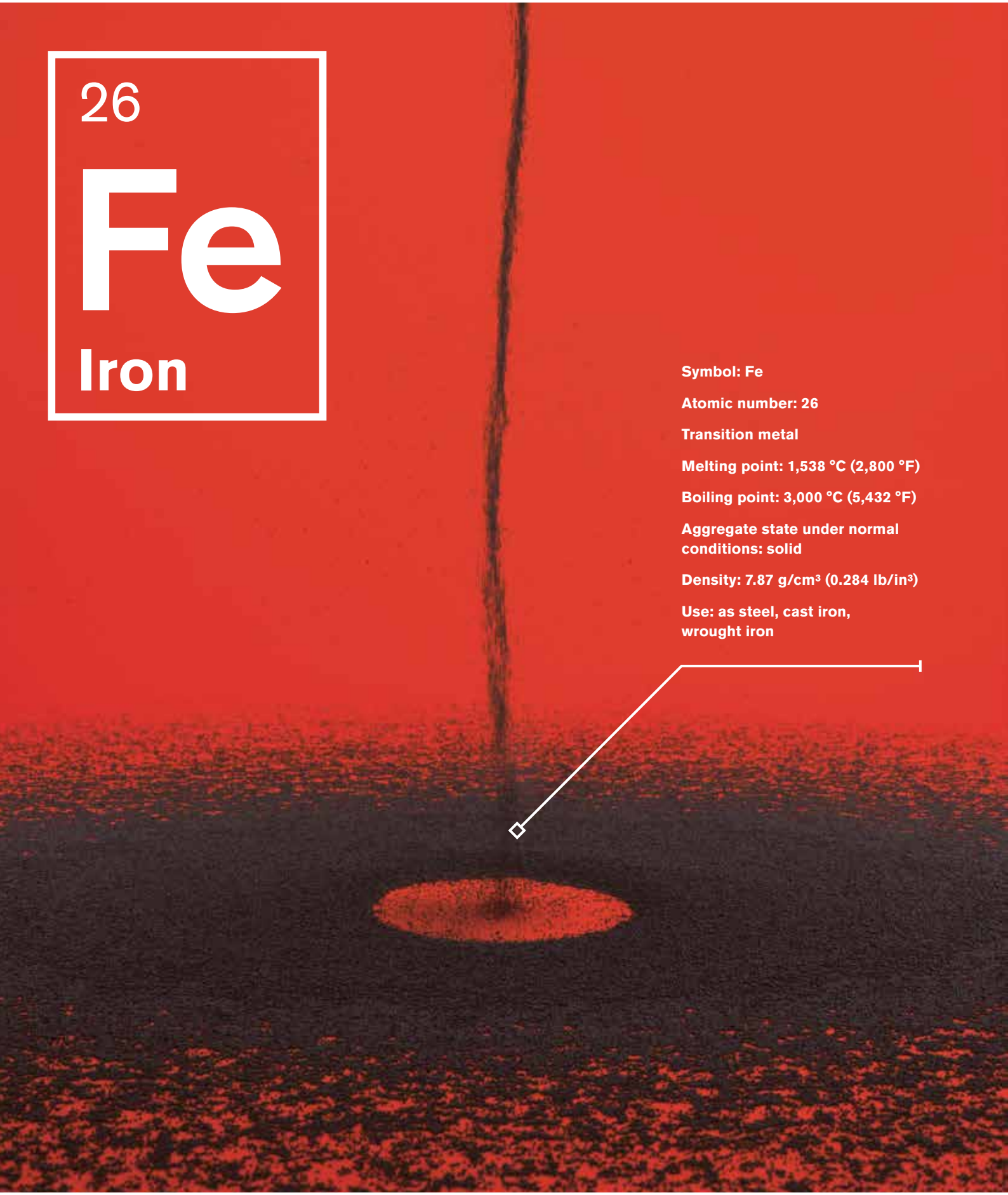
Shine in the classroom: the new chrome paint could be used for school furniture

SOME

60,000

TONS OF STEEL

were used in the construction of the Empire State Building in Manhattan. The limestone and granite façade is cased in a steel frame. The colossus weighs some 370,000 tons. Built in New York City in 1930/31, the building's height of nearly 450 meters (1,476 feet) to the top of the antenna made it the world's tallest building until 1972.



Symbol: Fe

Atomic number: 26

Transition metal

Melting point: 1,538 °C (2,800 °F)

Boiling point: 3,000 °C (5,432 °F)

Aggregate state under normal conditions: solid

Density: 7.87 g/cm³ (0.284 lb/in³)

Use: as steel, cast iron, wrought iron

Ready for anything

Higher corrosion protection with lower process costs: as a protective barrier for sheet steel bodies on heavy agricultural and construction machinery, powder-on-powder coating technology has proved highly effective. No matter how extreme the conditions may be, this paint can handle it.

For many, iron may conjure up images of rusty steel beams. Even visitors to the grounds of the Wirtgen company in Windhagen, Germany, initially see only the rust-brown steel body of a large construction machine, weathered in transport and storage. It's on its way into the continuous blasting system. There the body will be cleaned before it receives a new coat—a powder-on-powder coating—in the large component paint shop. The powder-on-powder coating consists of a primer that protects against corrosion, and a top coat paint that shields the primer against UV rays and weather.

After the process, the steel skin is scarcely recognizable. Wherever the heavy machine is ultimately deployed, the paint will withstand any conditions. The procedure, which dispenses with energy- and time-intensive intermediate curing, has proved its mettle over time. In 2015 alone, the share of powder-on-powder surfaces at Wirtgen rose from 30 to 70%. In manual application situations, powder-on-powder coating is possible even in hard-to-reach areas. The paint is applied using tribotechnology, in which the powder particles become electrostatically charged through friction.

The procedure has caught on. With the Pöttinger company from Grieskirchen, Austria, powder-on-powder expert Jochen Reihs handles an agricultural machinery manufacturer that uses this coating procedure in the Czech Republic. The ongoing development and adaptation of the technology to customer requirements at Pöttinger as well is demonstrated by the coating of a waste container in Slovakia. In this case, a metallic effect was added to the specially developed coating. "We had to use a few technical tricks to manage that with powder-on-powder," concedes Reihs. When he thinks of iron, rusty steel is just about the last thing that comes to mind.

JOCHEN REIHS *is responsible for technical customer management in Wörwag's Industrial Coatings Division. The 49-year-old advises and trains users in the powder-on-powder coating technique. He has fond memories of raw iron: "As a child I used to ignite small iron filings. The sparks flew just like in fireworks."*

FLUCTUATIONS OF UP TO

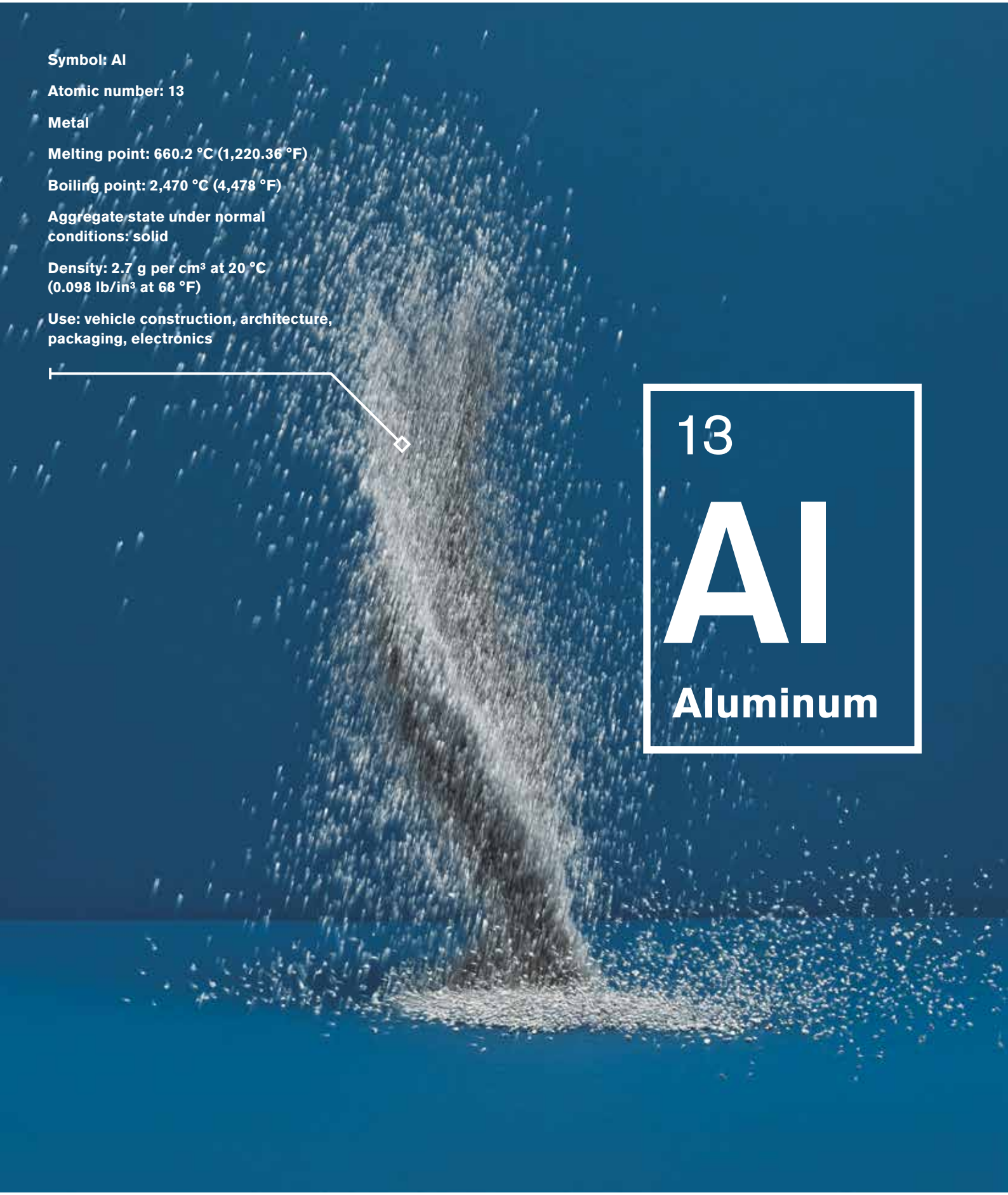
30

CENTIMETERS (12 INCHES)

can occur in the height of the Eiffel Tower in Paris between winter and summer. The reason for that is the normal thermal expansion of the iron from which the 18,038 parts and 2.5 million rivets of the tower are made. In normal weather conditions, it is just under 325 meters tall (1,066 feet); the final 25 meters (82 feet) are added by the antenna. Painting it requires 65 metric tons of paint.

Heavy-duty workers: thanks to Wörwag paint, the "surface miners" from Wirtgen can withstand the extremest conditions.

Photos: Wirtgen GmbH, Frederik Laux



Symbol: Al

Atomic number: 13

Metal

Melting point: 660.2 °C (1,220.36 °F)

Boiling point: 2,470 °C (4,478 °F)

Aggregate state under normal conditions: solid

Density: 2.7 g per cm^3 at 20 °C (0.098 lb/in^3 at 68 °F)

Use: vehicle construction, architecture, packaging, electronics

Heavy duty

Even in mass production models, the aluminum content in some vehicle bodies is nearly 50 %. An extremely lightweight metal, but at the same time extremely challenging to paint. Powder coating from Wörwag solves the problem. It is used to coat the cover plates on B-pillars, among other components.

Ever lighter, ever more economical: amid the general dieting trend in body construction, aluminum is playing an important role. The metal is some two-thirds lighter than steel, but considerably more difficult to coat. Without pretreatment, paint simply doesn't stick. The aesthetic and durability standards in this field of application are extremely high. A case for the acrylic powder from Wörwag, which enables energy-efficient coating of the aluminum cover plates on cars' B-pillars.

When Arne Mielke speaks of the harmonious overall appearance of a Audi A8, he knows precisely how much development work goes into ensuring that the paint ultimately does what is expected of it. "On cars with tinted rear windows, the cover plates in high-gloss black are a perfect match with the design," says the Director of the Powder Coating Lab. Acrylic powder also guarantees flawless gradation as well as a brilliant, scratch-resistant surface.

ARNE MIELKE *has headed Wörwag's Powder Coating Lab since September 2015. The chemical engineer is an expert in aluminum coating processes. And he appreciates the everyday benefits of aluminum: "Perfect for packing sandwiches."*

Application of the coating is relatively simple: apply the coating, cure, done. The cover plates are packaged and shipped directly after coating. The key to success when working with aluminum surfaces is the pretreatment, which ensures an optimal adhesive bond on the substrate. This is different from the application process on sheet steel, for example, on which the bond with the substrate can often be assured even without pretreatment. Alternatives include foils and liquid coatings. Wörwag also offers these types of products.

Aluminum looks set to become even more important in body construction. And with it, the use of powder coating will become more important as well. In the current C-class from Mercedes, the aluminum content is 50 % of the total. Compared to the first VW Golf, the aluminum content in the seventh generation rose from 50 kilograms (110 lbs) to 140 (308 lbs). No doubt about it—aluminum is no lightweight.

ROUGHLY

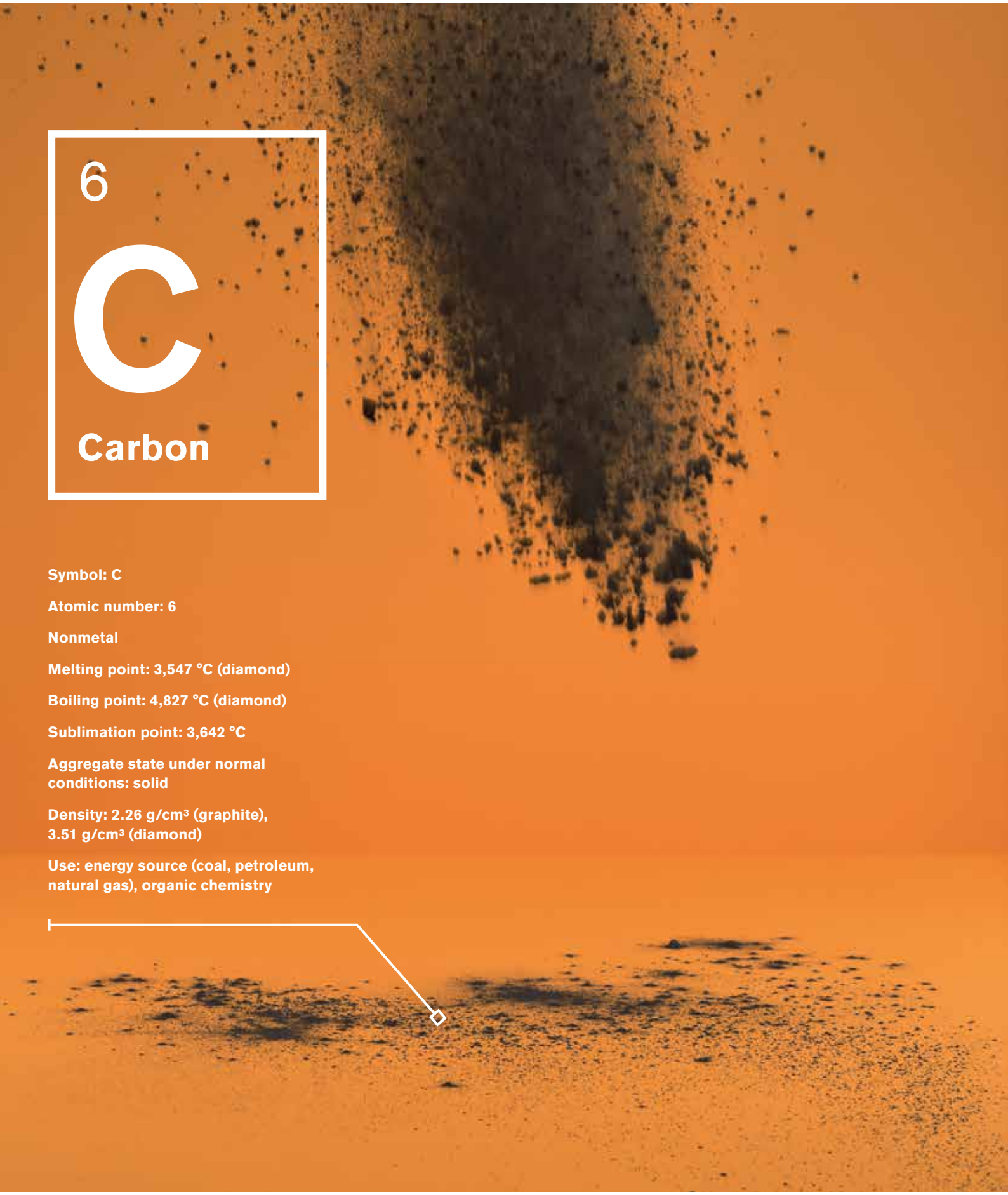
one

BILLION METRIC TONS

of primary aluminum have been extracted worldwide since 1880. Three-quarters of it is still in circulation and is recycled over and over again. Reprocessing into secondary aluminum requires just 5 to 10 % of the energy required for primary production.

Robust and beautiful: the B-pillars of the Audi A8 4.0 TFSI quattro are hidden behind aluminum cover plates covered with powder coating from Wörwag.

Photos: Audi AG, Frederik Laux



6

C

Carbon

Symbol: C

Atomic number: 6

Nonmetal

Melting point: 3,547 °C (diamond)

Boiling point: 4,827 °C (diamond)

Sublimation point: 3,642 °C

Aggregate state under normal conditions: solid

Density: 2.26 g/cm³ (graphite), 3.51 g/cm³ (diamond)

Use: energy source (coal, petroleum, natural gas), organic chemistry

Strong partner

Everyone is trying to lose weight these days, including trucks. That is why an increasing number of vehicle body parts are made of composite materials. These components, however, are hard to paint—but Wörwag has solved the problem.

WOLFGANG FRITZ *is a lab director in charge of special coatings for the plastic auxiliary components on commercial vehicles. "Thanks to our coating systems designed for SMC surfaces, we can now provide all the variants for commercial vehicles from a single source," says Fritz—for whom the term "carbon" immediately triggers the association "diamond."*

Photos: Daimler AG, Frederik Laux

What you cannot see, you still can feel. Visually, you can hardly tell the difference between a truck's metal body parts and its plastic auxiliary parts. But if you touch the paint, you can. The steel driver's cab feels cool in contrast to plastic components like bumpers, radiator grilles, cab steps, fenders, roof spoilers, and wind deflectors, all of which feel considerably warmer. The latter are made of sheet-molded compounds (SMC), which are compressed thermoset polymeric reaction resins reinforced with carbon or glass fibers. Carbon fiber-reinforced plastics are even used in racing cars.

SMC components are extremely stiff and have thermal expansion properties similar to those of steel. But they weigh a good two-thirds less. "These thermosetting components have high thermal resistance and excellent crash properties as well as a lot of design potential," says Wörwag laboratory director Wolfgang Fritz.

In order for 400-horsepower trucks weighing nearly 26 metric tons to be easily visible, a good paint job is more important than ever. The transportation sector has long since placed a premium on visuals. Coating SMC components, however, requires a special type of paint. Why is that? Because when the components are made, it is not possible to completely prevent tiny air bubbles from forming inside them. "So we use a special base coat to prevent the air from outgassing and thereby damaging the paint during the baking process," explains Fritz. The W321 barrier primer reduces these outgases to a minimum. "This means there's much less refinishing to do," says Fritz. And that is an important consideration. After all, the diet these beefy vehicles are on should not drive costs up, but down.

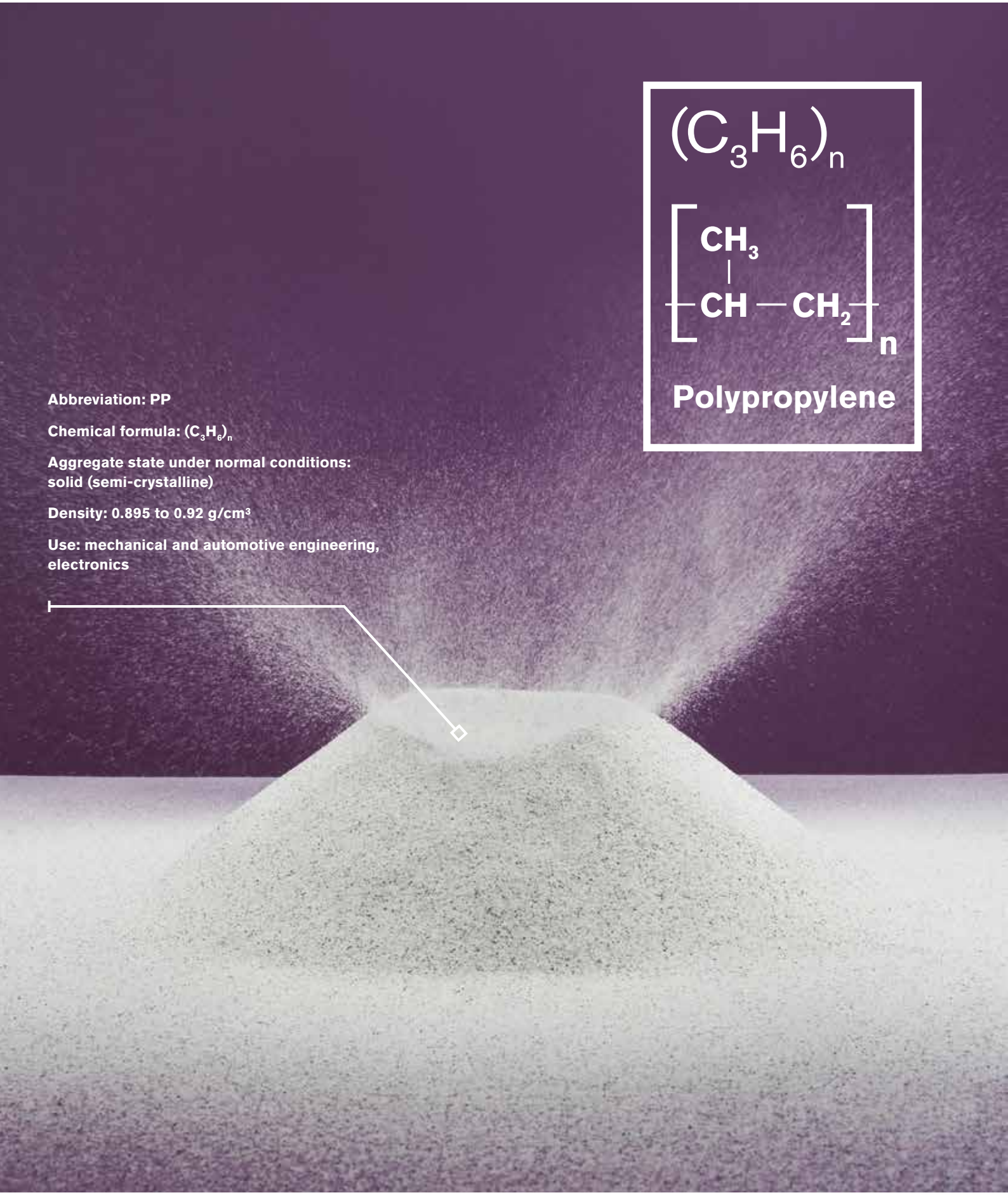
Work station with 400 horsepower: a good 50 % of the exterior of a driver's cab consists of auxiliary components that require a special coating.

WITH A GROSS WEIGHT OF

3,106.75

CARATS

the "Cullinan" was the largest gem-quality diamond of its time when found in South Africa on January 26, 1905. In 1908, the raw diamond was cut into 105 gems, the largest of which weighs 530.2 carats. Known as "Cullinan I" or the "Great Star of Africa," it is now part of the British crown jewels.



Abbreviation: PP

Chemical formula: $(C_3H_6)_n$

Aggregate state under normal conditions: solid (semi-crystalline)

Density: 0.895 to 0.92 g/cm³

Use: mechanical and automotive engineering, electronics

The beauty of film

Paint that sticks on doesn't have to be sprayed on. Which is why painted films present an alternative to wet coatings for plastic surfaces. Their advantages include no overspray, no drying time, no preparation for use, and good weather and scratch resistance qualities.

Ever more lightweight, ever more economical: the lighter the vehicle the better its fuel consumption, which is why lightweight plastics are replacing steel components in car bodies. They are already the second most important substrate for automotive paints. But they have one sticking point: automotive auxiliary parts made of the standard plastic polypropylene need to be exactly the same color as the base coat on the steel chassis. As demand rises for these auxiliary parts, so too does the demand for user-friendly and environmentally compatible coating technologies.

"Painting with films can save up to 80% of the energy needed for sprays," says Helge Warta, the head of painted film systems at Wörwag. "And the two processes provide the same results," he adds. Wörwag can produce around 550,000 square meters of painted film a year, which would cover around 77 soccer fields.

"We make the film under controlled cleanroom conditions in foil form, and then roll it," says Warta. This means that entire coating systems can be supplied as films. Instead of having to spray each layer on individually, users can apply a multilayer film in a single step. "We can even do metallic effects," says Warta.

Painted films make sense for geometrically simple surfaces made of plastic or metal. They currently have two main fields of application. They serve as decorative films for laminating window frames and other plastic components in buildings. And with a different structure, they serve as transfer films for coating vehicle body parts. One example would be the water deflector for the A-, B-, C-, E-, G-, and S-class cars from Mercedes.

Photos: Daimler AG, Frederik Laux

AT EXACTLY

232

DEGREES CELSIUS (449.6 DEGREES FAHRENHEIT)

acrylonitrile butadiene styrene (ABS) is molded into Lego bricks. Headquartered in the Danish town of Billund, Lego brings a good thirty billion of these bricks onto the market every year, including 500 million tires. This makes the toy maker one of the largest tire manufacturers in the world—at least in terms of unit numbers.

Stick-on paints: the water deflector on the Mercedes B-class are painted with film from Wörwag.

HELGE WARTA *has worked at Wörwag for 15 years. He currently heads the department of painted film systems, which he and his team developed and have been continuously improving ever since. His father was also a lab director at Wörwag. "We're all about plastics," says the son. "We think about them every day."*

ESSAY

Chrome

by magazine author Elmar Brümmer, who has never bonded with a material so brilliantly before

The fashion world is rediscovering the chrome look this year. Car and coatings manufacturers will argue that we never lost sight of it. For of all the metals, chrome is a very special one, and to many even the most beautiful. It reflects luxury and elegance like no other.

It's true that chrome is a metal. And even though it looks so regal, it is a transition metal rather than a precious one. Chrome compounds often serve as pigments in paints and coatings. However, chrome only unfolds its true brilliance when it stands on its own. As a coating on classic car trim, for example. So it beautifies beautiful things just a little bit more.

Long ago, the silvery metal was discovered in crocoite and separated from it by means of acid. The discoverers borrowed the Greek word chroma (color) to name it, because its salts glitter in a variety of colors, depending on the oxidation number. The ore it is extracted from is called chromite. In more recent times it has gained a shining reputation on the Internet: as "Chrome," the name Google has given its browser.

Chrome has brilliant characteristics. It doesn't tarnish or corrode. Its fascination can be explained as follows: it literally always retains its dazzling form. Hard chrome is even more durable. As a coating on steel, iron, copper or aluminum, it combines protection from wear with a hint of vanity. There are also more lightweight applications. Chrome-plated plastic parts, for example. Or water faucets, chair legs, free weights. The spectrum spans the entire household. Chrome's magnetism must provoke a natural reaction. Why else do even ravens and magpies grasp at anything that glitters? Attraction just never goes out of fashion. ■

Impeccable taste: a car enthusiast's heart skips a beat when vehicles sparkle and flash. Chrome doesn't cut a fine figure in classic and modern cars alone.

Photos: iStock

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