

ttime

A MAGAZINE FROM TRELLEBORG GROUP

1-2020

Solutions that seal, damp and protect critical applications.

PLUS
GO FULL CIRCLE

JUST-IN-TIME

DAMPING DOWN

Protecting people
from noise and vibration
is key to comfortable
city living.

Enjoy the silence

08

JUST-IN-TIME

IntelliStok®, a sensor that keeps an eye on parts inventory, spells a major leap forward in lean manufacturing.

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NOISE POLLUTION ON THE RISE

Protecting buildings and people from noise and vibration is crucial as urbanization increases.



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SYSTEMIC CHANGE

Go full circle means changing how we consume. In a circular economy, waste becomes a valuable resource.

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A QUIETER DRIVE

A new material takes much of the noise and vibration out of electric vehicles.



Cover photo:
Getty Images

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Trelleborg is a world leader in engineered polymer solutions that seal, damp and protect critical applications in demanding environments. Its innovative solutions accelerate performance for customers in a sustainable way. The Trelleborg Group has annual sales of about SEK 37 billion (EUR 3.46 billion, USD 3.87 billion) and operations in about 50 countries.

The Group comprises three business areas: Trelleborg Industrial Solutions, Trelleborg Sealing Solutions and Trelleborg Wheel Systems, and a reporting segment, Businesses Under Development.

The Trelleborg share has been listed on the Stock Exchange since 1964 and is listed on Nasdaq Stockholm, Large Cap.

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TRELLEBORG

PHOTO: ALTIN OSMAN/ALAMY

EDITORIAL

PROTECTS AGAINST NOISE AND VIBRATION

People, the environment, and assets; such as machines and buildings, are adversely affected by noise and vibration. Noise and vibration no matter where, when, and how they occur are inconveniences. It is therefore beneficial to be able to share stories in this issue of *T-Time* about solutions in different areas that are absorbing energy to achieve vibration or shock absorption. It's one of Trelleborg's specialties where our polymer engineering comes in handy.

A completely new offering from Trelleborg is presented in this issue of *T-Time*: IntelliStok®.

It's our latest service innovation that will be able to simplify workflows throughout the supply chain in a revolutionary way. We have long worked to ensure that our business is also about services, and not only products. IntelliStok is a good example of this.

Peter Nilsson,
President and CEO



TRANSFERABLE TERMINALS

New approaches to infrastructure development are reducing the cost of liquid natural gas transfer, pointing the way to a sustainable market.

TEXT JAMES HERMARY



The liquefied natural gas (LNG) industry thrives on new ways of doing things. As Ira Joseph, Head of Global Gas and Power Analytics at S&P Global Platts, recently wrote in the commodities bible *Platts*, “Breaking taboos in the LNG industry is a time-honored tradition.” This sentiment has underpinned Trelleborg’s work in the LNG infrastructure sector for many years. For LNG projects to succeed, they need to embrace fresh thinking when it comes to the transfer zone and to do things differently from the fuels that have gone before.

This is more important than ever in view of the dynamics of the market, marked by rapid evolution. The long-term outlook for LNG appears healthy, but it’s not without complications. This means that there can be no letup in the pace of development of physical

infrastructure that reduces both capex and opex for energy majors, terminal operators and others involved in the transport of LNG.

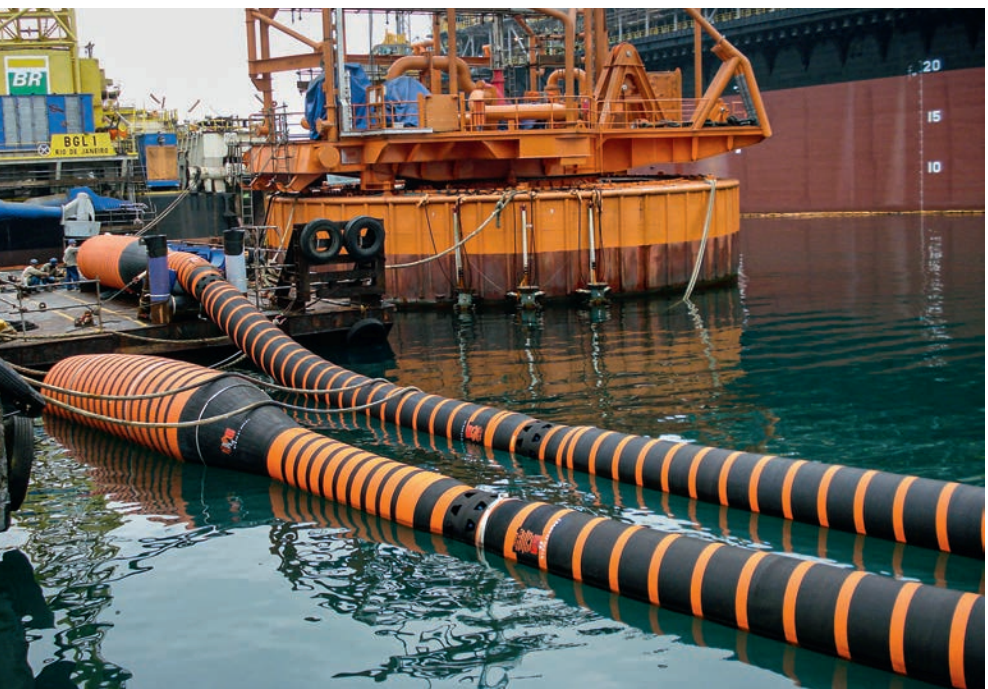
“LNG demand will only grow if the pricing point can be lowered, and it is the sellers that will need to foot the bill,” Joseph wrote. “Shaving down costs on delivery of LNG is necessary for gas to find a sustainable market.”

Few large terminals are set up to cater to smaller LNG carriers, a deficiency that suppliers hope to rectify by tapping underused floating storage and regasification units (FSRUs) anchored near areas of stranded demand.

“At the Gastech exhibition and conference last year, we saw how this is now coming together as the market adapts to these trends,” says Vincent Lagarrigue, Oil & Marine Director within Trelleborg Industrial Solutions. “There is

Right:

The cost advantages of floating infrastructure, as well as its inherent flexibility, are gaining prominence.



Left:

Floating hoses connected and ready for final installation.

PHOTO: CONNECT LNG

PHOTO: TRELLEBORG



a strong trend toward a more comprehensive chain of floating infrastructure. In addition to FSRUs, the idea of floating power plants is also becoming increasingly popular. Similarly, many existing FSRUs are being upgraded to handle smaller carriers and bunker barges. Overall, the cost advantages of floating infrastructure, as well as its inherent flexibility, are gaining prominence.”

Engineering, procurement and construction companies are now entering the small- and medium-scale LNG market as it matures into a fully comprehensive energy supply chain. With it, they are bringing global scale and expertise that is helping to develop best practices.



Trelleborg's Cryoline technology allows transfers that would otherwise not be feasible due to environmental concerns or remote locations.

“Cryoline technology when combined with a floating platform makes it possible to bring infrastructure to the vessel.”

Vincent Lagarrigue, Trelleborg





PHOTO: CONNECT LNG



PHOTO: SIGNUM TECHNOLOGY

Above:
KLAU LNG transfer system for offshore hose LNG transfer.

Left:
The universal transfer system of Norwegian technology provider Connect LNG is made possible through the use of Trelleborg's Cryoline technology.

System provider for LNG transfer segment

The engineering group Signum Technology Ltd. has been part of the Trelleborg Group since summer 2019. Consisting of the companies Gall Thomson, KLAU LNG, Vee Bee Filtration and KLAU Products, it delivers safety-critical flow control solutions for the oil, gas and petrochemical industries, such as marine break-away couplings and LNG transfer systems. The acquisition complements and extends Trelleborg's product portfolio and strengthens Trelleborg as a system provider, primarily to the fast-growing LNG transfer market segment.

"We are very pleased to announce the acquisition of Signum," says Jean-Paul Mindermann, President of the Trelleborg Industrial Solutions business area. "Combined, we are creating a very attractive offering of integrated packages and safety-critical systems for both LNG ship-to-ship and ship-to-shore transfer in demanding industries. Signum has a reputation for quality and innovation, very much like Trelleborg. This acquisition will also further strengthen our geographic coverage, notably in the aftermarket and service business – hence a really good fit for us in many respects."

"This reduces the need for extra construction while also enabling transfer or bunkering in areas that would be otherwise unsuitable."

Vincent Lagarrigue, Trelleborg

Suppliers are also playing a vital role in adopting new approaches to infrastructure development, reducing the cost of LNG transfer and accelerating deployment. With Trelleborg's Cryoline hose technology, for example, it's not only possible to conduct transfers that would otherwise not be feasible due to environmental concerns or remote locations, but also to adapt existing terminals to handle a wider range of vessels.

"Cryoline technology, when combined with a floating platform, makes it possible to bring infrastructure to the vessel," Lagarrigue says. "This reduces the need for extra

construction, while also enabling transfer or bunkering in areas that would be otherwise unsuitable, such as locations that are too shallow for carriers, or too deep to construct a jetty. In addition, it allows transfer infrastructure to be relocated when out of use, down for maintenance or moved into port to avoid damage from adverse weather." Significantly, the use of cryogenic hoses for LNG transfer also cuts down on the scale of the infrastructure required and allows for easier installation and decommissioning. ■

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NEWS

Unique ship in safe hands

The historic ship Pommern is the only tall ship in the world that remains structurally unaltered since her launch in 1903. The ship, located on the Åland Islands in the Baltic Sea, is protected by a bespoke dry dock, designed and built by Bengt Eriksson at Eriksson Bygg AB.

Trelleborg Industrial Solutions supplied a specially designed Gina gasket for the dock gate. "It was imperative that a manufacturer was specified that could provide a solution with a proven track record to successfully seal the dry dock door," says Emil Engblom of EE Engineering, who constructed the dock gate. "Trelleborg approached the challenge head-on and proved to be a very experienced and trustworthy partner."

Pommern is virtually unchanged since she left the shipyard in Scotland in 1903.



PHOTO: ÅLANDS SJÖFARTSMUSEUMS ARKIV



Digital hoses

A Wear Indicator System (WIS) for hoses from Trelleborg Industrial Solutions includes a sensor that monitors when it is time to replace the hose. The hose incorporates a network of copper conductive wires that are wound into the hose's inner tubes. An electronic sensor and indicator box are connected to the wires via a specially developed gasket. When the wire is broken, the WIS creates a red alert and the operator gets an e-mail saying it is time for the hose to be serviced.



Hurray! 10 years

Happy anniversary to Trelleborg in Qingdao, China – 10 years of success and achievement.

IMAGES: TRELLEBORG

Game on

The video game Farming Simulator 19, from Giants Software, features more than 300 agricultural and forestry machines, including tractors, from major original equipment manufacturers, equipped with Trelleborg and Mitas solutions. Trelleborg Wheel Systems is heavily involved with the game, partnering with the video game company to feature its products and sponsoring a team who will compete in the Farming

Simulator League for the second year running. The teams challenge one another to determine who is the best in the field, combining fieldwork, including harvesting, with other challenges.

The Trelleborg e-sport team includes Simon Hollweck (left in the picture), Lukas Bauer (third), Joshua Lobenhofer, Felix Hasenberger (far right) and Oke Güths. Also in the picture is Jana Stephan, Quality Assurance at Giants Software.



Lean manufacturing takes a cost-saving leap forward

A smart new approach to inventory management marks a major move into adding value for customers by providing the services they need and want.

TEXT JOHN N. FRANK PHOTOS CHRIS LOW

The concepts of just-in-time inventory management and lean manufacturing can be traced back to Japan in the 1940s, when the shipyards had very few financial resources and so sought ways to minimize their inventory costs. The practice later became popularized worldwide by automaker Toyota.

While techniques have changed, the basic concept remains the same: have just enough inventory on hand to keep your assembly lines humming, but not so much that you are needlessly using funds that could be more efficiently put to work elsewhere. That requires efficient

monitoring of inventory levels and fast ways to order more before a plant runs out of the parts it needs to operate.

One of Trelleborg Sealing Solutions latest moves into services is Trelleborg's IntelliStok® Advanced Delivery System, which seeks to advance that quest for optimum inventory management. IntelliStok, scheduled to debut in the first quarter of 2020, is a vendor-managed inventory solution and enhancement to the company's ServicePLUS program.

It essentially eliminates the need for companies to have someone walking around a manufacturing

Will Bacon

Title: ServicePLUS Segment Manager

Education: Master of Business Administration, Thunderbird School of Global Management

Family: Married with 6 children

Lives: Vancouver, Washington, US

Interests: I enjoy cycling and running. Have completed the Seattle To Portland one day ride twice.

Favorite Innovation: IntelliStok followed by developing SealScan.

A low-angle photograph of a man with glasses, wearing a dark polo shirt and light-colored trousers, leaning on a glass balcony railing. The building has a modern, geometric design with large concrete overhangs and glass railings. The scene is brightly lit, with strong shadows. The man is looking towards the camera. The balcony railing is made of glass and metal. The building's facade is composed of light-colored concrete or stone panels. The sky is not visible, but the lighting suggests a sunny day.

IntelliStok® is one
of Trelleborg's
latest moves into
services. It is one of
Will Bacon's favorite
innovations.



“I think it’s pretty exciting and think it will contribute to our growth strategy over the coming years.”

Will Bacon, Trelleborg

facility scanning bar codes on parts bins to find out which parts are running low and need to be reordered.

Trelleborg already had developed SealScan, a scanning system that allowed facility employees to use their iPhone or iPad to scan those bin barcodes. But, IntelliStok takes that a step further.

For IntelliStok, Trelleborg developed a pressure-based sensor pad which sits in the bottom of a parts bin. Using its own micro-controller and Wi-Fi technology, it automatically creates an order when the bin needs to be replenished with more parts. The device turns

on periodically throughout the day to essentially keep an eye on parts inventory.

Unlike other advanced delivery options, the IntelliStok solution is designed to fit existing rack and bin systems without modifications. It eliminates the need to manually check or scan inventory and so has the potential to save thousands of dollars in labor costs each year.

IntelliStok also fits nicely into Trelleborg’s new service model. With IntelliStok, “we’re doing something unique – becoming one of the leaders in managing customer inventory,” says Will Bacon, ServicePLUS Segment Manager

at Trelleborg Sealing Solutions.

“I think it’s pretty exciting and think it will contribute to our growth strategy over the coming years.

“We have to look at services because customers need more services,” Bacon explains.

“They want you to take on things not in their core value stream. If Trelleborg, by providing more services, can find ways to help customers focus on their core competencies, the company can increase its value to them,” Bacon says.

Offering more services can mean doing some subassembly

work, such as inserting a seal into a piece of metal that goes on to be combined into a larger part, or it can mean streamlining a customer's internal operations to reduce costs and increase efficiencies, as IntelliStok does.

"We want to get into those opportunities with key customers where we can offer that level of service to them," Bacon says. "Couple that with Trelleborg's strength in engineering and now you're getting more of the complete package. It makes us a partner and it makes us very attractive to people."

Getting sales staff to emphasize the benefits to our customers is key to marketing new services. "It's important that we educate our sales engineers so they offer the best service to our customers," Bacon says.

Sales people have started going through what is known as sales excellence training in which they

learn about building relationships with customers that can help them identify service opportunities. Because of what they learned in that training, sales now has "a way to build those relationships," Bacon says. The sales staff can analyze a customer's needs and wants and match them to services that Trelleborg develops.

Bacon started in the sealing business in 1998. He has made his career in it ever since, initially working for a firm called AFM Inc., which Trelleborg bought in 2007, and staying on with Trelleborg since then.

Along the way, he has worked in sales engineering, parts design, finance, warehouse management, operations and human resources; a diverse experience spectrum that makes him well qualified to oversee Trelleborg's move into services with its ServicePLUS program. ■

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Restocking the easy way

The IntelliStok System is designed to save time and resources, reduce costs and make restocking easier, especially in growing businesses. IntelliStok replaces physical inventory checks and manual ordering.



Left: Will Bacon with Bill Shirk, ServicePLUS Center Lead and IntelliStok, a pressure-based sensor pad which sits in the bottom of a parts bin.



FREEWHEELING THROUGH THE CITY

The number of cyclists in cities is increasing every year. It's a climate-smart and healthy mode of transport.

TEXT PETRA LODÉN ILLUSTRATION NILS-PETTER EKWALL



2. Coffee shop

3. Flower shop

4. Houses

5. Roads

6. Underground

7. E-Mobility

Seals in the e-axle are making electric car technology a reality.

The trend toward city cycling is catching on in many places, following in the slipstream of the Netherlands, where the bicycle has long been a popular mode of transport: 40 percent of all Amsterdam commutes are made by bike.

Trelleborg's products help to make riding a bike a smooth, enjoyable and sometimes even an exhilarating experience. And many of the shops, cafes and workplaces in the city to which people cycle benefit from high-tech, state-of-the-art and energy-saving solutions from Trelleborg. ■

URBAN LIFE

6 percent of Trelleborg's net sales derive from infrastructure construction.



750 calories

When cycling, the average person will burn between 450 and 750 calories per hour of cycling.



PHOTO: NORCONSULT

392 meters

The world's longest and deepest road tunnel is currently being built in Norway, north of Stavanger. It will be 27.3 kilometers long and the deepest point is 392 meters. It is expected to be completed by 2026.

30%

The collective aspirational market share goal for electric vehicles is 30% of all vehicles (except two-wheelers) by 2030, according to the International Energy Agency.

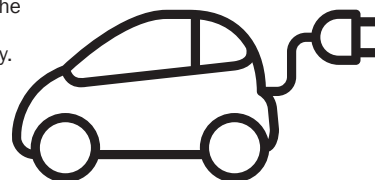


PHOTO: GETTY IMAGES

1%

It might seem that expanding cities take up a lot of land, but only around 1% of global land is defined as built-up area.



6 hours

The half-life of caffeine is about 6 hours, which means that a person who drinks coffee at 3 pm has half left at 9 pm, and a quarter of the caffeine is left at 3 am. How coffee affects us is individual, but anyone who cannot sleep on coffee should avoid coffee after noon.



PHOTO: GETTY IMAGES

1863

The London Underground first opened as an "underground railway" in 1863 and its first electrified underground line opened in 1890, making it the world's oldest metro system.

676 kilometers

The Shanghai Metro system is the world's largest rapid transit system by route length, totaling 676 kilometers. Opening in 1993, it is the third-oldest rapid transit system in mainland China, after the Beijing Subway and the Tianjin Metro. It has seen substantial growth, most significantly during the years leading up to the Expo 2010, and is still expanding quickly, with its most recent expansions having opened in December 2018.

An aerial, high-angle photograph of a densely packed urban area, likely Hong Kong, showing a multitude of skyscrapers and high-rise buildings. The buildings are tightly clustered together, with various architectural styles and colors visible. The overall tone is somewhat muted, with a dark, almost monochromatic feel, emphasizing the density and scale of the city.

PROTECTS WHAT MATTERS BEARINGS

The 'bear' necessities of city life

In our crowded cities, developers often build next to busy roads or above subways. The challenge: protecting buildings and their occupants from noise and vibration.

TEXT ANDREW MONTGOMERY

United Nations research projects that by 2050 almost 70 percent of the world's population will be living in cities. Imagine more than six billion people being exposed to the constant roar of traffic, ceaseless construction noise, sirens, honking horns or the shaking of subway trains.

In fact, trains, subways and cars are the primary causes of noise and vibration. Not only does the human body not respond well to these, but buildings are also affected. There is a growing need for noise and vibration isolation strategies in buildings, especially with the increasing number of prestigious commercial and residential developments springing up in cities worldwide.

Noise and vibration are a nuisance, but they're also dangerous. The World Health Organization (WHO) describes noise pollution as an underestimated threat that can cause hearing loss, cardiovascular problems, cognitive impairment, stress and depression.

The WHO guidelines for community noise recommend less than 30 A-weighted decibels (dB(A)) in bedrooms for good-quality sleep and less than 35 dB(A) in classrooms to allow good teaching and learning conditions – sound levels best compared to a quiet library or low-voice conversation. A European Union study though found that about 40 percent of the people in EU member countries are exposed to road traffic noise at levels exceeding 55 dB(A); 20 percent are exposed to levels exceeding

65 dB(A) during the day, and more than 30 percent are exposed to levels above 55 dB(A) at night.

The most effective way to control noise and vibration is always at its source. In line with the United Nations' Sustainable Development Goals – number 11 (Sustainable cities and communities), Trelleborg provides technologies for this, for instance, anti-vibration systems on trains, vehicles and machinery. However, further steps need to be taken to control and isolate noise and vibration in the basements of buildings. When installed within the base and body of a building,

Above:

As urbanization and resulting infrastructure grow, the vibrations caused by traffic and trains transfer directly through a building's structure, causing noise and vibration discomfort.

Trelleborg's innovative isolation bearings can dramatically reduce the effects of noise that is radiated onward by the building structure as a result of vibration near the structure.

After an initial assessment by an acoustic technician, the bearing manufacturer ensures that the natural frequency at which the building vibrates on its bearings is at just the right level. This has to be considerably less than what is called the forcing frequency, making the ratio between the two as great as possible (the forcing frequency refers to vibrations that radiate through the ground and into





PHOTO: GETTY IMAGES

“Building designs have to incorporate strategies that meet the change in demands from the environment.”

Simon Wolfert, Trelleborg

says. “For example, the rate of deflection isn’t always considered in bearing designs. This can be significantly affected by the varying weight distribution of a building and impact on the performance of the bearing.”

The behavior of buildings is also increasingly a factor, given that intense urbanization means they are being built so close to traffic and railways, exposing the building’s structure to increasing noise, vibration and structural stress.

“Therefore, building designs have to incorporate strategies that meet the change in demands from the environment,” Wolfert says. “Isolation bearings are one example of this.”

But when it comes to strategies, it’s a bit of a moving target, due to the lack of guidance.

“Our environment will continue to evolve and develop,” says Wolfert.

“Couple that with more stringent regulations in the construction industry and building designs must become even more sophisticated. The nature of our infrastructure is that it is built to last, so we cannot allow substandard products and techniques to take hold.”

Ground vibrations won’t disappear, but given the cost and effort associated with retrofitting units, Wolfert adds, “It’s vital that the industry gets this right the first time. The specification of bearings shouldn’t be feared, as the scientific principles are simple enough. A reinstated, valuable guidance that details this will help drive best practice by manufacturers and provide reassurance to architects, contractors and building owners.” ■

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a building’s structure, effectively turning it into a speaker that amplifies sound).

Ideally, the ratio between the natural and forcing frequencies should be three. This gives a transmissibility of 0.1, meaning that 90 percent of the vibrations are detuned. So, for the forcing frequency of 30 hertz coming through the ground, a natural frequency of 10 hertz is the aim.

However, the industry is facing some challenges, as Simon Wolfert, Design Engineer within Trelleborg Industrial Solutions, explains. “Specification guidance for these products is lacking,” he

Right:

Noise and vibration isolation bearings installed within the base and body of a building are a key way to dramatically reduce the effects of ground vibration.



PHOTO: TRELLEBORG



PHOTO: FOSTER + PARTNERS

“Fifty stories bring quite a significant mass. The challenge for us was to make it structurally stable.”

Simon Wolfert, Trelleborg

Case study

PRINCIPAL TOWER, LONDON

Even by London’s high-rise standards, Principal Tower is tall. It’s a 50-story residential skyscraper that lies just north of the city’s busy Liverpool Street railway station in the financial district and is part of the Principal Place mixed-use development that includes the London offices of Amazon.

The tower was completed in 2019, after the developers were able to successfully exploit a crowded-in “brownfield” site (previously developed land that was not in use at the time construction started). Not only that, but the site lies

directly above the railways leading in and out of Liverpool Street.

The tower’s basement developers needed a way to minimize ground-borne noise and vibration for both the building and its residents, who are paying up to GBP 3.1 million for their apartments, depending on where in the building they’ll live. In 2013, the developers turned to Trelleborg for its noise and vibration isolation bearings, which were installed in the basement of the building in 2016.

“As the bearing designer and manufacturer, the challenge was the combination of the loads that

were being introduced into the bearings and the small building footprint,” explains Simon Wolfert, Design Engineer within Trelleborg.

“Fifty stories bring quite a significant mass,” he says. “The challenge for us was to make it structurally stable, but it also had to isolate the vibrations, so a bespoke design was made for all supported locations. The most eye-catching assembly is one that was placed at an angle to deal with the horizontal forces that came through an inclined column comprising four member bearings, and each one has been tested for up to 900 tons of load.”

Left:

Principal Tower, a 50-story residential skyscraper, is base-isolated against ground-borne vibrations.

Testing for such a huge load was a real mission. The process was two-fold. Trelleborg conducted a statutory compression production test in its facility. “Not everybody can do a test like this up to the value of 900 tons,” says Wolfert. There was also a dynamic test.

“But in the short term, we weren’t able to locate a sufficiently qualified third-party testing facility that was able to introduce that much load in combination with the level of vibrations and at the same time measuring those,” Wolfert says. The answer was to build a scale model for a scaled-down version of the test and then extrapolate the results to the production items.

The result is probably Trelleborg’s heaviest loaded application to date for bearings of this kind, in what Wolfert says is the world’s highest base-isolated building against ground-borne vibration.

“It’s a project that’s pushed the envelope of what is considered possible” he says. “But that’s where Trelleborg’s strengths lie.” ■



Simon Wolfert, Design Engineer within Trelleborg Industrial Solutions.

NEWS



Mexican oil company chooses Elastopipe

Mexico's state-owned petroleum company Pemex has awarded Trelleborg a major multi-million-dollar contract. Pemex will use Trelleborg's Elastopipe system on board the Abkatun A off-shore oil complex, which consists of seven platforms in the Bay of Campeche in the Gulf of

Mexico. Elastopipe is a patented flexible piping system developed for transporting fluids and is known for its corrosion-free, explosion-, impact- and jet-fire-resistant properties. The Pemex contract is the largest-ever contract for the Elastopipe system.

Trelleborg 2019 year-end report summary:

36,588

Sales, SEK M

4,658

EBIT, SEK M
excluding items affecting comparability

23,935

Number of employees

50

Number of countries
with operation

Student sponsorship x 2



As an official sponsor of the German student race car organization GreenTeam, Trelleborg Sealing Solutions provides prospective engineers with seals and sealing expertise.

GreenTeam Uni Stuttgart designs, builds and tests fully electric racing cars for the Formula Student Electric competition. The team is composed of students from many different fields: mechanical and electrical engineering, business administration, humanities and communication studies.

"In our GreenTeam project, more than 60 students collaborate to build an e-powered race car, which is driven in international competitions," says Florian Fröhlich, from GreenTeam Uni Stuttgart e.V. "We've had a very successful past. Every year since 2010, our team has been a member of the top 10 teams in the world ranking list of electric Formula Student racecars."



Formula Student, an initiative of the Institution of Mechanical Engineers to promote excellence in engineering, challenges students to design, build, develop, market and compete as a team with their own single-seat racing car. Trelleborg sponsors teams around the world with Confor foam, designed to absorb and dissipate shock energy internally.

Expansion in Bulgaria

At an expanded manufacturing facility in Pernik, Bulgaria, Trelleborg Sealing Solutions produces Liquid Silicone Rubber (LSR) solutions for automotive, pharmaceutical and sanitary equipment, as well as for household electrical appliances and baby care. The site also has its own capabilities in tool design and manufacturing. The facility at Pernik works closely with the Swiss center of excellence for LSR in Stein am Rhein, Switzerland.





Easy round the bend

When train manufacturer Bombardier worked with Trelleborg to make a new version of Trelleborg's axle guide HALL, they developed something that saved even more energy and maintenance costs.

TEXT MICHAEL LAWTON **PHOTOS** STEFAN NILSSON

The innovative HALL® railway hydraulic axle guide unit allows axles to relax a bit into curves while ensuring they remain rigid when running at high speed on a straight track. With HALL, trains run more cost effectively, use less fuel, emit less CO₂, make less noise as they go through tight curves, and also save on track and wheel maintenance. Unfortunately, Bombardier, one of the world's leading train manufacturers could not benefit from the HALL technology as it was incompatible with its bogies.



Left:
Travelers by
Bombardier trains
can enjoy reduced
curve squeal
noise.

Right:
FLEXX Curve is
able to be installed
as a plug-and-play
solution.

PHOTOS: TRELLEBORG



“Hydraulic seesaw – when the forces on each wheel are about equal, the system is balanced and rigid, but when they are subject to different forces, the system moves in that direction.”

Alexander Zahnbrecher, Trelleborg

Right:
FLEXX Curve is
able to be loaded
with high vertical
forces, based
on its innovative
design.



as it's called, applies the HALL principle. And it can be retrofitted to Bombardier trains with FLEXX Compact bogies.

The real innovation is the cross-coupled version, where the HALLS on both wheels of an axle are hydraulically connected in what Alexander Zahnbrecher, Project Engineer with Trelleborg, describes as a “hydraulic seesaw – when the forces on each wheel are about equal, the system is balanced and rigid, but when they are subject to different forces, the system moves in that

direction.” That is particularly useful in starting and stopping and going through tighter curves: Bombardier will be applying it to all new trains running routes with many curves, saving an estimated 145 tons of CO₂ in 10 years for every four-car train.

A third version, called Passive Radial Steering, features an intelligent valve that blocks hydraulic movement under certain circumstances and improves performance on even tighter curves. On a 300-meter-radius curve, wheel wear will be reduced by 90 percent. That will come into its own on mountain routes such as in Switzerland, especially since track charges in the country are lower for trains that do less damage to the track. ■

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Andreas Wolf, then Chief Suspension Engineer with Bombardier, now Team Manager Engineering Railway within Trelleborg Industrial Solutions, remembers: “Bombardier approached Trelleborg to start a joint development project.” Not only did the cooperation produce a special HALL that fits Bombardier trains, but it extended the design to further improve performance.

In the Bombardier application, the unit must deal with high vertical loads, but essentially the FLEXX® Curve Standard,

Carina Ström and Anton Berner from ventilation producer Rasch, based in Motala, Sweden, says they had a good collaboration on product development with Trelleborg's Peter Somvall.

Energy-saving seals

Close collaboration proved key when ventilation company Rasch experienced issues with the seals on one of its damper products.

TEXT PER-OLA KNUTAS PHOTO TOBIAS OHLS

Today ventilation systems not only have to manage large airflows to be able to ventilate buildings that are tightly sealed. In a time of increasing climate and environmental awareness, intelligent control systems are becoming more common, making it possible to steer the airflow toward where it is needed or away from where it is not needed. In doing so, energy consumption can be minimized – an increasingly important requirement for real estate firms and property managers, many of whom want to become environmentally certified according to the international BREEAM standard.

An important element in achieving the goal of low energy consumption in the building's ventilation system involves the use of dampers with moving parts operated by motorized control systems. Current trends show more and more of these units being installed in modern buildings.

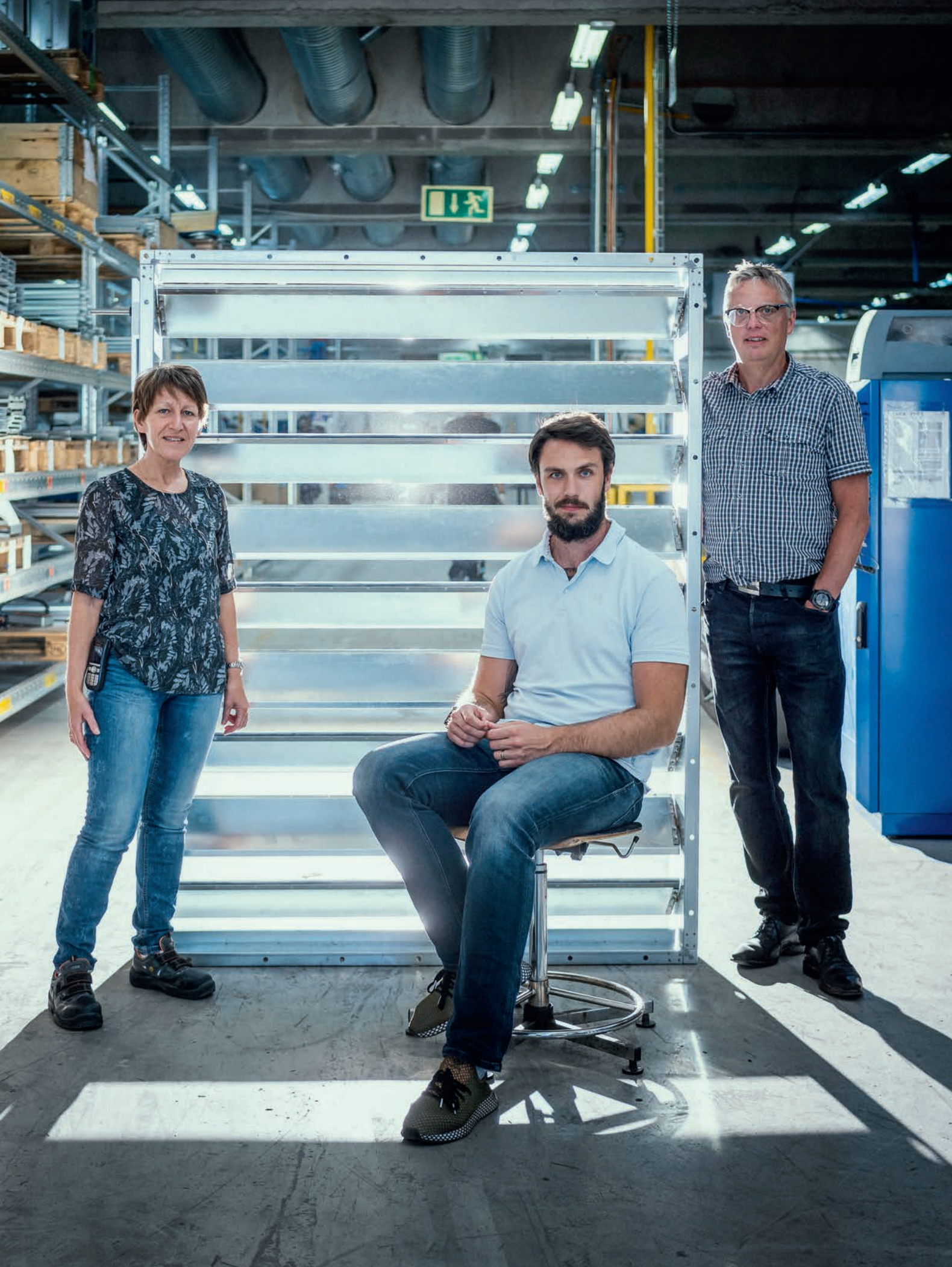
This is where Rasch comes in. Originally a family company started by three brothers in the 1930s, Rasch has grown to become a leading producer of different types of ventilation products, including fire-proofing and air dampers for installation in everything from nuclear power plants and mines to schools, offices and shopping centers.

When Rasch was in the process of product development a few years ago to redesign one of its larger louver dampers to make it lighter and smaller, a problem arose: the existing seals made it too heavy, preventing the electric motors from closing the louvers correctly.

"We called our contact at Trelleborg, Peter Somvall, to see if we could work out a solution to the problem," says Anton Berner, a product developer at Rasch.

Carina Ström, responsible for purchasing at Rasch, says: "We had good dialogue and collaboration from the very start, and Trelleborg has helped us a great deal throughout the process."







Trelleborg's team studied Rasch's problem inside and out. Peter Somvall, a business developer for sealing profiles within Trelleborg Industrial Solutions, brought a designer and a product developer with him to the facility to speak with the company's product developers and assemblers.

"We realized very quickly that it was a design problem, not a material problem," Somvall explains.

Then a process described by everyone involved as "close

cooperation" followed, during which Berner and his colleagues visited Trelleborg's manufacturing site.

"Our collaboration was extremely smooth from day one," Berner says. "Somvall and his colleagues came to us, studied and examined, took samples, simulated and analyzed, and came up with a sketch that we later discussed and modified. As part of the process, we also developed a prototype that we tested here in our manufacturing site."

Above: Product developer Anton Berner appreciates the collaboration with Trelleborg's Peter Somvall, which resulted in sketches and a prototype tested on site at Rasch's facilities.

Somvall stresses how it was important for Trelleborg's team to listen to the assemblers. The key to achieving a successful product is finding a solution that is easy to assemble.

"We know that it is on the construction site itself that costs develop," he says. "For this reason, it is important for us to find easy-to-assemble solutions that can be produced in large volumes while observing strict tolerance requirements."

Trelleborg has been an



Right:

Thanks to joint product development, Trelleborg could provide Rasch with optimal seals for the louver dampers.

Rasch, based in Motala, Sweden, has supplied ventilation products to several prestigious projects in Sweden, such as the Mall of Scandinavia.



important supplier of sealing profiles for Rasch's products, and Somvall says the company learned many lessons during the development of the large louver damper.

"It has affected the entire product assortment at Rasch," he explains. "Thanks to our new solution, all the company's dampers are now easier to operate." ■

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"Our collaboration was extremely smooth from day one."

Anton Berner, Rasch

CIRCUMNAVIGATING A CIRCULAR FUTURE

As the world consumes vastly more resources than it can regenerate, the circular economy may be the only thing that can help us change our habits.

TEXT AMY BROWN

PHOTOS FRED MACGREGOR

In 1984, when Julia Stegemann, now a Professor of Environmental Engineering at University College London (UCL), proposed doing her undergraduate research project on recycling of plastics, her professor laughed at her and said, “Why would anyone want to do that?” and shot down the idea.

Stegemann may not have been able to pursue that particular project, but her instincts were right. The world’s growing waste problem is now a central concern across academia, business, government and society in the face of mounting environmental impacts such as air and water pollution, soil contamination from chemicals, and inefficient use of scarce natural resources.

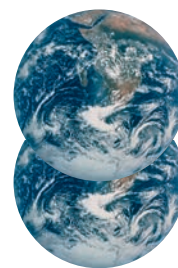
We are now consuming about 1.75 times the earth’s carrying capacity; that is, we are using 75 percent more natural resources than we are regenerating, according to the nonprofit Global Footprint

Network. It’s a trend that shows no signs of slowing in coming decades.

The circular economy offers a promising opportunity to rein in this unsustainable rate of consumption. According to the Ellen MacArthur Foundation, a thought leader in the circular economy, “A circular economy keeps products, components and materials at their highest utility and value, at all times, eliminating the concept of waste, with materials ultimately re-entering the economy at end of use as defined, valuable technical or biological nutrients.”


It’s this vision of sustainable resource use offered by the circular economy that has inspired much of Stegemann’s academic career over the past 35 years. She believes it’s an approach that can lead to greater economic stability with more equitable sharing of resources, maintaining consumption and environmental impacts within planetary boundaries.

“I’ve always been interested in



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1.75

We are consuming about 1.75 times the earth’s carrying capacity, using 75 percent more natural resources than we are regenerating.

A portrait of Julia Stegemann, a woman with short grey hair and glasses, wearing a dark blue cardigan over a patterned top. She is sitting on a red bench against a grey wall, looking thoughtfully to the right. Her hands are clasped in her lap, and she is wearing a watch and a ring.

Julia Stegemann's vision of sustainable resource use offered by the circular economy has inspired much of her career over the past 35 years.

waste and resource efficiency, but the circular economy is something that has really grown over the course of my career,” Stegemann says. “It’s trying to find that balance between making the best use of our resources and not actually contributing to our problems.”

She works closely with colleagues at the UCL Circular Economy Lab, a cross-disciplinary initiative aimed at improving the design of buildings and products, their reuse and recycling and the return of their constituent materials back to the economy.

More and more industries are exploring these opportunities. According to Peter Lacy and Jakob Rutqvist, authors of *Waste to Wealth: The Circular Economy Advantage*, the circular economy may be about

to drive the biggest transformation in business since the Industrial Revolution 250 years ago—USD 4.5 trillion in additional economic output by 2030.

Yet despite the progress, Stegemann says, “We’re just in the very early stages of the circular economy. I think the systemic change that needs to happen is still quite a long way from happening.”

For Stegemann, systemic change depends on creating interlinked systems that result in less use of resources overall. “There’s no point in cycling things if we can’t get the demand in check,” she says. “What we need to be doing is not just continuing to grow demand, but actually reducing the demand.”

One example of this dilemma is

the shift away from plastic packaging to more paper packaging. While that is a necessary shift, not least because of the growing problem of ocean-based plastic, greater reliance on paper packaging “just shifts the problem from one sector to the other, using up our forestry resources,” she explains.

Industry’s ability to rise to these kinds of challenges will be pivotal to making the circular transformation. The manufacturing industry “is the sector that has to drive the circular economy because consumers can only act in the boundaries of the choices that they’re given,” Stegemann says. “It’s up to industry to make those innovations so that consumers have more choice and can make a more sustainable choice.” ■

“There’s no point in cycling things if we can’t get the demand in check. What we need to be doing is not just continuing to grow demand, but actually reducing the demand.”

Julia Stegemann, University College London



PHOTO: U.S. DEPARTMENT OF AGRICULTURE

Above:

Cross-laminated secondary timber can potentially replace conventional material usually made from virgin timber.

Giving virgin timber new life

A significant amount of waste is created in the construction industry – not least waste timber. In one project, Professor Julia Stegemann of University College London, along with doctoral student and architect Colin Rose, looked at ways to recover the residual quality and value of virgin timber that dissipates in conventional waste management. Cross-laminated secondary timber, salvaged from demolition waste, can potentially replace conventional cross-laminated timber usually made from virgin timber. This

cross-laminated secondary timber could also replace structural steel and reinforced concrete in some applications.

This example of upcycling to displace materials with greater environmental impact, Stegemann points out, is “a very circular economy kind of practice because you’re trying to retain the value of that material. By salvaging the wood to create an engineered material, we are actually giving it a new life with a higher value than the way timber was used in the first place.”



Julia Stegemann

Lives: “I have quite a mixed background. I’m German by birth and grew up mostly in Canada. I have lived in the UK for 22 years, and today I live in an 18th century Huguenot weaver’s cottage in Spitalfields, London.”

Education: B Eng and M Eng in Chemical Engineering; PhD in Environmental Engineering, McMaster University, Canada; PhD in Environmental Engineering, Imperial College of Science; Postgraduate Certificate in Learning and Teaching in Higher Education, University of Oxford.

Work and career: “I’ve always been interested in waste and resource efficiency, and my interest in the circular economy has grown over the course of my career.” Current position: Professor of Environmental Engineering, University College London; Previous positions: Lecturer in Environmental Engineering, Oxford University; Research Associate, Imperial College; Head of Waste Management, Environment Canada’s Wastewater Technology Centre.

Family: Husband and 15-year-old Burmese cat named Filbert Tati, who can say “no” in English, and many other words and sentences in cat-Burmese.

Interests: Reading, gardening, spoiling Filbert.

Hidden talent: Excellent comprehension of cat-Burmese (still working on speaking it).

What drives you: “Respect for nature drives me. I have always tried to be conscious about my personal resource efficiency to an extent that my family and friends probably find difficult to understand. But even though I try my best, it is very difficult to live in a way that is sustainable and resource-efficient. With the alternatives that consumers are provided with, even if you’re trying to do your best, it’s very difficult.”

A smoother, quieter journey

If you thought electric cars were silent, think again. Electric drivelines are certainly quieter than internal combustion engines, but they have their own noise and vibration issues. Thankfully, new technology from Trelleborg helps ensure a smoother, quieter journey.

TEXT ANDREW MONTGOMERY

When electric cars were invented, many people thought the noisy world of the internal combustion engine would soon be history. But while electric and hybrid electric cars are quieter, it doesn't mean they're silent.

Electric drivelines have their own range of noise, vibration and harshness issues. And the noise of a typical combustion engine is no longer there to mask other structure-borne noises from the likes of the gearbox housing. But there's also another culprit.

"Power inverters are one of the main contributing sources of noise in the electric vehicles' driveline," says Reine Axelsson, Product Manager for Laminates for damping solutions within Trelleborg Sealing Solutions.

This worries automotive industry Original Equipment Manufacturers (OEMs) and their component suppliers. E-mobility is a fast-growing

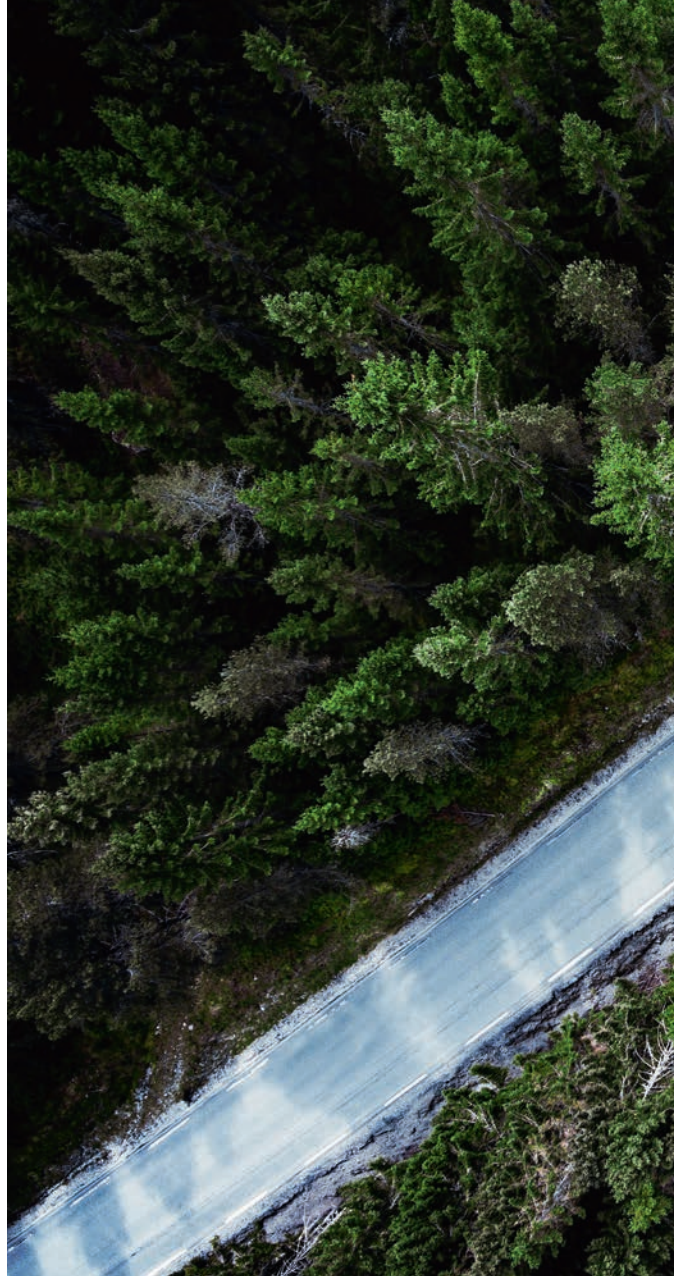
market, and the last thing they need is a noisy car that puts off potential consumers.

When a component supplier had a power inverter noise issue, it approached Trelleborg for help.

Trelleborg's solution is based on the same basic technology used for brake shims. It's called Applied Damping Material (ADM), a constrained layer damping material that consists of metal layers that have been vulcanized together with rubber to produce a strong and durable laminate. Together, the polymers, rubber and adhesive are an excellent material to absorb mechanical energy and the vibrations that radiate noise.

It works on all sorts of vibrating structures in automotive drivelines, but Trelleborg has come up with a new variant of ADM for the power inverter issue.

"We've developed a completely new material for inverters because they make a wider range of noise," says Arvid Norberg, Director of



Arvid Norberg, Director of Sales and Marketing for damping solutions at Trelleborg.

Sales and Marketing for damping solutions at Trelleborg. "By combining a different thickness of metal with different types of polymer thickness you can have a higher level of damping at a wider noise frequency and temperature."

The exact material composition is secret. Suffice it to say the polymers are based on nitril butadiene rubber (NBR), and the adhesive is typically an acrylic, though other materials can also be involved.

But it's a challenging development process because electrical engines and drives have even



PHOTO: GETTY IMAGES

What's that noise?

- **Sound** is a physical disturbance in the surrounding medium in the form of rapid pressure variation.
- **Noise** is defined as any sound that's perceived to be disturbing. It's audible air pressure, where a very small vibration (in this case, from the power inverter) interacts with the surrounding air to cause a sound wave that eventually reaches the human ear. "It's just like the speaker of a sound system," says Reine Axelsson.
- When something oscillates about a static position it can be said to **vibrate**.
- **Constrained layer damping** works by using a visco-elastic damping layer that is constrained (held down) by a metal layer.
- **Vibrations** in the structure will cause deformation in the constrained layer.
- **Damping** occurs due to shear deformation in the damping layer.
- Mechanical energy (vibration) is transferred into a small amount of heat in the damping layer (**structural damping**).
- **Trelleborg's Applied Damping Materials** lower the vibration in the structure, reducing the ability to transmit the vibration into the air. "You're lowering the volume of the speaker," says Axelsson.

tougher cleanliness standards than combustion engines.

"The most critical thing is that there are no loose metallic particles past a certain size, as these can get into the engine or even the electronics and cause a short circuit," Axelsson says. "We are asked to control the level of particles on the parts we supply."

Norberg adds, "We're talking about tenths of millimeters that are often invisible to the naked eye."

With the growth of e-mobility, Norberg believes ADM has significant market potential. It underlines the decision of Trelleborg Sealing Solutions several years

Above:

When the noise of a combustion engine is no longer there to mask noises from the gearbox housing or power inverters, innovative solutions are needed.

ago to diversify from brakes and solidify its marketleading position in damping solutions. The team working in this area is growing too.

"We are at the forefront of the market, and we see e-mobility as being very important in the years ahead," says Norberg.

So how will the technology develop?

"We're using more lightweight materials wherever possible," says Axelsson. "Our focus is noise and vibration, but we are also looking to see how we can respond to other new requirements that come from our customers. There are also new workplace directives

on noise from the European Union to consider. The health and safety requirements regarding noise and vibration are only getting tougher, but that's good for us as we're regarded as the leading developer of brake and damping products."

With the possibility of this technology being used in other industries such as consumer electronics, it's clear that ADM has enormous potential, keeping Trelleborg ahead of the competition. ■

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Blue Dimension™ protects the environment

At Trelleborg, we believe that the benefits of our solutions stretch beyond functionality and business performance. Whenever possible they should also contribute to better sustainability. In fact, many of our solutions protect the environment and people, as well as infrastructure and assets. This is what we call Blue Dimension™ – Solutions for Better Sustainability.

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