t·time

A MAGAZINE FROM TRELLEBORG GROUP | 2·2020

Solutions that seal, damp and protect critical applications.

PLUS
SAFE CHEMICAL TRANSPORTATION

SMART FARMING

CRITICAL CONNECTION AT SEA

Harnessing technology for the benefit of patients around the world.

Digital health liftoff

CONTENT

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TT Nyhetsbyrån

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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.

www.trelleborg.com

TRELLEBORG


PHOTO: SHUTTERSTOCK

EDITORIAL

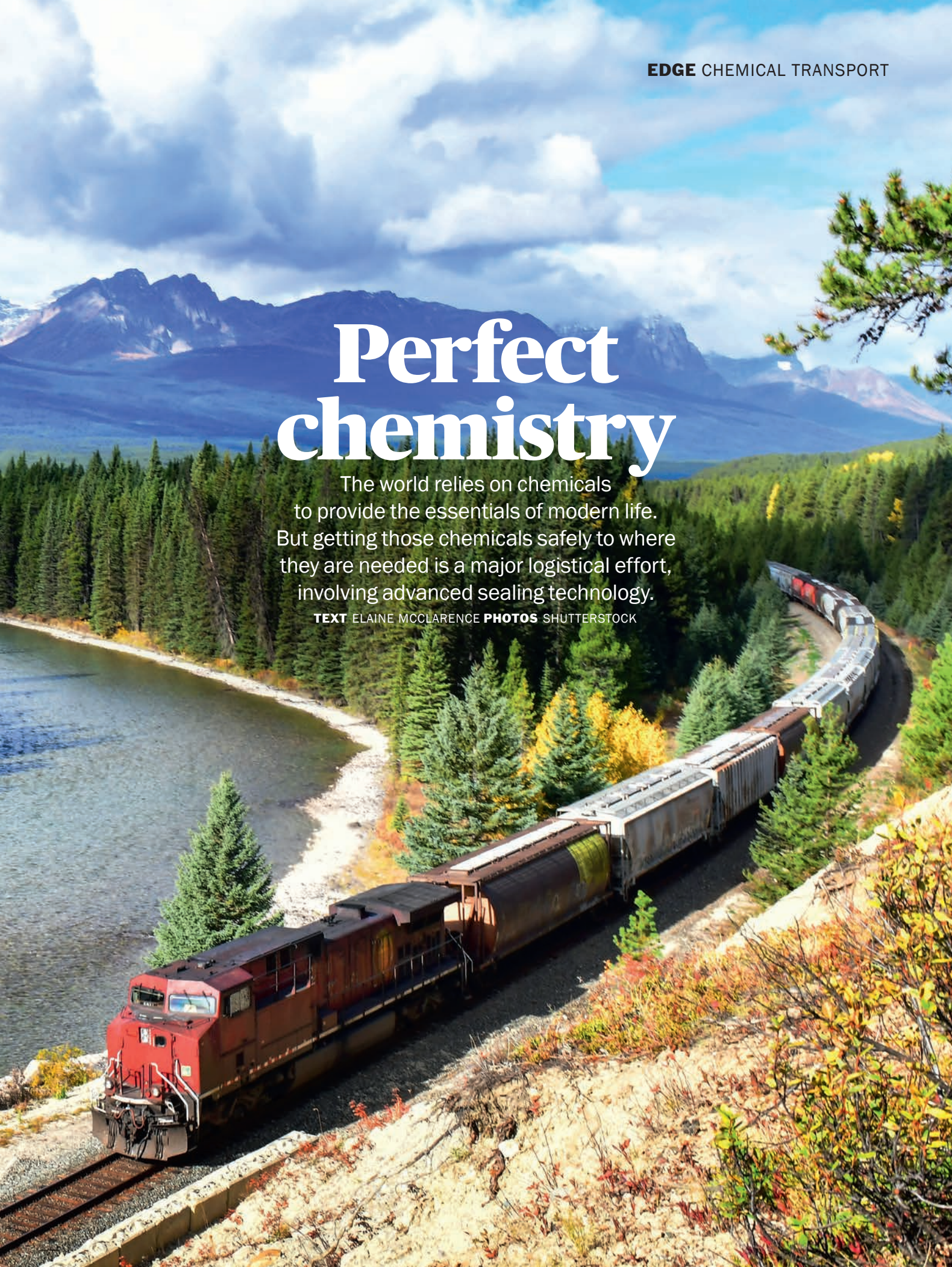
SUCCESSFUL SUSTAINABILITY

A success factor in our long history of producing exceptional products is customers and stakeholders viewing Trelleborg as a company with extensive knowledge of innovative solutions for a sustainable society. Providing customers with the right products; be it seals, agricultural tires or fenders, is perhaps our greatest contribution to global sustainability.

We assume responsibility for Trelleborg's operations also; and their impact on people, communities, and the environment.

In this issue of *T-Time*, we write about our grout seals for offshore wind farms. The seal is a small part of larger installations, yet essential for function and service life. Our Central Tire Inflation System (CTIS+ Inside) enables tire pressure adjustments for agricultural machinery depending on load and ground conditions. Fully integrated in the rim, it boosts tractor efficiency, sustainability, reliability, and improves the driver experience.

Peter Nilsson,
President and CEO



Perfect chemistry

The world relies on chemicals to provide the essentials of modern life. But getting those chemicals safely to where they are needed is a major logistical effort, involving advanced sealing technology.

TEXT ELAINE MCCLARENCE **PHOTOS** SHUTTERSTOCK

From the fertilizers that help grow our food to the beds we lie on, from the shoes on our feet to the cars that we drive, chemicals are the basic building blocks of our everyday lives.

To give some perspective, the UN Environment Programme's *Global Chemicals Outlook II* estimated that the global chemical industry was worth more than USD 5 trillion in 2017, with that figure set to double by 2030.

With end users of chemicals spread across five continents, the safe transport of huge volumes of materials to production plants by rail, road, sea or air is by itself a massive industry. In the US alone, the American Chemistry Council says that some 970 million tons of chemicals were shipped around the country in 2018.

Regardless of the type of chemical, producers and consumers need safe, efficient and cost-effective methods of transportation. The solution at the heart of any chemical transport system is a tank into which the substances are pumped prior to them being sent to their destination. The pumps, valves and seals that are involved in the filling and emptying of the tanks at the starting and end points of the journey, are crucial to ensure that chemicals do not leak into the

Below: With the right seal chemicals can be safely transported around the world regardless if it is by rail, road, sea or air.

“To make transportation as effective and economical as possible for the carrier, the ideal is that the same pump and valves can be used in the tank.”

Thijs Menzel, Trelleborg

environment. Seals have to perform well for a long time, regardless of how destructive chemicals may be.

With its extensive knowledge of sealing technology, Trelleborg Sealing Solutions has been able to make great strides in its development of chemical sealing solutions, particularly for transportation applications.

As Thijs Menzel, Chemical Transport Segment Director at Trelleborg Sealing Solutions, explains, “To make transportation as effective and economical as possible for the carrier, the ideal is that the same pump and valves can be used in the tank, whatever chemical is being transported.”

Menzel adds that seals need to last a long time to minimize downtime, maintenance and pump replacement. There are also the adverse environmental consequences to consider if a seal or seals fail.

“Sealing materials in the pump and valve must be resistant to the maximum number of chemicals that could potentially be transported in the tanks,” says Menzel. Then you have to factor in the range of environmental conditions to which the tanks may be exposed – from freezing ice fields to desert heat. It’s enormously difficult to develop a universal sealing solution that can function to both these extremes.

However, Trelleborg has a solution. Its materials for chemical seals are based on a compound called Perfluoroelastomer, which combines good sealing properties with resistance to the harshest of chemicals.

In fact, Trelleborg had already developed two compounds for use in other industry segments and believed that these would be suitable for use in chemical transportation.

Trelleborg tested these compounds rigorously and both materials performed well, particularly in comparison to competing seal materials. The company has now made these compounds available for a range of seals that can meet the diverse needs of the chemical transportation industry, whether it’s for trucks weaving their way through urban traffic or trains travelling through remote mountain passes. ■

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Testing times for seal materials

Ethylene Diamine and Glacial Acetic Acid are two chemicals that are often transported but which are highly destructive to seals. Ethylene Diamine is used in chemical syntheses and Glacial Acetic Acid in the manufacturing of acetates. Other commonly used acid and oil–based chemicals can also have a detrimental effect on seals.

Trelleborg’s response to this issue was to test its two compounds, Isolast® J9503 and Isolast® J9567, for possible usage in chemical sealing applications. It exposed them to a range of chemical media, gauging sealing performance by volume change in the material. The lower the volume changes, the better the sealing performance.

For all the chemical media in which both materials were tested, the volume change was less than 10 percent. In the chemicals most destructive to seals, both compounds performed exceptionally well. This indicates that these materials will offer optimum seal reliability in extreme environments, extending service life, while also minimizing the total cost of ownership.

NEWS

No interference

Wind turbines can cause radar interference, showing up on radar operator's screens as clutter, obscuring the display and resulting in lost aircraft tracking. Trelleborg is tackling these issues with Frame™, a radar absorbing material that mitigates wind turbine radar interference problems, unlocking gigawatts of new potential wind farm sites.

PHOTO: PEXEL

Fredrik Nilsson has been appointed new Chief Financial Officer of the Trelleborg Group and will assume this position during the first quarter of 2021. "We are pleased about the recruitment of Fredrik. His broad experience of a global finance function from relevant industries combined with a strong business focus makes Fredrik an excellent addition to Trelleborg," says Peter Nilsson, President and CEO of Trelleborg.

PHOTO: KION GROUP

Tires that care for the floor

The KION Group, one of the world's leading manufacturers of forklift trucks and warehouse equipment, has selected Trelleborg as their preferred main supplier for non-marking tires in the European market. The forklift trucks operate in demanding indoor environments where floor care is essential.

E-commerce the smart way

Norwegian company, Homeboxx, has created a hassle-free solution for deliveries that allow customers to have fresh goods and packages delivered directly to their home without actually having to be there. The box can be placed outside the front door and is designed to withstand the summer heat as well as the coldest winter days. Trelleborg was entrusted with designing the all-important seal, the key to maintaining a consistent temperature inside the box. The result is a brand-new, two-component sealing profile.

PHOTO: HOMEBOX

Focusing on carbon footprint

Trelleborg tire solutions and technology aims to reduce the global footprint of the agricultural industry. A company case study evaluated the CO_2 emission of an agricultural tire over its whole lifespan. While 6.6 kilograms of CO_2 are generated to produce a kilogram of tire, almost 647 kilograms of CO_2 per kilogram of agricultural tire are generated during the use of the tire itself. So, to reduce the carbon footprint of an agricultural tire, it is important to act on the manufacturing process, but it is a strategic necessity to act on the efficiency of the tires as they are used.

Passion for ports

This dedicated marine design engineer based in India finds great satisfaction in teamwork and welcomes each day as an opportunity to learn something new.

TEXT R F MAMOOWALA **PHOTOS** SUMANTH KUMAR


SEA GUARD

Divya Patel says the most exciting part of her job is the new thoughts and ideas that emerge when several minds come together.

Divya Patel, a young Design Engineer for the marine and infrastructure operation within Trelleborg Industrial Solutions in India, talks about designing fender systems with a passion and enthusiasm most commonly displayed by people discussing their favorite sports team. Divya says that real magic happens when Trelleborg's Think Tank, an innovative group of people brimming with ideas and ranging from rookies to veterans, gets together, brainstorms, comes up with new ideas and turns the client's request into a perfect engineering solution.

Divya began her journey as a design engineer with Trelleborg in 2014, and now she's one of the 36 engineers at Trelleborg's office on the 17th floor of a modern corporate building in the western city of Ahmedabad, Gujarat State, India, where Trelleborg's Indian Centre for Excellence (ICE) is located.

Development of port infrastructure has become a major driving factor for global logistics connectivity and economic growth. "We are a responsible partner, committed to provide the best industry solutions to ensure efficient berthing and mooring operations." As an integral part of Trelleborg, the Indian Centre for Excellence provides back-end engineering services and solutions to Trelleborg's global offices for marine systems, infrastructure products, mining solutions, and offshore operations, among other things.

Divya, says, "My major focus is to engineer fender systems, which are used for safe berthing of the ship to the wharf. The primary component used for these systems is made of rubber – natural or synthetic, or a blend of both, depending on the region where it is to be used, and its climatic conditions. For example, while designing fender systems for the Middle East or Canada, the varied temperatures have to be taken into account to ensure long-term

Divya Patel's major focus is to engineer fender systems, which are used for safe berthing of the ship to the wharf.

PHOTO: TRELLEBORG

durability without compromising the performance."

With great pride Divya says that while others in the market make and sell fenders as a mere commodity, her team provides solutions that build customer confidence and retain Trelleborg's market leading position. "Our fenders are designed and built to take thousands of compression cycles without being damaged."

Divya loves challenges. "After working for a while in the mature US market, I was thrilled to be aligned with the more demanding and challenging IMEA (India, Middle East, Africa) market. Here I have the opportunity to design unique solutions from concept to a functional product."

After being in her role for over five years, she still finds every day to be a new beginning, as there are always new challenges that need to be resolved. Another factor that whets her appetite is clients' awareness and demand for the best in the market, and the latest technology.

"People didn't always understand the importance of a fender system," she says. "But over the years, we've created awareness about the engineering involved in designing a fender system, the concept of smart ports and the checks required to ensure optimum product utilization."

A recent example was a client in Qatar who had undertaken a major upgrade of his berthing facility, which was an old wharf structure. During initial discussions it appeared to be a conventional project, but it became increasingly complex as the client expressed his reluctance to allow coring on the front face of the wharf, as it posed a potential threat of irreversible damage to the structure. "We brainstormed, and came up with a unique L-shaped bracket that was fixed to the jetty by coring only at the top."

Divya is all smiles as she recalls how happy the client was with the solution. "We really stretched the engineering to the final analysis; so much detailed work was done to design this unique system. This is the most exciting part of my job; new thoughts and ideas which emerge when several minds come together. We achieve great results that make the clients happy."

Divya believes that the future belongs to smart port technology. "We are spreading the message to our clients and consultants that this technology will improve the overall monitoring of berthing and mooring operations and will help to improve overall efficiency. Our R&D team has been instrumental in providing support for recently launched products with better technology, reducing manual operations." ■

"The technology will improve the overall monitoring of berthing and mooring operations and will help to improve overall efficiency."

Divya Patel, Trelleborg

Balancing life and work

Divya Patel qualified as a mechanical engineer in India, and then studied business management in the UK, where she worked for a couple of years, before returning to India to rejoin her family. Her first job involved designing fire fighting systems for hydro and nuclear plants. "I am very excited to work with fender designs at Trelleborg now, because every day I'm learning something new."

Divya is married and has a six-year old son, Rudra. Her day begins at 6 a.m. with a 20-minute yoga session to keep her fit. Breakfast follows, with Divya cooking staple Indian food such as roti, rice, dhal (pulses) and vegetables.

Aided by a domestic helper she calls "Aunty", Divya ensures that by 9:30 a.m. "my house is tidy and shining when I leave for the office."

Divya shares the responsibility for taking care of Rudra with her dentist husband. She's worked out a schedule that ensures her husband is home to spend a few hours with Rudra after school, before he begins his evening clinic for patients.

Divya's role model is her mother, who "at 60 is full of energy and so fit that she can run faster than me."

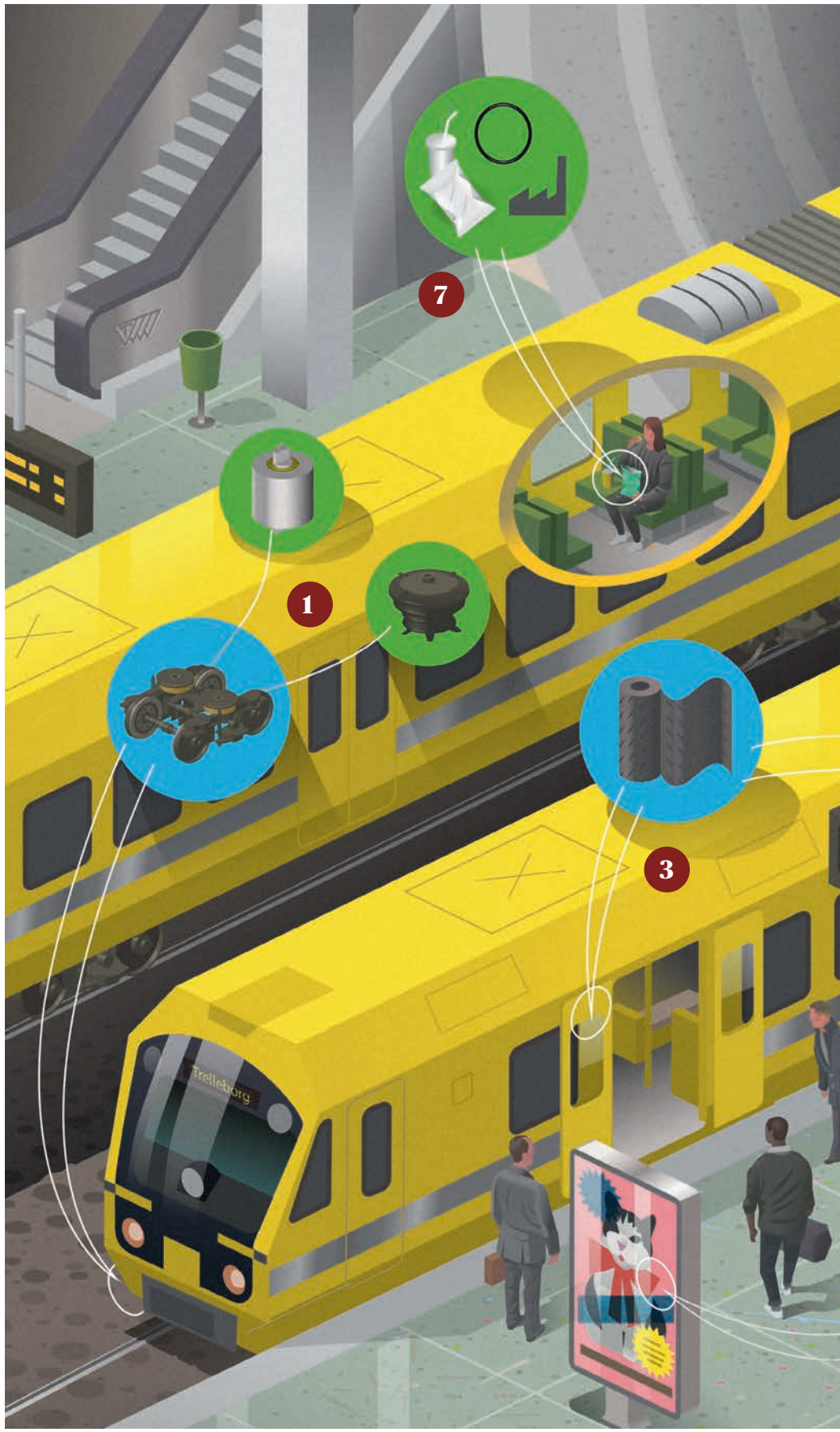
For more information:
www.trelleborg.com/en/career

Trelleborg's team in India creates awareness about the engineering involved in designing a fender system.

CITY SWIFTER

TEXT DONNA GUINIVAN
ILLUSTRATION NILS-PETTER EKWALL

In crowded and traffic-choked urban environments, one of the quickest ways of getting around town is by an underground rapid transit system. But did you know that when you are standing on the platform waiting for your train you are surrounded by innovations from Trelleborg? And that once you get on the train and it starts moving along the track, your ride is being made safer and more comfortable due to Trelleborg's inventions? Trelleborg has more than 100 years of experience in the global rail market, with materials and technologies that help provide faster, smoother, quieter and safer rail and urban transit travel for the world's fast-growing urban populations. ■



1. Springs, bearings and the revolutionary HALL axle guide are fitted to trains to improve efficiency and performance.

2. On the tracks, dampers and embedded rail systems reduce noise and vibration.

3. Coated fabrics help make the sliding doors open and close reliably, but are also used as flexible gangway bellows.

4. Giant segment gaskets are utilized in excavated tunnels to provide a secure rubber-to-rubber water-proof seal.

5. In buildings that have been constructed above underground railways, bearings dampen the noise and vibration caused by trains.

6. Passengers waiting for trains are the perfect captive audience for companies promoting their goods and services, often with high quality posters that have been produced on Trelleborg printing blankets.

7. Time-pressed commuters who snack on the move can be confident that hygienic seals used in processing mean their food or drink is safe to consume.


4
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2

TRAVELLING UNDERGROUND

Equipment for the transportation industry accounts for 19 percent of Trelleborg's net sales.

178
subway systems
There are more than 178 subway systems around the globe, which on average carry 168 million passengers a day.

PHOTO: GETTY IMAGES

Underground art gallery
The Moscow subway is Europe's largest underground system and is perhaps the world's most beautiful metro. With its art deco design and mosaic ceilings, Mayakovskaya is one of the city's most famous stations. Other well-known stops are Novoslobodskaya, illuminated by 32 glass mosaics in bright colors, and Komsomolskaya, whose baroque styling features yellow ceilings, giant bronze crowns and marble arches. Moscow subway has 232 stations, with plans for 64 more in 2025.

Metro name
The Paris Métro was opened on 19 July 1900. It was one of the first to use the term 'metro', an abbreviation of the original operating company's name, Compagnie du chemin de fer métropolitain de Paris.

Ghost stations
In 1961, the Berlin Wall divided the city's public transit system in two. Most S– and U-Bahn lines were divided between East and West Berlin, but two U-Bahn lines running north and south only passed through East Berlin for a short distance. The East German authorities closed the stops in East Berlin, turning them into ghost stations where trains were prohibited from stopping.

PHOTO: GETTY IMAGES

Sliding Doors
In 1998, the movie Sliding Doors alternated between two storylines, showing the two paths the central character's life could take, depending on whether or not she catches an underground train.

PHOTO: PINMG

Vintage Art
In the early 20th Century, posters became a real art form, with renowned artists being commissioned to produce designs to decorate early rail and underground stations.

1863

The London Underground was originally opened in 1863 for locomotive trains. In 1890, it became the world's first metro system when electric trains began operating. It is the world's third longest metro system, measuring 402 kilometers with 270 stations across its 11 lines. Only 45% of the network actually runs underground, mainly in the city center, with lines in the suburbs mostly running above the surface.

World Heritage
In 2002, the subway system in Hungary's capital Budapest was listed as a UNESCO World Heritage Site.

SOURCES: RAILWAY TECHNOLOGY, DAGENS NYHETER

No more compromises

With Trelleborg's Ultra High Temp Seal, the global aerospace industry can help aircraft be safer, lighter and faster.

TEXT ANDREW MONTGOMERY
PHOTOS GALLERY STOCK/BENEDICT REDGROVE

Plane engines run at higher and higher temperatures. The new Ultra High Temp Seal meet all the customer requirements for a fire seal.

It's a conundrum that aircraft manufacturers have faced for many years: how to reconcile the conflicting needs of engine heat – which boosts thrust, optimizes engine efficiency and lowers fuel consumption – with keeping passengers safe.

The key to it is fire seals, which are found in the plane's fuselage, pylons, thrust reversers and engines. They act as a barrier to prevent airflow from one area of the plane to another during normal operating conditions.

Fire seals are also a sort of 'built-in firefighter', containing a fire in one section of the plane on the very rare occasion that a blaze breaks out, giving the pilots a 15-minute window to make a safe landing.

But as aircraft manufacturing has developed, designers have been striving to run plane engines at higher and higher temperatures. The latest planes are operating north of +538 °C (1,000 °F), significantly higher than their predecessors.

And with that sort of heat, existing fire seals have not been able to do the job without secondary thermal protection. This increases the number of parts required and consequently weight, making the airplane heavier and constraining its potential speed.

Step forward Trelleborg Sealing Solutions with its answer to the issue: the new Ultra High Temp Seal. Trelleborg has been supplying fire seals for decades and its range of products are well-established in the market, but the company describes the Ultra High Temp Seal as 'the next generation'.

"Up until now there has been no high temperature fire seal that can operate up to +538 °C (1,000 °F) and also meet all the customer requirements for a fire seal. There has always been a compromise," explains Quinn Collett, General Manager for aerospace airframe seals within Trelleborg Sealing Solutions.

"Competitive products, such as metal-mesh seals, do not meet

all the requirements of a fire seal. Claims have been made by other suppliers that they have achieved a silicone fire seal that can operate at high temperatures. However, when put to the test in typical dynamic requirements at elevated temperature, we have found them to fail."

The Ultra High Temp Seal works by preventing airflow and flame penetration from one area of the aircraft to another and is fully operational with minimum compression set over a seal compression range of 15 to 40 percent. This means it retains positive contact with the surrounding hardware over the seal compression range.

Rigorous testing proves that the new seal can operate at a temperature range from -40 °C (or -40°F) to +538 °C (1,000 °F), while fully meeting all aircraft manufacturers' requirements.

Collett adds: "To manufacture the product we developed a proprietary methodology to integrate all components and make complex geometries. To increase its usability, the Ultra High Temp Seal can be a drop-in replacement for seals that currently fail at elevated temperatures or for customers seeking extended life."

And finally, here's what seals the deal. The fact that Trelleborg's new fire seal doesn't need the assistance of thermal protectors reduces weight and part count. This allows the airplane to be lighter and faster due to weight reduction and optimized engine heat, while lowering fuel consumption – and all this while ensuring the utmost in passenger safety.

It's an ideal and lasting solution to a longstanding conundrum. ■

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The seal has been tested to prove its capabilities. It performs better than other seals, 15 percent below the set target.

PHOTO: TRELLEBORG

Fire seal

- **The Ultra High** Temp Seal is engineered to have a lifetime is 60,000 flight cycles (take off, flight and landing).
- **A full test** program was undertaken to prove the product's capabilities at various levels of compression. In heat soak tests, the Ultra High Temp Seal performed better than other fire seals and, in all cases, it was below a 15% permanent set target.
- **Conforms with** AC20-135 Powerplant Installation and Propulsion System Component Fire Protection Test Methods and Standards and Criteria. It also conforms to ISO 2685:1998 Aircraft – Environmental Test Procedure for Airborne Equipment – Resistance to Fire in Designated Fire Zones.

PRESSURE WHERE IT'S WANTED

In recent years, farming and agriculture have taken a huge leap forward, thanks to the development of modern technological solutions. A new tire pressure system by Trelleborg and Dana Incorporated will help farmers improve their yields still further.

TEXT TSEMAYE OPUBOR **PHOTOS** TRELLEBORG

A common challenge for farmers is the need to adjust tractor tire pressure to the type of soil or terrain that they are working on. Heavy machinery loads compact the ground, potentially irreversibly damaging the soil. Not only that, using the wrong tire pressure can damage the tractor, reduce lifespan of its tires and increase fuel consumption levels. But if farmers can adapt their tractor tires according to terrain, it's possible to improve energy use, traction force, and protect the soil.

Easier said than done. Manually, it's a time-consuming process that means stopping production while the farmer exits the tractor cab to make manual adjustments to each of the tires; or visits a garage to have the tractor's tire pressure adjusted by a mechanic. Up until now, the alternative has been an after-market add-on that needs to be modified to the specific tractor model, with the pipes on the outside of the wheels. With this, there's a risk of damage during operation.

But Trelleborg Wheel Systems has the answer to farmers' prayers. It's a unique smart tire solution that can be tailored to the needs of any terrain. The Central Tire Inflation System, CTIS+ Inside, is an integrated pressure control system that allows the driver to inflate or deflate tire pressure at the touch of a button, directly from the tractor cab.

Trelleborg developed the system with Dana Incorporated, a supplier of axles, driveshafts, transmissions, and electrodynamic thermal sealing, as well as digital equipment for conventional, hybrid, and electric-powered vehicles. Dana worked with Trelleborg on the development of suitable valves.

The CTIS+ Inside system features the Trelleborg Load Calculator, an algorithm that establishes the best tire pressures for the condition of the terrain. This algorithm instructs the Mechatronic Control Unit developed by Dana, to control the distribution of air

pressure for each wheel, through the Trelleborg manifolds that are installed in each wheel's inner rim.

"CTIS+ Inside differs from competitors' offerings, as there are no external parts or pipes sticking out from the wheels, and it's for the rear and front tires without any need for drilling holes in the axles. Our customers are seeing fuel reduction, better traction and soil protection, and a return on investment in three years or less," says Andrea Evangelisti, Advanced Engineering Manager at Trelleborg Wheel Systems. The starting point for Trelleborg in developing the CTIS+ Inside solution was the findings from its market surveys about the future requirements for functionality of tires and smart solutions.

"It's important to know end users well and show them the advantages of product innovations," says Evangelisti.

He adds that the challenge was to develop a rotating manifold that was 500 millimeters in diameter, which could be used with a tractor that normally travels between 60 and 70 kilometers an hour. This means that the seals in the wheels are rotating with a peripheral speed of seven meters per second, which is high. There were no suitable seals for this task, so in a great example of the synergies there are within the Trelleborg Group, Trelleborg Sealing Solutions contributed its expertise, developing a unique product to work at the velocity required.

Trelleborg also called on the help of one of its bearing suppliers to develop a suitable bearing. The architecture of the solution for the complete manifold for the rim also needed to be developed, to fit the limited space of the rim area.

The CTIS+ Inside system was made with the support of several original equipment manufacturers including John Deere, and AGCO Group. "This was a good example of industry 4.0, putting into action components using solutions from different domains," says Evangelisti. ■

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Totally white

Trelleborg is working with Massey Ferguson on the "MF NEXT Concept Tractor", fitting a futuristic machine with the new TM1000 Progressive Traction farm tire in a totally white compound, free from carbon black. The TM1000 tires are mounted on advanced extra light rims that have been integrated with the innovative CTIS+ Inside central tire inflation pressure system, co-developed with Dana. Massey Ferguson initiated the "MF NEXT Concept" as part of their commitment toward smart and future farming.

Left: Blue tire technology
The Trelleborg journey toward smart farming started with the introduction of the Trelleborg Load Calculator in 2012. CTIS+ Inside is the latest upgrade of previously available Trelleborg solutions, with Trelleborg now offering a fully integrated system.

Effective diversion

In Stockholm, Sweden, one of the world's longest motorway tunnels is under construction. In order for the tunnel to be safe, high demands are placed on all materials included in the project.

TEXT PETRA LODÉN **PHOTOS** TT NYHETSBYRÅN

A new bypass route for the E4 European highway, *Förbifart Stockholm*, connects the southern and northern parts of Sweden's capital. In addition to relieving traffic congestion in the inner city and increasing the capacity of the Stockholm road system; the new link will have 18 kilometers of its 21 kilometer length going below ground in a tunnel to reduce the impact on important natural and cultural environments. The construction period is expected to be 14 years, with the link opening for traffic in 2030.

The tunnel is equipped with high-tech equipment and advanced systems for electricity supply, ventilation, monitoring and traffic control. In order to safely handle water in the tunnel, a unique egg-shaped concrete pipe, ALFA Qmax, is laid along the entire distance of the tunnel; a total of 36 kilometers in both directions. The pipes are joined together with oil-resistant seals from Trelleborg Industrial Solutions.

Stefan Karvonen, business manager at Meag Va-system AB, part of ALFA Rör AB, which supplies the pipes, explains that in a road tunnel there won't be much stormwater, except at the tunnel entrances. However, when the tunnel is cleaned during maintenance, the water used needs to be diverted as does water used to extinguish a fire if it occurs.

"The requirement from the client, the Swedish Transport Administration, is that all pipes must be tight, nothing must leak.

SPRING 2020
KEY STATISTICS IN BRIEF:

- **49% of the** total tunnel has been blasted.
- **800 meters** are blasted per month.
- **9.5 million** metric tons of rock masses are transported by sea; temporary ports have been built for this.
- **6,000 of the** total 24,000 Qmax pipes have been installed.

"We have a close collaboration with Trelleborg and good delivery conditions."

Stefan Karvonen, Meag Va-system AB

In addition, oil-resistant seals are specified in case of oil leakage in the event of an accident," Karvonen says.

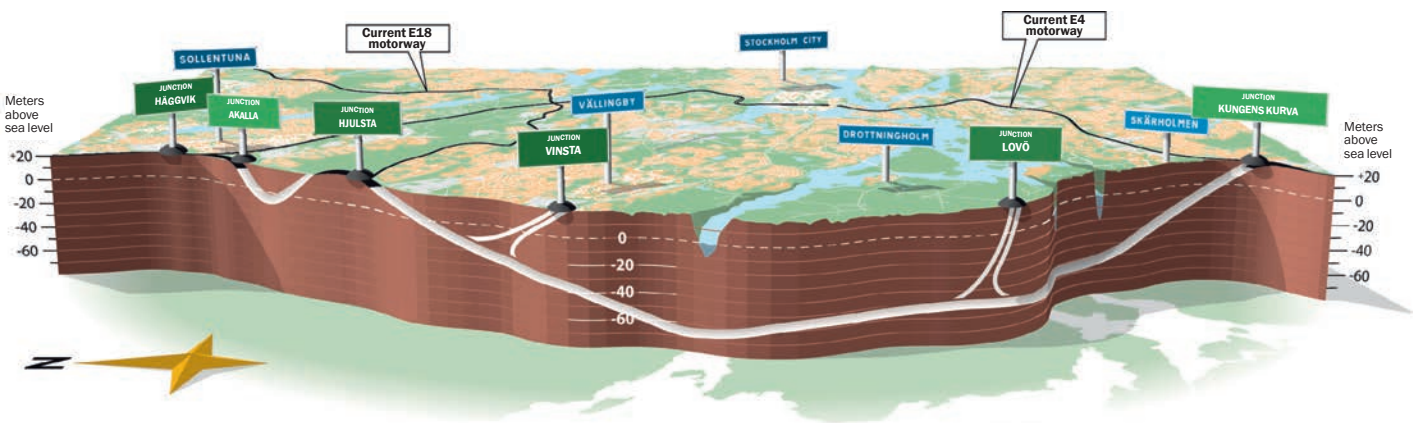
The unique oval shape, like a standing egg, which is narrow at the bottom and top, and wide in the middle, gives the pipe superior self-cleaning ability with small flows of water, while also being able to handle large flows.

ALFA Rör has been working with Trelleborg since the 1970s. The integrated sealing joint in the concrete pipe sleeve was developed by the companies in a collaboration during the 1980s, and the solution has since become the market leader and used in many projects around the world.

Förbifart Stockholm is an extensive project and all material must be supplied exactly when the contractor demands it. This places high demands on reliable delivery from all subcontractors.

"The pipes are not a stock item, so we manufacture them when customers place orders. When we are going to cast the pipes, we have to have the seals available so they can be cast-in-place in the concrete pipes. We have a close collaboration with Trelleborg and good delivery conditions," says Karvonen. ■

Below: *Förbifart Stockholm* connects the southern and northern parts of Sweden's capital.



Choose the right one and extend life

ALFA Qmax is a joint-proof unreinforced concrete pipe with egg-shaped cross sections. The egg-shaped cross section allows the pipe to have better self-cleaning ability (the narrow part is turned downward) at small flows compared to round pipes, while the pipe can also handle large flows in the wide upper part.

Trelleborg 103 is a pipe sealing system where the seal is cast into the pipe socket in the manufacture of concrete pipes and complies with all European standards.

It is manufactured in oil-resistant rubber, Nitrile Rubber (NBR), and Ethylene Propylene Diene Rubber (EPDM).

Gudrun Uhlmann, Sales Manager at Trelleborg Industrial Solutions, explains that it is important to choose the right type of rubber material for different applications, to ensure a long service life.

"EPDM is usually the most suitable rubber material for pipe seals, but in the Förbifart Stockholm project where one can expect the influence of oily water on some parts of the route during the tunnel's operation, oil resistant NBR seals are more suitable. With a long-term resistance to mineral oil, NBR gives a longer service life. This is good for the environment and the pipes are kept tigh for a longer time. The application uses integrated seal, PG joint (Prefabricated Glide joint), reducing the risk of the assembly being in-correct," says Uhlmann.

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Gudrun Uhlmann, Sales Manager Trelleborg.

Short facts:

- **24,000** Qmax pipes
- **Individual pipe** length: 2 meters
- **150 mm** radius on top of pipe
- **75 mm** radius on the lower part of the pipe
- **Internal** height 450 mm
- **2 x 18 km** tunnels
- **A total** of 21 km of motorway
- **14 years** of construction
- **Estimated traffic** 140,000 vehicles/day (year 2035)*

*Swedish Transport Administration (Trafikverket)

Above:
The new link has been under investigation for several decades. The construction period is expected to be 14 years. The Stockholm bypass will open for traffic in 2030.

Right:
The pipe is shaped like an egg, which gives it self-cleaning ability, while also being able to handle large flows.

The answer is blowing in the wind

Grout seals for wind turbine foundations may be relatively minor components, but they are critical to the ability of the massive constructions to withstand the harshest conditions out at sea.

TEXT SUSANNA LINDGREN **PHOTO** UNSPLASH

For many countries globally, offshore wind energy will play a key role in reaching their renewable energy targets. In Europe, countries like Denmark, Germany and the UK are leading the way. Europe now has 20 GW of offshore wind capacity and the European Commission estimates that more than 400 GW of offshore wind is needed to reach the European Union's target of net-zero carbon emissions by 2050.

The market interest in offshore wind is growing rapidly, not only along Atlantic coastlines but also in Asia. With turbines becoming bigger and more efficient, fewer wind turbines can generate more energy.

"Subsidies are no longer necessary to make wind a financially profitable investment that can meet the goals for a climate neutral future," says Cees Wien, Sales Manager at Trelleborg Industrial Solutions. Wien has monitored the market for the last 15 years from his position at Trelleborg in Ridderkerk in the Netherlands.

"There has been a recent and rapid change in turbine capacity. It took ten years for a turbine's output to grow from 2 to 4 MW but only two years for it to increase from 4 to 8 MW. And while we are still installing 8 MW turbines, 12 MW models are already available," he says.

Wien believes that the capacity of offshore turbines should be compared with wind turbines built onshore, where the biggest turbines to date generate only between 2 and 3 MW. Apart from the increased generator size, the quality of wind offshore is also better with higher and more consistent wind speed.

The rubber grout seal that Trelleborg supplies is a minor expense when viewed as part of the total cost of a wind turbine's foundation, and it is not visible in the final construction as it is hidden deep underwater. Even so, it is a critical component, especially during the installation of the turbine foundation at sea.

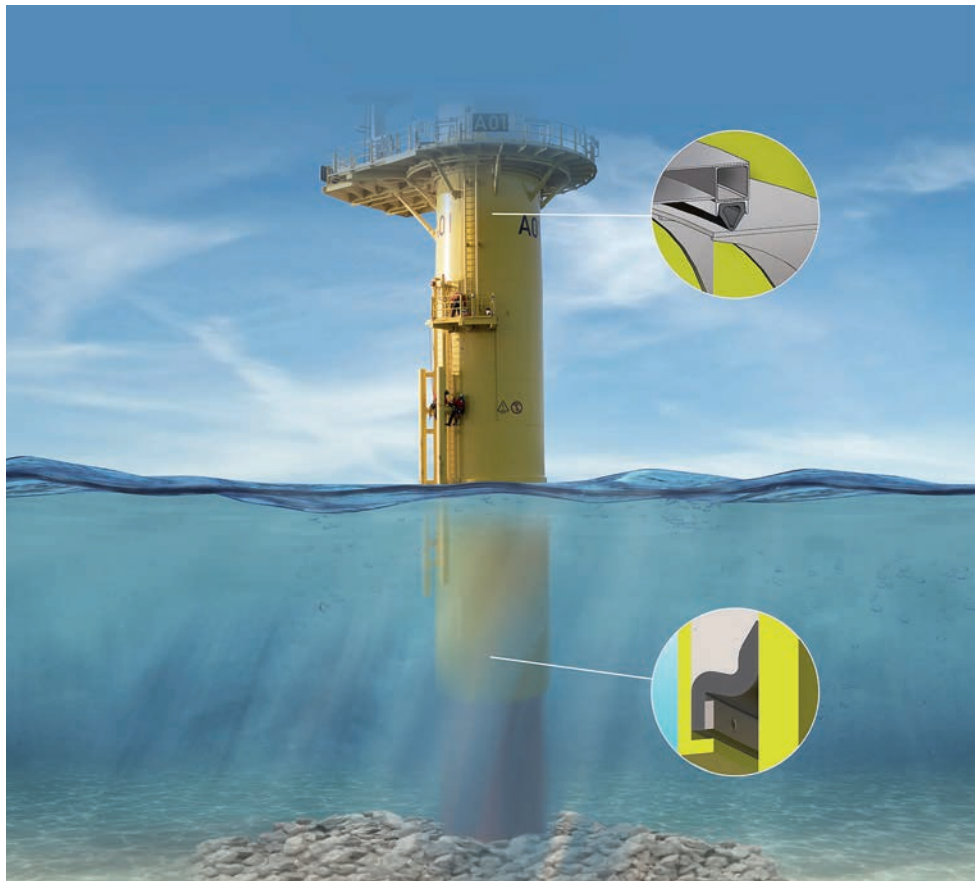


PHOTO: TRELLEBORG

Above: Airtight platform seal and grout seal for offshore wind foundation.

"Our edge is that we can provide certainty to the customers that the seal will function during the decisive and expensive grouting operation that can only be performed once, and where failure isn't an option," says Wien.

Grout seals for wind turbines and jackets are used to close the gap between the turbine's tower and pile, so that grout can be inserted to make a solid and stable connection. The rubber seals are up to eight meters in diameter and have to support the steel monopile and the larger transition piece that slides over it during

A complete package

Trelleborg has been involved in development of solutions of wind power applications since the inception of the technology and is now the leading supplier for foundation seals. It works with major customers, and in addition to the grout seal, the Group supplies everything from seals for the turbine itself, anti-vibration solutions for turbines to innovative protection systems for power cables in foundations.

PHOTO: GETTY IMAGES

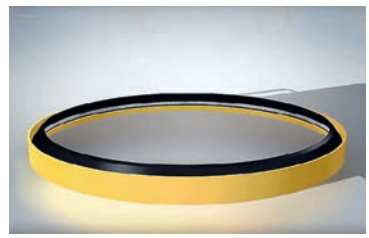


PHOTO: TRELLEBORG

Trelleborg grout seals for offshore wind.

the foundation's construction.

The seal has to cope with installation issues, such as misalignment due to the hammering of the monopile into the seabed, as well as the weight of the grout added to secure the connection. After the curing process, the grout creates a secure join, where the seal remains part of the structure for a lifespan of at least 27 years.

"In offshore wind, we have solutions for nearly all monopile and alternative constructions; to date we have supplied seals to about 2,500 offshore wind turbine foundations worldwide," says Jurriaan van den Berg, Design Engineer at Trelleborg's facility in Ridderkerk, in the Netherlands.

Part of van den Berg's job is to provide the customized solutions that are required for each specific windfarm, and sometimes even for individual turbine foundations within the farm.

"Every windfarm is different, depending on the turbines chosen, variations in the seabed and the designs of the foundations," says van den Berg. "Building in Asian waters is different from building in European waters. We are designing the seals for Japan's first offshore wind farm in Noshiro Port, Akita, and due to the risk of earthquakes and typhoons the conditions are much harsher. The foundations need to be stronger, which also affects the seal."

The growth in wind energy is certainly keeping the Ridderkerk facility busy. Its Dutch team is also designing, manufacturing and testing the seals for the foundations at the very first Taiwanese offshore wind farm. Grout seals have just been delivered for Taiwan's second offshore wind project in Yunlin, where 80 wind turbine foundations are under construction. In Europe, the latest project is off the coast of Saint-Nazaire in France, where 80 offshore wind turbines will generate 480 MW from 2021 to 2022. ■

For more information:
cees.wien@trelleborg.com

Above: The quality of wind offshore is better than onshore, with higher and more consistent wind speed.

PHOTO: TRELLEBORG

Cees Wien, Sales Manager and Jurriaan van den Berg, Design Engineer, Trelleborg.

Grouting – a critical phase

Offshore windfarms are built using various types of foundations, depending on turbine size, water depth, seabed and climate. The main foundation types are monopile, jacket, gravity-base or floating structures. However, currently monopiles are the most cost-effective solution, so they are used most often.

Grouting the connection is a critical part of a foundation's installation phase. Weighing up to 400 tons, the transition piece hangs in the cranes of the jack-up or vessel while the grout – a fast-curing concrete – is continuously injected. Failure in this process is not an option. A safety factor of 1.5 is applied on the maximum operating pressure and a scale 1:1 factory acceptance test is performed for every project.

The grout seal carries the weight of the entire grout column, which has a height of up to 11 meters, during curing and prevents grout washing out of the joint. After curing the grout creates a strong and rigid connection and provides a stable foundation for the gigantic tower and turbine. During its lifespan, the seal remains part of the structure to secure the grout.

NEWS

PHOTO: LEONARDOCOMPANY

Less emission with tiltrotor technology

A new type of aircraft, a tiltrotor, will bridge the gap between traditional helicopters and fixed–wing aircraft, minimizing the environmental impact through reduced emissions, CO_2 and noise, and without the need to create large and expensive infrastructures.

A tiltrotor is an aircraft that generates both lift and propulsion using rotors that are mounted on swiveling engine pods or nacelles. The aircraft will enable increased opportunities to ensure people's mobility and freight transportation, reaching remote geographical areas than helicopters and airplanes cannot easily reach today.

The project, Next Generation Civil Tilt Rotor Technology Demonstrator (NGCTR TD), is launched and executed through the Clean Sky 2 initiative under the European Commission's Horizon 2020 Framework Program for Research and Innovation.

Trelleborg is participating with sealing solutions in the design and development.

-11%

Energy efficiency measured as consumption relative to sales, improved 2019 by 11 percent, and clearly beats the Trelleborg Group's annual internal goal of 3 percent.

Did you know...

...that food powders such as flour, milk powder can explode? The solution: Trelleborg ATEX-certified hose; it can help prevent igniting a powder during the pneumatic conveying of milk powder or other powder.

PHOTO: TRELLEBORG

Use of UN Sustainable Goals in the canteen

Sustainability is a common theme for the prize winning canteen at Trelleborg in Denmark. The team that runs the canteen has had a strong focus on the UN Sustainable Development Goals, which they use in day–to–day work, demonstrating how significant results can be achieved by working together.

115 years young

Trelleborg celebrates 115 years of business in 2020.

Yesterday's healthcare? **Today's digital health**

Innovative technologies are having a growing impact on healthcare. Meet Professor Derek O'Keeffe, who has a background in both engineering and medicine, he calls himself a "physicianeer," a mix of physician and engineer.

TEXT TSEMAYE OPUBOR **PHOTOS** JULIA MONARD

As digital technologies develop and evolve, new areas of application within healthcare and medicine are set to play a powerful role in improving the health of people around the world.

Professor Derek O'Keeffe is a biomedical engineer and physician who believes that digital health is the future of global health. "As technology becomes more and more a part of daily life, there will be more ways to incorporate it into the structure of clinical medicine," he explains.

Digital health covers a broad range of fields including artificial intelligence, robotic surgery, virtual and augmented reality, health information technology, biomedical and wearable technologies. Finding new areas to use digital health for the benefit of patients is leading to exciting developments around the world.

For O'Keeffe, an academic background in electronic and computer engineering coupled with studies in biomedical engineering led him to medicine and endocrinology, the study of systems of glands that secrete hormones, with a specialist interest in diabetes and medical device technology.

Today he describes himself as a "physicianeer," designing his career to cohesively connect the clinical requirements of the medical profession with the problem-solving thought processes of engineering.

"My research encompasses both medical technology and clinical medicine domains," O'Keeffe explains. "I started off with a degree in electronic engineering because I was interested in how things work, and electronics are obviously everywhere."

In his last year of study for his electronic engineering degree, he developed technology for people with strokes to use an electronic stimulator to move muscles that were paralyzed. "I thought this was an interesting project because when you develop electronics, you need to understand the physiology of the muscles and nerves, and you need to

High-precision devices

A broad array of different healthcare needs arise from everything from booming populations to aging communities. Trelleborg's experts develop solutions that meet demands for the ultimate in quality, creating high-precision medical components and devices from innovative polymer technology. Here are just a few examples:

Transdermal patch, virtually pain-free and self-administered, resulting in improved medication compliance. It delivers an even flow of an active ingredient over an extended period.

Advanced sealing systems for prosthetic devices to provide the best quality of life for those who find themselves in need of a replacement limb.

Pressure ulcers are a huge problem. The technology behind the fabric that covers bed mattresses and chairs is highly advanced and can be critical to patient recovery.

Derek O'Keeffe describes himself as a "physicianeer," connecting the clinical requirements of the medical profession with the problem-solving thought processes of engineering.

Drones can make it possible to deliver vital medicines and medical supplies to rural areas.

PHOTO: TT NYHETSBYRÅN

make something practical," he says.

He then studied for a master's degree in computer engineering and a Ph.D. in biomedical engineering where he could build and test products and then put them in a hospital environment. "It was a great learning curve from electronics to computer to biomedical engineering," he says.

Asked if all doctors of the future should also be engineers, O'Keeffe says that isn't necessary, but he says encouraging the thought processes of problem solving with an engineering mindset will ultimately provide medicine with additional solutions that benefit patients.

After presenting his Ph.D. work at the Massachusetts Institute of Technology, a professor at Harvard University offered O'Keeffe the opportunity to do a postdoctoral degree there. The environment at Harvard was an eye opener. Suddenly he was studying with engineers who were working on medical degrees at the same time.

"It was very inspiring meeting people doing this mix," he says. "They encouraged me to study medicine, because they felt my engineering background was thorough, but my medical knowledge wasn't complete."

After that, O'Keeffe returned home to Ireland and studied medicine. He is currently a professor of medical device technology at the National University of Ireland Galway and a practicing consultant physician at University Hospital Galway.

"I really love medicine," he says. "I thought I would, because I really enjoyed the clinical part of my Ph.D. and meeting patients and helping them with technology that I had developed, and I really enjoyed the science side as well."

Additional study at Oxford University and in Australia helped O'Keeffe fine-tune his medical knowledge and specialist training. At the Mayo Clinic in Minnesota he did a residency in clinical general medical training and specialist training in endocrinology, the field of hormone-related diseases such as diabetes.

O'Keeffe recently led a successful world-first project to fly a drone with vital medical supplies to the Aran Islands off the west coast of Ireland and back again in September 2019. He and his team delivered insulin to the patient and returned the patient's diabetes blood sample by drone. "This project will help patients in geographically remote communities, especially in times of extreme weather such

as Storm Emma in 2018, when many patients were isolated for days due to large snowdrifts."

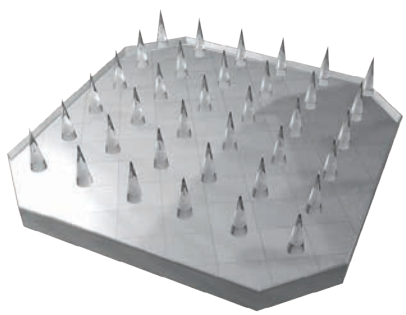
The drone research project took more than a year and involved many different professionals with different skill sets to achieve aviation regulatory approval for the flight. "The project involved significant technical, regulatory and clinical challenges, and represented a world-first for autonomous BVLOS (beyond visual line of sight), VTOL (vertical take-off and landing) drone delivery and collection of prescription medications and biospecimen for the patient with diabetes," he explains.

As an inventor, scientist, doctor and engineer on the cutting edge of new medical technology, O'Keeffe believes that companies like Trelleborg and its clients should focus on developing "digital polymers."

"Imagine receiving a text message from a digital polymer that collects real-time quantitative data. It could be from a medical catheter is starting to clog up, or from a road bridge that has early structural damage," he says. "The potential applications of 'digital polymer' technology would be immense across the medical and engineering domains." ■

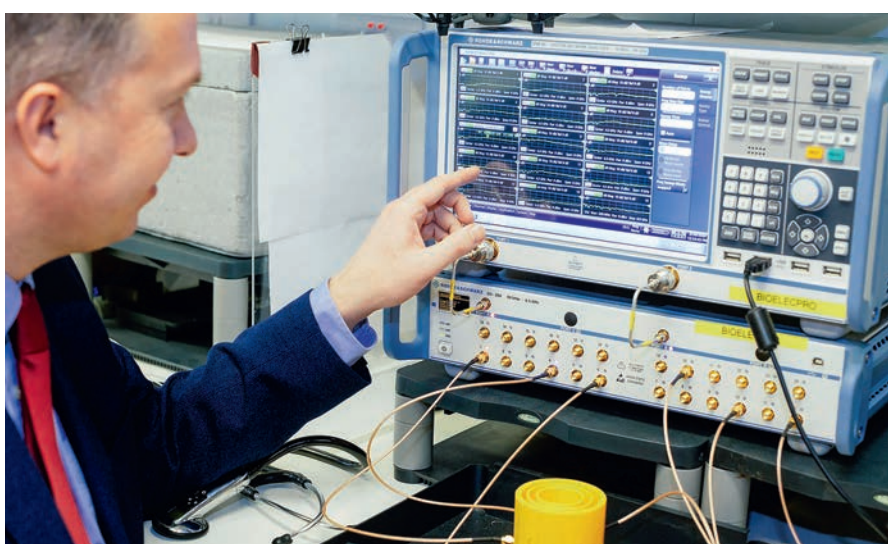
"The project will help patients in geographically remote communities, especially in times of extreme weather."

Derek O'Keeffe, University Hospital Galway



Above: Trelleborg partners with pharmaceutical companies to design and manufacture drug-device combination products.

Below: Professor Derek O'Keeffe in his lab at University Hospital Galway, Ireland.



Derek O'Keeffe

Lives: Galway, Ireland

Education: Physician/engineer who has studied at some of the world's leading institutions in his field.

Work and career: He has worked with the U.S. National Aeronautics and Space Administration (NASA) to place a sleep experiment onboard the International Space Station. In addition, he has acted as flight surgeon for a NASA Extreme Environment Mission Operation (NEEMO), which used digital health data to monitor crew health and make mission decisions.

He currently works as a consultant endocrinologist at University Hospital Galway and is a professor of medical device technology at the National University of Ireland Galway.

As well as having written for multiple academic publications, he holds biomedical patents and several international research prizes. He was named Outstanding Young Person of the World by Junior Chamber International.

Interests: Learning new things "ancora imparo".

Sports: Running, black belt taekwondo instructor, advanced scuba diver.

Hidden talent: Qualified pilot, completing Big Six marathons around the world.

What drives him: Curiosity, innovation and excellence.

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.

www.trelleborg.com