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CARBON COMPOSITE TO THE RESCUE

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Luc Perrad, DENSO Group Germany, discusses the company's new carbon fibre-based repair system, designed to restore and extend the service life of pipelines.

Light and stable – for a long time, well-known technologies have made use of the properties of plastic fibres, such as rotor blades for wind turbines or solar panels in space travel. However, wing panels for aircraft or entire car bodies are also manufactured using carbon. Automotive manufacturers are aware that if you master lightweight construction using carbon fibres, you can build fast sports cars. And many tennis duels in Wimbledon would have been slower if carbon fibre reinforced plastics (CFRP) weren't used in tennis rackets. Lighter than aluminium – harder than steel.

Quick and cost-effective pipeline repairs using CFRPs

One of the special properties of so-called carbon composite materials is that some of them have a higher strength than steel. For this reason, they also play an important role in building pipelines. As temperatures, mechanical loads and long-term chemical influences have a permanent corrosive effect on the steel on the inside and on the outside, serious defects can occur in the pipe wall. Whether this is repaired with a steel sleeve or the damaged section is completely replaced, the pipeline must first be decommissioned at great expense.

However, this is entirely different if the pipeline is repaired with the help of carbon composite materials: DEXPAND®-CF70, the new composite repair system from DENSO Group Germany, allows repairs to be made to

The advantages of DEXPAND®-CF70 at a glance

Because the repair is carried out during ongoing operations without shutting down the pipeline, there are clear advantages compared with repairs using steel components or replacing a damaged pipe section:

- Cost-effective: around 75% cost savings compared with replacing the section of pipe.
- Quick: more than 50% time savings.
- Simple: no work to do with additional machines.
- Safe: no gas flames for application, no welding and therefore no fire or explosion hazard. This is particularly important for works in chemical plants and refineries. WP

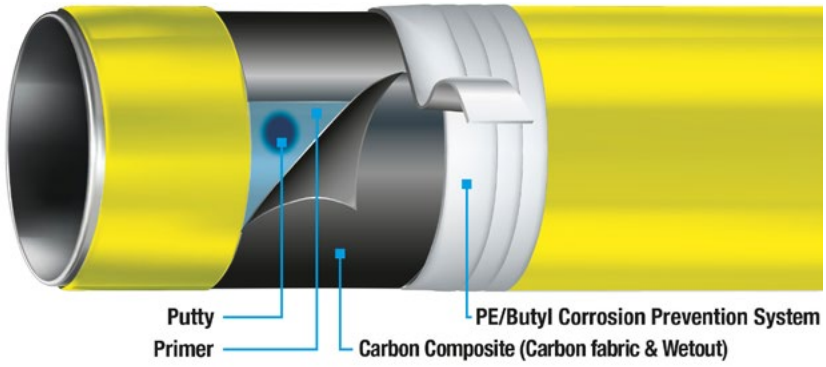

Figure 2. System structure of DEXPAND®-CF70.

Figure 3. Exceeded minimum hardness requirements.

the pipeline whilst operations are ongoing – a quick and cost-effective alternative to other processes.

This product, of tried-and-tested DENSO quality, was launched in May 2020, expanding the existing range of services for corrosion protection and road construction offered by DENSO Group Germany of Leverkusen. DEXPAND-CF70 repairs damaged sections of steel pipes and restores the material's original structural integrity, i.e. its intact state. The pipelines can then be recommissioned safely at the original operating pressure – guaranteeing long-lasting operation.

"Steel pipelines, whether they transport gas, water or oil, are very costly. For this reason, it is necessary to operate them for as long and as safely as possible. The question of the service life of such transport systems is therefore essential," explains Thomas Kaiser, Managing Director of DENSO Group Germany. "With our new product DEXPAND-CF70, we are extending the service life of pipelines by many years. We are thus once again focusing on forward-looking solutions that contribute to safety."

Sophisticated technology with verified safety

The carbon fibres used in DEXPAND-CF70 are amongst the strongest industrially-manufactured fibres. Pipeline repair systems based on carbon fibres are currently the most resilient non-metallic systems. In long-term trials which correspond to the equivalent of 100 years of use, they demonstrate the highest levels of long-term durability.

Where is a product with such excellent properties used? The system is suitable for repairing defects where up to 80% of the original wall thickness has been lost. Only when even more extensive damage and leakages have taken place is the system not used. The good news for all operators is that with DEXPAND-CF70, almost all damage that occurs in practice in transportation pipelines can be quickly and easily repaired whilst the pipeline is in operation.

Gasunie Deutschland, the operator of the ETL 05 natural gas pipeline (pipe diameter DN 250, 10 in.) near Bielefeld, Germany, was already able to see this at the end of November 2020. STRABAG AG Directorate North, which was commissioned to carry out the construction work, repaired two defects with DEXPAND-CF70 on 30 November at an ambient temperature of 0°C (+32°F). The defects in the pipeline had led to a reduction in wall thickness of up to 32%. The repair was carried out with the line staying permanently in service within only three hours. The minimum requirements for Shore D hardness were even exceeded at both locations in less

than 24 hours: an excellent proof of the performance of DEXPAND-CF70. The following day, the gas pipeline could be operated again at its original operating pressure.

In general DEXPAND-CF70 system is suitable for operating temperatures of up to 70°C (+158°F). For quick repairs to the damaged areas, project-specific repair kits are available at short notice.

The independent laboratories of TÜV-Süd (certificate IS-AN11-Muc/ml-1915) have verified the fatigue strength of the section repaired using DEXPAND-CF70. Up until now, the planned usage period was generally up to 20 years. However, DEXPAND-CF70 is one of the few systems which has been certified for an unrestricted service life.

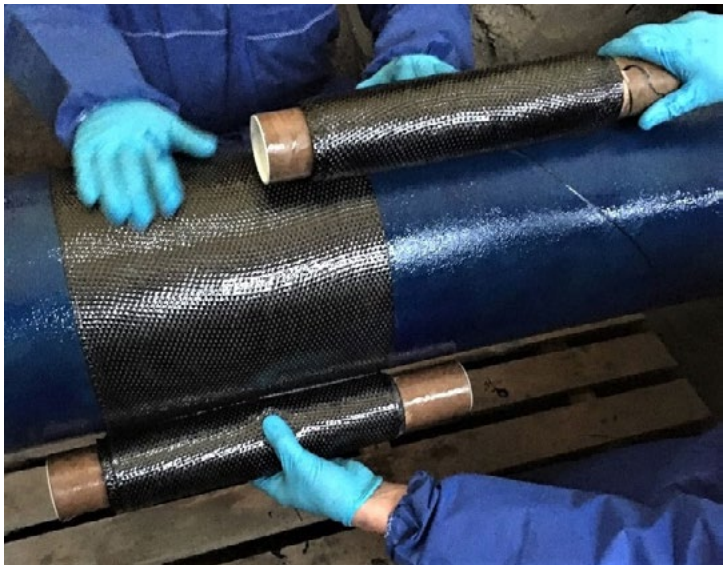

Figure 4. Easy application of DEXPAND-CF70.

Clear advantages with DEXPAND-CF70

DEXPAND-CF70 restores the integrity of pipeline systems on a long-term basis, extending their service life. As the repair can be carried out during ongoing operations without shutting down the pipeline, there are clear advantages compared to replacement or repair with steel components.

"If we take into account the costs for shutdowns as well as the cost of materials and labour for replacement using a steel sleeve, there are cost savings of around 75% associated with the use of DEXPAND-CF70. In addition, the affected defect is repaired more than twice as quickly," says Luc Perrad, Head of International Sales at DENSO. Replacing a section of pipeline or repairing it with a steel sleeve takes around four to five days. By comparison, the time required when using DEXPAND-CF70 is only two days as a maximum. Since there is no need to empty the pipeline, or carry out welding operations, working with this innovative product is not only extremely economical, but also ecological, safe and simple.

A unique system for decades of pipeline operation

DEXPAND-CF70 is a unique system consisting of only four components, which are guaranteed to repair the damaged pipe on a long-lasting basis. The system comprises the DEXPAND®-CF70 Putty, the DEXPAND®-CF70 Primer and a high-strength, mechanical reinforcement consisting of DEXPAND®-CF70 Carbon fabric and DEXPAND®-CF70 Wetout. With the help of the

From a family company to a family of companies

- Since it was founded in 1922, DENSO Group Germany has grown into an international family of companies, with subsidiaries in six European countries and sales partners in more than 100 countries around the world.
- By 1927, the company was already revolutionising the passive corrosion protection of pipelines with the invention of the DENSO tape (petrolatum tape). To this day, the company is considered to be synonymous with the world's first reliable corrosion protection for pipelines.
- DENSO is now known as a specialist for product and system solutions in corrosion protection and sealing technology. With the "Made in Germany" quality guarantee as well as its pioneering developments, DENSO offers greater security and durability for new builds and renovations. WP

What are carbon fibres & why are they an ideal material?

Carbon fibres are industrially produced, high-tensile fibres. Fabrics made of carbon fibres bonded with a reactive resin are characterised by extremely high adhesive strength and stiffness with low elongation at break.

- The best results in long-term testing – corresponding to 100 years of use – are achieved using carbon fibres e.g. for pipeline repairs.
- They are among the strongest industrially produced fibres, and their strength is sometimes higher than steel. WP

Putty filler, dents in the pipe surface are first of all filled in and evened out. The Primer is a dual component epoxy adhesive, which ensures that the power of the repair system is perfectly transferred to the pipeline surface. The high strength mechanical reinforcement consists of the carbon fabric, a carbon fibre fabric, and the Wetout, a dual component resin. The Wetout forms a bond with the layers of the fabric and ensures that the mechanical loads are evenly distributed. Finally, an additional corrosion protection system based on PE/butyl rubber completes the protection of the pipeline – for safe pipeline operation for decades.

The procedure – four steps to success

If an operator is interested in using DEXPAND-CF70 when damage has occurred, the process is clearly structured according to responsibilities to ensure a smooth repair. Step one begins with the damage assessment by the pipeline network operator: it determines the data concerning the damaged pipe section as well as the current operating conditions (in addition to pressure and temperature, other conditions such as remaining pipe wall thickness, steel quality used or pressure range form part of this). These data provide the basis for the use of the DEXPAND-CF70 system.

The second step is the calculation of requirements by DENSO. Based on the operator's data, a DENSO calculation tool calculates the materials required to restore the integrity of the pipeline, particularly with regard to the number of reinforcement layers. In the third step, DENSO produces and delivers the tailored, project-specific repair kit to the pipeline operator. Then, the actual repair takes place: the pipeline network operator will have the pipeline repaired by qualified processing partners certified by DENSO, taking into account the currently valid processing information.

Conclusion

If a pipeline is repaired with the help of carbon composite materials, it does not have to be taken out of service beforehand in a cost-intensive manner, as is the case with other methods. DEXPAND-CF70, the new composite repair system from DENSO Group Germany, enables the pipeline to be repaired while it is still in operation and restores its original structural integrity. This extends the service life of a pipeline by decades. Almost any damage that occurs can be repaired quickly, economically, easily and safely with DEXPAND-CF70.

Shortly after its market launch, DEXPAND-CF70 was able to live up to its claim in practice. Gasunie Deutschland, as the operator of the ETL 05 natural gas pipeline, was very satisfied with both the application of the product and the speed of the entire process.