COVER STORY

Pipeotech has been blazing the trail for zero-leakage gaskets. The Norwegian company has developed a patented design –the DeltaV-seal– that is the tightest, safest and most durable gasket on the market, the company claims. Not surprisingly, Pipeotech has issued a 10-year gas-tight guarantee on this product.

By Lucien Joppen

Pipeotech-CTO Jan Oredsson: "We have the tightest, safest and most durable flange gasket on the market that ensures pipeline integrity over an extended period of time with all the benefits that come with it." (Source: Pipeotech)

Pipeotech: blazing the trail for zero-leakage gaskets

The DeltaV-Seal was developed by the Norwegian company to address the weakest link in industrial pipeline systems, the gasket. The company states that the reason for this invention was that conventional technologies weren't able to perform a gas-tight sealing that stayed tight over many years, mainly because they were affected by various forms of wear and tear to the soft sealing elements.

By adapting metal-to-metal sealing principles from subsea and gas applications, Pipeotech developed a single-piece metal gasket for raised faced and flat faced flanges that could not only seal tighter than existing technologies, but stay tight over time.

"Due to careful material selection our product mitigates some of the major driving factors in seal degradation and failure such and thermic cycling and galvanic corrosion, preventing the damage and costs associated with leakage as well as reducing the need for regular maintenance."

Economic impact

With its product, Pipeotech intends to fully deliver on its promise: "to deliver absolute integrity, always. Pipeotech prevents leaks, protecting people, the environment and businesses from the dangers of leaks (see box text Triple Ps). We transform standards for industrial piping one leak at a time."

As mentioned before, corrosion is one of the main culprits in damaging pipeline integrity. This degradation process ultimately can lead to dangerous situations, putting human lives and the environment at risk and also leading to economic damage due to damaged equipment and unplanned downtimes.

There have been various studies conducted on the economic impact of corrosion. According to the United States Cost of Corrosion Study (2018), produced by NACE International, one of the world's leading authorities on corrosion engineering and control, corrosion costs the US oil and gas exploration and production industry $1.4 billion a year. Broken down, this equates $589 million in surface pipeline and facility costs, $463 million annually in downhole tubing expenses, and another $320 million in capital expenditures related to corrosion.

The triple Ps of Pipeotech

The triple p-concept encapsulates the requirements for 21st century product development. Products that improve economic and environmental performance and protect human health are the way to go.

Pipeotech claims its DeltaV-Seal does the trick. Also, the industry needs to be receptive towards such modern solutions. If not, ultimately they will have to be, as regulations regarding fugitive emissions and GHG-emissions are becoming more stringent, Pipeotech states.

Apart from environmental regulation, protecting human health is paramount. There are various hazards the Delta V-Seal addresses, such as leakages of toxins and fires/explosions. Regarding the latter, DeltaV-Seal is highly likely to affect ATEX-zoning (as explained later in the article), which also has implications for other equipment that doesn't need an ATEX-certification.

This brings us to the economic impact. Pipeotech states that the economic impact of gasket failures is avoidable. The company mentions project delays, unplanned shutdowns, the need for emergency services but also costs related to maintaining (and retorqueing) and replacing gaskets.

Ultimately, the gasket itself can be recycled into a new, high-value product, making it a perfect example of the circular economy.

Rigourous testing

Given Pipeotech's new technology, the company has tested its product extensively (see overview 'Certifications and tests'). These tests have been conducted by renowned institutes such as DNVGL or amtec. To this date, DeltaV-Seal is the only gasket that has received type approval from DNVGL. Another milestone was passing EN-13555 and Shell MESC SPE 35/300 with "flying colours".

Recently, the University of Wrocław in Poland conducted cryogenic testing on the DeltaV-Seal. The BFJ contained a DN40/PN40 material 316L DeltaV-Seal with a sealing length of 0.2 metres and containing helium pressures from 10 bar to 100 bar.

The results show that the DeltaV-Seal maintains a tightness level higher than

The brand new production facility of Avista in Kalundborg for which Pipeotech supplied over 6,000 gaskets. (Source: Avista)

Full metal gasket

The DeltaV-Seal set itself apart from the competition by combining material selection and design, Pipeotech states. First of all, the gasket is CNC-machined and water-cut from a single piece of metal. Currently, the gasket is available in two metal alloys, Carbon Steel and 316L Stainless Steel. The company will also add other, higher alloys to expand the application range of the DeltaV-Seal (to be mentioned later in this article).

The gasket design is also unique. The sealing performance is based on proprietary, V-shaped rings to achieve "sealing strengths exceeding 10,000 times stronger than the requirements of the oil and gas industry". These V-rings are able to compress and conform - due to its material properties - to the surface of a flange, even at low-torques.

As the gasket and the flange are made of a compatible material, they expand and contract in unison, "ensuring maximum sealing strength through a full range of temperature fluctuation."

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10 year warranty for cryogenic applications

To emphasize the performance of its sealing technology, Pipeotech has extended its 10 year-warranty for applications running at -196°C, based on results of cryogenic leakage tests.

In 2020, Pipeotech launched the sealing industry's first 10-year gas-tight limited warranty, creating a "truly unique value proposition and cementing the claim of being the tightest, safest and most durable flange gasket technology in the world".

Pipeotech has now blazed a new trail, conducting leakage testing of a bolted flange joint (BFJ) under cryogenic conditions in a laboratory testing program engineered and carried out together with Wroclaw University.

Pipeotech claims that the DeltaV-Seal has superior material properties in terms of creep resistance and recovery, even at large reloads. (Source: Pipeotech)

10-8 mg/s at temperatures down to -196°C at all tested pressures. "The seal was also shown to expand and contract at the same rate as the temperature fluctuations, confirming in action that extreme temperature fluctuations do not affect the tightness of the seal", the company states.

"When compared to other gaskets that have undergone similar tests at lower pressures (spiral-wound + graphite, Kammprofile + graphite & Kammprofile + PTFE) comparisons show that the DeltaV-Seal was more than 10,000 times tighter. The other technology stopped testing at 8 bar. We continued to 100 bar and maintained a perfect gas-tight seal."

Tests at O&G-majors

Despite the aforementioned test results and certifications, the industry prefers field tests before adopting this new technology. At the moment, several O&G-majors are conducting field tests with the DeltaV-Seal. For now, it's too early to disclose any preliminary results, Pipeotech says. "We understand that the oil and gas industry needs extra assurance that our technology works for their particular process conditions", the company states. "We are confident that we can meet their requirements."

As for greenfield projects, Pipeotech has entered several agreements with companies that have decided on the company's technology. "For these projects, often the best available technology is selected in the FEED-stage. We also notice that (private) investors are more focused on sustainable solutions that are geared towards reducing GHG-emissions and have a circular nature."

Avista's brand new facility

One of these projects is the brand-new re-refinery of Avista Oil in Denmark. Ironically, the old refinery in Kalundborg, Denmark, burned down in 2017 due to leakages. In 2020, Avista Oil rebuilt this facility re-refinery that is capable of refining a variety of used oil products.

The new facility has twice the capacity of the old re-refinery and is constructed with the best available technologies. Regarding gaskets, Avista Oil's project organisation chose together with the engineering company, Process Engineering A/S, to use the standard EN-1127-1:2009, defining Durable Technically Tight solutions (in 2019-version, "Enhanced Tight") and to select gaskets which could satisfy these requirements. "Based on an impressive selection of AMTEC's test results on the DeltaV-Seal, this metallic gasket was selected as a Durable Technically Tight sealing solution for the refinery, and among them, the critical and challenging hot oil processes", says Nils Christian Mathisen, sales manager at Pipeotech.

In total, roughly 6,400 gaskets are involved, for high-temperature conditions, installed at all the oil pipelines, all high-temperature locations, including hot oil systems, and zones which normally would require ATEX zoning (intrinsic zoning).

Currently, the new plant is almost one year in operation. According to Pipeotech, the results are good. The ATEX zoning in re-refinery has been eliminated, hence lower operational cost and tightness levels are as expected.

Hydrogen will be a growing market due to the ambitions of various countries in the scale-up of green hydrogen production. (Source: Pipeotech)

New alloys

As mentioned before, Pipeotech offers its gasket in carbon steel and 316L. The company aims to extend this portfolio to other alloys that serve highly-demanding applications.

"We have carefully selected five alloys: 321H, 253MA, 6MO, titanium and 800HT", Oredsson says. "With the latter, we are looking at applications that require high temperatures and pressures. For example, in hydrogen for mobility temperatures around the 800-900 degrees Celsius and pressures ranging from 5 to 50 bar are no exception. These process conditions are very hard to handle for a lot of metal alloys. 800HT should be able to do the job."

Material science

A significant share of Pipeotech's product performance rests on the choice of materials and the detailed machining. With the hiring of Jan Oredsson as the CTO – in Q1 of 2021 -, Pipeotech has managed to attract a very experienced specialist.

According to a company statement, "Jan - who has joined us as a Corrosion and Integrity Management Specialist - is an internationally recognized pipeline integrity and corrosion expert and has decades of extensive experience in leading positions in the pipeline engineering sector, including working on large offshore projects for BP. His detailed knowledge of pipeline and process integrity is the perfect fit for Pipeotech as it drives forward delivering permanent leak-proof seals to the industry."

Mr. Oredsson - when interviewed by Valve World - says that the DeltaV-Seal technology and its working principle are unique in the industrial pipeline sector. "It is a perfect example of utilizing an important characteristic of metals, namely plasticity. This is the ability of metals (and other materials) to change shape under certain pressures and/or temperatures. These parameters are prone to change depending on the metal."

Devil in the detail

One would think that using carbon steel and 316L in a single piece wouldn't involve much material science as these are readily available on the market. However, as Mr. Oredsson claims, the devil is in the detail. Referring to "chemistry", he says Pipeotech can analyze the process parameters and media to select the optimal product. "It is also a matter of cost-benefit ratio. What does an end user want from our product and how much should this cost?"

The latter statement indicated that Pipeotech more and more moves towards tailor-made solutions – within certain boundaries – to get the best possible solution per client. "There are various parameters we need to consider for our Delta V-Seal. First of all, the flange size and the material. The size of the sealing area, as we need sufficient space for the sealing ridges of the gasket. Then we need process conditions (temperature, pressure, media) to select the right material. Finally, we employ modelling and corrosion testing to confirm our design."

Insights into end-user's processes

According to Oredsson, Pipeotech is more and more moving towards a combination of production and consultancy. "The better insights we have into the processes (media, temperatures, pressure levels etc.) of our customers, the better our solution fits. When you think of it, it makes sense. Whereas gaskets originally were an afterthought, they are equally important as the other components in an industrial piping system. As such, they deserve more attention, both from the end-user and the manufacturing industry's perspective."

Given Pipeotech's mission, it comes as no surprise that the company is involved in developing a NACE-standard regarding the degradation of sealing systems. Mr. Oredsson is the documentation project manager of a select group of ten experts. This standard, which is expected in a first draft later in 2021, is aimed at improving the integrity of existing assets. The initiative clearly resonates with an earlier statement in this article that every component in industrial piping should not be taken for granted as the weakest link determines the strength – or integrity- of the entire process configuration.

Oredsson: "Again, we have the tightest, safest and most durable flange gasket on the market that ensures pipeline integrity over an extended period of time with all the benefits that come with it."

Summary of Significant DeltaV-Seal Certifications & Tests

Shell MESC 85/300

The Shell Specification MESC SPE 85/300 describes several testing procedures for the evaluation of the gasket's compressibility and the tightness characteristics of the gasket material at ambient and elevated temperature.

- *Shell leakage test at ambient temperature (MESC SPE 85/300 - 3.3.2)*
- *Shell leakage test at 400°C (MESC SPE 85/300 - 3.3.2)*
- *Compression test at ambient temperature (MESC SPE 85/300 - 3.3.4: EN 13555)*
- *Compression test at 400°C (MESC SPE 85/300 - 3.3.4: EN 13555)*
- *Relaxation test at ambient temperature (MESC SPE 85/300 - 3.3.4: EN 13555)*
- *Relaxation test at 400°C MESC SPE 85/300 - 3.3.4: EN 13555)*
- *Leakage test (MESC SPE 85/300 - 3.3.4: EN 13555)*
- *HOTT Shell cycle test at 400°C (MESC SPE 85/300 - 3.3.5)*
- *Hot Blowout Test at 400°C (MESC SPE 85/300 - 3.3.6)*

Fire Safe Test - API 6FB

Fire test approved, high temperature (650°C), AMTEC cert. no. 30328901E/CS/28.10.16

Tightness Test - VDI 2440

TA-Luft helium test approved for low emissions, AMTEC cert. no. 30328902E/BU/28.10.16
DeltaV-Seal can be characterized as "A high-grade sealing system for the purposes of TA-Luft"

DNV GL Type Approval

The world's first DNV GL type approved flange sealing, approved for use with ASME B16.5 and EN 1092-1 flanges. Tests in the series included…

- *Vibration testing*
- *Leakage tests*
- *Burst pressure tests*
- *Pressure pulse tests*

Cryogenic Test

Leakage test of a pressurised bolted flange joint dipped in liquid nitrogen conducted with the University of Wroclaw, Poland.

The test results show that DeltaV-Seal™ has an extreme level of tightness at cryogenic temperatures down to -196°C at pressures from 10 bar to 100 bar. Based on these tests, it was found that DeltaV-Seal maintains a tightness higher than 10^{-8} mg/s.