Keeping Hydrogen under Control for the Energy Revolution

Green hydrogen[1] is playing a crucial role in the energy transition, which is why it is known as the energy source of the future[2]. It can be used directly as a final energy source, such as for fuel cells and in gas power plants, as a reducer in steel production, or as a material in the chemicals industry. It can also be converted into fluid fuels (power-to-liquid). What's more, electrolytically produced hydrogen can serve as an energy reservoir for excess electricity produced by regenerative means.

Sealing of Hydrogen
Trials according to EN 13555[3]
This requires a secure seal for the necessary facilities, devices, flanges, etc. The relevant calculations for flange connections are usually conducted according to EN 1591-1[4], with gasket parameters according to EN 13555. Since leakage values under EN 13555 are determined using helium as the test gas, the question arises as to whether these results can also be used with the medium hydrogen – a gas with a smaller molecular size and high diffusibility. In order to investigate this, EN 13555 leakage tests were carried out with AFM gasket materials using hydrogen as the medium.

AFM 34 | AFM 30 | AFM 34 CO ME

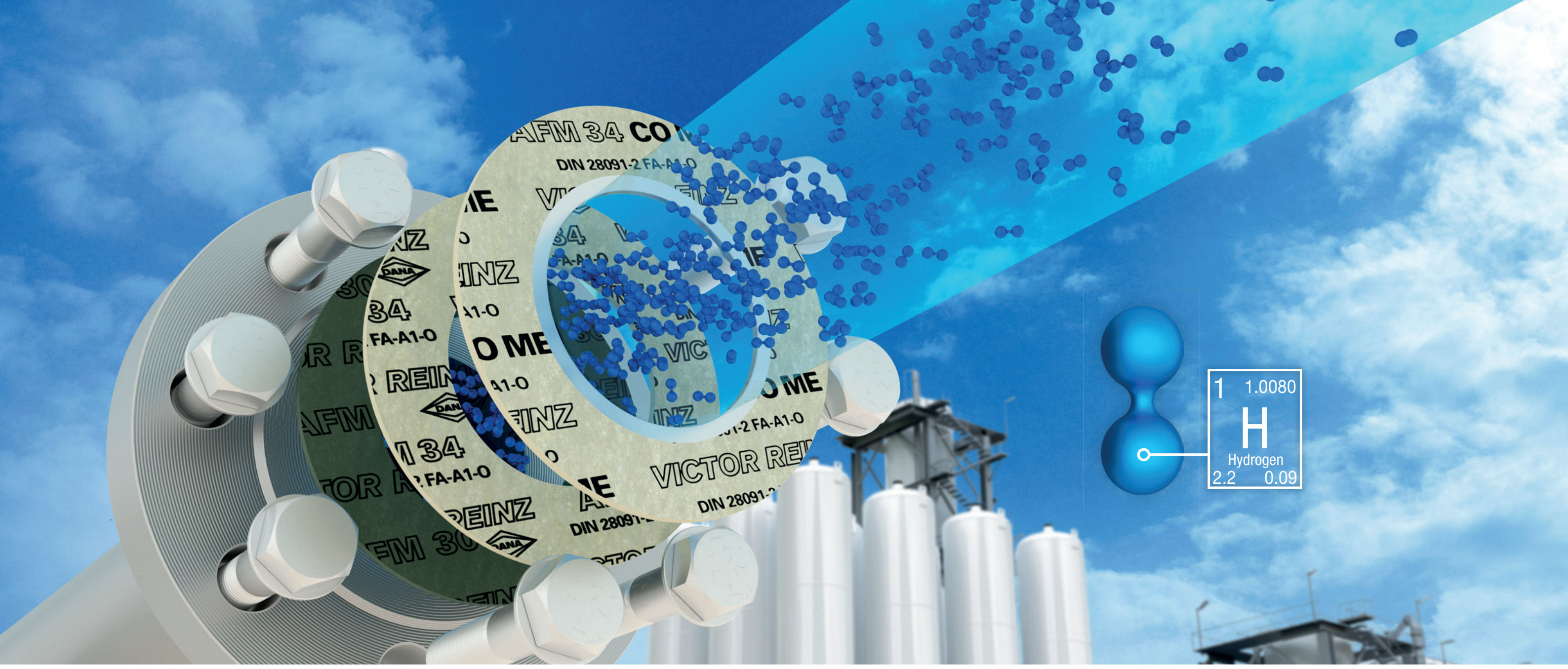

Diagram 1 shows the results of leakage rates as per EN 13555 with the test gases helium and hydrogen at a pressure of 40 bar for the gasket material AFM 34.

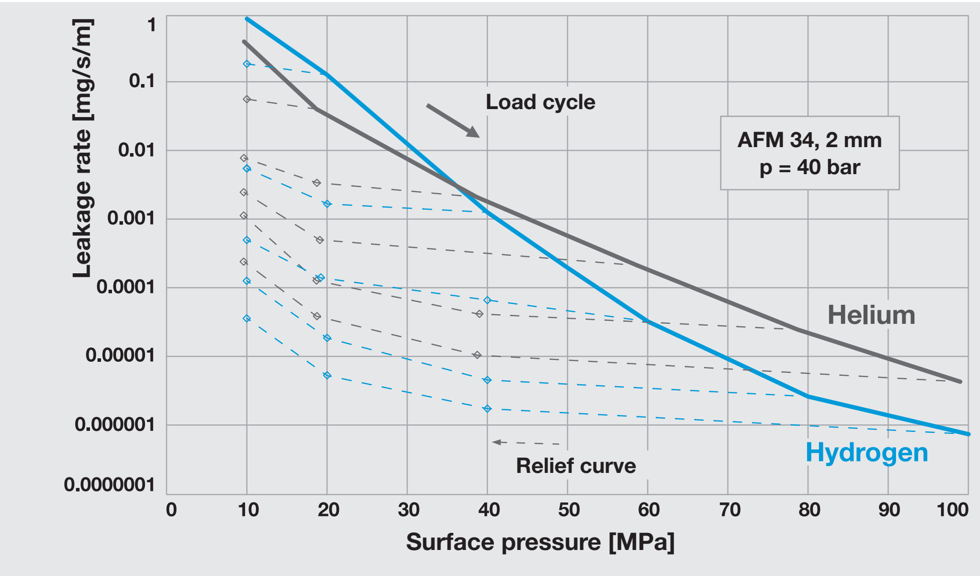

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***Diagram 1:** AFM 34 leakage rate at surface pressure as per EN 13555.*
Comparison of test media helium and hydrogen at 40 bar.

At low surface pressures, the leakage rate with hydrogen is a bit higher than that with helium, but this reverses as surface pressure increases, resulting in a leakage rate with hydrogen even lower than that with helium. Within the range of measuring accuracy, it can be said that the leakage rates are comparable, especially within the crucial surface pressure range of 30 to 50 MPa.

Further trials – also with the gasket material AFM 30 and at different pressures – confirm this comparability.

Chemical Resistance

Molecular hydrogen (H_2) interacts with high-grade aramide fiber soft gaskets such as AFM 34 or AFM 30 in a chemically inert (unreactive) manner within operational temperature limits. The gaskets are chemically resistant to hydrogen (H_2) and have proven effective at sealing it off for many years in the chemicals industry.

Blowout Resistance

AFM 34 CO ME – the version of AFM 34 with inner flange – is ideally suited to sealing off hydrogen. The metallic inner flange provides additional security in the process.
It is made of austenitic stainless steel 1.4571, making it impervious to hydrogen embrittlement[5].

1 Green hydrogen: Hydrogen produced using renewable energies (through electrolysis in particular)
2 https://www.bundesregierung.de/breg-de/themen/klimaschutz/wasserstoff-technologie-1732248; accessed on 08/18/2022
3 DIN EN 13555: Flanges and their joints – Gasket parameters and test procedures relevant to the design rules for gasketed circular flange connections
4 DIN EN 1591-1: Flanges and their joints – Design rules for gasketed circular flange connections – Part 1: Calculation
5 Embrittlement of metals at risk of developing cracks through diffusion of (atomic) hydrogen in the material

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