LIFESPAN OPTIMIZATION OF PRESSURE TRANSMITTERS IN HYDROGEN CONTACT

THE PROBLEM

Hydrogen atoms are extremely tiny and because of this property they can also penetrate solid materials. This process is known as permeation. Over time, pressure transmitters become inoperative due to this process. Their lifespan can however be optimized.

IMPORTANT FACTORS

Pressure range

The gas flow through the sensor membrane is proportional to the square root of the gas pressure.
A pressure ten-times lower increases the lifespan of the sensor by about 3 times.

Temperature

The gas flow through the sensor membrane increases at higher temperatures and depends upon the material constant.

Membrane thickness

The gas flow is inversely proportional to the membrane thickness. The use of a 100 µm instead of a 50-µm-thick membrane doubles the lifetime of the sensor.

Membrane area

The gas flow is directly proportional to the membrane surface area (the square of the membrane diameter). Using a Ø 13 mm instead of an Ø 18.5 mm membrane, the lifespan of the sensor thus doubles.

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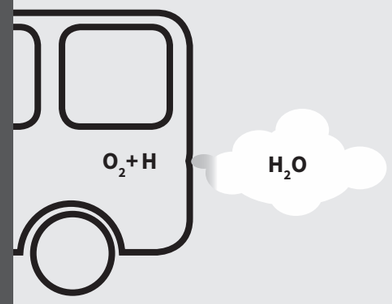
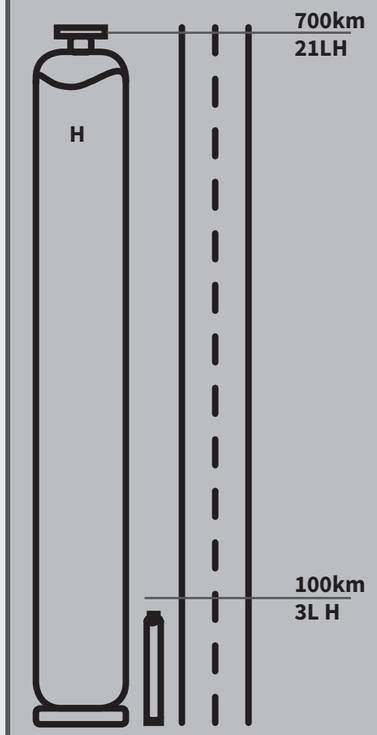
CHALLENGE IN USAGE

APPLICATION

Pressure sensors come into contact with hydrogen in a wide array of applications, be it in the monitoring of hydrogen tanks themselves, in submarines or in the automotive sector. Especially in the latter, hydrogen is being increasingly used in the development of alternative drive systems. Many manufacturers have been working for some years on models using fuel cells and some cities have already opted for hydrogen buses in public transport. The advantages are not to be dismissed, since only hydrogen and oxygen are required as source materials. Through a chemical reaction, energy in the form of electricity is produced. No exhaust gases are created at all here (the only combustion product is water vapor). Furthermore, hydrogen, as opposed to fossil fuels, is available in inexhaustible quantities.



DEVELOPMENT



Development is already well advanced and there are now models, which consume only 3 liters of hydrogen over a 100 kilometer stretch. Distances of up to 700 kilometers with one tank filling are, in part, already possible.

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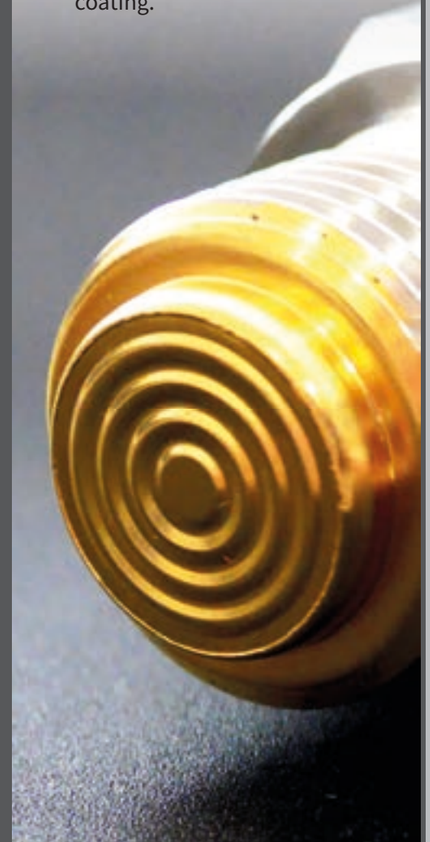
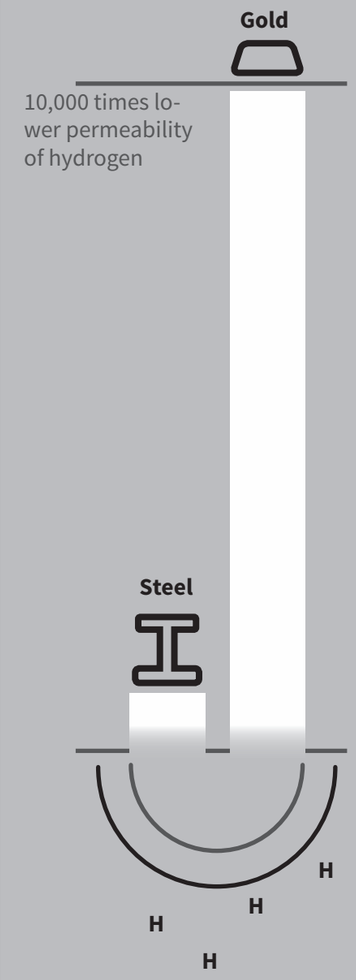
THE MOST EFFECTIVE SOLUTION

GOLD COATING

The permeability of gold is about 10,000 times lower than that of stainless steel. With the gold coating (0.1 to 1 µm) of a 50 µm steel membrane, hydrogen permeation can be suppressed significantly more effectively than by doubling the membrane thickness to 100 µm. In the first case, the time for a critical hydrogen gas volume to accumulate in the interior of the pressure sensor can be increased by a factor of 10 to 100, whereas in the second case only by a factor of two. The prerequisite for this is a fully gapless and optimized welding, as well as a largely defect-free coating.



PROPERTIES



Because of these properties of gold regarding hydrogen permeability, STS uses gold-coated stainless steel membranes as standard for hydrogen applications.

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