TRITON Hydrogen

Solving Impossible Problems

TRITON HYDROGEN INTRODUCTION

OUR STORY

Five years ago, Triton Norway successfully embarked on a mission to address the challenge of hydrogen permeation and as a result revolutionise how we approach using hydrogen. With a team comprising of some of the brightest minds in material science, electrochemistry, and nanotechnology, they were uniquely positioned to take on this task.

Our approach was rooted in innovation and precision. We turned to electro-osmosis, a concept familiar yet unexplored in our context, to control the movement of liquid through a porous material. But the real breakthrough came with the integration of nano sequencing – a method where materials are engineered at the nanoscale to specific parameters, tailored to combat hydrogen permeation effectively.

This journey wasn't without its challenges. It involved rigorous testing and a process of trial and error, narrowing down on the solution, where each setback was a learning opportunity. Our team's resilience and dedication were key in navigating these complexities and advancing our understanding of nano-material interactions with hydrogen.

Triton Hydrogen is co-owned by Henning Syversen the founder and Chief Executive of Triton Norway (established in 2012). The Triton Norway team developed the groundbreaking Tritonex Hydrogen Barrier Coating System. This innovation became the catalyst for establishing Triton Hydrogen Ltd in the UK, aimed at commercialising and exploiting the market opportunities for Tritonex and associated products.

HYDROGEN'S CHALLENGES

THE COST OF HYDROGEN EMBRITTLEMENT

Hydrogen embrittlement is a critical issue in material science, particularly relevant in the context of the hydrogen sector. This phenomenon occurs when metals like steel are exposed to hydrogen, reducing toughness and ductility and causing premature failure. The effects of hydrogen embrittlement start from the moment that steel is exposed. An unprotected infrastructure will fail far sooner when used for hydrogen than it would if used for oil and gas.

THE COST OF LEAKAGE

Based on 80 million tonnes of total production, hydrogen leakage ranges from 2.16 million tonnes (2.7%) to 4.48 million tonnes (5.6%). At an average rate of $4.80 per kg, this amounts to an annual value loss of approximately $10.37 billion to $21.50 billion.

THE ENVIRONMENTAL IMPACT

Hydrogen leakage poses significant environmental concerns due to its indirect global warming effects. Hydrogen molecules can extend the lifetime of other greenhouse gases such as methane, leading to increased atmospheric warming. A report suggests that over a 10-year period, hydrogen's warming impact could be approximately 100 times stronger than that of carbon dioxide (Ocko and Hamburg 2022), highlighting the urgency to address this issue.

TRITONEX HYDROGEN BARRIER COATING SYSTEM

Tritonex is a state-of-the-art nano-coating with a non-toxic, water-based composition that provides a complete isolation barrier between hydrogen gas and other surfaces. This innovative solution is engineered to be universally applicable across diverse substrates, including but not limited to geological materials, metals, and polymers.

Its versatility extends to manual and robotic application methods, making it ideal for OEM use and field retrofitting across diverse industries. With a dual-layer coating system, Tritonex establishes a robust barrier, ensuring hermetic sealing and effectively stopping the risk of hydrogen permeation and associated steel embrittlement.

KEY FEATURES:

- **Hydrogen Barrier Efficiency:** Tritonex establishes a complete isolation barrier between hydrogen gas and other surfaces, effectively preventing penetration. It has passed the ISO 17081:2014 Hydrogen permeation test standard with 0.000% penetration of the hydrogen.
- **Ease of Application:** The coating can be easily applied without necessitating any modifications to existing infrastructure, streamlining the implementation process.
- **Chemical and Electrical Inertia:** Tritonex is electrically inert and does not react to chemicals.

- **Temperature Resistance:** Designed to resist heat absorption, Tritonex serves as an efficient thermal barrier. Tritonex has been tested to withstand temperatures over 1,000°C without compromising its integrity. It can also withstand extremely cold temperatures and has been cryogenically tested.
- **Leak Prevention:** Tritonex has proven 100% effective for hydrogen containment, eliminating hydrogen leaks and preventing metal embrittlement.
- **Flow Assurance:** Tritonex surface is smooth and equals the flow assurance coatings and has no negative impact on pipelines.
- **Adherence:** The nanotechnology ensures extreme adherence to surfaces. The coating penetrates the surface it is applied to making it extremely hard and resilient.
- **Flexibility:** Tritonex is extremely flexible and is designed to follow the thermal expansion and contraction movements of pipes and storage vessels.
- **Non-Toxic:** Tritonex is safe, non-toxic, organic and environmentally friendly.

Our patent-pending Tritonex Hydrogen Barrier Coating System represents a significant advancement in coating technology, offering unparalleled protection and efficiency for a wide array of applications in the hydrogen sector and beyond.

REAL WORLD APPLICATIONS

Asset Protection: By preventing asset deterioration, Tritonex plays a vital role in prolonging the life and maintaining the integrity of essential infrastructure.

Efficiency in Hydrogen Systems: Tritonex is particularly beneficial in enhancing the efficiency of hydrogen storage and transportation systems. Its barrier properties ensure the safe and cost-effective handling of hydrogen, crucial for the energy sector.

Stops Corrosion: Tritonex is noted for its remarkable strength and flexibility, along with its ability to stop corrosion. These properties make it an ideal choice for diverse environments and demanding applications.

Pipelines and Pressure Vessels: The coating is highly suitable for both new constructions and retrofitting existing pipelines and pressure vessels. This wide-ranging applicability makes it a go-to solution for upgrading current infrastructure to meet emerging hydrogen economy demands. It eliminates the pressure limitations due to higher leakage rates at higher pressures.

Aerospace Industry: Tritonex can be used to enable the application of lightweight materials like fiber-reinforced polymers in constructing fuel tanks for the aerospace industry. These materials, while light, do not provide sufficient barriers to hydrogen permeation on their own. Tritonex can significantly reduce the weight of these constructions by enabling new materials while maintaining safety standards.

Space Sector: In space applications, Tritonex has shown promise for coating the inner walls of fuel tanks to prevent hydrogen permeation. This is critical for both liquid and gaseous hydrogen, ensuring safe and efficient storage in spacecraft.

Transportation Industry: Beyond aerospace, Tritonex's capabilities are vital in the transportation sector, particularly for vehicles that use or transport hydrogen as a fuel source. The coating ensures that hydrogen tanks and transportation systems are safe and efficient.

Hydrogen Storage: Its barrier properties enable safe, long-distance hydrogen transportation and storage, thereby reducing costs in the hydrogen value chain and removing the need for local production.

REAL WORLD APPLICATIONS

Gas Pipelines and Storage Tanks: Tritonex can be retrofitted to existing gas infrastructure to meet the unique requirements for mixed hydrogen and gas pipelines and storage tanks in the energy sector.

Fuel Cells: Tritonex can be critical in producing and maintaining fuel cells, especially high-temperature solid oxide fuel cells (SOFCs). These cells, which operate at around 600 degrees Celsius, benefit from the coating's ability to protect metallic components from heat and to facilitate the dissipation of electric current generated within the cell. This application is particularly relevant as fuel cells are increasingly being used to supply electricity and heat in an environmentally friendly manner.

Compressed Hydrogen: Tritonex has undergone testing at pressures up to 180 bars and has proven effective in maintaining its structural integrity.

Gas Turbines: With the growing trend of mixing renewable hydrogen with natural gas, the use of Tritonex can be extended to gas turbines. As this mixture leads to higher combustion temperatures, it increases the risk of hydrogen embrittlement. Tritonex can be advantageous in protecting turbine parts against this risk, ensuring more efficient and safe operation of turbines in power generation.

Gaskets and Valves: Tritonex also comes in a gel for application to prevent leakage from gaskets and valves.

Vehicle Fuel Systems: The Tritonex coating can play a crucial role in ensuring the safety and efficiency of vehicles' hydrogen fuel tanks and systems. This application becomes increasingly important as the automotive industry shifts towards more sustainable fuel options.

Safety Enhancement: The coating significantly contributes to addressing safety concerns, especially in environments where hydrogen is stored or transported, thereby reducing risks associated with hydrogen handling.

MARKET IMPACT

ENHANCING INFRASTRUCTURE DURABILITY AND COST EFFICIENCY WITH TRITONEX

Collaborative efforts to revitalise existing infrastructure using Tritonex, Triton Hydrogen's innovative technology, can significantly extend the lifespan of pipes and storage systems. This approach conserves resources and eliminates major cost drivers such as leakage and the need for new infrastructure, substantially reducing carbon dioxide emissions associated with constructing new facilities. The use of Tritonex aligns with both sustainability and cost-efficiency, offering a comprehensive solution to current market challenges.

TRITONEX: A CATALYST IN ADDRESSING INDUSTRY CHALLENGES

The hydrogen industry faces a significant challenge with hydrogen permeation. Tritonex, with its advanced nano-technology-based coating, addresses this issue effectively. This shift from traditional solutions to Tritonex enhances the integrity and efficiency of storage and transportation systems and supports sustainable practices by reducing the need for frequent replacements and maintenance.

BOOSTING GREEN HYDROGEN PRODUCTION WITH TRITONEX

Tritonex could significantly elevate the proportion of green hydrogen in the energy sector. Tritonex facilitates buffer storage and long line pipe systems, which is essential for harmonising the supply and demand dynamics within renewable energy frameworks. Thus, implementing Tritonex represents a substantial advancement in pursuing sustainable energy solutions.

OPTIMISING GRID CAPACITY AND SUSTAINABLE ENERGY DISTRIBUTION

The current energy grid, operating at maximum capacity, faces challenges in meeting the rising energy demands. Tritonex enables the efficient transportation of hydrogen to areas in need, effectively offloading the grid. This strategic solution, coupled with Tritonex's contribution to the increased production of green hydrogen, ensures a more sustainable and efficient energy distribution system. In addition, Tritonex enables wind and solar farms to convert excess energy production into hydrogen and store it in lossless buffer storage to balance energy production fluctuations.

SUMMARY

Tritonex coating technology is a versatile solution, adaptable to diverse contexts and applications. It significantly reduces cost by eliminating cost drivers across the entire hydrogen value chain while enhancing safety, efficiency, and asset longevity in hydrogen storage and transportation. Tritonex helps asset owners reduce the Holistic Life Cycle Cost (HLCC). Additionally, it is suitable for a wide range of industrial applications. This underscores Tritonex's value in today's rapidly evolving hydrogen technology landscape.

LET'S TALK

If you would like to learn more and have a friendly chat please contact:

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