



# On track with hydrogen

Van Halteren Technologies secures constant refueling pressure for hydrogen trains

**Efficient and reliable hydrogen infrastructure has become a focus point on the path towards fossil-free mobility. In 2021, VHT completed its second large hydrogen project in collaboration with Linde. This time pioneering high capacity refueling for hydrogen-powered trains. The project was an important step forward for VHT as a provider of green innovations.**

In 2018, industrial gas provider Linde was preparing to develop the world's first refueling station for hydrogen-powered trains. Linde had previously collaborated with VHT to devise fast and efficient hydrogen refueling for buses. Building on the same technology, the train station's capacity would need to be much larger. Once again, Linde approached VHT. Linde's knowledge about hydrogen, and VHT's expertise about hydraulics was the right combination.

## Keeping the pressure

The key to fast and efficient refueling at the Linde hydrogen stations are the hydraulic accumulators provided by VHT. With conventional hydrogen tanks, there is a significant drop in pressure as the compressed gas leaves the tank. This reduces the flow of gas towards the end of refueling, adding time to the refueling process. It also prevents the total storage volume from being utilized. Piston accumulators eliminate these problems. Using hydraulics to keep the hydrogen under constant pressure, the accumulators from VHT enable customers to refuel faster, with a controlled flow of hydrogen. And no gas from the tank is lost. It's a seemingly simple solution, but it comes with serious challenges that must be solved.

Because it's the smallest element, it's crucial to use the right materials when you are dealing with hydrogen

With regular high strength steel there is a significant risk of hydrogen embrittlement. The hydrogen diffuses into the walls, creating hydrogen-induced cracking that can have disastrous effects. Because welding seams increase the risk of embrittling, the construction of the accumulators must be seamless. A requirement that becomes more difficult as the accumulator increases in size.

### Purity is crucial

The next challenge is to safeguard the purity of the hydrogen. It's crucial to eliminate any risk of contamination. If one drop of hydraulic fluid finds its way into the gas, it can seriously damage the fuel cell in the vehicle. A standard method to seal off hydrogen dynamically is dry sealing. But in the accumulator, dry seals would have to be changed almost every month to safely seal off the gas. And the hydrogen still wouldn't be completely sealed off. With 64 accumulators in the station, maintenance and gas leakage would become very problematic.



Instead, a lubricated seal system was selected in cooperation with Linde, with the tribological system further optimized by VHT to ensure efficient sealing and an extended lifetime.

In the end, VHT delivered 64 piston accumulators for the station: 9 meters long and made from high-strength steel suitable for hydrogen storage. Together, VHT and Linde managed to create the world's first high capacity refueling station for hydrogen powered trains. Jointly taking an important step towards providing sustainable solutions for tomorrow's fossil-free transportation.

For upcoming systems, VHT has almost completed a new tribological system for dynamical hydrogen sealing. It utilizes the hydraulic fluid to act as a dynamic seal, lubricating the seal system while preventing any cross-contamination. These are the small but crucial steps that will take us to a hydrogen-powered future.