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# THE CASE for hydrogen

Compact PEM electrolyzer generating hydrogen on-site for balloon lift

**Nel Hydrogen** explores how the use of hydrogen in weather balloons is gaining ground in the meteorological sector thanks to the development of proton exchange membrane technology

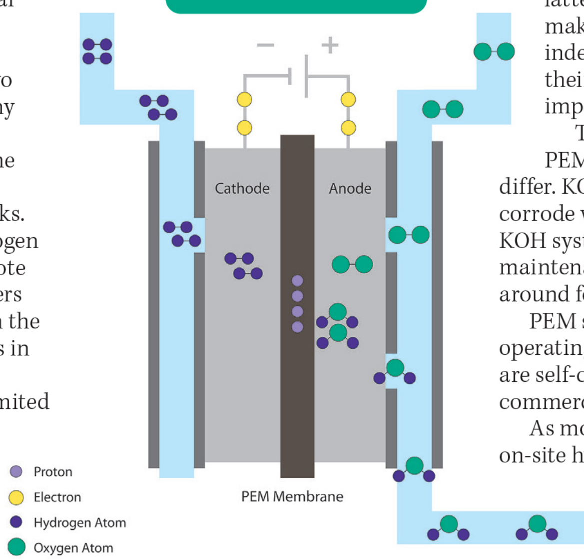
There has been much recent debate about which type of gas should be used in weather balloons. Many organizations in the weather balloon market, from the military to civil government and meteorological users, typically resort to using helium due to concerns over the safety of hydrogen. However, hydrogen generation has changed dramatically since the advent of proton exchange membrane (PEM) technology. This technology produces pure hydrogen safely and reliably on-site – using only water and electricity – at an affordable price.

The PEM electrolyzers sold worldwide, such as those from Nel Hydrogen, are used in a variety of applications outside the meteorological field, including heat treating, electronics manufacturing, cooling of power plant turbine generator windings and gas chromatography. They have demonstrated high reliability in a wide range of environments and duty cycles.

Having used helium for the past 40 years, many meteorological agencies, such as Environment Canada and the US National Weather Service, are now allowing some sites to fill their balloons with hydrogen. These organizations are switching for two main reasons: price and availability. Many balloon sites are in remote areas where delivering gas is difficult. Additionally, the delivery of either hydrogen or helium in high-pressure cylinders poses certain risks. Through the deployment of on-site hydrogen generation systems, observations in remote locations can be made without the dangers and logistical difficulties associated with the transportation and storage of these gases in high-pressure cylinders.

Furthermore, helium availability is limited but hydrogen can be made anywhere at any time using only water and electricity. On-site hydrogen generation eliminates the issues of scarcity, delivery and cost when compared with helium, and there are several economical ways of generating the gas: on-site production via a chemical reaction like steam reforming (a process that generates hydrogen from natural gas or other hydrocarbon fossil fuels); using calcium hydroxide cartridges; on-site production via electrolysis with a liquid potassium hydroxide (KOH) electrolyte; or via electrolysis with a proton exchange membrane.

Illustration of the proton exchange membrane (PEM) electrolysis process




For the generation of systems that produce hydrogen gas from electricity and water, there are two main options: KOH electrolysis and PEM electrolysis; the latter uses a solid polymer electrolyte. There are many differences between KOH and PEM electrolysis, with the KOH systems presenting more drawbacks and safety risks.

KOH systems, for example, require the use of hazardous, caustic chemicals, including potassium hydroxide. Also, KOH systems typically use a balanced pressure design, which, if not maintained properly, may allow the hydrogen and oxygen gases to mix, creating the risk of a dangerous explosion.

PEM systems, on the other hand, do not use hazardous chemicals. They also employ a differential pressure design, which eliminates the risks associated with mixing the two gases. Using a solid electrolyte, PEM systems produce hydrogen from pure water and electricity. The latter can be generated by solar panels, making on-site hydrogen generation independent of local power grids and their possible limitations, which is an important secondary benefit.

The maintenance needs of KOH and PEM hydrogen generation systems also differ. KOH system components, for example, corrode with every system startup and shutdown. KOH systems typically require 40+ hours of maintenance each year, compared with only around four hours for PEM systems.

PEM systems require a much smaller operating footprint, and their components are self-contained in smaller cabinets than commercially available KOH systems.

As more and more upper-air sites turn to on-site hydrogen generators, it is important to consider the most viable option for production of the gas: proton exchange membrane systems. ∎