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Electrolyzer Maker Avalence Eyes Low-Cost Renewables Market

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MILFORD, CT - The basic idea is seductive:

Produce electricity from wind or solar power, plug in an electrolyzer - and voila, you produce and store clean renewable hydrogen energy, preferably at high pressure, for when the wind doesn't blow or the sun doesn't shine.

The practice is more complicated:

Wind- and solar-generated electricity are intermittent energy sources characterized by fluctuations in output and voltage. PEM electrolyzers, which can generate moderately pressurized gaseous hydrogen, typically operate over a very narrow voltage range, and they require fairly sophisticated and expensive power conditioning equipment to get the kind of steady electricity needed to reliably generate hydrogen and oxygen from H₂O.

Alkaline electrolyzers, on the other hand, can handle power fluctuations without any problems, but in the past have required add-on compressors to pressurize the gas.

Now, a small two-year-old, innovative company here has come up with a design that can do both. Avalence, LLC has designed and built a unipolar alkaline electrolyzer that can take raw, renewable fluctuating electricity to electrolyze water and generate compressed hydrogen directly.

Avalence's design generates hydrogen inside a containment vessel at pressures of up to 10,000 psi (700 bar) without the need for an extra compressor - an extra piece of expensive equipment with maintenance needs and costs of its own.

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"The bottom line is our system is extremely flexible in dealing with external transients in input power," Deborah Moss, Avalence's chief executive officer told H&FCL during a visit here. "This is why we believe, and have demonstrated in models, we can connect right to a renewable energy source."

Earlier this year, Avalence won a contract for a 15 standard cu. ft./hour, 3,000 psi "Hydrofiller" electrolyzer for an environmental center in Wiscasset, ME (*H&FCL July 04*). The company has also won a contract to supply a 7,000 psi unit to Fort Collins, CO to fuel fleet vehicles and city buses, and it is in negotiation with several potential partners to develop energy storage systems based on this technology.



The Avalence team: From left, Martin Shimko, Thomas Jackson and Deborah Moss in front of one of their electrolyzers.

Unorthodox Technology, Lower Cost

Avalence says its unorthodox approach translates into lower equipment costs. Even with the same electrolysis efficiency of typically 70-75% as other electrolysis technologies, Avalence figures its investment cost can be 5% less because of the absence of power conditioning equipment.

And because Avalence's "Hydrofiller" electrolyzers can produce pressurized hydrogen directly, the absence of a compressor further reduces the cost of the total generating package:

"Compressors can cost as much as the electrolyzer itself," accounting for as much as 50% or more of the entire system's price for smaller applications, says Avalence president Thomas Jackson. "The other thing we gain is the elimination of a whole bunch of maintenance issues."

"Plus, no noise," adds Martin A. Shimko, executive vice president.

One interesting aspect of high-pressure liquid electrolysis is that counterintuitively, the thermochemical efficiency increases with increased pressure, and the cost of generating the gas actually decreases. Efficiency is impeded by the formation of gas bubbles which means that there is less surface area for the liquid to interact with the electrode surface, and, secondly, gas bubbles increase the resistance and make the liquid less conductive.

But as pressure increases, the bubbles become smaller, and efficiency increases again, typically about 2% better at 2,500 psi than at 250 psi. At pressures greater than 2,000 psi, the overall efficiency is about 10-15% higher than what is achievable with conventional electrolyzers teamed with compressors, says CEO Moss.

"It's not a lot different than how we did it in the mid-sixties," says Jackson. He explains the entire technology is an offshoot of know-how originally developed by Avalence's two parent companies, Gas Equipment Engineering Corp. (GEEC), and Electric Heating Equipment Company. Electric Heating has been producing industrial low-pressure hydrogen generating equipment for 70 years.

GEEC began developing highly reliable high-pressure oxygen generation equipment for the U.S. Navy's nuclear aircraft carriers almost 40 years ago to produce liquid oxygen for the breathing supply of Navy carrier pilots. GEEC equipment is still used today in almost all of the Navy's active nuclear carriers. Expertise from both flowed into the design of the new technology, and all three companies, with less than two dozen employees, are housed under one roof here. *Contact: Deborah Moss, 203/701-0052; dkm@avalence.com; www.avalence.com.*

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