Materials Evaluation for Hydrogen Infrastructure

Hydrogen offers many advantages as a low-carbon fuel. It can be produced readily by pairing wind and solar generated power with electrolysis, resulting in a carbon-free fuel that inherently addresses solar and wind's energy storage issues. Hydrogen fuel cell-powered trucks provide a zero-carbon alternative to conventional transport vehicles. Likewise, hydrogen-powered turbines offer a zero-carbon alternative to power generation.

> Transitioning to hydrogen (H_2) as a utility-scale fuel source comes with many fundamental materials challenges to the trasnmission, distribution, and end-use systems.

Successful development and adoption of a hydrogen economy will require industry to take a hard look at the broader materials integrity picture. Hydrogen can significantly degrade the integrity of engineered structures, but mechanisms and impacts can vary broadly. Even when focusing on the transportation side of the equation, potential integrity threats associated with hydrogen fuel blends reach beyond embrittlement of pipe steels. Other critical materials and applications that will be affected by a conversion to high-hydrogen fuel blends include:

- ***Elastomeric materials*** *– Gaskets and seals in valves, transfer lines*
- ***Fluoropolymers*** *– Compressor seals, liners*
- ***Cast alloys (brass, martensitic stainless steel)*** *– Fittings, valve bodies*
- ***Mild steel*** *– Compressor station infrastructure*
- ***High strength materials*** *– fasteners, flanges*

EWI has established a dedicated laboratory for performing materials testing and evaluation in pressurized, gaseous hydrogen environments. The current dedicated infrastructure is as follows:

- *Seven load frames with integrated pressure vessels*
  - *Four 15-kip load frames (fracture and fatigue)*
  - *Two 10-kip load frames (fracture and fatigue)*
  - *One 5-kip load frame (slow strain rate)*
- *Direct Current Potential Drop (DCPD) crack growth measurement in-situ*
- *Integrated pressure vessels equipped with specially designed sliding seals which allow the passage of a pull rod for active loading regimens in pressurized hydrogen environments*

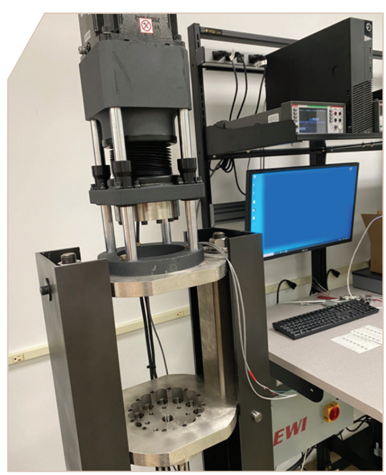
Twenty-four additional pressure vessels designed to hold up to 5,000 psi gaseous H_2 environments.

- *A mixture of 2L and 4L vessels*
- *ASME B31.12 testing on bolt-loaded CT specimens and statically loaded SENB specimens.*

Supporting H_2 testing equipment

- *Two double-flux hydrogen permeation cells enabling analysis of time-to-breakthrough for various metallurgies, microstructures and compositions, and surface conditions.*
- *Gas chromatography for total hydrogen content.*

EWI has a host of traditional in-air fracture mechanics testing capabilities, a full suite of materials characterization resources (including optical microscopy, SEM, Keyence surface analyzer, etc.), and an in-house machine shop which may be leveraged as needed for specific programs.



The EWI Advantage

EWI empowers industry leaders to overcome complex manufacturing challenges and integrate new processes to bring products to market more quickly and efficiently. With unmatched expertise and advanced manufacturing technology resources, EWI is an integral extension of our clients' innovation and R&D teams. We can assist you at any stage in your process—or collaborate with you from start to finish.

Get Started

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