

Material Analysis for Carbon Capture, Utilization, and Storage

Significantly lowering and even eliminating carbon (CO₂) emissions has become an urgent international goal of both governments and industry. Carbon capture infrastructure and technology development is critical if companies or countries want to achieve their near-term Net Zero targets. While the oil & gas industry is familiar with pure CO₂ in a dry, gaseous state, we can't assume its design approaches will work for carbon capture technology across all industrial sectors.

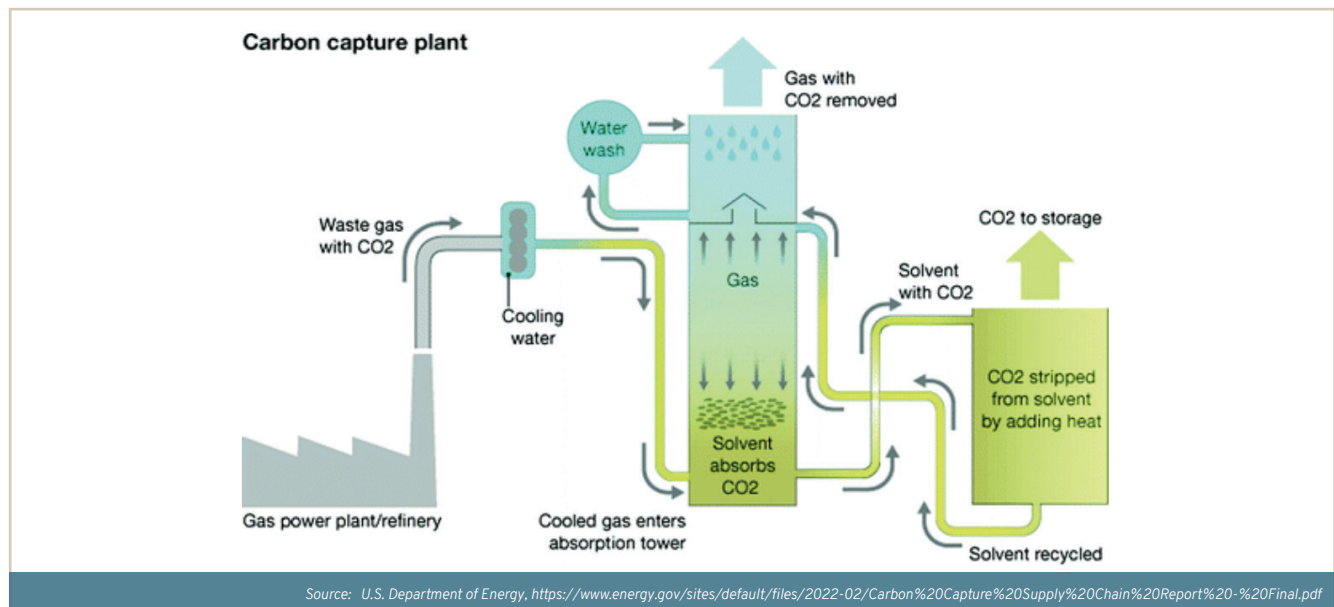
CO₂ emitted by power plants, steel mills, waste processing, and other man-made sources carries noxious gases, flue gas constituents, vaporized heavy metals, ionic salts, and other contaminants. These toxins combined with entrained moisture drive the need to understand and address material degradation issues that affect the evolving carbon capture, utilization, and sequestration (CCUS) landscape.

Capturing CO₂ waste from industrial sources will cause us to rethink everything we know about transporting and storing CO₂



MATERIAL CONCERNS FOR CCUS

Understanding the effects of CO₂ on materials used for carbon capture, transport, and processing systems is key in creating a CCUS infrastructure that will succeed on a broad scale. With a wide range of corrosion testing resources, deep expertise in materials and fracture mechanics, EWI can assist you with carbon capture system design and material evaluation.



METALS IN CO₂ SERVICE

Dry, “clean” CO₂ does not present much of a threat to typical infrastructural metals under nominal CCUS operating conditions. However, as demand for CCUS operations intensifies, viable CO₂ sources will rarely be dry or free of impurities which will lead to many potential threats to metallic infrastructure including:

- *Contaminant species interaction leads to acid gas formation*
- *Aqueous drop-out causes accelerated corrosion rates*
- *Pit to crack transition under cyclic loading*
- *Decompression creates running ductile fracture*

EWI offers the following assessments for your metal materials:

- *High pressure environmental testing and analysis of materials*
 - *PPM level dosing of gaseous environment constituents*
 - *Electrochemical parameter measurement of corrosion in high pressure environments*
 - *Thermophysical modeling for accurate prediction of phase and chemical equilibria*
- *Assessing material resistance to CO₂ damage and improved dynamic fracture resistance.*
 - *CVN and drop weight tear testing*
 - *Properties assessment for advancing decompression models*
- *Post-test metallurgical analysis, fractography, and quantitative microscopy*

POLYMERS IN CO₂ SERVICE

CO₂ absorbs into elastomers seals used in pumps and storage operations which can cause catastrophic failure during decompression due to supersaturation and foaming. The swelling of polymeric materials in high pressure CO₂ can result in the following circumstances:

- *Plasticizers diffuse out of the polymer leaving the material less elastic and more brittle.*
- *Contaminants diffuse into the polymer and increase hydrolysis or oxidation rates.*
- *Compression set in seals increases which leads to leakage.*
- *Geometric changes cause design issues.*

EWI offers the following assessments for your plastic materials:

- *Measure in-situ swelling under high pressure.*
- *Measure thermal transition shifts using Differential Scanning Calorimetry (DSC) and Thermogravimetric Analysis (TGA) in materials before and after soaking in CO₂.*
- *Measure differences in mechanical properties (Young's modulus, strain at yield, compression set) before and after soaking in CO₂.*
- *Choose materials based on product requirements translated into searchable material properties.*

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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