

# PermaSet R cement system

Cement and resin system for corrosive environments such as CO<sub>2</sub>

## Applications

- Conventional Primary and remedial cementing operations in CO<sub>2</sub> and H<sub>2</sub>S environments
- Ideally suited to carbon capture, utilization and storage wells (CCUS)

## Features and Benefits

- Improves the cement's resistance to attacks from CO<sub>2</sub>, H<sub>2</sub>S, magnesium, and sulfate
- Provides minimal permeability and improved mechanical properties
- Minimal portlandite content eliminates weak points and reduces carbonation
- Offers fit-for-purpose designs for specific applications
- Compatible with virtually all API and ASTM cements and most Baker Hughes cement additives
- Substantially increases tensile strength and shear bond strength for further improved zonal isolation in areas of constant stress changes
- Reduces the risk of costly remedial repair treatments during the life of the well

The Baker Hughes PermaSet R™ cement slurries are fit-for-purpose, carbon dioxide (CO<sub>2</sub>)- and hydrogen sulphide (H<sub>2</sub>S)-resistant cement systems for use in challenging carbon capture utilization and storage (CCUS) virtually any well condition around the world.

Resin added to cement or our already CO<sub>2</sub> resistant PermaSet™ system results in an economical fit-for purpose solution compared to treatments utilizing 100% Baker Hughes resin system. The addition of resin, like the PermaSet itself reduces the volume of portlandite in the final slurry which will reduce the attack on the cement. The resin also coats the particles of cement and helps to block the permeability of the cement matrix itself which reduces the CO<sub>2</sub> attack and CO<sub>2</sub> leaching respectively. Table 1 demonstrates the resistance to CO<sub>2</sub> which can be caused by carbonic acid.

Baker Hughes prides itself on solving potential problems at the wellhead, understanding that a single slurry does not fit all applications. This approach allows unlimited design flexibility. The Baker Hughes portfolio of resin/ cement/PermaSet solutions results in highly engineered solutions for specific well requirements.

Our cementing philosophy utilizes state-of-the-art cement pumping equipment, such as the Baker Hughes Seahawk™ cement unit, to help ensure a quality cement job.

PermaSet R cement slurries are part of the Baker Hughes Set for Life™ family of cement systems, which are designed to isolate and protect the targeted zone for the life of the well. These slurries can be blended with other systems in this family to help ensure long-term zonal isolation.

## Safety and handling

Refer to system component material safety data sheets (MSDS) for handling, transport, environmental information, and first aid.

## Product comparison

	0.1 M acetic acid % weight loss		4 M acetic acid % weight loss	
	2 weeks	4 weeks	2 weeks	4 weeks
PermaSet™ R	2.58	2.1	15.75	15.8
Conventional	4.91	4.5	18.38	33.7

Table 1: Comparison of PermaSet™ R vs conventional cement after curing in acetic acid as an analogue to H<sub>2</sub>O/CO<sub>2</sub> generated carbonic acid (190°F/88°C and ambient pressure).

## Typical properties

Temperature range Up to 300°F (149°C)

Typical density Up to 15 ppg (1797 kg/m<sup>3</sup>)

## PermaSet R vs. PermaSet/DuraSet Hybrid

	Temperature	Tensile strength	Youngs Modulus	Poisson's ratio	Shear bond	Compressive strength		
						12 hours	24 hours	Final
PermaSet D™	145.4°F (63°C)	343	0.645	0.063	20	467	1,262	2,043
PermaSet R™	145.4°F (63°C)	737	1.08	0.218	75	818	2,103	2,467

Table 2: Mechanical Properties testing of 14 ppg CCUS designs at 1,000 psi confining demonstrates PermaSet R™ significantly outperforms the PermaSet™/DuraSet™ Hybrid system in tensile strength and is nearly 4x better in shear bonding test.