

H₂Zero™ Service

COST EFFECTIVE POROSITY-FILL SEALANT FOR WATER AND GAS SHUTOFF

OVERVIEW

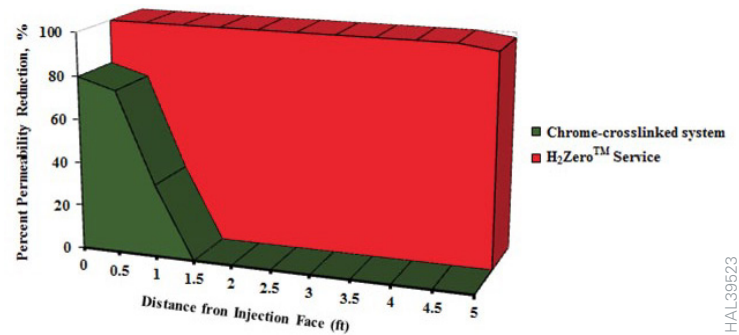
Halliburton's H₂Zero™ service uses a revolutionary polymer system to provide unprecedented capabilities for controlling unwanted fluid production. Compared to widely used chromium crosslinked polymer systems, the organically crosslinked H₂Zero system provides these important benefits:

- » Deeper permeability shutoff properties than any chrome-based system on the market. No concern with crosslinker adsorption in the rock matrix as the system penetrates the reservoir.
- » One of the longest lasting polymer systems available. It has been tested to be thermally stable to at least 400°F (204°C).
- » Wide temperature range of application, ranging from 32°F(0°C) to 400°F (204°C).
- » Backed by Halliburton's reservoir-focused Conformance control engineering and technology.
- » H₂Zero service has been successfully tested to withstand at least 7000 psi differential pressure.

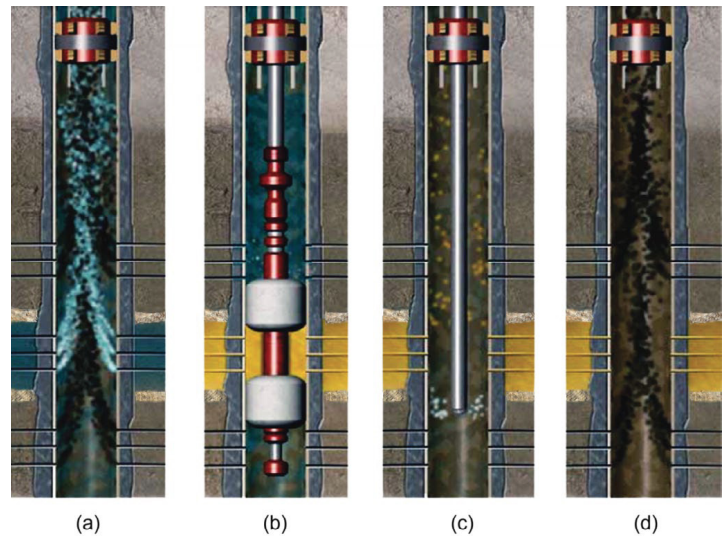
Halliburton's H₂Zero Conformance control service is simply one of the most cost-effective polymer sealant systems available today and only Halliburton can offer it.

H₂ZERO™ SERVICE IS A FIELD FRIENDLY SYSTEM

- » Easily mixed. H₂Zero service components are all liquid additives; they are easily diluted in the mixing brine. This avoids lumping problems that can occur when dealing with dry polymers.
- » Easily pumped. Initial viscosity of the base fluid is no more than 30 cP at surface conditions, so friction pressure during pumping is minimal and injectivity, even in low-permeability formations, is not a concern.
- » Predictable reaction time. H₂Zero service provides a predictable and controllable crosslinking time (phase change from liquid to gel state) to obtain adequate placement. H₂Zero service is insensitive to formation fluids, lithology, and/or heavy metals.
- » H₂Zero service can also be foamed up to 70% quality.



Laboratory testing results demonstrated the superior penetration permeability shutoff capabilities and performance of Halliburton's H₂Zero™ Service vs. typical chromium-based polymer systems. This graph shows the permeability reduction created by both systems in a 5 ft porous media (~600 mD).



Typical scenario for Halliburton's H₂Zero™ Service: (a) Zone with unwanted fluid production (water or gas) is clearly identified (middle interval), (b) deployment of the H₂Zero Service with inflatable straddle packers run through CT, injecting treatment only in the middle zone, (c) wellbore cleanup after shut-in stage (no milling or drilling required), and (d) production is resumed.

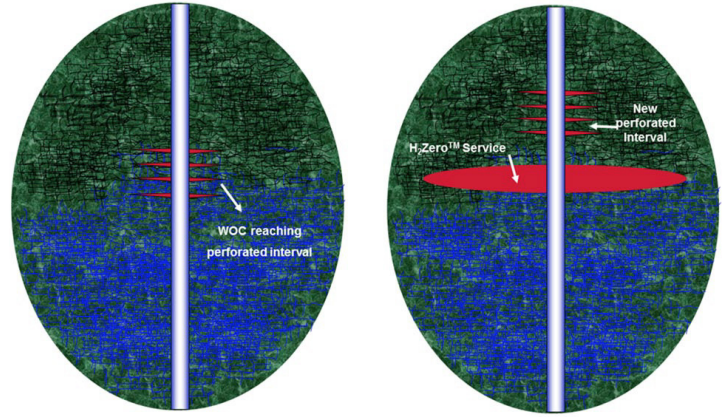
FIELD PROVEN

To date, Halliburton's H₂Zero™ Conformance control service has been used in more than 1000 wells around the world with excellent results.

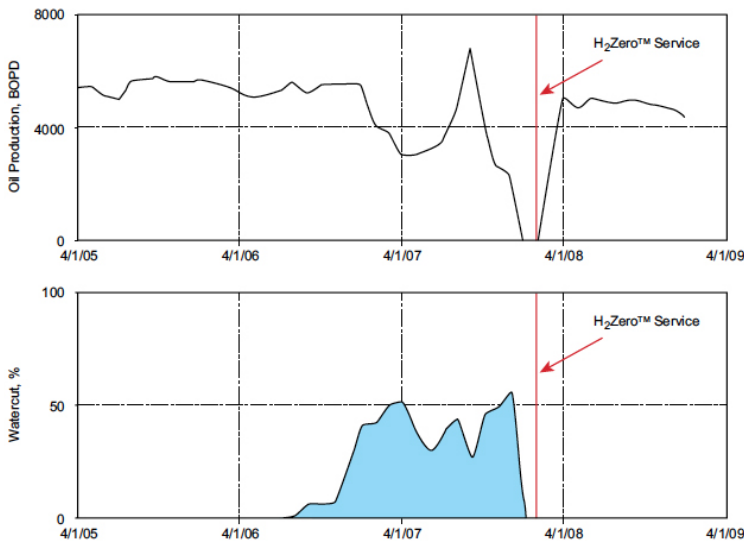
Case History – Well A is a cased-hole, offshore oil producing well drilled in a highly naturally fractured carbonate reservoir in the Gulf of Mexico. This field is considered a mature reservoir. Attributed to a combination of high vertical permeability and natural fractures, water coning has become a major problem in this field. Well A was producing from 14,173 to 14,222 ft MD (49 ft interval). This well started producing in September of 1992 with no water production until 2005, when the WOC started reaching the perforations (water coning). In April 2008, Well A had a production of 4,418 BFPD, 1,902 BOPD, and 2,516 BWPD (57% water cut). The bottomhole temperature for this formation was 290°F.

The treatment consisted of bullheading 622 bbls of the H₂Zero service (a theoretical radial penetration of 16 ft). This well was re-perforated a few feet up from 13,993 to 14,058 ft MD (65 ft interval). Initial production was 5,014 BOPD with no water, as shown in the figure below.

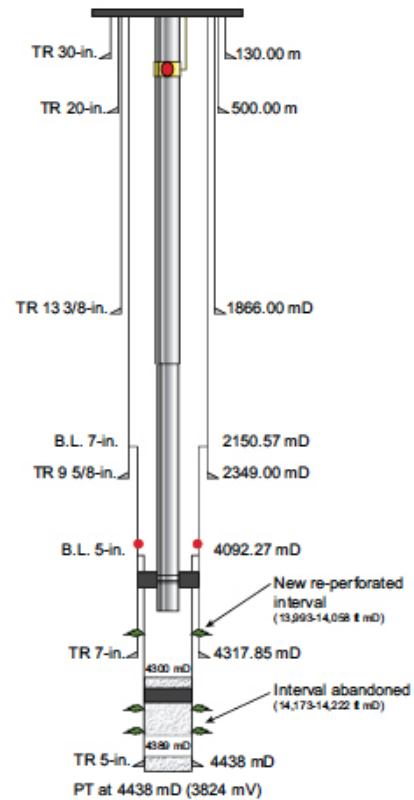
After one year of production, this well is still showing less than 4% water cut. This completion strategy has proved effective to delay the onset of the WOC, especially when compared to conventional cement squeezes.



H₂Zero™ Service water-shutoff treatment: (a) WOC rising and reaching the perforated interval, (b) injection of the H₂Zero Service to form a barrier inside the formation and prevent the WOC from rising, followed by the re-perforation of a new interval a few feet up in the same payzone.



Well A – Wellbore diagram and production history (before and after Halliburton's H₂Zero™ Service).



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