

# InnovOil™

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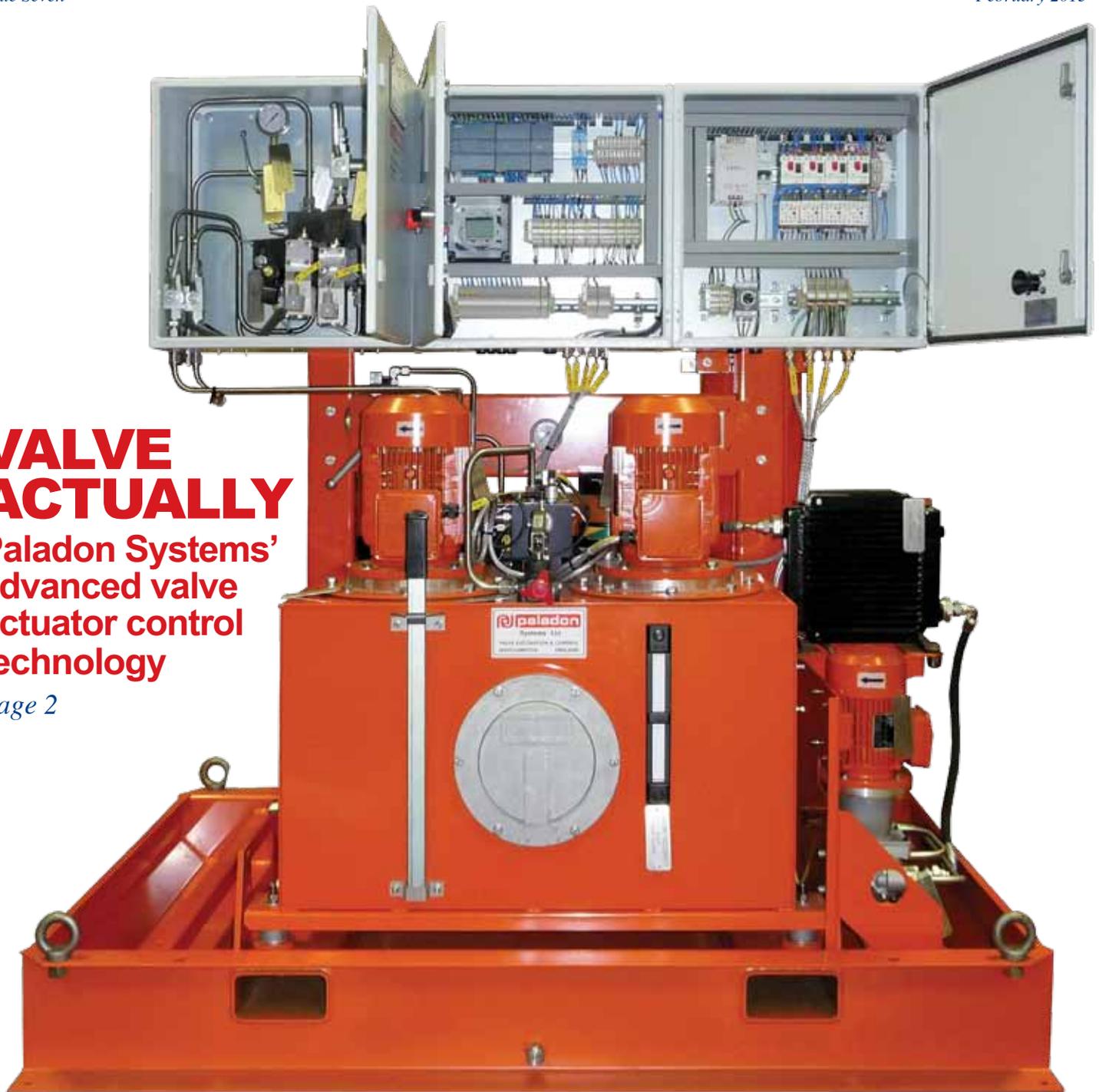
Issue Seven

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# Better biocides

BWA Water Additives introduces its fast-acting, long-lasting biocide that improves health and safety

**A**DVANCED stimulation techniques such as high volume hydraulic fracturing (fracking) of horizontal wells have made the exploitation of low-permeability oil and gas formations possible in recent years. This type of fracturing can use more than 5 million gallons (22.7 million litres) of water per horizontal well. The water used for the fracturing process is obtained from a variety of sources including municipal water, ground water, rivers, lakes/ponds and well flow-back water.

These waters typically contain a variety of micro-organisms such as sulphate-reducing bacteria and acid-producing bacteria. If left untreated, these bacteria can become established in the well and cause severe problems, including formation souring from sulphide production, formation plugging because of iron sulphide, and corrosion of equipment. To prevent these problems, an effective biocide programme is required.

Biocides commonly used in fracturing include bleach and glutaraldehyde-based products. Whilst generally effective, each of these biocides has disadvantages. Bleach is chemically aggressive so can increase the corrosion rate of equipment. Glutaraldehyde-based products are well known dermal and respiratory sensitisers so present a significant worker exposure risk.

An alternative biocide which overcomes these disadvantages is tributyl tetradecyl phosphonium chloride (TTPC) from BWA Water Additives offered as Bellacide® 355. A fast-acting but also

long-lasting biocide that minimises worker exposure and impact on infrastructure, Bellacide® 355 is well suited to hydraulic fracturing and has been successfully applied in numerous shale gas basins.

## Features and benefits

While TTPC is a potent biocide, unlike glutaraldehyde, it is not classified as a skin sensitiser and is not subject to exposure limits. As a non-oxidising biocide, TTPC is less aggressive to equipment compared to oxidising biocides like bleach. In fact, in a standard high-temperature oilfield brine corrosion test, TTPC has been proven to exhibit corrosion inhibition properties. (See below)

### Corrosion inhibition of mild steel

TTPC Concentration, ppm	Percent Corrosion Inhibition (based on weight loss)
25	82%
50	81%

TTPC is an amphipathic molecule, which means it has both hydrophilic and lipophilic functional groups. TTPC interacts with and disrupts the structure and function of the cell membrane of bacteria. Disruption of the cell membrane can result in the inhibition of membrane-associated metabolism, loss of intracellular material and osmotic lysis, which ultimately leads to cell death. ►►

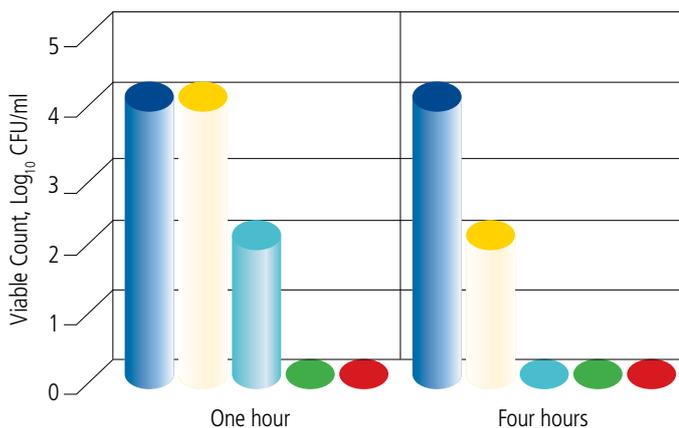


▶▶ TTPC has broad-spectrum biocidal activity but is especially effective against the sulphate-reducing bacteria which cause the most problems if they become established in a well.

The graph below compares the biocidal activity of TTPC and glutaraldehyde (GA) against sulphate-reducing bacteria under typical fracturing application conditions (pH 7 & 20,000 ppm TDS).

**Biocidal activity of TTPC and glutaraldehyde (GA) against sulfate-reducing bacteria**

● Control ● GA, 12.5ppm ● GA, 25ppm ● GA, 50ppm ● TTPC, 12.5ppm



The results show that TTPC is rapidly biocidal at low concentrations against sulphate-reducing bacteria, giving complete kill in one hour with just 12.5 ppm. It takes significantly higher concentrations of glutaraldehyde to match the performance of TTPC in this test.

Fracturing fluids can remain down-hole for several weeks, so good thermal and hydrolytic stability of the biocide is important to provide prolonged protection. TTPC shows excellent hydrolytic stability when incubated under down-hole conditions (80 degrees Celsius, pH 7 & 20,000 ppm TDS) for extended periods. The table below shows that TTPC retains essentially 100% of its biocidal activity against acid-producing bacteria (APB) after the test. ■

**Effect of high temperature incubation on the biocidal activity of TTPC**

Days of Incubation @ 80°C	Log Reduction in APB Viable Count @ 25 ppm TTPC	
	1 hour	4 hours
0	3.5	6.6*
28	3.0	6.7*

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## Bellasol® Antiscalants & Bellacide® Biocides Sustainable Solutions for Severe Service Conditions

BWA Water Additives is the global leader in sustainable water treatment solutions for topside or down-hole production, seawater injection or squeeze treatment.

- Bellasol scale inhibitors are environmentally friendly, high-performance antiscalant polymers.
- New Bellacide 350 – highly effective non-oxidizing biocide that improves health and safety. Widely used in hydraulic fracking.
- BWA supports oil and gas service companies in over 80 countries.

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