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WATER MANAGEMENT

Responsible Solutions for North America's Oil and Gas Industry

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March / April 2014

Ohio Regulations: Role, Regulations and Responsibility

Turnkey Approaches

Create Synergy, Reduce Costs

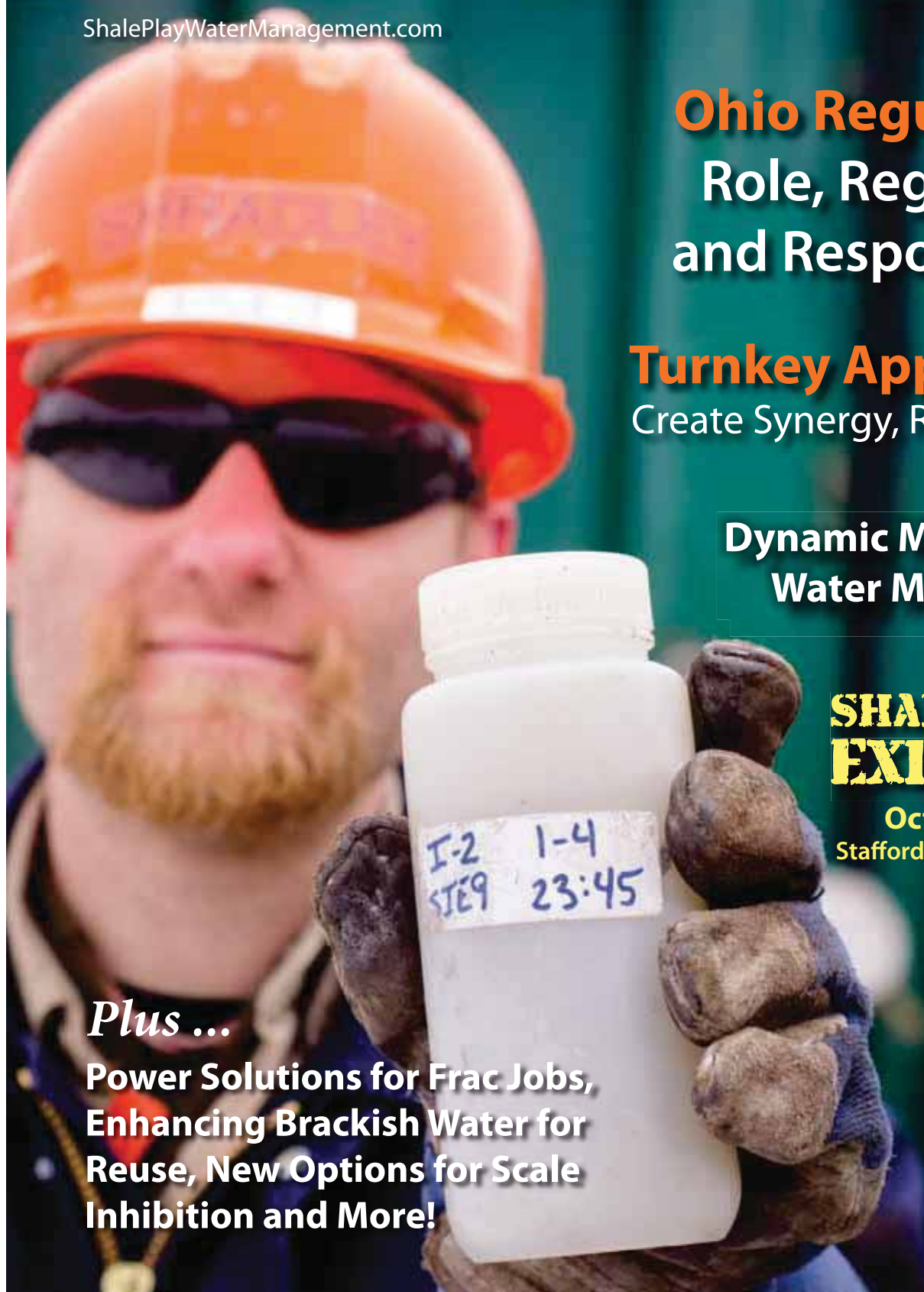
Dynamic Modeling for Water Management

SHALE WATER EXPO 2014

October 14-15
Stafford Convention Centre
Houston

Plus ...

Power Solutions for Frac Jobs,
Enhancing Brackish Water for
Reuse, New Options for Scale
Inhibition and More!





INNOVATIONS

from Desktop to Drill Site

Specialty Polymers Provide New Options in Scale Inhibition

New scale inhibition chemistry helps operators keep wells producing and prevents degradation of production value.

BY SHAHNOZ ("NOZI") HAMIDI, BWA WATER ADDITIVES

In the business of recovering oil and gas and keeping wells producing at high yield, scale is a dreaded and unwanted obstacle. Specialty chemicals such as polymeric scale inhibitors play an important role in removing such obstacles and prolonging the producing life of an oilfield. Choosing the right scale inhibitor to prevent the build-up of topside scale and to inhibit the formation of scales downhole can mean all the difference in uninterrupted well production and prolonging the need for squeeze treatment.

INCREASINGLY HARSH ENVIRONMENTS

As more wells are being drilled at greater depths, higher temperatures and higher pressures (HT/HP) are being encountered. In these harsh environments, typical low cost scale control agents like phosphonates functionally fail as they cannot withstand such extreme temperatures and high pressures. Additionally, in a HT/HP environment, the rate of inorganic scale formation increases greatly, thus exceeding the typical performance profile of phosphonates. These types of

operations require high performance scale inhibitors that can control not only common scale species like barium sulfate and calcium carbonate, but also iron and difficult to remove scales such as lead sulfide and zinc sulfide.

No longer is the operator's choice of scale inhibition chemistry based on performance alone. Some E&P and oilfield service companies now practice corporate sustainability and purposely seek to use products that have a reduced environmental impact. Others are driven by the growing public pressure to disclose frac chemicals. While disclosure to the

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Frac Focus registry was voluntary at first, as of July 2013, 20 states had passed legislation with requirements to either partially or fully disclose chemical additives used in fracking. This represents 75% of the 27 states that account for 99.9% of the oil and natural gas produced in the U.S. Some states allow reporting through Frac Focus but require even the proposed rate of concentration and total volume of the chemical additive to be included in the disclosure.

For many E&P and oilfield service companies, it makes more economic sense to, where possible, switch to chemistries with reduced environmental impact rather than manage potential follow-on treatment costs and additional public pressure and regulations that could result from the disclosures. Some companies operating in the U.S. shale plays have started taking their environmental cues from the U.K. and European operators in the North Sea. These companies have been adopting the requirements of the Convention for the Protection of the Marine Environment of the North-East Atlantic, also known as the OSPAR Convention. OSPAR limits the use of certain chemistries based on their profile of environmental persistence, bioaccumulation, and toxicity. Consequently, these operators tend to be ahead of the curve in determining options for oilfield additives that have an improved environmental profile, in particular biodegradable additives.

While much of the oil and gas industry tends to rely on low cost, near commodity scale inhibitors such as phosphonates, this class of scale inhibitor fails to exhibit the desired improvements in biodegradation, bioaccumulation and toxicity profile sought by the OSPAR convention. Additionally, the alternative biodegradable polymers such as polyaspartate (PASP) fail

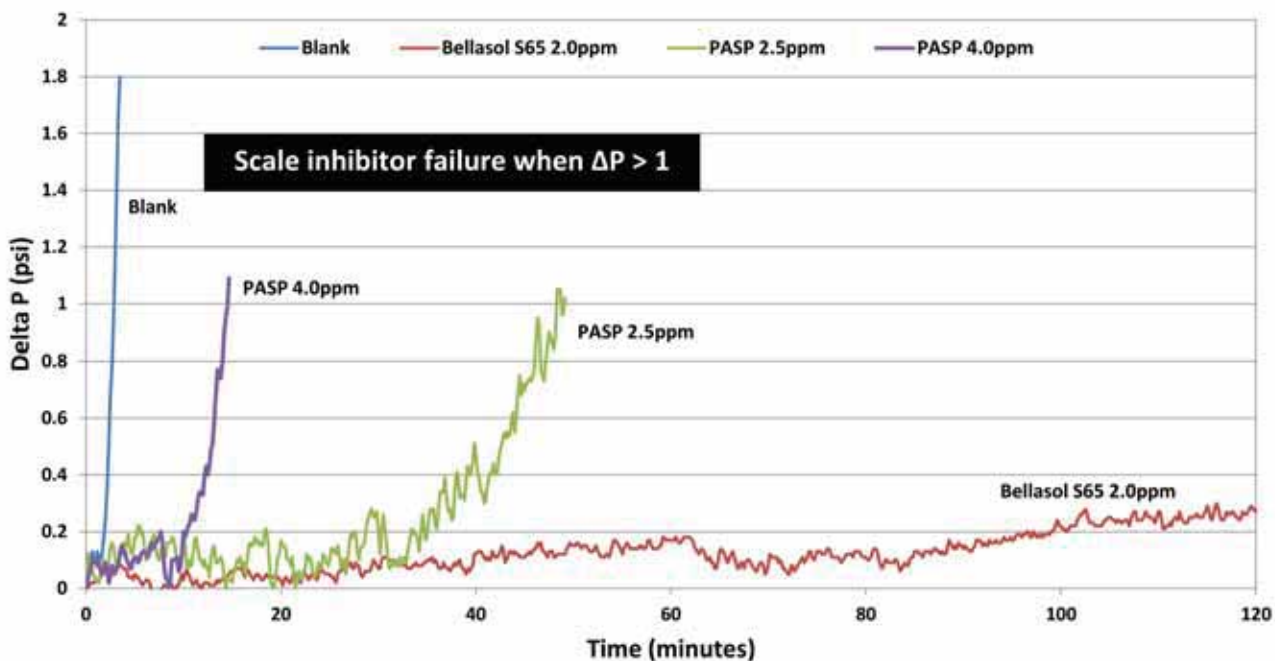
in HT/HP environments, leaving operators without a good high performance, biodegradable scale inhibitor option.

IMPROVING PERFORMANCE AND ENVIRONMENTAL PROFILE

In response to the industry’s continued interest in high performance scale inhibitors with improved environmental profiles that work under HT/HP conditions, BWA Water Additives recently introduced Bellasol® S65, a biodegradable antiscalant effective for both barium sulfate and calcium carbonate scale inhibition and hydrothermally stable to 180°C at pH 12. The biodegradable maleic polymer (BMP) chemistry of Bellasol S65 meets the highest OSPAR standards (“Gold” in the UK/Netherlands and “Yellow” in Norway). Per the Organization of Economic Cooperation and Development Test (OECD) 306 standard, BMP biodegrades to 70.2% in 28

Bellasol® S65 is a biodegradable antiscalant effective for both barium sulfate and calcium carbonate scale inhibition and hydrothermally stable to 180°C at pH 12

Figure 1 Typical North Sea waters, CaCO₃ dynamic tube blocking test dosed as solids



Continued >

days. Bellasol S65 is also compatible with other oilfield additives and is not weakened by the presence of oxidizers used at normal biocide dosages.

Although Bellasol S65 was developed with a goal of achieving best in class biodegradability, BWA is finding that global oil and gas companies are choosing Bellasol S65 purely for its performance profile. As example, **Figure 1**, which depicts dynamic tube blocking tests that simulate actual oilfield conditions that are more severe than typical static jar tests, shows that Bellasol S65 outperforms PASP for calcium carbonate inhibition *even at lower dosages* than PASP. When dosed at

4.0 ppm and 2.5 ppm, PASP fails in under 30 and 60 minutes respectively, as evidenced by a change in pressure of ≥ 1 psi. Bellasol S65, however, continues to inhibit calcium carbonate even after 2 hours.

Likewise, Bellasol S65 also outperforms traditionally used phosphonates such as deta-phosphonate (DETAP). **Figure 2** depicts dynamic tube block tests for barium sulfate inhibition based on synthetic brine waters described in **Table 1**. At the same dosages, PASP fails in under 2 hours, DETAP fails at 2 hours, yet Bellasol S65 continues to inhibit barium sulfate scale well beyond 2 hours.

Figure 2 BaSO₄ dynamic tube blocking test dosed as solids

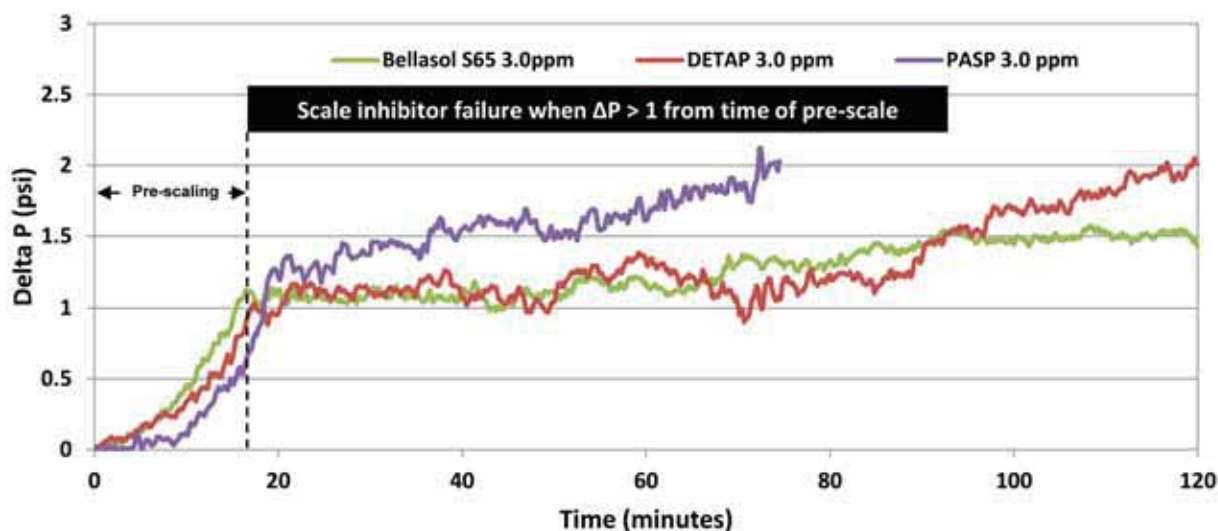
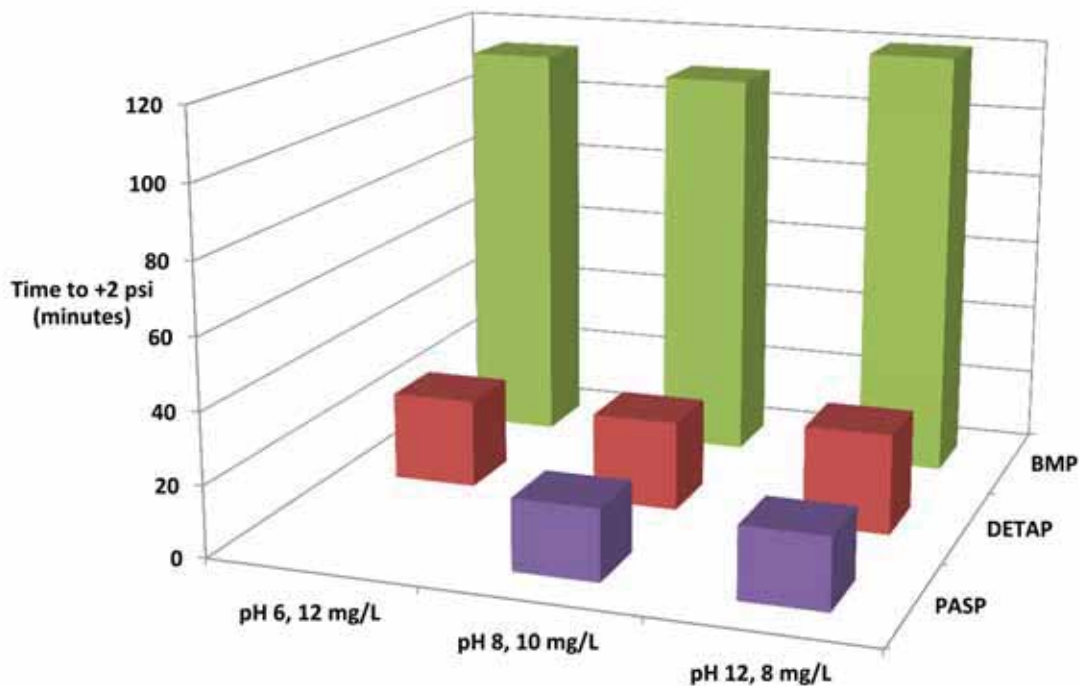


Table 1

Ion	mg/L
Ba ²⁺	120
SO ₄ ²⁻	530
Ca ²⁺	636
Mg ²⁺	634
Na ⁺	15,004
Cl ⁻	26,338
K ⁺	446
Sr ²⁺	190
CH ₃ CO ₂ ⁻	1,015
TDS	43,898
pH	5.5



Figure 3 Hydrothermal Stability Profiles after 7 days aging at 200° C



Equally impressive as its ability to outperform typical phosphonates and other biodegradable scale inhibitors is the ability of Bellasol S65 to withstand extreme high temperatures. This is important because scale inhibitors used in squeeze treatments must withstand reservoir conditions for extended periods of time, typically 12 to 18 months or longer. If a polymer is not hydrothermally stable, its scale inhibition performance will start to fail. Scale inhibitor failure during squeeze treatments means lost revenue. In **Figure 3**, the hydrothermal stability profiles of BMP (Bellasol S65) are compared to PASP and DETAP when held for extended period at 200° C in a worst case scenario of a solution phase rather than the typical field scenario of adsorbed onto rock. While PASP and DETAP fail hydrothermal stability in 40 minutes or less, Bellasol S65 remains hydrothermally stable for nearly 2 hours.

CONCLUSION

Oil and gas operators continue to face more extreme HT/HP environments which make for difficult-to-treat scale conditions. The low cost phosphonate scale inhibitors that are commonly used in shale gas are not always fit for such extreme environments. Additionally, phosphonates do not meet certain environmental standards, thus limiting the operator’s options.

The new all-organic, phosphorus-free BMP addresses the operator’s dual requirements of both high performance

chemistry and reduced environmental impact. Specifically, BMP has been designed to offer:

- Improved carbonate and sulfate scale inhibition compared to existing phosphonate and polyaspartate-based scale inhibitors.
- Resistance to thermal ageing compared to existing phosphonate and polyaspartate-based scale inhibitors.
- Detectability in brine solutions to the 1 ppm level.
- Biodegradability meeting the highest tier of OECD/ OSPAR standards. □

About the Author:



Shahnoz (“Nozi”) Hamidi, VP Marketing for BWA Water Additives, leads BWA’s global marketing and new product commercialization. Her background is in marketing, product management, mergers & acquisitions with specialty chemicals, water treatment and energy services businesses. She holds a BS in

Chemical Engineering (Ohio University) and MBA (Capital University), and can be reached at Shahnoz.Hamidi@wateradditives.com.

Gentle on nature.

Brutal on scale.



Bellasol[®] S65

Oil & Gas Antiscalant

**High pressures and high temperatures?
Now get the highest performance
oilfield antiscalant on the market.**

New Bellasol S65 biodegradable antiscalant - outperforms traditional phosphonates and polyaspartate for calcium carbonate and barium sulfate scale inhibition. Hydrothermally stable to 200°C at pH 12. Resistant to iron. Detectable in brines to 1ppm. Meets highest OSPAR biodegradability standards.

Bellasol oilfield antiscalant range

- Bellasol S28** General scale control
- Bellasol S30** Calcium scale control
- Bellasol S50** Mixed scale control & chemical compatibility
- Bellasol S65** High performance and biodegradable



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