

Effect of Dosing BromMax on Two Water Samples used in Oilfield Fracturing

Two samples of water used in oil formation fracturing were received on May 10th 2007. One was labeled creek water and the other flow-back water. The samples were plated immediately for aerobic bacteria using 3M Petrifilm and anaerobic bacteria using thioglycollate vials. The films and vials were placed in a 35°F incubator. Then the water samples were stored in the refrigerator overnight. The following morning the pH, total alkalinity, and calcium hardness was measured for each water sample. Table I reports the data.

Table I

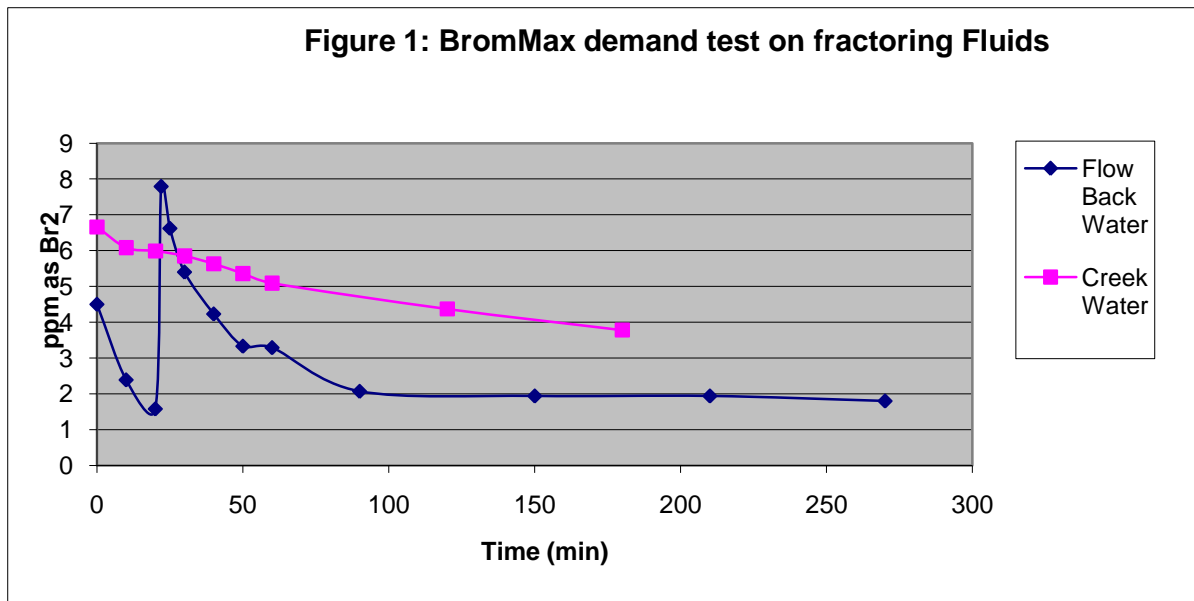
	pH	Total alkalinity /ppm as CaCO ₃	Calcium hardness /ppm as CaCO ₃
Creek water	5.95	20	20
Flow-back water	7.17	N/A*	20

* The flow back water did not register an alkalinity response due to an unknown interference effect.

Decay Profiles

Using a freshly prepared stock solution, each sample was dosed with BromMax to 9 ppm bromine (4 ppm as Cl₂). The amount of bromine consumed by the immediate chemical demand was measured using the DPD colorimetric method for total chlorine. The decay profile of the bromine in the respective samples was then tracked over the following 3-4.5 hours. At 22 minutes the amount of bromine remaining in the flow-back water had dropped to an ineffective level of 1.58 ppm as bromine. Consequently, it was re-dosed with another 9 ppm bromine (nominal). Figure 1 displays the results.

The pink line represents the Creek water data. There was an immediate demand of 2.34 ppm bromine. This immediate demand was surprising, but was confirmed by repeating the test. The water was tested every ten minutes for an hour and then on the hour for two



hours. The Creek water showed a gradual decay of bromine from the initial reading of 6.66 ppm to 3.78 ppm bromine over 3 hours. The blue line illustrates the flow-back water data. There was an immediate demand of 4.5 ppm bromine corresponding to half of the nominal dose. At 22 minutes, when the bromine level reached 1.58 ppm bromine, which was considered to be a microbiologically ineffective level, the water was re-dosed with another nominal 9 ppm bromine. This time 7.79 ppm bromine was immediately recovered. After the second addition of BromMax, the sample showed a gradual decay from the 7.79 ppm to 1.80 ppm bromine after four and a half hours.

Microbiology

Using 3M Petrifilm and thioglycollate vials, each water sample was tested for aerobic and anaerobic bacteria before they were dosed with BromMax and at an arbitrary one-hour time period after the BromMax was introduced. The vials and films were incubated at 35 °F for 48 hours and then enumerated. The results are illustrated below in Tables 2 and 3.

Table 2

Flow Back Water	Before BromMax	After BromMax	
	Log ₁₀ CFU/ml	Log ₁₀ CFU/ml	Log ₁₀ Reduction
Aerobic	6.6	<2	>4.6
Anaerobic	>6	4	>2

Table 3

Creek Water	Before BromMax	After BromMax	
	Log ₁₀ CFU/ml	Log ₁₀ CFU/ml	Log ₁₀ Reduction
Aerobic	1.69	0	>1.69
Anaerobic	1	1	0

Table 2 shows that the double dose of BromMax (to a nominal level of 9 ppm Br₂) each dose) to the flow-back water, and a contact time of 1 hour affords a more than 4 log₁₀ reduction in the number of aerobic bacteria, and a greater than 2 log reduction in anaerobic bacteria. The Creek water on the other hand was relatively uncontaminated with either type of microorganism. BromMax totally eradicated all the aerobic bacteria but had no effect on the low level of anaerobic bacteria. The Creek water probably does not require a chemical treatment prior to use.

Conclusion

- BromMax represent a satisfactory means of biocontrol of the flow-back water, provided the economics of double-dosing (with 2 x 9 ppm as Br₂) are favorable. The low level of contamination in the Creek water means that it does not require treatment with any biocontrol agent.
- The doses utilized in this study were intended to be minimal. Subsequent tests presented in another paper from Enviro Tech showed similar results, but the optimum dose is typically between 10 and 25 ppm as available bromine (4.2 – 10 ppm reported as Cl₂), depending on the chemistry and quality of the treated water.
- The concentration of the anaerobic organisms was too low to allow any meaningful conclusions for the Creek water sample using this test.

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