Native Chemical

Hypochlorous Acid Technical Review

2024

Native Chemical

- CONFIDENTIAL

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Partnership and Advantages.

Native Chemical is here to support Operators and be here as a resource to enhance and optimize your production.

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HOCl Advantages

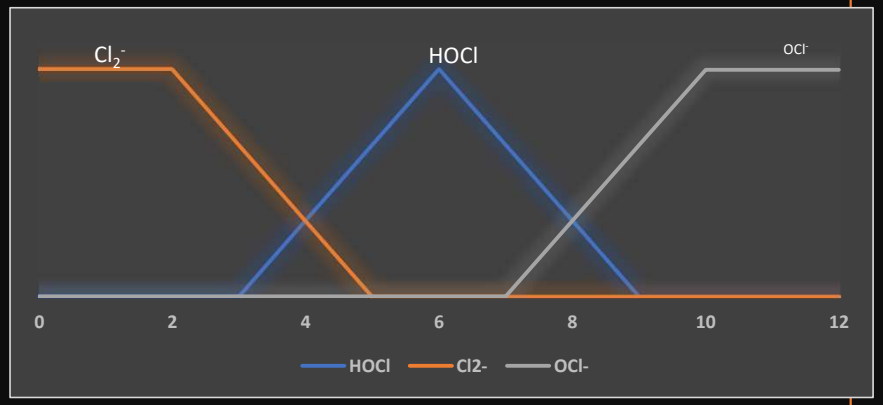
- **Safety: Hypochlorous (HOCl) is a non-toxic non-HAZMAT Biocide**
- **Efficacy:** Hypochlorous is 80 to 200 times more effective as a biocide than bleach
- **Optimal pH Range:** HOCl works best in a slightly acidic to neutral pH range, ideal for maintaining the stability of fracking fluids.
- **Cost-Effective:** HOCl treatment is economical, historically treatments have been as low as $0.04/bbl
- Rapid Action: HOCL acts faster than bleach giving a quicker kill.
- Less Corrosive: HOCl is less corrosive to metals and surfaces compared to other oxidizers.
- Effective at low concentrations: Due to its high efficiency, HOCl can be used at lower concentrations
- Environmental impact: HOCl breaks down ito harmless substances ie. water and salt (NaCl). Unlike bleach it does not generate chloramines or trihalomethanes.

What is HOClX-1

- Hypochlorous acid (HOCl) is recognized as the most effective chlorine-based oxidizer and is faster than bleach in killing microorganisms; as well as, having broad-spectrum antimicrobial properties.
- HOCl is approximately 80 to 200 times more effective as a biocide compared to sodium hypochlorite (NaOCl). This heightened efficacy is attributable to the unique properties of HOCl. Sulfate-reducing bacteria (SRB) and acid-producing bacteria (APB) possess cell walls with a net negative charge. Because HOCl is neutral, it can more readily penetrate these cell walls, leading to cell lysis and effectively neutralizing these microorganisms.
- HOCl exhibits optimal effectiveness within a slightly acidic to neutral pH range (approximately pH 5-7). In this pH range, HOCl not only functions as a potent oxidizer but also serves as a buffering agent, thereby maintaining the pH stability of fracking fluids without causing an increase in their pH levels.
- HOCl is a safe, non-HAZMAT (hazardous material) oxidizer that does not generate chlorine pollutants when utilized within the accepted pH range. This makes it a more environmentally friendly option compared to other chlorine-based oxidizers.
- In contrast, sodium hypochlorite (commonly known as bleach) can produce chlorine gas through off-gassing, as described by the following chemical reaction: $2ClO^- \rightarrow Cl^- + ClO_2^-$
- This reaction highlights a significant drawback of using sodium hypochlorite, particularly in environments where the release of chlorine gas poses a safety risk.
- Hypochlorous acid (HOCl) offers significant safety benefits over other oxidizers, primarily due to its lower toxicity and reduced corrosiveness. HOCl is much less irritating to the skin, eyes, and respiratory system. Additionally, HOCl is less corrosive to metals and surfaces, which helps to preserve equipment and infrastructure, reducing maintenance and replacement costs. These properties make HOCl a safer, more user-friendly disinfectant compared to traditional oxidizers.

pH Effects on Chlorine Based Oxidizers.

- Bleach – OCl^- has a pH range of 8-14, when added to production fluids it causes an increase in fluid pH which needs to either be buffered back down or can cause frac chemical issues.
- Hypochlorous Acid - HOCl has a pH range of 5-7 which is typical range for frac and production fluids, HOCl will act as a natural buffer by maintaining these pH fluids eliminating the need to influence pH



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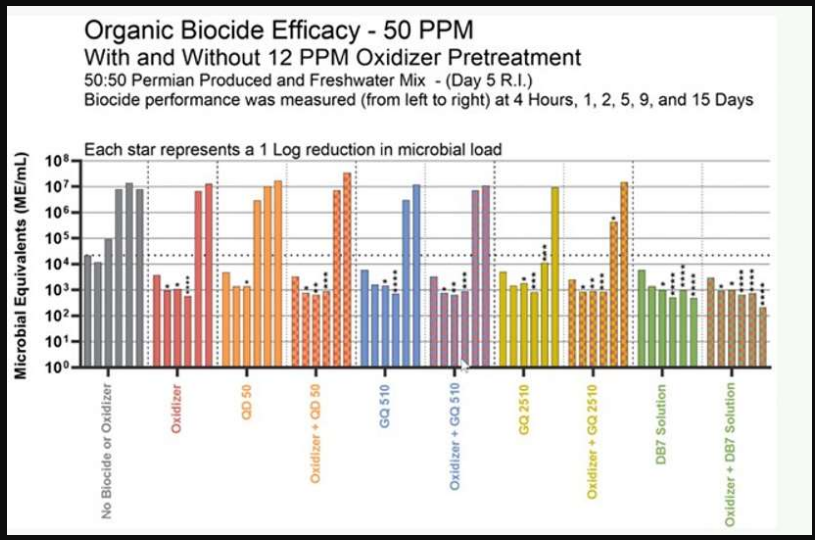
Production Reduction Mechanism
Impacts on Wells Productivity

Oxidizing Biocide – HOClX-1

- Easy-to-use biocide that has multiple applications
- Prevents and removes biofilm and slime build up
- Disinfects frac water and prevents groundwater contamination
- Neutralizes hydrogen sulfide
- Effective in controlling Sulfate Reducing Bacteria (SRB)
- 100% natural and safe to use around people and animals without PPE
- Non-toxic and non-corrosive and non-combustible
- Broad range of bactericidal and virucidal effects
- Lower operating costs

Figure 2. 3rd Party Kill Study Testing with OSP.



Production Reduction Mechanism
Impacts on Wells Productivity

CLR Oak Barrel 1-36-25-24XHW
Biocide Application

Native Chemical provided HOClX-1 at a average rate of 0.2gpt as the biocide.
Treatment cost was $0.04/bbl for a total job volume of 425,000 bbls.
Delivered chemistry in an Iso on location and plumed into water transfer manifold system upstream of the frac tanks.
Residuals were monitored and a 1ppm FAC was maintained in the working tanks.

Outcome: Monitored flowback and production for 120 days. No H_2S or incompatibility issues in well water production.

Royalty Field Report – H_2S Mitigation

On June 16, 2022, Native applied 660 gallons of HOCl to 130bbl of water to be used as flush fluid for a 4,000-gallon HCl acid job completed June 17, 2022, on the Yale 21-3H API# 3512523887 located near Maud, OK. Prior to treatment H_2S was captured at the sales meter ranging from 25-30 ppm that was being treated with 15 gallons of H_2S scavenger per day in order to sell residue gas to the purchaser below their field standard of 3ppm.

After Completion of the acid treatment with HOCl flush on June 17, 2022, the Yale 21-3H was shut in for 24 hours. Upon resuming production on June 18, 2022; H_2S was undetectable and has remained so today's date Feb. 24, 2023. The treatment has resulted in over $20,000 in chemical savings to date. Pictures below show the location with the jobs and current readings of H_2S on location.

Executive Summary

- Hypochlorous acid (HOCl) is recognized as the most effective chlorine-based oxidizer, significantly outperforming sodium hypochlorite (bleach) in microbial eradication. HOCl's neutral charge allows it to penetrate negatively charged cell walls of sulfate-reducing bacteria (SRB) and acid-producing bacteria (APB) more effectively, making it 80 to 200 times more potent as a biocide than bleach. Optimal effectiveness is achieved within a pH range of 5-7, aligning perfectly with the slightly acidic to neutral pH needed for fracking fluids, thus maintaining pH stability without increasing fluid pH.
- HOCl is non-HAZMAT, does not produce harmful chlorine pollutants, and poses minimal safety risks compared to bleach, which can release chlorine gas. Its lower toxicity and reduced corrosiveness make HOCl safer for skin, eyes, respiratory systems, and less damaging to equipment, thus reducing maintenance costs.
- An efficacy test conducted by a leading biocidal application lab demonstrated that HOCl (HOCLX-1) performed equally well or better than competitor products, maintaining biocidal efficacy for up to five days at only 12 ppm, compared to 50 ppm for other biocides. The cost-effective treatment, at $0.04 per barrel for a total volume of 425,000 barrels, included easy application via the water transfer manifold system, ensuring consistent residual levels.
- HOCl's versatile applications include biofilm and slime prevention, groundwater contamination prevention, and hydrogen sulfide neutralization. It is non-toxic, non-corrosive, non-combustible, and safe to use around people and animals without the need for PPE.