Metastable Hypochlorous Acid *(HOCl)* As An Oilfield Biocide

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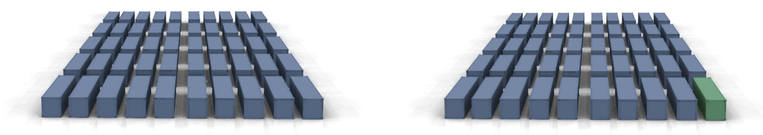
ABSTRACT

A metastable form of hypochlorous acid (HOCl) has been registered with the USEPA as a biocide suitable for use in oilfield applications. It is registered for use in 49 states, and is pending registration in the 50th (California). More than 500,000 gallons of the biocide have been used to treat water for hydraulic fracturing treatments in Pennsylvania, Louisiana, Oklahoma, and Texas. The USEPA registered product is trademarked by Integrated Environmental Technology, Ltd., the entity which manufactures the EcaFlo® devices to make the USEPA registered biocide, as EcaFlo® Anolyte. For oilfield applications, the biocide is sub-registered as Excelyte® and is patent pending for this application. The metastable form of hypochlorous acid, hereinafter referred to as ms-HOCl, is up to 100 times more effective as a biocide than hypochlorites (i.e., bleach, NaOCl), and is not DOT Corrosive, as is the case with bleach.

Identical Footprint



1,000,000 gallons of untreated frac water

1,000,000 gallons of frac water treated with 20 gallons per thousand of Excelyte® (ms-HOCl 500)

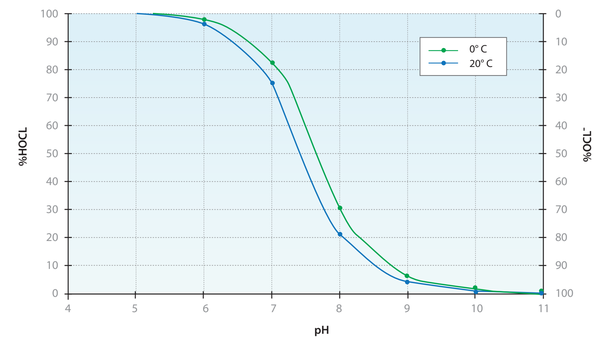
OVERVIEW

A metastable form of hypochlorous acid (HOCl) has been registered with the U.S. Environmental Protection Agency and most US States as a biocide suitable for use in treating water for oilfield applications. Registration in California is pending. The biocide provides an effective “double-edged” weapon against oilfield bacteria, combining both oxidation/reduction potential and chlorination to achieve an easily and quickly measured effectiveness.

More than 500,000 gallons of the biocide have been used to treat water for hydraulic fracturing treatments in Pennsylvania, Louisiana, Oklahoma, and Texas. The USEPA registered product is trademarked by Integrated Environmental Technology, Ltd. (IET), the entity which manufactures the EcaFlo® devices to make the registered biocide, as EcaFlo® Anolyte. For oilfield applications, the biocide is sub-registered as Excelyte® and is patent pending for use in fracturing.

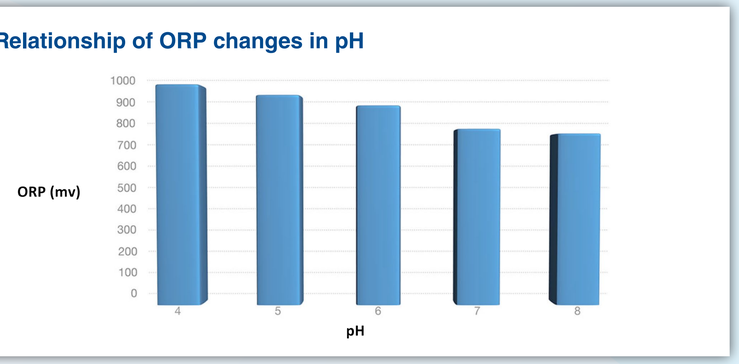
The metastable form of hypochlorous acid (ms-HOCl) is up to 100 times more effective as a biocide than hypochlorites (i.e., bleach, NaOCl), and is not USDOT Corrosive, as is the case with industrial bleach solutions. For oilfield applications, the biocide is typically provided as a pH circumneutral product possessing a minimum free-available chlorine content of 500 ppm. A method to determine the biocide requirement, called the Free-Available Chlorine (FAC) Demand test, is available. The test provides for a method to quickly determine the necessary biocide dosage without having to wait two to four weeks for the more-accepted microbiological test method results.

Ratio of HOCl to OCl- as a function of pH



Metastable hypochlorous acid has been demonstrated to be a powerful, fast acting biocide compatible with Slickwater Fracturing additives such as polyacrylamide friction reducers, microemulsions, and surfactants, and with Crosslinked Polymer fracturing fluids, such as borate crosslinked guar and zirconium crosslinked CMHPG. As a fast-acting biocide, metastable hypochlorous acid performs its function under surface conditions eliminating the need to evaluate the efficacy of the product under down-hole environments.

Relationship of ORP changes in pH

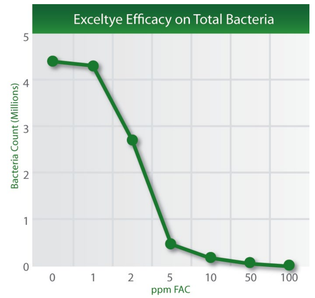


Hypochlorous acid is a mild acid which decomposes very rapidly to a very dilute sodium chloride solution. Metastable hypochlorous acid (ms-HOCl), as represented by Excelyte® manufactured by IET’s EcaFlo® units, decomposes much more slowly while still responding very quickly to any bacteria present, and to oxidizable molecules such as hydrogen sulfide, providing for an active product which can be delivered to drill-sites, well-sites, or other field locations to act quickly upon iron-, sulfate-, and/or sulfate-reducing bacteria in water.

This article is confined to discussing the use and benefits of metastable-hypochlorous acid (ms-HOCL) in well fracturing applications.

Microbiological Analysis - Planktonic Enumeration			
Sample Number	**GHB** *(QW1522)*	**APB** *(QW1529)*	**SRB** *(QW1521)*
Excelyte 50mL + FR pH 7.0 (0 mins)	4.5 X 10^5 /ml	4.5 X 10^5 /ml	4.5 X 10^4 /ml
Excelyte 50mL + FR pH 7.0 (30 mins)	1.5 X 10^1 /ml	1.5 X 10^1 /ml	0.4 X 10^0 /ml
Excelyte 50mL + FR pH 7.0 (24 hours)	2.5 X 10^1 /ml	2.5 X 10^1 /ml	<0.3 X 10^0 /ml
Excelyte 50mL + FR pH 7.0 (7 days)	9.5 X 10^0 /ml	9.5 X 10^0 /ml	<0.3 X 10^0 /ml

Excelyte® at 50 gallons per thousand (5 ppm FAC net); FR - Anionic Polyacrylamide Friction Reducer; APB - Acid producing bacteria; GHB - General Heterotophic bacteria; SRB - Sulfate reducing bacteria



Properties	Bleach	Excelyte™
Disinfectant	Strong	**Strong**
Biocidal Property	Weaker	**Stronger**
Toxicity, mammalian	Yes	**No**
Ionic Charge	Anionic, Negative	**Neutral**
Corrosivity	Strong	**None**
DOT Hazardous	Yes	**No**
Protective Equipment	Yes	**No**
Environment Friendly	No	**Yes**
Frac Fluid Compatible	?	**Yes**

CONCLUSIONS

1. The metastable form of hypochlorous acid (ms-HOCl) is an effective and environmentally-acceptable biocide.

2. Metastable hypochlorous acid is available to most drill-site, well-site, and other field locations, as a USEPA registered biocide. (California pending)

3. Metastable hypochlorous acid is not DOT regulated.

4. An FAC-Demand Test is available to quickly determine ms-HOCl dosage for any quality water.

5. Metastable hypochlorous acid is compatible with additives such as polymers, crosslinkers, and friction reducers, typically used in well fracturing applications.

6. As a fast acting biocide, ms-HOCl is suitable for use in wells with BHST’s from 85F to 450F.

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