

THE RENEWIQ™ SOLUTION: MICROBIAL AND IRON CONTROL IN FRAC WATER



BACKGROUND

A major producer in the Fayetteville shale used hydraulic fracturing as the completion method to produce wells. Their fracturing fluid was a mixture of water, chemicals and proppant, and the water used in fracturing operations was a blend of fresh water and produced/flowback water from the operator's other producing well sites.

PROBLEM

The two major concerns when fracturing these wells were bacteria that can reduce sulfates and create hydrogen sulfide (H₂S), and iron in the water, which can precipitate and plug the reservoir.

The producer historically used a commonly-available, non-oxidizing biocide to control bacteria in the frac water, an option that was quite costly. However, the producer was still seeing unacceptable H₂S levels in the production stream. In addition, iron was not being controlled by the biocide, adding to the operating risk. The producer engaged Nalco Champion to find a better solution to manage these risks.

SOLUTION

After conducting a detailed review of the production system and a combination of testing in the lab and in the field, Nalco Champion recommended a RenewIQ solution for trial. BIOC16734A biocide is a rapidly reacting, broad spectrum biocide that oxidizes proteins in microbial cells as its biocidal kill mechanism. It is also a weak oxidizer that is effective at selectively oxidizing Iron and H₂S. The post-oxidation byproducts of BIOC16734A biocide are water and acetic acid.

Prior to implementation of any RenewIQ solution program, Nalco Champion conducts thorough training for all its operations staff, as well as the customer's staff and their vendors. In addition, specialized chemical injection equipment has been designed for these applications. Both of these elements are part of Nalco Champion's comprehensive RenewIQ solution safety program.

The fracturing site solution was designed as follows: The producer's water was brought in by trucks and was aggregated in a nearby recycle battery (see Figure 1). From the recycle tanks, the water flowed to a second set of holding tanks where the fresh water was added. The combined water stream was sent to the blender tub,

which fed the downhole injection pumps (see Figure 2). BIOCI6734A biocide was injected at two points in the process; in the produced water to control bacteria and oxidize iron, and in the blender tub to ensure low bacteria levels in the combined water stream just prior to downhole injection.

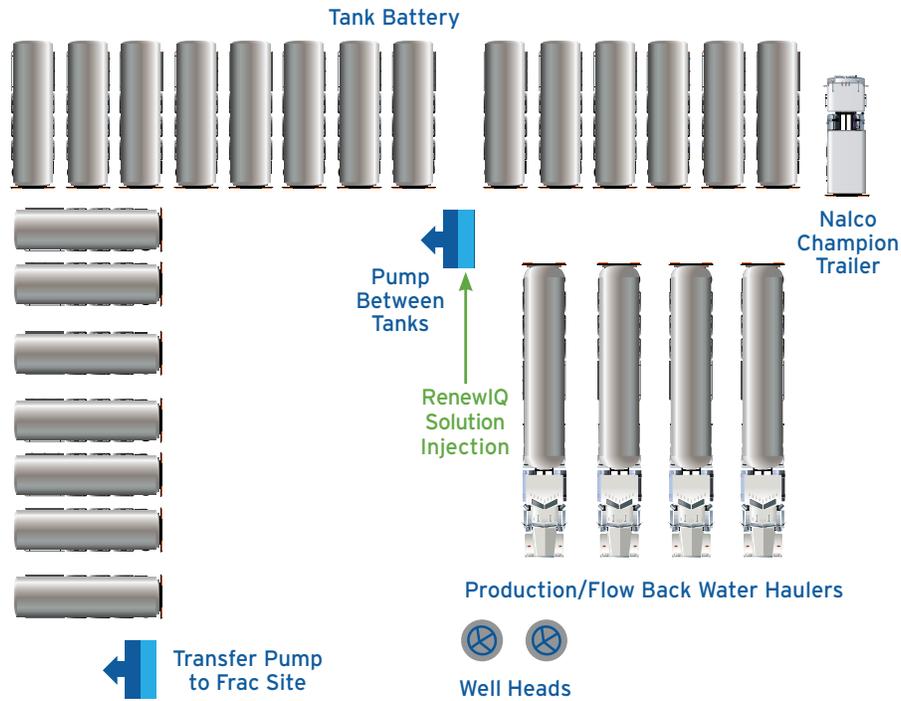


Figure 1 - Typical recycle battery layout. Nalco Champion injects BIOCI6734A biocide in these holding tanks to manage bacteria and to oxidize dissolved iron.

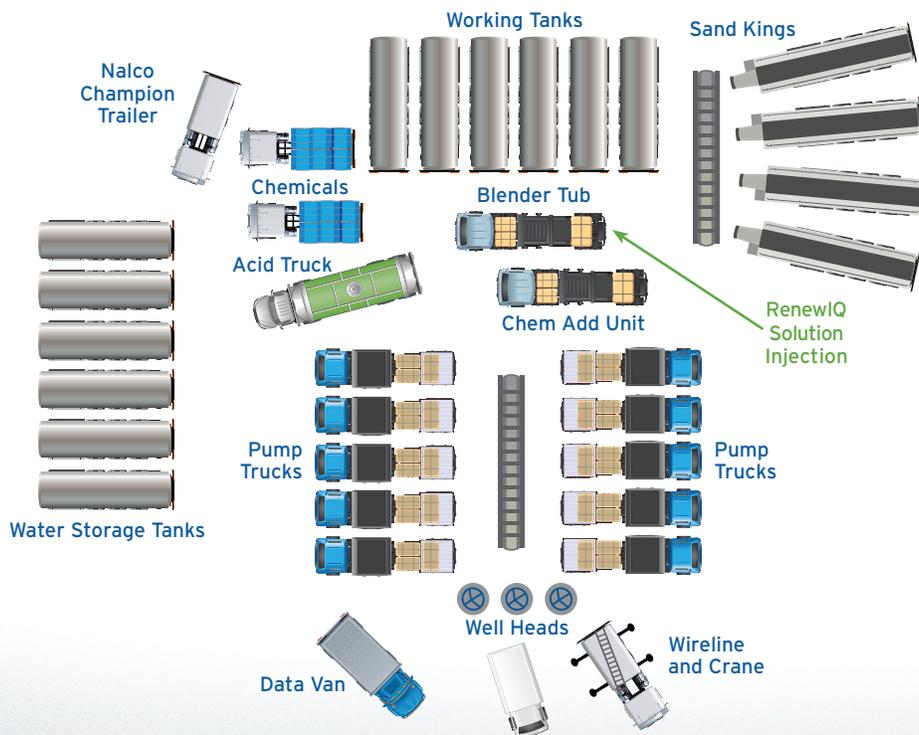


Figure 2 - Typical frac site layout. Nalco Champion injects BIOCI6734A biocide into the blender tub to ensure low levels of bacteria going downhole.

RESULTS

The RenewIQ treatment program recommended by Nalco Champion was very successful in reducing iron and in controlling bacteria (which in turn controlled H₂S). The treatment resulted in >95% average reduction in both bacteria and iron levels for all of the produced water treated; 85% of completed wells had ATP readings below the goal of 100,000 microbes equivalent per milliliter (me/mL). In addition, over the course of a year, 75% of wells met the stringent pipeline H₂S specifications of <4 ppm without the use of other H₂S scavengers, saving the customer money that would otherwise be used on H₂S scavenging chemicals.

The average cost of treatment for the re-used water was \$0.42 per barrel, and the combination of the cost and performance of BIOC16734A biocide allowed the producer to recycle 99% of their produced water. The water recycling, facilitated by the use of BIOC16734A, was a significant cost savings for the producer in comparison to alternative water-management strategies, such as having to haul the water away for disposal.

The producer continues to apply RenewIQ solutions in all new wells completed by the company. Since implementation, Nalco Champion has applied BIOC16734A biocide to the completion process in >100 wells with this producer. Results continue to show the exceptional bacterial control and cost effectiveness.



Before and after treatment of produced water for fracturing reuse with the RenewIQ solution.

Typical Formation Well - Total System ATP Monitoring Averages

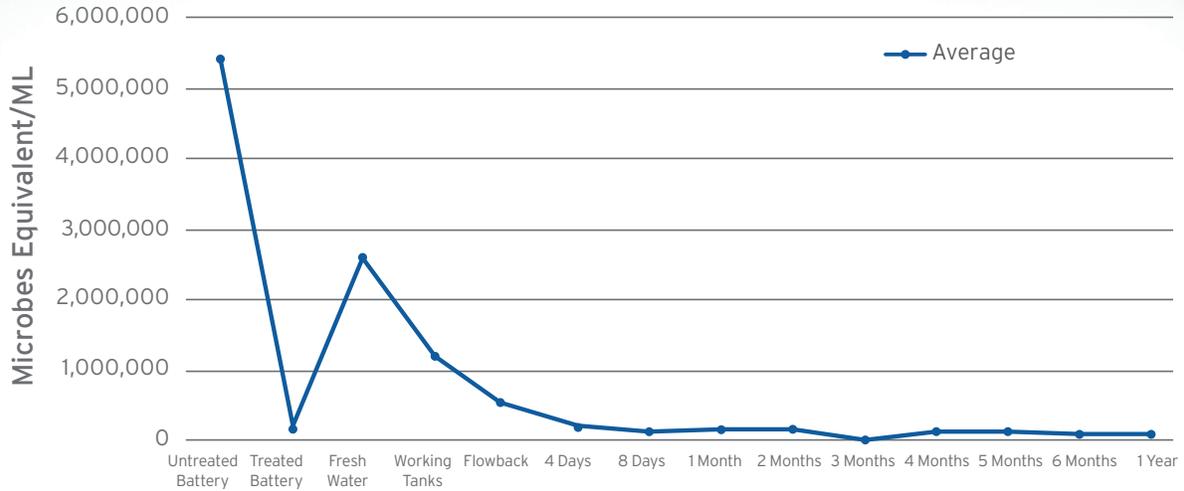


Figure 3 - Bacteria count is substantially reduced when the produced water is treated with BIOCI6734A biocide. Bacteria count in flowback/produced water remains low over time.

H₂S Occurrence < 4 PPM

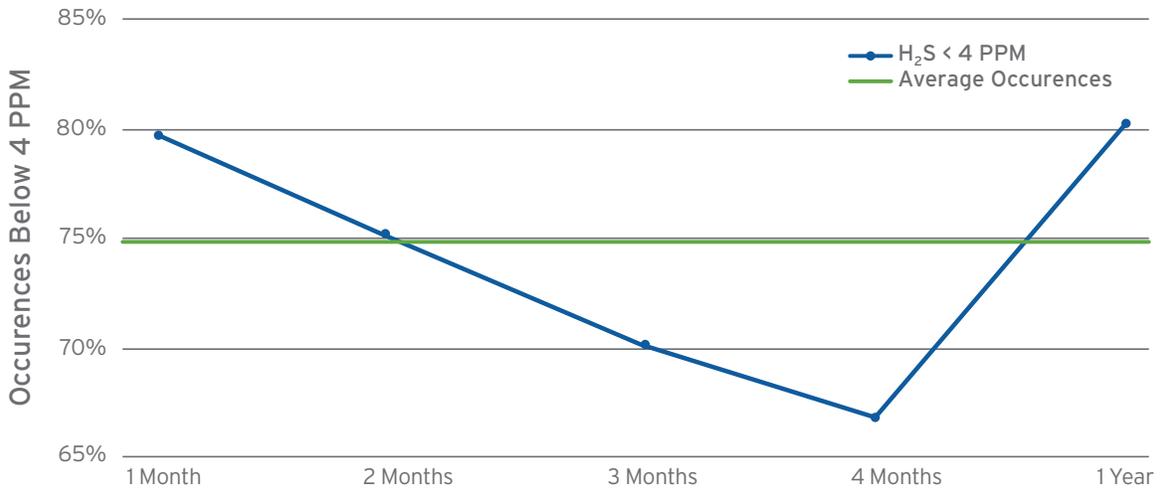


Figure 4 - In 75% of all wells tested over the course of 1 year, H₂S levels were kept below the 4 ppm pipeline specification threshold without the use of H₂S scavengers.

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