

nanoActiv[®] HnP Powered by Messer.

A next generation *Boost-EOR*[™] well enhancement solution.



trademark of NCA

nanoActiv® HnP.

Energize, activate and enhance hydrocarbon recovery.

nanoActiv® HnP is a multi-spectrum treatment for vertical and horizontal wells suffering from declined production with restrictions to fluid flowing into the wellbore. This treatment enables the recovery of hydrocarbons to be accomplished faster, more completely, and with longer efficacy than existing options on the market today.

A Productive Collaboration.

Messer and Nissan Chemical have joined efforts to enhance downhole performance by combining nanoActiv® with a carbon dioxide (CO₂) or nitrogen (N₂) application method.

Nissan Chemical's excellence in nanotechnology and Messer's global reach and expertise in job design and technical services in oil and gas well remediation and restimulation, combine to provide maximum techno-economic production results in today's market.

A Powerful Combination.

Combining properties of gas and nanoparticles creates a unique, synergistic treatment that addresses several potential production issues simultaneously. The gas helps remove debris, fines and other matter and stimulates the well with pressure, while driving the effective distribution of the nanoActiv® HRT particles to deeper parts of the formation. In cases where the gas is miscible, it also contributes to mobilizing crude oil due to swelling and viscosity reduction.

nanoActiv® HRT's nano-sized particles penetrate further and more thoroughly permeate the natural fracture network than traditional remediation or restimulation technologies. These particles produce a Brownian-motion, diffusion-driven mechanism, known as disjoining pressure, resulting in longer and more complete production efficacy. Field application data validates that particles pushed with Messer's gas produce significant and sustained improved hydrocarbon recovery.

Application.

Our solution is a prescribed, well remediation treatment (Huff'n Puff) consisting of three phases: injection, soaking and production. Because of the synergies between the nanoActiv® HRT and gas, the soak times can be dramatically reduced from traditional HnP treatments. Depending on the type of formation, well history and identified issues, a specific treatment plan is prescribed.

Well Treatment Screening.

For a successful treatment, appropriate screening of candidate wells is the first step. Messer and Nissan will work with operators on candidate identification before prescribing a recommended treatment plan.

| | |
|----------------|---|
| Production | Good initial production (IP) with decline curve that indicates wettability issues. Current production <20% of IP and >5-10 BOPD or 20 mscf. |
| Field Data | Overall well performance should be on par with other wells in the field. |
| Treatments | Acid and other chemical treatments may negatively impact properties of nanoActiv® HRT. |
| Well Equipment | To be in good mechanical condition. Pumps, linings, gaskets. |
| Water | Too high content of salts (e.g., KCl) and TDS may negatively impact nanoActiv® HRT. |
| Water Cut | <80% (N ₂), <90% (CO ₂) |
| Net Pay Zone | <100 ft (30 m) to optimize for 60-90 days pay-back. |
| Porosity | Conventional >8%, Unconventional >4%. |
| Oil | Oil gravity <30 API it's recommended to use CO ₂ . Asphaltene precipitation may be caused by gas injection. |

"Every well is different, so the nanoActiv® HnP treatment is tailored for every well. We work with Nissan and well operators to appropriately screen and prescribe the right nanoActiv® HnP treatment for each well."

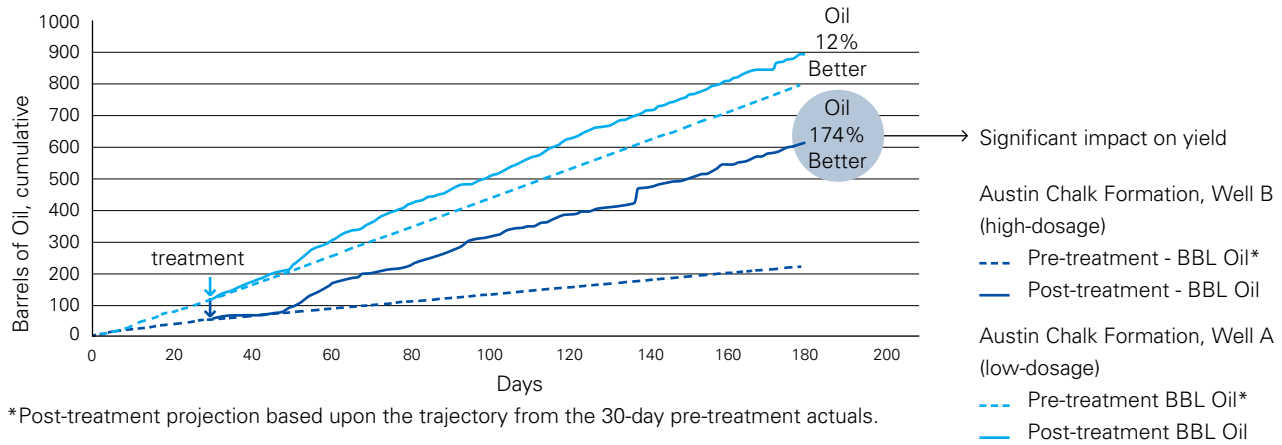
Robin Watts, Program Manager,
Chemistry & Energy, Messer



Oil production.

Austin Chalk Wells A&B – FRIIO County

nanoActiv® HnP (nanoActiv® HRT and Nitrogen) pre- and post-treatment comparison after 180 days of cumulative production.



Austin Chalk Formation, Well A (low dosage).

nanoActiv® HnP pre- and post-treatment comparison after 180 days of cumulative production. Cumulative oil production increased 12%.

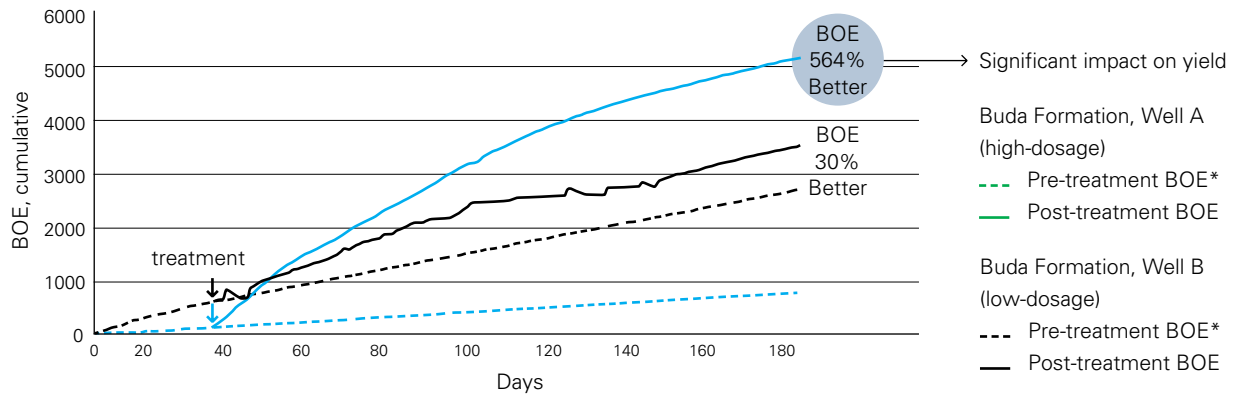
Austin Chalk Formation, Well B (high dosage).

nanoActiv® HnP pre- and post-treatment comparison after 180 days of cumulative production. Cumulative oil production increased 174%.

Gas production.

Buda Well A&B – FRIIO County

nanoActiv® HnP (nanoActiv® HRT and Nitrogen) pre- and post-treatment comparison after 180 days of cumulative production.



Buda Formation, Well A (high dosage).

nanoActiv® HnP pre- and post-treatment comparison after 180 days of cumulative production. Cumulative gas production increased 564%.

Buda Formation, Well B (low dosage).

nanoActiv® HnP pre- and post-treatment comparison after 180 days of cumulative production. Cumulative gas production increased 30%.

Numerous factors affect the performance of an oil well — the geology, the number and size of treatment stages, the choice of additives, etc. nanoActiv® HnP treated wells have shown meaningful performance improvement versus comparative wells from the same operators. While no single technology or treatment can account for the entire performance of an oil well, the effects of nanoActiv® HnP are significant and compelling.



A history of success.

Nissan Chemical America Corporation is a division of Nissan Chemical Corporation, founded in 1887 as the first chemical fertilizer manufacturer in Japan. A forerunner in chemical innovations for more than 130 years, Nissan Chemical currently manufactures products for the chemical, agrochemical, and pharmaceutical industries and is a market leader in the production of nanoparticles for the automotive, coatings, electronics, and oil and gas industries.

Nissan Chemical has been perfecting nanoparticles since 1951, making it one of the first companies in the world to produce highly surface-modified particles for industrial applications. Our years of experience, proprietary materials, and patented technologies have helped us become a worldwide leading provider of refined nanoparticle solutions.



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