Biological solutions for a clean, safe environment.

PARA-BAC

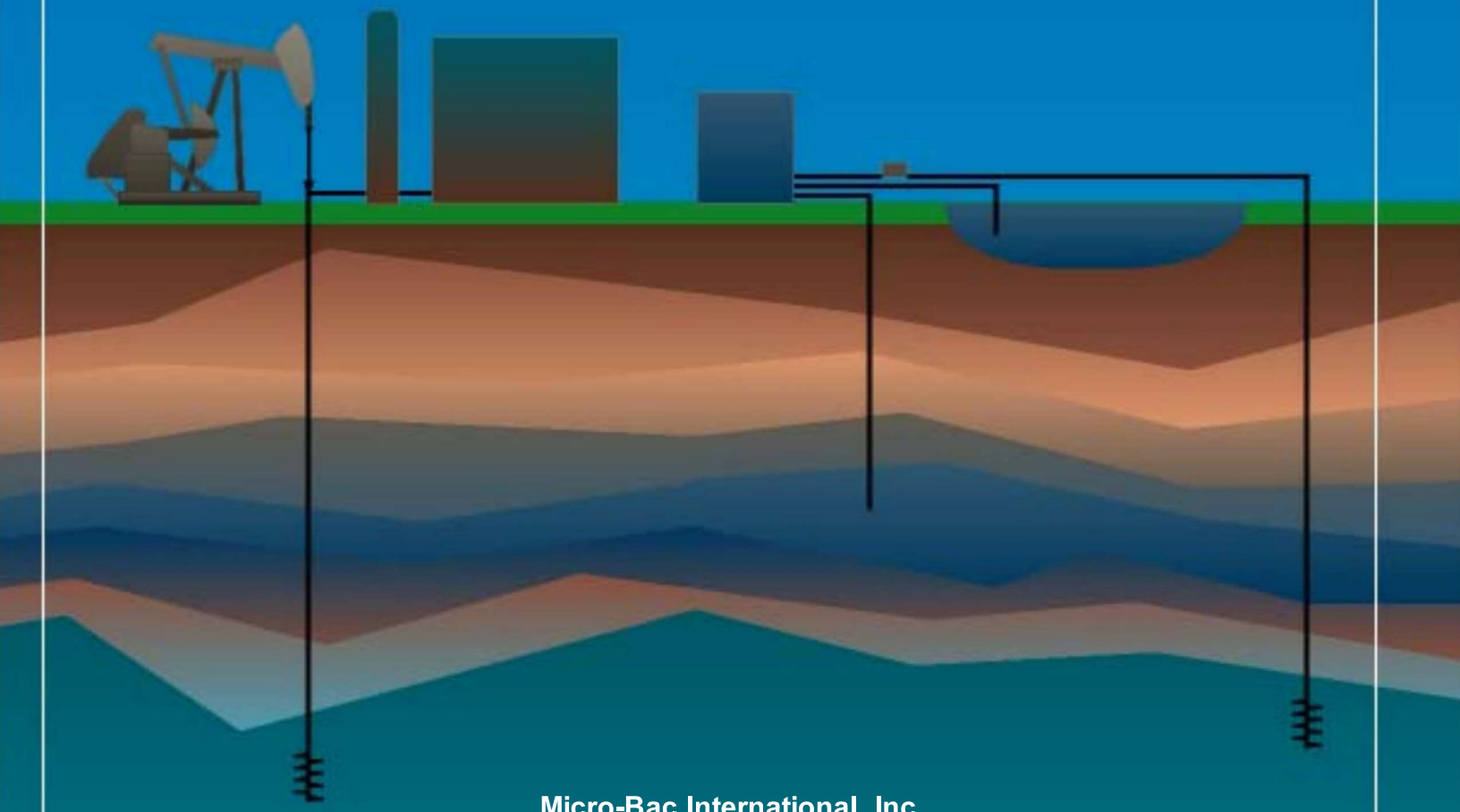
Effective control of paraffin.

Prevention of scale and corrosion.

Microbial enhanced oil recovery.

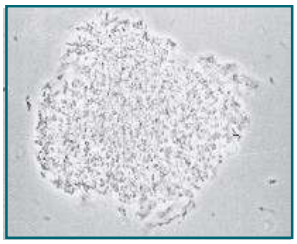
Safe to handle— no environmental hassles.

Laboratory analysis and technical support.



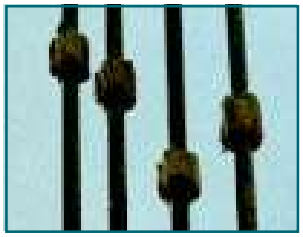
Micro-Bac International, Inc.
3200 N IH35, Round Rock, TX 78681-2410
Toll Free (877) 559-1800 Fax (512) 310-8800 www.micro-bac.com

Para-Bac Oil Field Products



For half a century, researchers have pursued the improvement of petroleum production through microbiology. But not until the introduction in 1986 of Para-Bac™ by Micro-Bac® International, Inc., has there been a commercial biological product that offers successful long term control of paraffin, scale, and corrosion. Various Para-Bac products also treat emulsion, basic sediment and water (BS&W), hydrogen sulfide (H_2S), and sulfate-reducing bacteria (SRBs). In recent years, Para-Bac has advanced into the field of microbial enhanced oil recovery. Products in the Para-Bac line have been used in many types of reservoirs with differing characteristics such as carbonate and sandstone rock, and water driven, solution gas driven, or reservoirs under secondary recovery. Para-Bac products contribute to the successful operation of thousands of oil wells worldwide, helping oil producers reduce operating costs, improve oil production, and increase profits.

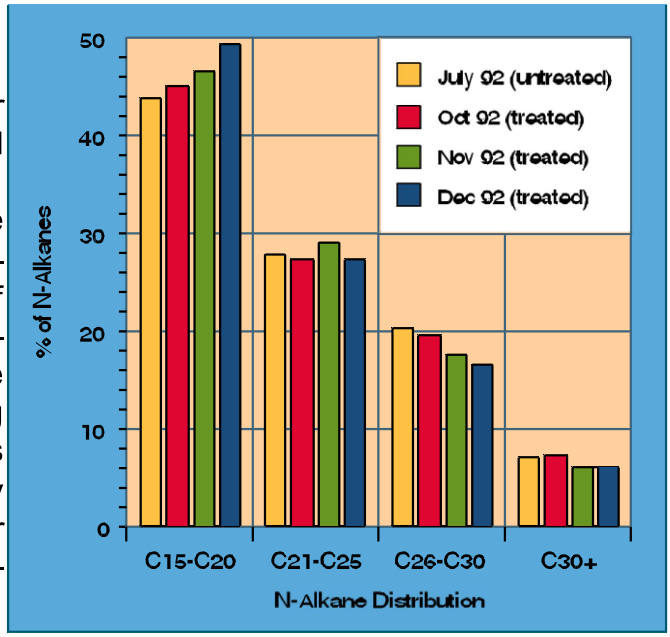
Para-Bac Bacteria



Para-Bac products are comprised of 100% natural (not genetically engineered), non-pathogenic, live bacteria that have been specifically selected and adapted for petroleum production problems. Although these products represent a new era in oil field treatment methodology, the Para-Bac process is based on scientifically established principles. Para-Bac's microorganisms use paraffin in their metabolic activity. In the digestion process, Para-Bac bacteria control paraffin accumulations and produce by-products that act as surfactants and paraffin solvents. The proprietary knowledge used to develop and manufacture Para-Bac involves isolating and adapting specific strains of bacteria. And because the principal strains in Para-Bac are facultative anaerobic bacteria, they are able to work in the presence or the absence of oxygen.

Paraffin Control

Conventional methods for treating paraffin can be costly, damaging, and dangerous. Hot oiling results in lost production time, is potentially explosive, and may damage the formation; chemical paraffin solvents and dispersants may be toxic; and mechanical removal of paraffin requires production downtime and is limited to accessible areas. Above all, each of these methods is only partially effective. By introducing Para-Bac bacteria, customary treatment methods can be eliminated or greatly reduced. This directly impacts oil production and equipment repairs or replacement — all of which can lower lease operating costs.

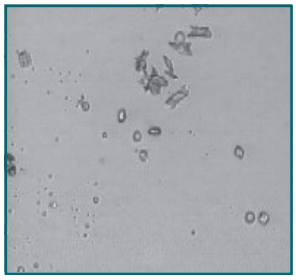


Corrosion, Scale, H_2S, and SRBs

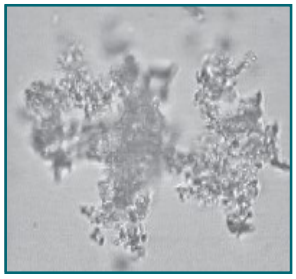
Problems arising from scale formation and corrosion are traditionally treated with methods that can be expensive and dangerous. With Para-Bac, though, microbial metabolism produces several substances that have chelating, anti-precipitation, filming or bio-surfactant activities — the same properties of conventional products used as scale and corrosion inhibitors. And the filming activity of Micro-Bac International products fights corrosion by coating metallic surfaces.

H_2S of microbial origin is usually generated by a group of obligate anaerobic bacteria known as sulfate reducing bacteria (SRBs). Para-Bac products will not cause or aggravate problems related to SRBs. In fact, Para-Bac bacteria are competitors for the organic nutrients found in oil, and thus are able to control the growth of SRBs by reducing the food sources available to them. Furthermore, certain products in the Para-Bac line are specifically directed at wells where SRBs pose a serious problem.

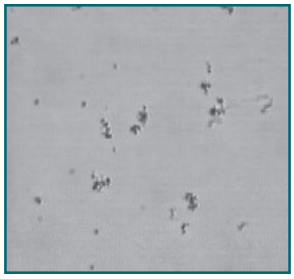
Untreated calcium sulfate scale. Notice large crystals.



Calcium sulfate solution treated with Corroso-Bac



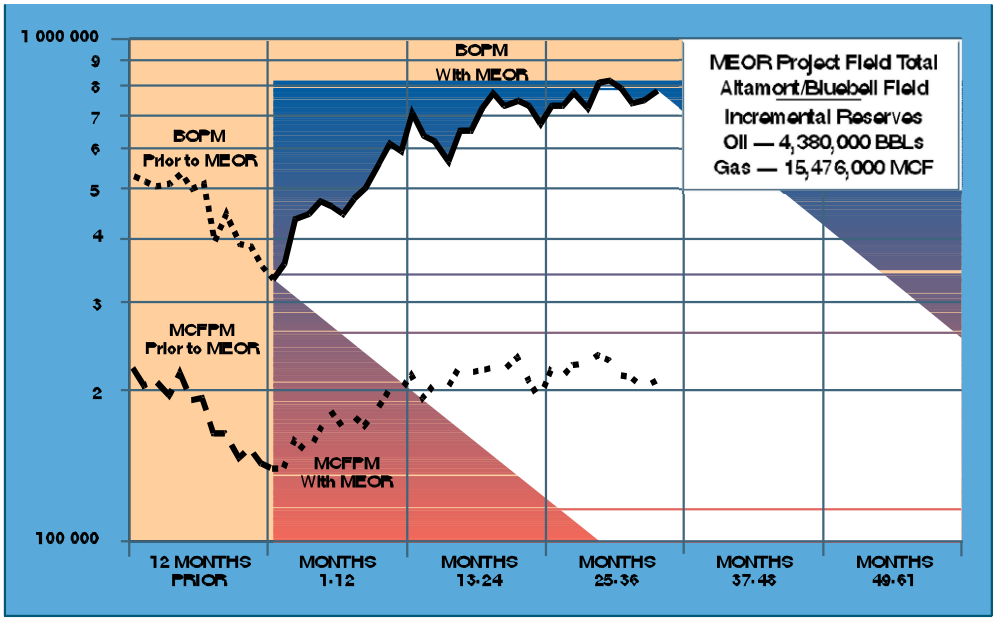
Untreated barium sulfate scale. Notice large crystals.



Barium sulfate solution treated with Corroso-Bac

Enhanced Oil Recovery/Increased Production

Para-Bac products not only improve operations and reduce costs, they can also increase oil production. Increases from ten to fifty percent are not unusual. Some of the reasons are operational, some are scientific. Oil producers experience decreased downtime with Para-Bac because production is not interrupted for treatment with hot oil or chemicals. And with Para-Bac, well bores are cleaned — Para-Bac removes paraffin-based skin damage that restricts perforations, pump operation, or tubing.



Para-Bac treatments can also enhance oil field recovery, improve recovery efficiency, and increase recoverable reserves by introducing the microorganisms directly into the formation. Paraffin deposits are removed from the formation itself, thus allowing oil to move to the well bore.

Tank Cleaning, Emulsion Breaking, and Pipelines

Stable emulsions, sediments and precipitates in tank bottoms, and accumulations of paraffin in pipelines are a frequent problem in oil production. Para-Bac products have been very successful in improving oil/water breakout and in solubilizing precipitates. Various products of Para-Bac's bacterial metabolism, such as biosurfactants, organic acids, and alcohols, may amplify the process of breaking the emulsion; and the bacteria also degrade solids that contribute to accumulations in tank bottoms and pipelines. By taking advantage of the natural biological activity of Para-Bac products, costs are reduced for conventional heat treatments, chemicals, centrifuges, and ultra-filtration.

Field Applications

When a field is identified as a potential candidate for microbial treatment, samples are submitted to Micro-Bac International's laboratory. Information is gathered on the history of the targeted wells & on the problems that need to be treated. Following analysis of the fluids, specific dosages of products or blends are recommended. Para-Bac products are usually introduced into the well bore annulus by batch-treatment. Periodic retreatment is required to maintain the bacterial colony. In most cases, little or no modification of wellhead plumbing is required, & daily production is not adversely affected.

Control with water and carrier oil before incubation.

Control after 60 hours incubation.

Sample after 60 hours incubation with Para-Bac/S at 25,000 ppm.

PIPELINE CLEANING with PARA-BAC MICROBES

A section of an actual pipeline with approximately one centimeter of paraffin on the inside surfaces was tested to determine the effect of Para-Bac on paraffin accumulation.

Segments were cut, immersed in water, and amended with 50 ml of pipeline oil. Following 60 hours of incubation at 35°C, excess water was removed. The remaining paraffin was weighed.

The pipe segment treated with 25,000 ppm of Para-Bac/S showed a 36% reduction in paraffin accumulation.

Environmentally Safe, Easy to Use

Because Para-Bac products are natural and non-pathogenic, they will not harm people, equipment, or the oil. Since their introduction in 1986, Para-Bac products have shown no discernable negative effect on wells, refineries, transport facilities, or the actual oil sold. Para-Bac is also environmentally safe and displays minimal toxicity in standard fish toxicity tests. Because Para-Bac bacteria are naturally occurring and non-pathogenic, there are no EPA restrictions regarding their use or transport.

Strong Service and Support

Micro-Bac International, Inc. has been specializing in bacteria for over two decades. As a leader in the microbiology industry, Micro-Bac supports its products with sophisticated lab facilities, an ongoing commitment to research and development, and proprietary technology for in-house production and quality control. Micro-Bac products are utilized worldwide to provide quality biological products for cost-effective solutions to oil field production problems.

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PHONE (512) 310-9000 • TOLL-FREE (877) 559-1800 • FAX (512) 310-8800 • E-mail: mail@micro-bac.com