



**Microbial Biotechnology** for Oil + Gas  
Operations, Water Treatment, and  
Environmental Cleanup.

**Nobody does saltwater disposal and  
waterflood treatments better than we do.**



JGL Solutions is a **leader in the development, delivery, and  
application of microbial biotechnology** to the oil and gas industry.

# OIL AND GAS

## MICROBIAL BIOTECHNOLOGY SOLUTIONS

JGL Solutions provides a full range of water treatment microbes, oil + gas production microbes, and environmental cleanup microbes.

### TECHNOLOGY OVERVIEW

JGL Solutions applies millions of live microbes to each system, never freeze-dried or bagged, **in order to maintain colonies of approximately one million cells per mL of fluid for disposal, injection, and produced water.**

The colonies are primarily maintained by the microbes reproducing in surface facilities and in the reservoir, therefore, reducing cost and eliminating the need to maintain “ppm.” **They are always present and always working full strength to:**

- Remove deposits and dissolve thick pads
- Improve water quality
- Reduce oil carryover
- Prevent scale and corrosion

### APPLICATIONS INCLUDE:

- Commercial Disposals
- Flowback Pits
- Oil Spills
- Pipelines
- Pretreatment Frac Water
- Produced Water
- Producing Wells
- Saltwater Disposals
- Site Cleanup
- Soil Remediation
- Waterfloods

### JGL SOLUTIONS IS A FULL SERVICE COMPANY

In addition to our comprehensive portfolio of microbial products, **our experienced field and office personnel work together to create an optimal treatment design and a specific microbial blend for your system** based on detailed lab analysis completed at the *JGL Solutions Laboratory*.

**From in-lab to on-site, JGL field personnel delivers, handles, and injects the tailor-made microbial blend directly into your system.** No pump or tank to maintain, no ppm to regulate, and no environmental liability.

# WATER TREATMENT TECHNOLOGY



## SALTWATER DISPOSAL & WATERFLOOD TREATMENT

Four Key Benefits of JGL Microbes to **Achieve Clean Water and Operating Efficiency in Water Treatment:**

### 1 Improves Oil in Water Separation

JGL Microbes produce biosurfactants that effectively break interfacial tension, they also:

- Reduce viscosity of hydrocarbons, allowing the oil and water to easily separate
- Strip hydrocarbons off solids allowing them to fall out of emulsion
- Improve oil quality, allowing sellable oil to float to the top

### 2 Remediate and Inhibit Rag Layers

The small size (less than .5  $\mu\text{m}$ ) of JGL Microbes allows them to penetrate the rag layer and gain access to the various components of the pad.

Additionally, JGL Microbes:

- Break paraffin carbon chains down to the C12 range, facilitating refinement of paraffin to oil
- Reduce viscosity of asphaltenes
- Strip hydrocarbons from solids
- Break interfacial tensions

### 3 Significantly Reduces Corrosion

JGL Microbes are facultative anaerobes; meaning they utilize available oxygen first, removing it from the system. Once removed, they take an anaerobic metabolic pathway (without oxygen). Additionally, the Microbes:

- Produce a thin polysaccharide coating on all metal surfaces they come in contact with; forming a barrier from corrosion
- Remove under-deposit corrosion by dissolving acid-soluble deposits and releasing hydrocarbon deposits

### 4 Reduces Solids Injected in the System

JGL Microbes strip hydrocarbons from the solids, allowing them to fall to the bottom of the tank, they also:

- Dissolve and inhibit the formation of acid-soluble solids, such as iron sulfide, calcium carbonate, and calcium sulfate
- Change paraffin to oil and reduce the viscosity of asphaltenes
- Allow the hydrocarbons to float to the surface instead of going downhole; increasing sellable skim oil

## WATERFLOOD SYSTEM UNIQUE BENEFIT: MICROBIAL ENHANCED OIL RECOVERY (MEOR)

- Biosurfactants are produced in the formation as motile microbes move back into capillaries, releasing residual oil to be swept up for recovery
- The cracking of carbon chains causes a significant reduction in viscosity, allowing improved mobility of the oil
- Removal of skin damage (*scale, paraffin, and iron compounds*) throughout perfs and the formation, improving sweep efficiency

## DO YOU HAVE IRON IN YOUR OIL?

Recently, commercial disposal operators have been receiving less for their recovered oil due to new dissolved iron in oil limits.

JGL has helped numerous operators solve this problem by significantly reducing iron in oil concentrations.

# CASE HISTORY | SALTWATER DISPOSAL

## PERMIAN BASIN, TEXAS

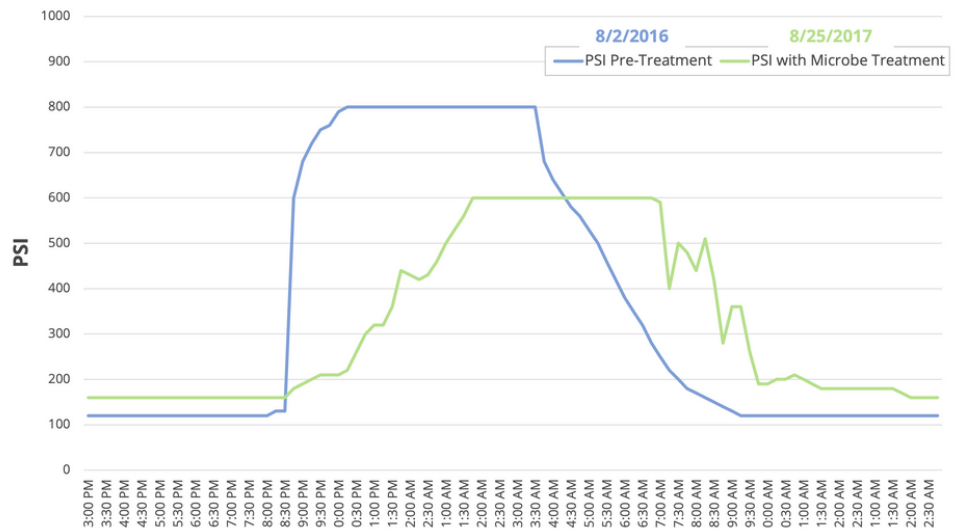
### History:

A Permian Basin producer had **substantial scale build-up on a problem SWD**.

As a result injection pressure went to 800 psi in less than 90 minutes following pump start. After pump shut down, it took over 6 hours to return to static pressure.

The start of the pressure rise indicates when the pump turned on. The start of the pressure decrease indicates when the pump turned off.

PSI Over 24 Hours



### Results:

With JGL's Microbe Treatment, the operator experienced three specific indicators of skin damage removal, which **led to greater water flow and improved injectivity**.

- 1 The duration of the pressure rise was extended by 250% from 1.5 hours to 5.25 hours
- 2 The maximum pressure decreased by 25% from 800 psi to 600 psi
- 3 The pressure decline interval dropped by 50% from 6 hours to 3 hours

### UNIQUE PROPERTY:

#### THE ABILITY TO REMOVE SKIN DAMAGE

JGL Solutions Microbes have the unique ability to **remove skin damage, in addition to preventing it**. Chemical does not have this ability and must resort to acidizing, which is costly and leads to corrosion.

#### This includes skin damage caused by:

- Asphaltenes
- Paraffin
- Calcium carbonate
- Calcium sulfate
- Iron carbonate
- Iron oxide
- Iron sulfide

#### ► FAQ: Will dead microbes plug my filter?

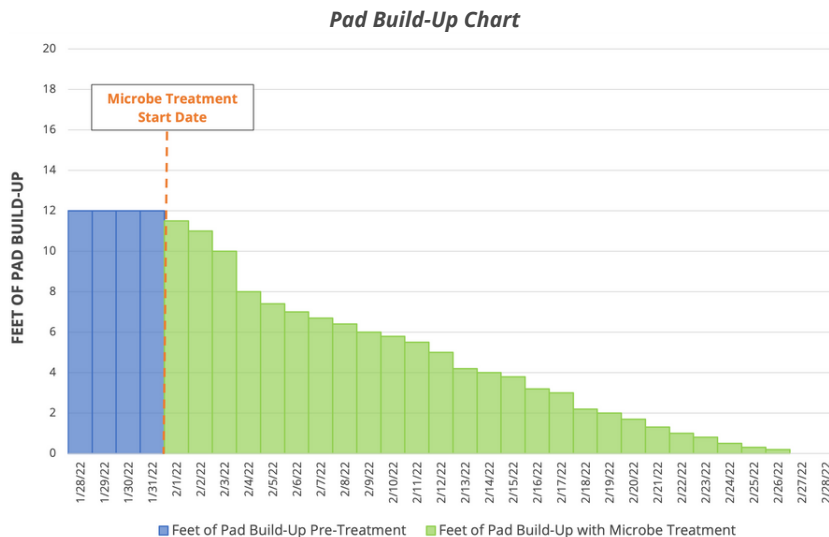
**No**, the microbe's exoskeleton dissolves into solution. Plus, they are less than .5  $\mu\text{m}$  in size and can pass through virtually any filter or formation.

## CASE HISTORY | SALTWATER DISPOSAL

### PERMIAN BASIN, TEXAS

#### History:

A West Texas disposal system had a holding tank with 12 feet of pads. The operator **used chemical to try and break the pads for over a year but found no success.**



#### Results and Savings:

The operator eliminated chemical treatment and introduced JGL Microbes to the disposal system.

**After 2 weeks, the operator was skimming sellable oil.**

**After one month, the pads were completely dissolved.**

In addition to removing the pads, JGL's Microbe Treatment has also prevented any additional pad formation to date.

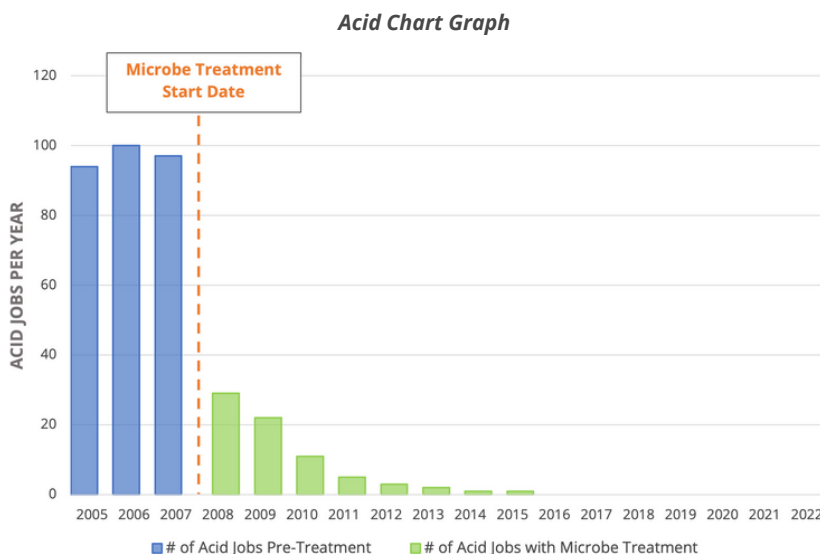
**+ Significant increase in sellable skim oil**

## CASE HISTORY | SALTWATER DISPOSAL

### CHEROKEE BASIN, KANSAS

#### History:

These (67) Kansas SWDs were treated continuously with chemical and acidized yearly to maintain injection pressures.



#### Results and Savings:

With JGL's Microbe Treatment, the operator realized:

- **50% increase** of sellable skim oil
- **71% reduction** of LOE after the first year of treatment
- **100% elimination** of all acid jobs + chemical treatments

**+\$6MM**

**Approximate value of reduced acid jobs to date through 2022**

**+\$2.4MM**

**Approximate value of eliminated chemical treatments through 2022**

# CASE HISTORY | WATERFLOOD

## PERMIAN BASIN, TEXAS

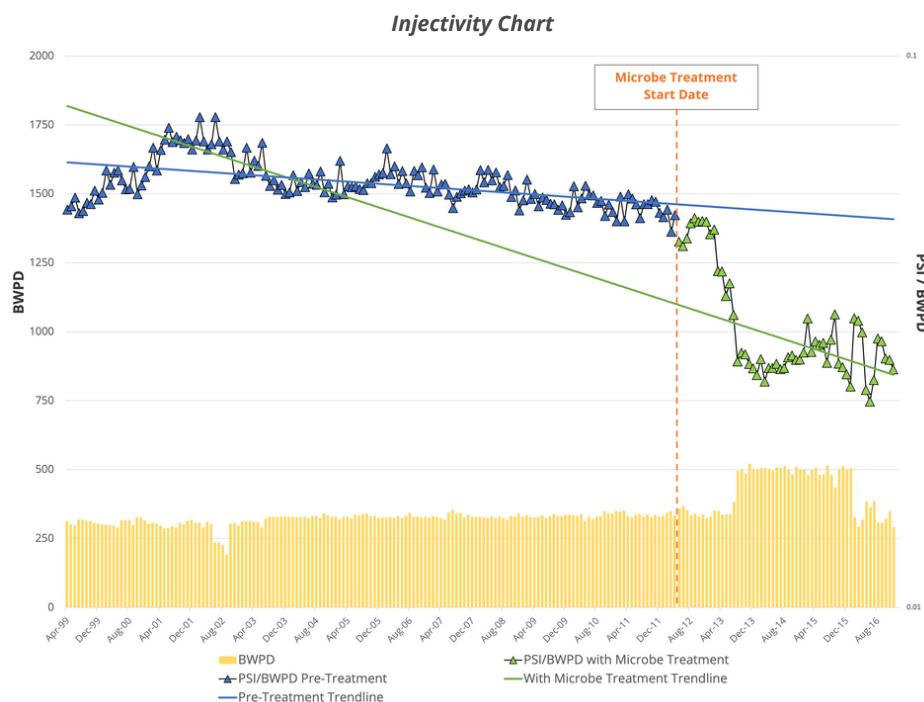
### History:

A West Texas operator wanted to utilize microbes as a tertiary form of enhanced oil recovery.

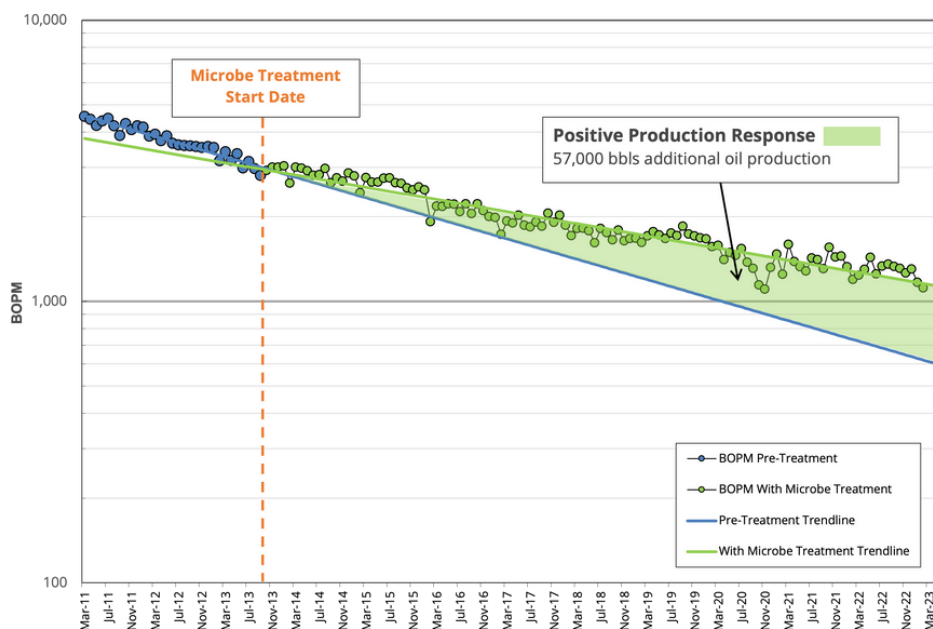
Meanwhile, the produced water was experiencing oil-coated iron sulfide and calcium carbonate scale precipitation; causing poor water quality and injectors to plug.

### Results and Savings:

The Injectivity Chart (right) highlights BWPD and PSI/BWPD. The trendlines illustrate the **dramatic improvement in injectivity; significantly reducing operating costs, while extending the lifetime of the well.**



**MEOR Production Chart**



### Results and Savings:

The MEOR Production Chart (left) shows a significant production response. The MEOR tax credit more than covered the JGL Microbe Treatment cost. **Plus, the additional revenue of over \$3.4MM in oil recovered resulted in a very successful and profitable MEOR project.**

#### CUSTOMER HIGHLIGHT:

"We were pleased to find out that JGL Solutions could address both oil recovery and poor water injectivity simultaneously."

**+\$3.4MM**

Approximate value of additional oil production

**+\$300K**

Approximate tax credit

**< \$200K**

JGL Solutions Microbe Treatment cost to date

## CASE HISTORY | PRODUCING WELL

### PERMIAN BASIN, TEXAS

#### History:

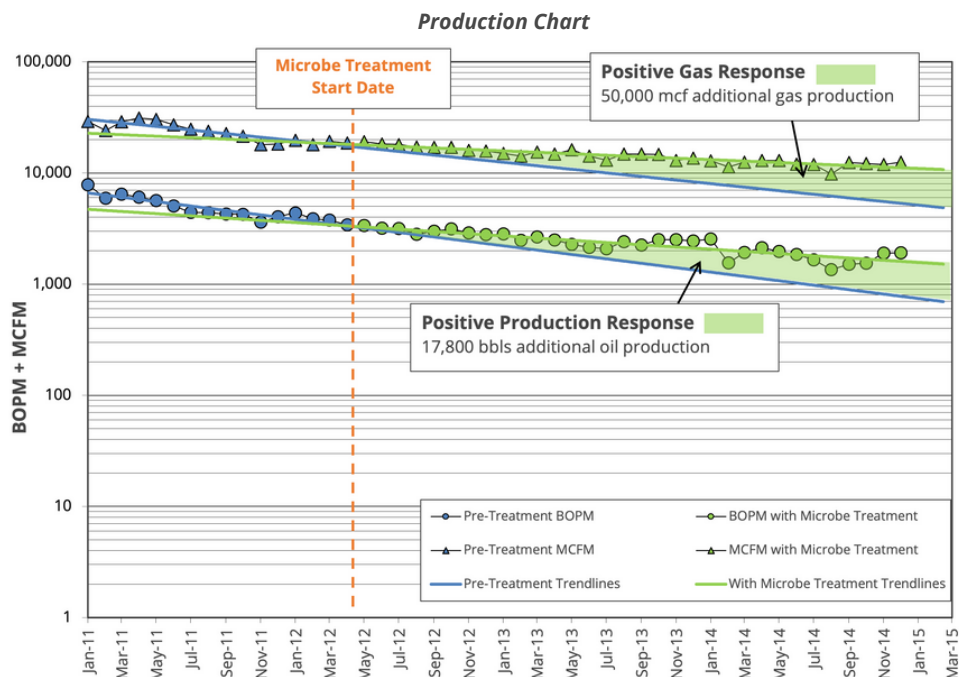
This producing well had a **severe paraffin issue**.

The operator was hot oiling the well two times per month due to paraffin and asphaltene accumulations in the tubing, flowlines, and on rods.

In addition to hot oiling, the operator also had to use scale inhibitor; increasing operating costs without solving the problem.



Rods After 9 Months



#### Results and Savings:

The well was hot oiled twice more in the next 60 days, after that, the well was pulled after 9 months for a pump change (left). **The rods and pump came out of the hole easily with no need for hot oil. Rods were clean, production improved, and LOE was reduced significantly.**

There was no subsequent hot oiling for over five years and no further use of scale inhibitor required.

**+\$1MM**

Approximate value of additional revenue

#### UNIQUE PROPERTY: CRACKING PARAFFIN CHAINS

JGL Solutions Microbes have a unique property; their ability to crack long chain hydrocarbons (C14 to C105 +) into short chain hydrocarbons (C12 range), transforming paraffin to oil.

**This is a much more beneficial and efficient process than:**

**HOT OIL** raises the temperature of paraffin to temporarily lower the pour point, delaying precipitation of paraffin to another location. This can leave heavy ends in the wellbore due to the cooling of the hot oil as it travels downhole.

**CHEMICAL** dilutes the paraffin using aromatic hydrocarbons to temporarily lower the pour point, delaying precipitation of paraffin to another location.



**A BETTER *SOLUTION*  
FOR YOUR FIELD.**

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**CURRENTLY SERVING:**

ARKANSAS  
COLORADO  
KANSAS  
LOUISIANA  
MISSOURI  
NEW MEXICO  
OKLAHOMA  
TEXAS

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