

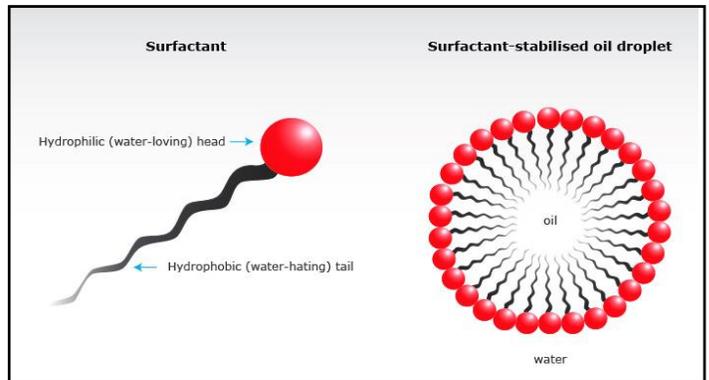
## Petroleum Industry

**triple<sup>7</sup> Products are biobased, non-toxic, non-corrosive, readily biodegradable and safe to use in virtually all areas of the petroleum industry.**

### Technology Overview

EFS Group manufacturer innovative plant-based chemistries for environmental solutions in the petroleum industry. Our **triple<sup>7</sup>** cleaners, **purasolve** solvents and specialty products are readily biodegradable, non-toxic, non-hazardous and contain no measurable VOCs. Unlike most surfactants currently used in the petroleum industry, our plant-based surfactants and solvents break down organic contaminants, increase oil well production, break oil/water emulsions and remediate petroleum hydrocarbons, chlorinated solvents and heavy metals.

Our plant-based surfactant, **triple<sup>7</sup> Colloidal Concentrate** does not create a standing emulsion. **Triple<sup>7</sup> Colloidal Concentrate** is comprised of amine reacted free fatty acids, fatty alcohols, esters and wax esters derived from soy, corn, and other seed oil fractions. **triple<sup>7</sup> Colloidal Concentrate** is a hydrophilic and has a HLB of 13.85, favouring water phase attraction, and therefore a very weak fatty phase interface. Non-ionic in nature, **triple<sup>7</sup> Colloidal Concentrate** in water solution will auto disperse rapidly to displace petroleum hydrocarbons including contaminated solids, tank sludge, drilling muds, gases and solvent fractions and cause inert solids including tars, gravel and sands to stay at the bottom of the storage vessel while the hydrocarbon fractions rise to the top of the water column.



**Surfactant**

Hydrophilic (water-loving) head →

← Hydrophobic (water-hating) tail

**Surfactant-stabilised oil droplet**

oil

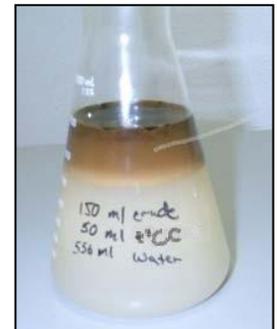
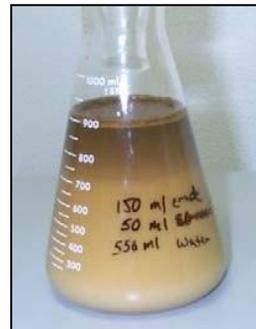
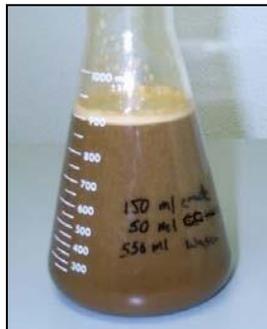
water

A surfactant (surface-active agent) is a compound that has two groups present in the molecule:

- One being hydrophilic in nature - water-liking
- One being hydrophobic in nature - water-hating or oil-liking.

When you have a surfactant with two groups present, you have a chemical compound that has surface-active properties or the ability to affect the interfacial relationship between two dissimilar substances such as oil and water.

Illustrates the separation of crude oil and water using our plant-based, non-ionic surfactant system: **triple<sup>7</sup> Colloidal Concentrate**



## Product Applications

Benefits of *triple<sup>7</sup>* formulations:

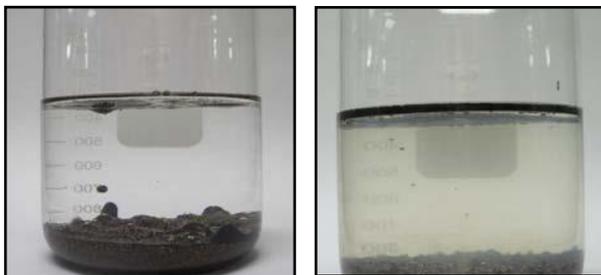
- May be used with salt water and wastewater
- Improves thermal conductivity of water
- Helps buffer acid pH
- Reduces calcium build-up
- Extends the life of metal parts, pipes and valves

### Enhanced Oil Recovery/ Improved Yields:

Surfactant assisted water-flooding is appropriate in low permeability reservoirs (0.1 – 100 mD) where it is difficult to inject water. This tertiary recovery method is effective where traditional polymer or alkali products cannot be introduced into the reservoir because permeability is too low, the temperature is too high, or the salinity is too high to use polymer. This process can also be used where the amount of divalent cations is too high to use alkali.

The use of surfactants, typically anionic, with polymers has been part of the EOR process since the 1980s. However, the benefits of non-ionic plant-based surfactants and solvents have been gaining attention because of their proven performance and environmental safety. Depending on site conditions, *triple<sup>7</sup> Heavy Duty* an enhanced formulation of *triple<sup>7</sup> Colloidal Concentrate* may be used to boost the effectiveness of “water-flooding” by increasing “injectivity” and lowering interfacial surface tension. The use of plant-based (or biobased) surfactants are growing because of:

- Lab evaluations support the feasibility of surfactant enhanced water-flooding
- Field data proves surfactant enhanced water-flooding is an effective way to recover residual oil
- New biotechnology and processes open the door for new opportunities while protecting the environment



Demonstrates the immediate release of oil from sand using *triple<sup>7</sup> Heavy Duty* at a 5% solution.

Top view of the beaker at 30 minutes and two hours



### Soil / Groundwater Remediation:

Soil and groundwater that have heavy hydrocarbon contamination including NAPL, DNAPL creosote and LNAPL fuel oil can be treated by using *triple<sup>7</sup> Heavy Duty*. The micelle technology of *triple<sup>7</sup> Colloidal Concentrate* surround the contaminants to form a temporary micro-emulsion which allow the hydrocarbon to release from the soil.

The soil washing process involves the introduction of the contaminated soil into a treatment chamber (pug mill) which contains a *triple<sup>7</sup>* formulation and water at a specified ratio which depends upon available ambient heat, the available water component, agitation (if any) and dwell time. The solids are then mixed with the *triple<sup>7</sup>* formulation to assure effective contact between the solution and absorbed oil contaminants. Upon contact, the *triple<sup>7</sup>* solution releases the contaminants off the solids into the water phase. Following treatment, the solids and water area easily separated to yield clean solids, which can be re- used onsite, and a liquid effluent from which the oil can be recovered. The subsequent liquid effluent can then be further treated by conventional oil water separation methods, thereby further reducing the clean water system requirements.

#### Methyl-tert-butyl-Ether (MtBE) EPA 8021B

Testing conducted:

<b>MtBE Working Std:</b>	<b>t7 CC Working Std:</b>
10 mg/l Std MtBE	10 mg/l Std t7 CC
0.010 mg/l MtBE	0.100 mg/l t7 CC

Sample Identification	Lab Detection Limit (ug/L)	Analytical Result (ug/L)
Control – Top	5.0	6.7
Control – Bottom	5.0	6.6
t7 CC – Top	5.0	Non Detected
t7 CC – Bottom	5.0	Non Detected
MtBE was displaced by the triple7 Colloidal Concentrate in the water column		

## Oil Spill Recovery:

While no two oil spills are the same, and the four basic methods for cleaning are widely accepted and practiced, **triple<sup>7</sup>** can reduce the use of traditional chemicals currently used with a plant-based surfactant system. The colloidal micelle structure of **triple<sup>7</sup> Colloidal Concentrate** has an extremely high hydrophilic, lipophilic balance (HLB) favoring water attraction while having an extremely weak lipophilic attraction (fatty phase). **triple<sup>7</sup> Colloidal Concentrate** cleans by displacing petroleum contaminants as it seeks to attach to water molecules.

**triple<sup>7</sup> Colloidal Concentrate** reduces the surface tension of the oil at the substrate surface interface, which then weakens the polar attraction of oil to the surface and allows it to rise from the substrate surface in the presence of water (either fresh or salt water) by its relative density to the surface of the water column. With adequate oil absorbent materials available, contaminant oils can be easily recovered.

When oil spills occur in open water, **triple<sup>7</sup> Colloidal Concentrate** can be used to move the oil to absorbent booms more quickly and efficiently. The characteristic property of **triple<sup>7</sup> Colloidal Concentrate** is to push oil sideways in water, an excellent aid in herding oil slicks to assist boom absorption or skimming. When skimming the oil from the water surface, **triple<sup>7</sup> Colloidal Concentrate** will separate the oil from the water so that the oil can be collected from the water and safely contained.

## Wellbore Productivity:

The application of **triple<sup>7</sup> Heavy Duty** will increase production, permeability in the nearfield, and flow to well by treating blockages and clogs in wellbore casing, well perforations and nearfield including clays, asphaltenes, paraffins, biological blockages and biofilms. **triple<sup>7</sup> Heavy Duty** is applied to product or injection wells to increase permeability in the nearfield and lower injection pressures on injection wells. **triple<sup>7</sup> Heavy Duty** activates the formation to effectively:

- Break apart bonds that hold hydrocarbon and biological blockages together
- Decrease the viscosity of heavy oils
- Create pressure to drive the dissolved blockages through the perforations into the wellbore where they can be removed
- Cause clays to go from a solid to a more free flowing suspension enabling them to be readily removed
- Dislodge and dissolve asphaltenes and paraffin waxes



## Cooling Pond Cleaning:

Cooling systems can directly affect efficiency and cost if not maintained properly. Monitoring and controlling corrosion, microbial growth, and system operation is essential to providing optimum cost efficiencies. Selecting the appropriate chemical treatment program is the first step in minimizing stress on the cooling system. One such treatment is the use of a non-ionic surfactant that can minimize corrosion, improve thermal exchange efficiency and help to reduce related microbial growth.

Cooling pond cleaning using **triple<sup>7</sup> Colloidal Concentrate**, **triple<sup>7</sup> Easysolve** and **triple<sup>7</sup> Supersolve** have been demonstrated to improve thermal transmission, reduce corrosion, and biological growth, as well as separate petroleum and other oil related fractions, and reduce total chemical cost through recycling.

## Tank Cleaning:

When sludge accumulates inside your storage tanks and storage capacity decreases so do your profits. By removing the sludge you increase your storage capacity, but more importantly you recover valuable hydrocarbons present in the sludge. Generally, sludge is made up of oil, water and tar-like solids. **triple<sup>7</sup>** products help to remove the oil and water from the solids, then further separate the oil from the water. When **triple<sup>7</sup> Colloidal Concentrate** and/or **triple<sup>7</sup> Supersolve** are mixed with the oil, water and sludge they create a temporary micro-emulsion. Usually through a closed-loop system, this emulsion can then be separated whereas the oil can be pumped directly to another vessel and the water can be pumped to a wastewater system.

Because of their non-VOC or low-VOC properties, **triple<sup>7</sup>** products are safer to use for various storage tanks and vessels that require service personnel entry.

## Rig / Equipment Maintenance:

**triple<sup>7</sup>** products can be used for virtually any space or surface associated with land or offshore oil production, including:

- Decks
- Walkways
- Cantilevers
- Crane booms
- Pump room and bilge
- Portable water tanks
- Accommodation areas

To prepare all rig components for painting and/or re-coating, use **triple<sup>7</sup> Colloidal Concentrate** or **triple<sup>7</sup> Supersolve** to provide an absolutely clean surface, which improves surface contact thereby extending the life-cycle of the finish components.

Because **triple<sup>7</sup>** products are readily biodegradable, non-toxic, non-hazardous and non-reactive they are safe to use and store throughout production facilities.



**For more information or product samples for bench testing, contact:**



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