What is in the emulsified layer on top of an oil spill treated with De-Oil-It?

Typical testing or in-situ application clients see an emulsified layer on top of water particularly and in some cases on solid surfaces. The coloration of the emulsified layer (a condition of adding De-Oil-It to oil and having water present) is light tan to white. This emulsified layer has been a concern of people because they are not sure if De-Oil-It is working at all or to what level. This article seeks to unlock the mystery of the emulsified layer. We will help explain what this layer is, why it forms, and why it is beneficial.

The emulsified layer

Before we begin, the emulsified layer is

- Partially broken down oil into simpler hydrocarbon elements
- The formation is due to the “capping” effect making the suspension hydrophobic (does not mix with water anymore) and is usually blond / white / tan in color
- Capping occurs because De-Oil-It has broken down complex hydrocarbon chains (oil) and attached a hydrogen molecule to one end and an oxygen molecule to another end: i.e. capping at each end

Chemical make-up of the emulsified layer is

- Degraded oil into a variety of less complex hydrocarbons
- The formation is due to the “capping” effect making the suspension hydrophobic (does not mix with water anymore)
- Capping occurs because De-Oil-It has broken down complex hydrocarbon chains (oil) and attached a hydrogen molecule to one end and an oxygen molecule to another end: i.e. capping at each end

The emulsified layer will require agitation to break down further, more product, more time, and possibly will be required to be collected and discarded depending on the remediation process(es) implemented.

What the emulsified layer <u>is not</u>

- De-Oil-It not working (it is working !)
- Original oil (it is a simpler hydrocarbon chain in the degrading process)
- The only form of De-Oil-It action (in fact many molecules of the original oil / fuel spill are broken down in water / soil (check the pictures above, the water is brown for a reason, its degraded oil !)

Why the emulsified layer is beneficial

- On water it floats on the surface (on land De-Oil-It acts as a surfactant and will draw into the soil; compare this to encapsulating technology products like Corexit which act to create a hydrophilic surface tension causing the degrading oil to sink
- In this state simplified hydrocarbon chain is very vulnerable to continual degrading action by
    - The introduction of agitation (stirring, tilling, mixing, etc.)
    - Adding more De-Oil-It (straight, diluted, or sprayed)
    - Eating time by bacteria found everywhere in nature, even in the oceans
    - Adding enzymes or microbes to increase rate of hydrocarbon chain break down

How long does it take to degrade hydrocarbon chains / emulsified results, etc.?

- The answer to this depends on
    - Viscosity of the hydrocarbon chain — crude and paraffin based are thick!
    - Dilution factor of De-Oil-It — ranges 1:1 up to 30:1 (H2O to DOI)
    - Time allowed to soak — preferably hours to days
    - Temperature of water used for dilution — best temp is 95-120 degrees F
    - Ambient environment — best is hot and humid

Note: soaking time and when you reapply De-Oil-It is based on experience, visual inspection and always should accompany lab results to understand how much toxicity remains. Remediation is almost always an iterative process

Note: we provide dilution guide charts, temperature range charts, and square foot coverage charts on http://www.deoilit.com

Note: when De-Oil-It is dumped in the water to control a major oil spill (recommended) in time the most the solution will naturally dilute to is 30:1 (water to De-Oil-It), even in the open water.

Note: De-Oil-It does not have a shelf life, even during degrading action (emulsified layer); it will continue to work as long as water, oxygen and an available hydrocarbon (oil, fuel, grease/ lipid).

What is the chemistry of De-Oil-It, Oil / Petroleum and the emulsified layer?

-- From Wikipedia--

Petroleum is a mixture of a very large number of different hydrocarbons; the most commonly found molecules are alkanes (paraffins), cycloalkanes (naphthenes), aromatic hydrocarbons, or more complicated chemicals like asphaltenes. Each petroleum variety has a unique mix of molecules, which define its physical and chemical properties, like color and viscosity.

The *alkanes*, also known as *paraffins*, are saturated hydrocarbons with straight or branched chains which contain only carbon and hydrogen and have the general formula C_nH_{2n+2}. They generally have from 5 to 40 carbon atoms per molecule, although trace amounts of shorter or longer molecules may be present in the mixture.

The alkanes from pentane (C_5H_{12}) to octane (C_8H_{18}) are refined into gasoline, the ones from nonane (C_9H_{20}) to hexadecane ($C_{16}H_{34}$) into diesel fuel, kerosene and jet fuel. Alkanes with more than 16 carbon atoms can be refined into fuel oil and lubricating oil. At the heavier end of the range, paraffin wax is an alkane with approximately 25 carbon atoms, while asphalt has 35 and up, although these are usually cracked by modern refineries into more valuable products. The shortest molecules, those with four or fewer carbon atoms, are in a gaseous state at room temperature. They are the petroleum gases. Depending on demand and the cost of recovery, these gases are either flared off, sold as liquefied petroleum gas under pressure, or used to power the refinery's own burners. During the winter, butane (C_4H_{10}), is blended into the gasoline pool at high rates, because its high vapor pressure assists with cold starts. Liquified under pressure slightly above atmospheric, it is best known for powering cigarette lighters, but it is also a main fuel source for many developing countries. Propane can be liquified under modest pressure, and is consumed for just about every application relying on petroleum for energy, from cooking to heating to transportation.

The *cycloalkanes*, also known as *naphthenes*, are saturated hydrocarbons which have one or more carbon rings to which hydrogen atoms are attached according to the formula C_nH_{2n}. Cycloalkanes have similar properties to alkanes but have higher boiling points.

The *aromatic hydrocarbons* are unsaturated hydrocarbons which have one or more planar six-carbon rings called benzene rings, to which hydrogen atoms are attached with the formula C_nH_{2n-6}. They tend to burn with a sooty flame, and many have a sweet aroma. Some are carcinogenic.

Crude oi composition

Composition by weight

Hydrocarbon	Average	Range
Alkanes (paraffins)	30%	15 to 60%
Naphthenes	49%	30 to 60%
Aromatics	15%	3 to 30%
Asphaltics	6%	remainder

-- End of Wikipedia info--

While not meant to be a science lesson in this document we want to point out some of the components of hydrocarbon chains of petroleum / oil / fuel. The reason for pointing out the composition of petroleum / oil / fuel is to in part remark on the elements that are possibly completely broken down or trapped inside the emulsified layer but still vulnerable to further breakdown.

In time with enough product, water, oxygen, and proper application we do know that De-Oil-It will nearly or completely eliminate the hydrocarbon chains.

While everyone wants to test in a laboratory in glass vessels to watch the process, we want people to know that the lab is very restrictive and you might not see a complete breakdown fast enough to feel comfortable. This is natural, everyone wants to see. But until you have for example the right salinity, bacteria, water, De-Oil-It and have time you might not see a complete breakdown.

The EPA tests the ability to show visible signs of breakdown within 10 minutes. That is unrealistic unless you are a harsh chemical which De-Oil-It is not. The above photos in the beginning of this document were created in a range of time 3 hours to 24. There is significant break down. In much larger containers we had breakdown so complete the dirty brown water was crystal clear.

But on an exact answer of the chemistry of the emulsified layers, we only know that it contains a range of various specific elements (part of showing all the kinds of chemicals in the Wikipedia info above) to smaller non-measurable elements. We are told that our best way to measure is to undergo a very expensive long drawn out DNA testing to determine amount of breakdown this way as specific chemical measurements are incomplete (because the hydrocarbon chain has been broken down to non-measurable elements).

The real results are actually working with the product and adopting an iterative process that continues until the breakdown is both visually noticed, or as on water the emulsified layer is simply removed, or testing in a laboratory show significant reduction PPM of measurable toxicity (most likely on the elements that were noted in the Wikipedia information above…

Final note on the emulsified layer; this layer has the surface tension reduced such that the layer will not stick anymore to surfaces making cleaning very easy. This is an excellent product that is non-hazardous before, during and after the cleaning process. A must for minor and major oil / fuel spills

Typical contaminants clients have successful tested on land remediation include eliminating or drastically reducing some / all of the following kinds of contaminants that De-Oil-It can be effective, but not limited to:

- Hydrocarbons with carbon chains C-5 to C-40
- Benzene, Xylene, Toluene
- TCE, PAH, and PCB contamination
- Fuel Oils Fossil Fuels: gasoline, diesel, and aviation gas
- Condensate from Pipeline leakage
- Glycols