

## Prevention of diesel bug growth using SulNOxEco™ Fuel Conditioner



[SulNOx Group Plc](#) with its [unique emulsification product](#) has teamed up with [SciMed Ltd](#) and [Hielscher Ultrasound GmbH](#) to bring a novel solution a continuing problem in the fuel industry, namely, how to prevent the growth of diesel in bug in fuel contaminated with water.

### **Microbial contamination of diesel fuel.**

Diesel bug is a contamination of diesel fuel by microbes such as bacteria and fungi. Over 1,400 different species have been identified living in diesel when stored for any length of time. Growth occurs when water is introduced into diesel fuel typically inadvertently from condensation, adsorption from the air or even rain. Modern diesel is particularly hygroscopic, meaning it readily attracts moisture, which only heightens the problem.

As water accumulates in the diesel it settles out at the bottom of the tank due to its higher density than diesel. The site of growth is the interface between the oil and water layers. This means over time the growth medium for diesel bug increases as more water accumulates. As more diesel bug grows it will ultimately form a thick layer of sludge which, without removal, may be drawn into the fuel lines resulting in blockages and possible engine failure.

If left untreated, diesel will remain reliable for between 6 and 12 months after which fuel contamination begins to appear. Subsequently, most industrial engine manufacturers now recommend a fuel conditioning program to ensure the reliability of the fuel.

### **Dealing with Diesel Bug.**

There are numerous recommendations for dealing with diesel bug. Some involve biocide additives designed to dehydrate and kill the contaminant. These can cost anything from 1p to 16p per litre of fuel making contamination an expensive problem to eradicate.

<https://www.pbo.co.uk/gear/12-diesel-bug-treatments-tested-43353>

Other solutions involve regular and continued good maintenance of tanks and procedures to prevent water contamination in the first place. However, we recognize that this may not be possible in all circumstances for a variety of reasons. If diesel bug is found, the remedy is always the same – empty and clean the tank. This is both time consuming and costly, especially if the fuel must also be disposed of or treated as one cannot put contaminated fuel back into a clean tank to cause re-contamination.

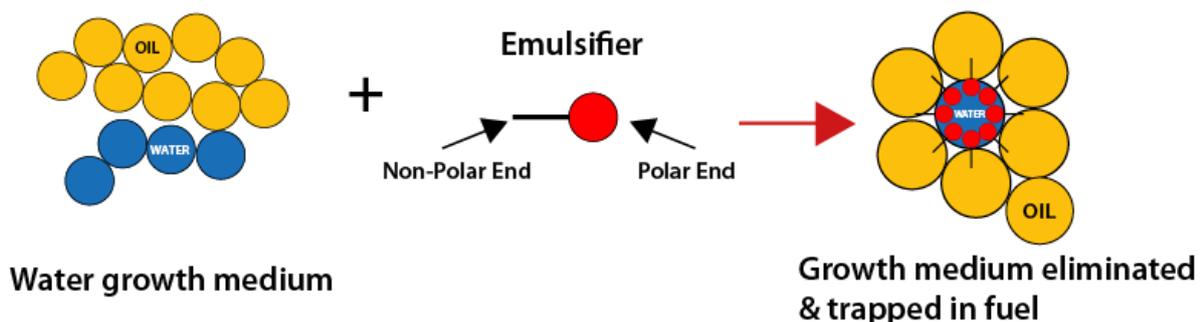
## The SulNOx solution.

The key to dealing with diesel bug effectively, as with many things, is prevention rather than cure.

The best method of prevention is to remove the growth medium for the diesel bug by eliminating the water build up. However, it would prove to be an expensive and futile task to attempt to prevent all sources of water from contaminating the diesel. Condensation is a natural unmanageable occurrence for example, so a solution is needed to deal with water once it is already in the fuel.

This is where SulNOxEco™ Fuel Conditioner comes in. SulNOxEco™ is a unique formula of lubricants and emulsifying agents. A formulation of 1:2000 ratio of SulNOxEco™ to fuel prevents water from accumulating and settling out at the bottom of the tank. SulNOxEco™ Fuel Conditioner is an emulsification agent and traps droplets of water throughout the fuel by forming a stable emulsion. This scavenging of water prevents the formation of the settled-out water growth environment at the bottom of the tank meaning the diesel bug has nowhere to grow. Prevention.

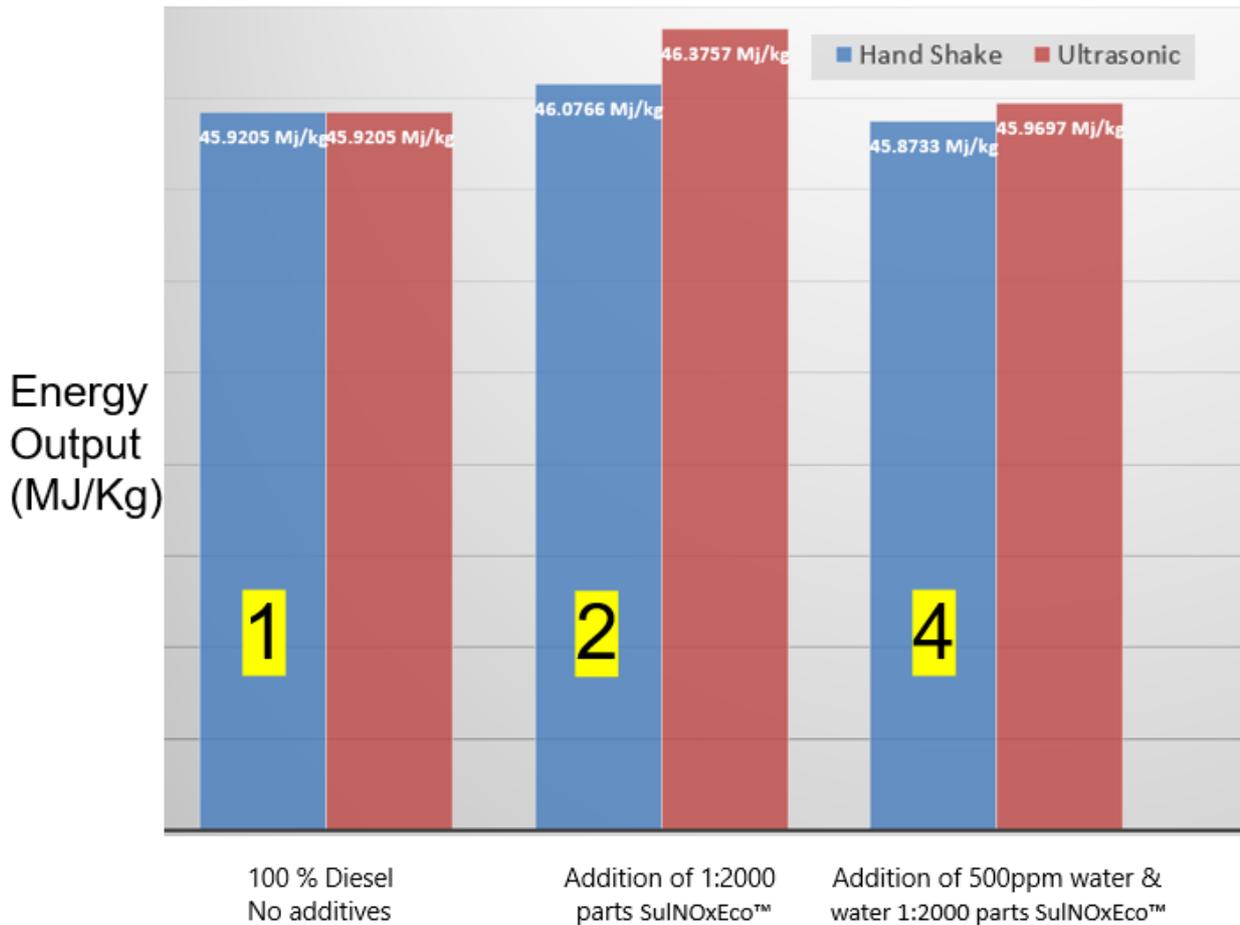
SulNOxEco™ Fuel Conditioner forms a single homogeneous phase.



(Figure 1.0. Formation of the emulsified fuel using SulNOxEco™.)

## Trial and Results.

Our plan was to combine this study stability and growth of the diesel bug with our previous report on the energy content in diesel where we looked at the addition of water to diesel and the energy output with and without SulNOxEco™. See Figure 1.1



## Additional water content & composition

(Figure 1.1. Energy content tests results from our previous report. Labels correspond to below formula for diesel bug test.)

Regular diesel was obtained from a UK garage forecourt and mixed through hand shaking for 5 seconds with the addition of varying amounts of water to mimic natural levels of water contamination. The dosage of SulNOxEco™ remained constant at 1:2000 parts in diesel (irrespective of the free water content). 100 ml volume in total was used in total in all formulations.

Diesel fuel from a UK garage forecourt may contain up to 200 ppm of water to be considered in specification.

Tests 1 & 2. No additional water. (Up to 200ppm)

1. 100% diesel.
2. 1 : 2000 parts SulNOxEco™

Tests 3 & 4. Additional 500ppm water. (Up to 700ppm)

3. 500ppm water.
4. 500ppm water and 1 : 2000 parts SulNOxEco™ (1:1 ratio SulNOxEco™ to water)

Test 5. Additional 1000ppm water. (Up to 1200ppm)

5. 1000ppm water and 1 : 2000 parts SulNOxEco™ (1:2 ratio SulNOxEco™ to water)

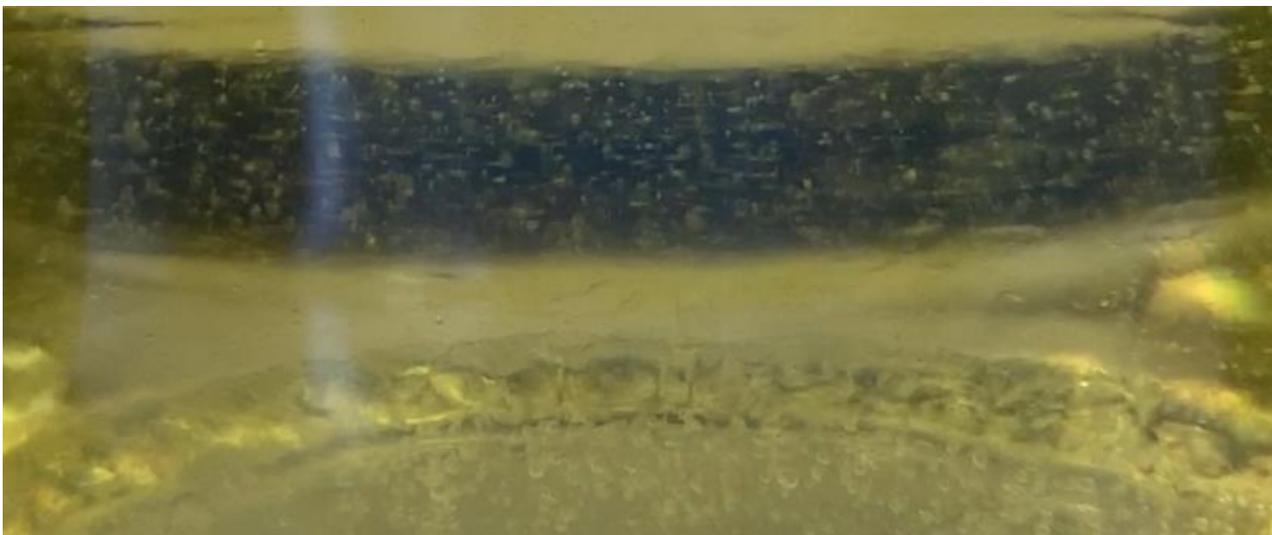


(Figure 1.2. Formulation in progress.)



(Figure 1.2. Formulations post shaking.)

After shaking formulations 1 & 2 looked no different. However, formulation 3, with the additional 500ppm water, showed visible droplets of immediately falling to the bottom of the jar. This highlighted the problem of water settling out in diesel to form a growth medium for diesel bug, even after agitation through shaking. (Figure 1.3)



(Figure 1.3 Visible water droplets settling out from formulation 3)

Formulation 4 with up to 700ppm water with SulNOxEco™, and more significantly, formulation 5 with up to 1200ppm water with SulNOxEco™, looked to have perfectly emulsified the water with no visible separation. (Figure 1.4)



(Figure 1.4. Formulations 4 & 5. Emulsified diesel with no precipitation)

This clearly demonstrates the efficacy of SulNOxEco™ Fuel Conditioner and its ability to rapidly form stable emulsions as outlined previously in figure 1.0.

It is expected that formulations 2, 4 and 5 will remain free from diesel bug due to the emulsification of the water growth medium. All five formulations will remain under observation for an extended period as part of an examination into the stability and the formation of any bacterial or fungal growth. The findings will be reported later.

If you would like to discuss this further or other possible fuel emulsification solutions and systems, in the first instance, please contact either [SulNOx Group Plc](#) or [SciMed](#).

[dan@scimed.co.uk](mailto:dan@scimed.co.uk).

[nicholas.nelson@sulnoxgroup.com](mailto:nicholas.nelson@sulnoxgroup.com)

A handwritten signature in blue ink, appearing to read 'D Clarke', is positioned above the name of the signatory.

**Dr D A Clarke**