

**Ball, Steve J**

---

**From:** Oliver Taylor [otaylor@ntlworld.com]  
**Sent:** 12 October 2011 15:37  
**To:** Evans Maria; Ball, Steve J  
**Cc:** Gerwyn Willams  
**Subject:** Fw: Pure-Bore drilling fluid environmental information  
**Attachments:** Pure Bore Environmental Report.pdf; Pembroke-Gas-Pipeline-Press-Release-2.pdf; Solent-Press-Release\_2\_070411.pdf; Clear Stabiliser HV.pdf; Pure-Bore®.pdf; Drill-Sorb®.pdf

Dear Maria / Steve

Please see email from Clear Solutions International Limited who supply the Pure-Bore product, included is an environmental report showing the chemical composition of the product.

Kind Regards

Oliver Taylor  
**Coastal Oil and Gas Limited**  
Email: [otaylor@ntlworld.com](mailto:otaylor@ntlworld.com)  
Tel: 07767698765

----- Original Message -----

**From:** [James Mansell](mailto:James.Mansell@ntlworld.com)  
**To:** [otaylor@ntlworld.com](mailto:otaylor@ntlworld.com)  
**Sent:** Wednesday, October 12, 2011 2:35 PM  
**Subject:** Pure-Bore drilling fluid environmental information

Dear Oliver,

Further to our telephone conversation please find attached the environmental report on Pure-Bore®.

As we discussed we firmly believe that Pure-Bore® generates the most environmentally friendly drilling fluid in the market. This drilling fluid system is commonly used to drill boreholes throughout Europe. We have used this product on a number of drilling projects in South Wales including the record breaking Milford Haven HDD crossing (please see the attached press release) and Composite Energy's Pontardawe – 1 well. In addition Pure-Bore® has been used on numerous other CBM, shale gas, geothermal, water wells and site investigation boreholes throughout the UK with excellent results from both a drilling and environmental perspective. Further to this on the recent Solent HDD transit (please see attached press release) we worked with the Environment Agency and were able to prove to the Environment Agency that used Pure-Bore® drilling fluid actually generates environmental benefit when spread to land.

With specific regard to potential down hole losses – Pure-Bore® drilling fluid is designed specifically to develop a tight firm filter cake to seal/stabilise unconsolidated formations to help prevent down hole losses. If the filter cake needs to be further tightened we use a small dose of Clear-Stabiliser® or Ultra-Bore® bentonite in the top hole section. In the case of down hole losses into fractured formations we would recommend using Drill-Sorb® as a loss circulation material as a first option and have had excellent results with this product.

As an independent British company Clear Solutions International Ltd prides itself on developing and producing unique and innovative products and solutions which provide sound environmental benefits. Pure-Bore® is one of our leading products, with unique technical and environmental benefits. Pure-Bore® is

manufactured entirely from natural starches which are cross linked under pressure - as Pure-Bore® breaks down it degrades into natural sugars and ultimately biodegrades 100% so would not in itself cause formation damage.

I hope that this helps and please feel free to contact me should you have any questions or require further information.

With very best regards James

James Mansell

Clear Solutions International Ltd

Unit B3, Wem Industrial Estate, Soulton Road, Shropshire, SY4 5SD, UK

Tel: +44 (0) 1939 235754 - Fax: +44 (0) 1939 232399 - Mobile: +44 (0) 7957 136517

**[www.drilling-products.com](http://www.drilling-products.com)**

**INNOVATION – SERVICE – RELIABILITY – PERFORMANCE**

---

## **PURE-BORE**

### **Chemical Analysis**

A Technical Scoping Study of 5 days duration was undertaken by EnviroInnovate to investigate the potential toxicity and environmental impacts of PURE-BORE drilling fluid. PURE-BORE is composed of biopolymer, which biodegrades within 8 to 52 weeks.

Several analytical techniques were used to determine the main elemental and anionic composition of the drilling fluid.

The main findings of this investigation are as follows:

1. Five-Day Biochemical Oxygen Demand (BOD<sub>5</sub>) can be considered relatively high with BOD<sub>5</sub> values measured at 9 mg/l and 36 mg/l for a 1:10000 and a 1:1000 dilution of PURE-BORE, respectively. However, these BOD<sub>5</sub> values are comparable with wastewater often discharged into surface waters.
2. X-Ray fluorescence spectroscopy (XRF) and inductively coupled plasma atomic emission spectrometry (ICP-AES) recorded low concentrations for the majority of the elements that were analysed. Sodium and calcium are present in relatively large quantities when compared to the other elements that were measured, but can still be considered to be present at very low concentrations.
3. Ion chromatography (IC) recorded low concentration for fluoride, bromide and sulphate but recorded a noticeably greater concentration of chloride (15.1 ppm). However, all of the anions can be considered to be present at very low concentrations.

4. Eco-toxicology was assessed using juvenile Daphnia Magna. As a 1:10000 dilution toxicity was minimal and is indistinguishable from the degree of error involved in the test. A dilution of 1:1000 showed a degree of toxicity after 48 hours, with 42% of the organisms being immobile.

## **2. Methods of analysis**

The laboratory methods used in the analysis of PURE-BORE are described under the appropriate headings. For chemical analysis appropriate standards were used throughout.

### **X-Ray Fluorescence spectroscopy**

X-Ray fluorescence spectroscopy analyses non liquid samples, therefore, analysis could be undertaken on the PURE-BORE powder directly without requiring dilution with water or acids. The PURE-BORE sample was passed through the system after being prepared by a method standard to this type of instrument. The analysis was repeated three times and the average value for each analyte was calculated. The appropriate standards were used in the calibration of the equipment.

### **Ion Chromatography**

A Dionex Ion Chromatograph Model DX-100 was used to measure all the major anions. A 1:1000 dilution of PURE-BORE was prepared with ultra pure water and then passed through the



chromatograph. The analysis was repeated three times and the average value for each analyte was calculated. The appropriate standards were used in the calibration of the equipment.

### **Inductively Coupled Plasma Atomic Emission Spectrometry**

A 1:1000 dilution of PURE-BORE was prepared with ultra pure water and then passed through the spectrometer. This was repeated three times and the average value for each analyte was calculated.

The appropriate standards were used in the calibration of the equipment.

### **Biochemical Oxygen Demand**

An 'Oxiotop' kit was used to determine BOD<sub>5</sub> for PURE-BORE dilutions of 1:1000 and 1:10,000.

The 'Oxiotop' system is a standard respiration test that utilises changes in pressure, within the Oxitiop bottle, to determine the BOD<sub>5</sub>.

### **Eco-toxicology**

The test was based on a method derived by the Environment Agency from the BSI method BS6068, Part 5: Section 5.1. The test is designed to investigate the toxic effect of substances on the swimming capabilities of juvenile *Daphnia magna*. In this case, groups of juvenile daphnids were exposed to the PURE-BORE solutions for a period of 48 hours under controlled laboratory conditions (pH 6.0 to 8.5, dissolved oxygen > 60% ASV, hardness 80 to 320 mg/l, temperature 20 ± 2°C).



At the end of this time period, the number of immobile daphnids out of a test population of 100 was counted by optical microscopy. The test defines immobilisation as ‘juvenile *Daphnia magna* that do not actively swim within 15 seconds of gentle agitation of the test vessel’. Swimming is taken as an indicator of survival in the environment.

Two concentrations of PURE-BORE were used in this test – a 1:1,000 solution and a 1:10,000 solution.

### 3. Results

#### X-Ray Fluorescence spectroscopy

Element	Symbol	Concentration (%)	Abs. Error (%)
Sodium	Na	0.748	0.05
Magnesium	Mg	0.0395	0.0031
Aluminium	Al	<0.0031	0
Silicon	Si	0.00607	0.00067
Phosphorous	P	0.04203	0.00042
Sulphur	Si	0.02439	0.00021
Chlorine	Cl	0.3179	0.0005
Potassium	K	0.0676	0.0011
Calcium	Ca	0.6165	0.0022
Titanium	Ti	<0.00012	0
Vanadium	V	<0.00015	0
Chromium	Cr	<0.00055	0
Manganese	Mn	<0.0004	0
Iron	Fe	0.00538	0.00023
Cobalt	Co	<0.00015	0
Nickel	Ni	<0.0001	0
Copper	Cu	0.00015	0.00005
Zinc	Zn	0.0011	0.00004
Arsenic	As	<0.00003	0.00002
Selenium	Se	0.00004	0.00002
Rubidium	Rb	<0.0003	0.00006
Strontium	Sr	0.00116	0.00003



Zirconium	Zr	<0.05	0.036
Molybdenum	Mo	<0.0013	0
Cadmium	Cd	<0.00036	0
Tin	Sn	<0.00056	0
Antimony	Sb	0.0018	0.00024
Barium	Ba	0.0064	0.0015
Tungsten	W	<0.00016	0
Mercury	Hg	<0.00006	0
Lead	Pb	0.00005	0.00004

### Ion Chromatography

Component name	Retention time	Amount (ppm)
Fluoride	2.42	0.8
Chloride	2.92	15.1
Bromide	4.2	0.9
Sulphate	5.92	0.07

### Inductively Coupled Plasma Atomic Emission Spectrometry

Element	Symbol	Concentration Mean (ppm)
Aluminium	Al	0.001
Arsenic	As	0.067
Boron	B	0.059
Calcium	Ca	2.189
Cadmium	Cd	0.002
Cobalt	Co	<lod
Chromium	Cr	0.009
Copper	Cu	0.005
Iron	Fe	<lod
Germanium	Ge	0.181
Mercury	Hg	0.157
Potassium	K	0.355
Magnesium	Mg	0.106
Manganese	Mn	0.002
Sodium	Na	3.422
Nickel	Ni	0.049
Phosphorous	P	0.176
Lead	Pb	0.041



Sulphur	S	0.118
Antimony	Sb	0.117
Selenium	Se	0.059
Silicon	Si	1.591
Tin	Sn	0.091
Strontium	Sr	<lod
Titanium	Ti	0.001
Vanadium	V	0.024
Zinc	Zn	<lod
Lithium	Li	0.007
Beryllium	Be	<lod

## Biochemical Oxygen Demand

BOD5 results are as follows (all in mg/l)

1:10,000 solution

Day	BOD
1	0
2	3
3	6
4	8
5	9

1:1,000 solution

Day	BOD
1	2
2	14
3	25
4	31
5	36

## Eco-Toxicology

Dilution	Mortality (%)
1:10,000 solution	15
1:1,000 solution	42





## 4. Interpretation

### Chemical content

For all the analytes (elements and anions) measured the concentration in PURE-BORE can be considered very low and for the majority of analytes are only just above the limit of detection of the instruments. Sodium (3.42 ppm and 0.75%), calcium (2.19 ppm and 0.62 %) and chloride (15.1 ppm) are present in quantities greater than all the other analytes but can still be considered very low and at these concentrations would not be considered an environmental threat.

### BOD<sub>5</sub>

The BOD<sub>5</sub> of PURE-BORE, when diluted to a concentration of 1:1000, can be considered similar to that of treated sewage and other effluents that are emitted directly into surface waters. The BOD<sub>5</sub> of a 1:10000 dilution is below a level that would be considered an environmental threat and is similar to that of many unpolluted surface waters. As a comparison typical BOD<sub>5</sub> from various sources has been measured as follows:

Source	Typical BOD <sub>5</sub> (mg/l)
Hand basin greywater	109 (Al-Jayyousi, 2003)
Normal domestic wastewater	100-200 (Garcia, et al. 1995)
Treated sewage	20-60 (DEFRA)



## Eco-toxicity

A PURE-BORE concentration of 1:10000 showed only a 15% mortality rate after 48 hours exposure, as 10% mortality is allowable for experimental error, the toxicity at this concentration can be assumed to be negligible. At a 1:1000 concentration 42% of the juvenile *Daphia magna* were immobile after exposure for 48 hours. Therefore, the test suggests a degree of toxicity at this PURE-BORE concentration.

## 5. Conclusions

1. The chemical analysis of PURE-BORE shows that the concentrations of the elemental and anionic analytes measured is very low.
2. The BOD can be considered relatively high. However, this would be expected for an organic based material such as PURE-BORE which is designed to readily biodegrade.
3. The eco-toxicology test suggests a certain degree of toxicity at the 1:1000 concentration, but toxicity decreases to almost zero when diluted 1:10000. Any toxicity that was observed in the test organisms is likely to be due to the oxygen demand of PURE-BORE, as opposed to any chemical toxicity. For a more complete understanding of toxicity a full ECOTOX 02 test would be useful.

## 5. References

Al-Jayyousi, O R. (2003) Greywater reuse: towards sustainable water management. Desalination. 156. pp. 181 – 192.

Department of Environment Food and Rural Affairs (1999) Economic instruments for water pollution discharges.

Garcia, A. Rivas, H M. Figueroa, J L and Monroe, A L. (1995) Case history: Pharmaceutical wastewater treatment plant upgrade, Smithkline Beecham Pharmaceuticals Company. Desalination, 102. pp. 255-263.

Horan, N J. Gohar, H and Hill, B. (1997) Application of a granular activated carbon-biological fluidised bed for the treatment of landfill leachates containing high concentrations of ammonia. Water Science and technology. 36. pp. 369-375.



---

## PRESS RELEASE

### Horizontal Directional Drilling Project under Milford Haven breaks European Records

- The longest HDD to have been completed in Europe
- Arguably the World's longest HDD in rock
- Project completes ahead of schedule
- *Pure-Bore*® based drilling fluid system approved for use by the Environment Agency

28<sup>th</sup> February 2011. The recent installation of a 457mm diameter, 3000m long gas pipeline under Milford Haven, South Wales has completed ahead of schedule, with minimal environmental impact.

The trial drill commenced in May 2007 and Clear Solutions worked closely with the drilling contractor, LMR Drilling UK Ltd, to test the viability of the crossing. Clear Solutions environmentally friendly, water-based *Pure-Bore*® drilling fluids system was approved for use by The Environment Agency and this - together with the expertise of the Clear Solutions drilling fluids engineers - contributed to ensuring the outstanding success of the project.

The rock under the Haven primarily comprises the steeply dipping Devonian Old Red Sandstone Formation. The drill line also passed through the Ritic Fault - a major regional fault plane. The strength and abrasivity of the rock over this crossing length presented a considerable challenge for the HDD, and the downhole tooling and drilling fluids regime had to be chosen carefully to mitigate risk wherever possible. All drilling fluids engineering was performed by Clear Solutions, who ensured constant monitoring of the drillings fluid rheology. Clear Solutions ensured that the large formation cuttings remained in suspension and were transported effectively for the unprecedented distance from cutting face back to surface.

Clear Solutions identified a series of critical drilling fluids properties for the project which were achieved and maintained using the company's own proprietary products. The outcome was a highly inhibitive fluid providing outstanding hole cleaning, borehole stability, effective clay inhibition, lubricity and a slick gauge borehole. The results were outstanding, with construction of the HDD crossing commencing in October 2009 and completion just 7 months later in May 2010. *Ends*

#### **Notes:**

*Clear Solutions International Limited is an independent drilling fluids specialist, employing a team of geotechnical specialists and drilling fluids engineers across Europe. The company has developed a range of revolutionary water-based drilling fluids, including *Pure-Bore*®, and continues to lead the field with its products. The company has worked extensively on high-performance drilling and underground construction projects, and prides itself on providing an environmentally friendly world-class service.*

#### For further information contact:

+44 1939 235 754 [info@drilling-products.com](mailto:info@drilling-products.com)  
[www.drilling-products.com](http://www.drilling-products.com) / [www.pure-bore.com](http://www.pure-bore.com)

# Clear Stabiliser HV™

NATURAL CELLULOSIC HIGH VISCOSITY FLUID LOSS POLYMER

<p><b>Description</b></p>	<p>Clear Stabiliser HV™ is an ultra pure, non-fermenting, high viscosity granular fluid loss polymer designed for building a low solids drilling fluid with increased borehole stability. Clear-Stabiliser HV™ is a highly dispersible polymer designed for maximum product efficiency.</p>
<p><b>Functions</b></p>	<p>Clear Stabiliser HV™ is designed to increase borehole stability in a wide variety of rotary and horizontal drilling applications.</p>
<p><b>Benefits</b></p>	<p>Controls filtration rate and assists in forming a thinner, less permeable filter cake.</p> <p>Improves fluid viscosity for effective removal of drilled cuttings.</p> <p>Provides clay and shale inhibition to aid borehole stability and the removal of drilled solids by solids control equipment.</p> <p>Highly dispersible.</p> <p>Helps stabilise drilled formations.</p> <p>May be used in fresh or salt water conditions.</p> <p>Non Toxic.</p>
<p><b>Recommended Treatment</b></p>	<p>Mix at low shear through a mud hopper to avoid lumping and to minimise waste. Add 0.5 - 2.5 kilograms per cubic metre or 0.4-2 pounds per 100 gallons of drilling fluid.</p>
<p><b>Packaging</b></p>	<p>25 kg multi-ply bags, 40 drums per pallet. All pallets are stretch-wrapped.</p>

*The information and data contained herein are believed to be accurate and reliable. Clear Solutions International Limited makes no warranty of any kind and accepts no responsibility for the results obtained through application of this information.*

# Pure-Bore®

THE DRILLING FLUID FOR A CLEANER TOMORROW

<b>Description</b>	Pure-Bore® is a natural biodegradable drilling fluid, which can be used in a wide variety of drilling applications. Specially produced, dry free flowing polymer, Pure-Bore® provides exceptional bore hole stability and cuttings removal in a wide range of ground conditions.	
<b>Functions</b>	Biodegradable drilling fluid. Effective in all ground conditions (one sack drilling fluid). High viscosity for efficient hole cleaning. High yield point and gel strength for maximum cuttings suspension and transport. Generates a tight filter cake and provides exceptional bore hole stability in unconsolidated formations. Provides clay and shale inhibition. Minimises formation damage. Maximises production rates. Can be cleaned down through regular de-sanders.	
<b>Benefits</b>	Environmentally friendly, non-toxic drilling fluid. Fast and efficient mixing in salt or fresh water. Stable whilst drilling. Recycles through standard de-sanding/de-silting equipment. Minimises formation damage for improved well development. Better formation samples. Reduced swelling clay problems Reduced abrasive wear Increased penetration rate Reduced power / fuel costs 3 Kilos of Pure-Bore® provides the same viscosity as 60 Kilos of civil engineering grade bentonite or 25 Kilos of high yield bentonite Naturally biodegrades (stabiliser can be added to retard biodegradation) Can be chemically destroyed with calcium hypochlorite Low cost slurry disposal. Destroy or Biodegrade the Pure-Bore® polymer to settle out drilled cuttings in a settlement pit. The fluid phase can then be treated at a sewage treatment works leaving semi dry cuttings	
<b>Recommended Treatment</b>	Add slowly and uniformly through a high-shear venturi type hopper. Continue to agitate/circulate until Pure-Bore® is fully dispersed	
<b>Pure-Bore® Mixing Ratios</b>		
<b>Pure-Bore® Degradation</b>		
<b>Packaging</b>	Pure-Bore® is packaged in 5kg plastic bags (5 x 5kg bags per cardboard case)	

	kg/M3	lbs/100 US Gal
Consolidated Formation (Clay/Shale)	2 – 4 kg's	1.6 – 3.3 lbs
Unconsolidated Formation (Sand/Gravel)	3 - 7 kg's	2.4 – 5.6 lbs
Calcium hypochlorite (65% active)	1 – 3 kg's	0.8 – 2.5 lbs

The information and data contained herein are believed to be accurate and reliable. Clear Solutions International Limited makes no warranty of any kind and accepts no responsibility for the results obtained through application of this information.

# Drill-Sorb®

LOSS CIRCULATION MATERIAL AND DRILLING FLUID SOLIDIFIER

<p><b>Description</b></p>	<p>Drill•Sorb® is a granular, advanced super-absorbent material that rapidly absorbs and retains large volumes of water from aqueous solutions. Drill•Sorb® can absorb 200 times its weight.</p>
<p><b>Functions</b></p>	<p>Drill•Sorb® is a very effective drilling fluid solidifier (adsorbing the water phase of the drilling fluid) and ideally suited for lost circulation control in highly fractured zones and permeable and porous formations.</p>
<p><b>Benefits</b></p>	<p>Excellent at sealing sand, gravel and fractured rock. Capable of absorbing 200 times its own weight. Converts drilling fluid into dry disposable solid by absorbing water.</p>
<p><b>Recommended Treatment</b></p>	<p><i>Loss Circulation:</i> Pre-mix 1-5 kg/m<sup>3</sup> or 2.5-11 pounds/100gal into the drilling fluid on the surface, wait 5 minutes for the Drill•Sorb® to soften and then pump quickly into zone to be sealed. Allow time for Drill•Sorb® to expand into the loss zone before proceeding with drilling.</p> <p><i>Drilling Fluid Solidification:</i> Spread Drill•Sorb® over the waste slurry and mix it in with a digger bucket or shovel – depending on the solids content of the waste slurry, typical usage is between 3Kg and 7Kg per cubic meter of slurry. Depending on the amount of free water it takes roughly ½ hour - 2 hours for the Drill•Sorb® to go off and set like stiff jelly for easy waste disposal.</p>
<p><b>Packaging</b></p>	<p>Drill•Sorb® is packaged in 25 Kg plastic bags, 40 bags per pallet. All pallets are stretch-wrapped.</p>

*The information and data contained herein are believed to be accurate and reliable. Clear Solutions International Limited makes no warranty of any kind and accepts no responsibility for the results obtained through application of this information.*