Pure-Bore®

THE DRILLING FLUID FOR A CLEANER TOMORROW

Introduction

As part of a Technical Scoping Study undertaken by Enviro.Innovate to investigate the potential environmental impacts of PURE-BORE® drilling fluid, several analytical techniques were used to determine the main elemental and anionic composition of the drilling fluid. Pure-Bore is composed of biopolymer, which biodegrades within 8 to 52 weeks.

The main findings of the analysis are as follows:

1. 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.
2. 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.

Methods of Analysis

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 1:1,000 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 1:1,000 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.

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

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

T. +44 (0) 1939 235 754
F. +44 (0) 1939 232 399

E. info@drilling-products.com
W. www.drilling-products.com

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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

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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.
Conclusions	1. The chemical analysis of Pure-Bore shows that the concentrations of the elemental and anionic analytes measured is very low.

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