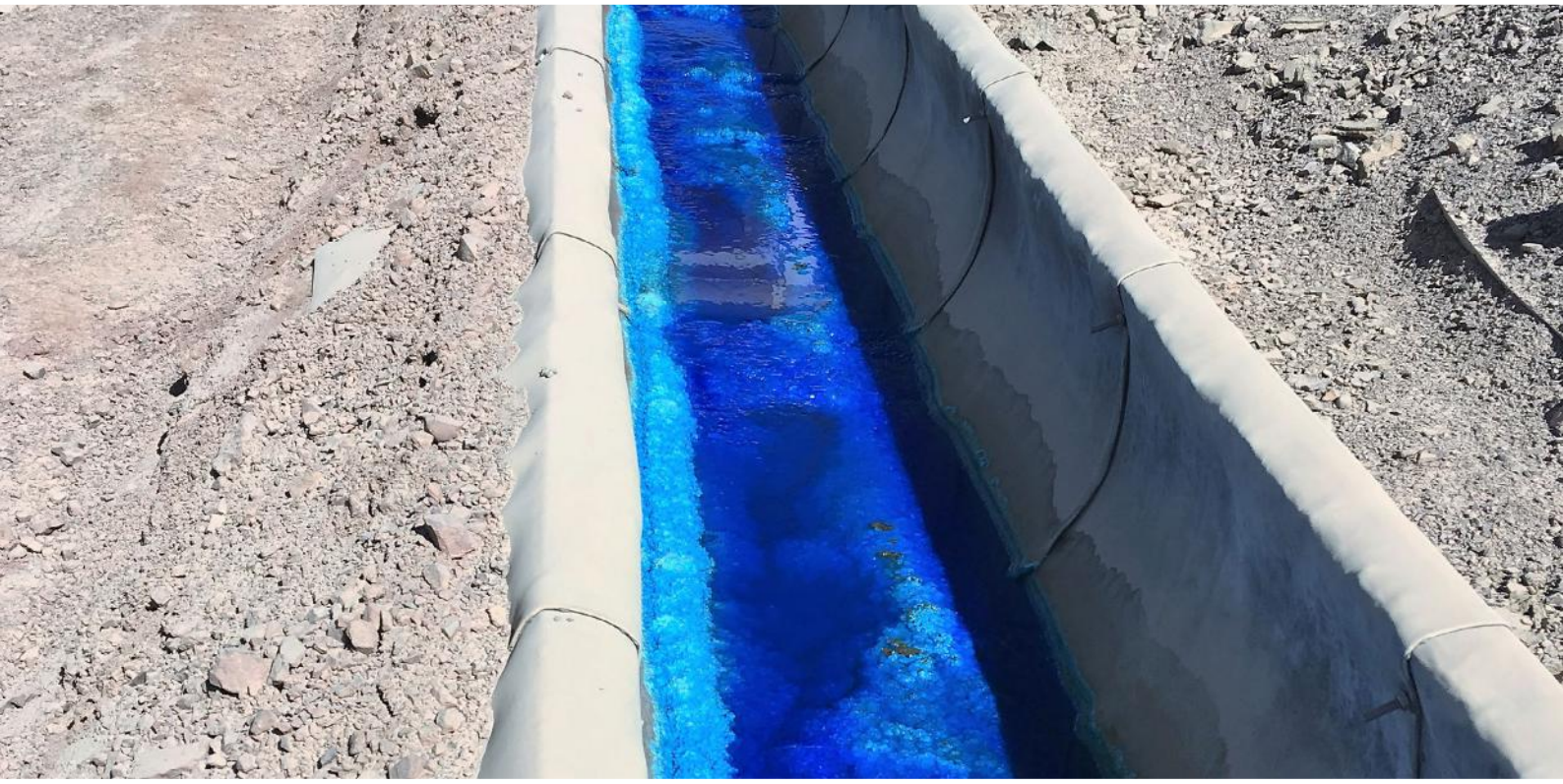
CONCRETE CANVAS®

Concrete Impregnated Fabric

1703.EN.BR

MADE IN UK



CCHYDRO™

Concrete Impregnated Containment

GEOMEMBRANE 14-DAY EXPOSURE TEST TO PETROL & DIESEL

RAIL · ROAD · MINING · PETROCHEM · AGRO · UTILITIES · PUBLIC WORKS · DEFENCE · DESIGN · SHELTER

2014 Fast Track 100 16th fastest growing company in the UK.

2014 Queen's Award for Enterprise in Innovation

2013 Macrobert Award Finalist

2013 Innovation Award Winner Railtex Exhibition

2012 R&D 100 Award winner R&D Magazine

2011 Expert's Choice Winner Most Innovative Product

2011 Brit Insurance Designs of the Year Nominee

2009 Winner Material Connexion Medium Award Material of the Year

2007 Winner D&AD Yellow Pencil Award Product Design

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CC HYDRO™
Concrete Impregnated Containment

14-DAY EXPOSURE TEST TO PETROL & DIESEL

CC Hydro™ Geomembrane 14-day Exposure Test to Petrol & Diesel

Based on testing to **BS EN 14414:2004** *"Geosynthetics. Screening test method for determining chemical resistance for landfill applications".*

14-day exposure testing to Petrol and Diesel to assess the resistance of the geomembrane laminate used on rear surface of the CC Hydro ™ product has been conducted.

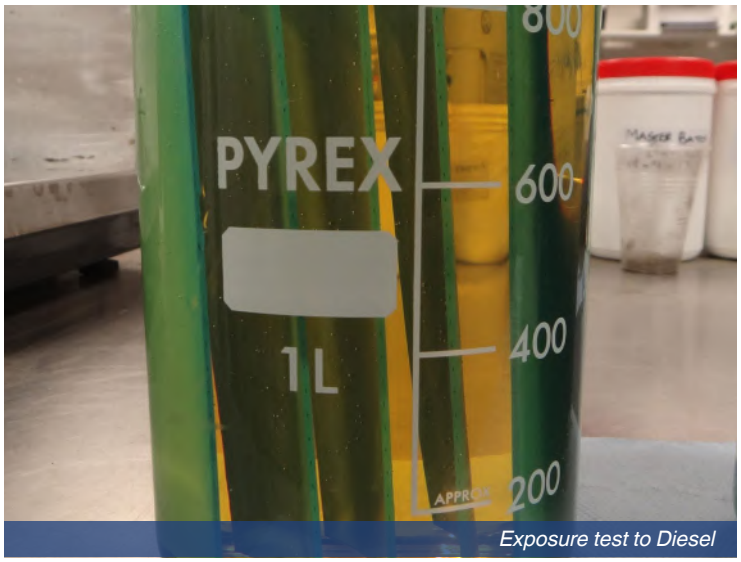
The test method used is based on BS EN 14414:2004, "Geosynthetics. Screening test method for determining chemical resistance for landfill applications". The test method involves full immersion of the test specimens (50x160mm) in the test chemicals.

The test method has been modified for the original standard to reflect real world conditions in the event of a containment event where the product is used as the secondary containment liner.

This involved testing at ambient temperature rather than an elevated temperature of 56^{O}C and testing was based on 14 days exposure rather than 56 days to reflect the maximum possible exposure time expected in the field.

Following the 14 day immersion period, the samples are subjected to a visual inspection, assessment of dimensional stability (mass and thickness change) and tensile strength tests (to BS-EN-12226). Results were compared to control specimens.


Exposure test to Petrol



Exposure test to Diesel

Summary of Results

		PETROL	DIESEL
		%	%
Dimensional Stability	Retained Weight	94%	101%
	Retained Thickness	105%	101%
Mechanical Performance	Retained U.T.S	93%	102%
	Retained Elongation	112%	135%

Diesel: Specimens exposed to Diesel demonstrated no loss in ultimate tensile strength (UTS), no loss in mass and no loss in thickness. There was an increase in elongation at failure of 35%.

Petrol: Specimens exposed to Petrol demonstrated a 6% loss in mass and no loss in thickness. There was a increase in elongation at failure of 12% and a 7% drop in ultimate tensile strength (UTS).

*Geosynthetic Cementitious Composite Mat

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DATE RELEASED: 24/02/2017

ARD-2017-04 CHEMICAL RESISTANCE OF CCH LAMINATE TO PETROL AND DIESEL

SOURCE / MASTER PROJECT		
DATE	MASTER PROJECT ID	SOURCE ID
01/02/2017	CHEMICAL RESISTANCE OF CC HYDRO	ARD-2017-04

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1. SCOPE

The purpose of this experiment is to determine the 14 day resistance of CCH geomembrane laminate when exposed to two mixes: petrol and diesel.

The test procedure is based on BS EN 14414:2004 and on previous experiments and projects performed with CC and CCH.

The tests are to be performed at ambient temperature.

2. DATA

2.1. Roll of reinforced CCH geomembrane laminate

2.2. Petrol and diesel specimens obtained from local fuel station.

3. PROCEDURE LOG

3.1. PREPARATION OF TEST SPECIMENS:

3.1.1. Samples of laminate were cut into 36 specimens (50mm x 160mm).

3.1.2. Specimens were labelled (1-36) and dimensional measurements were performed (weight, thickness). All results were recorded in the **ARD 2017-04 DIESEL & PETROL CHEM RES 170201**.

3.1.3. Set of 12 specimens were selected to be immersed in each liquid.

3.1.4. Remaining set of 12 specimens were retained as a CONTROL SET.

3.2. PREPARATION OF TEST SOLUTION:

3.2.1. NA

3.3. EXPOSED SAMPLES:

3.3.1. Selected specimens of laminate were attached to glass rods using specimen holders (metal paper clips).

3.3.2. Specimens were placed in a beaker suspended from the glass rod such that the laminate was fully immersed in the test solution (petrol or diesel).

Figure 1 CCH5 in diesel (on the left) and petrol (on the right) - immediately after submersion

3.3.3. Beakers were sealed and placed in the water bath to maintain constant temperature, with the entire setup within the fume hood.

3.4. CURED SPECIMENS INSPECTION AND TESTING:

3.4.1. After 14 days exposure the specimens were securely removed from the test solution and placed in empty beaker so that the excess of liquid could be drained off the surface.

3.4.2. Specimens were then rinsed in water and left to dry.

3.4.3. Specimens were then visually inspected after 24 hours.

3.4.4. Width, length, thickness and weight measurements were performed prior to tensile testing.

3.4.5. CCH laminate was tested following **CC JOINT TENSILE TEST V2** (based on ASTM XXXX) with the following modifications:

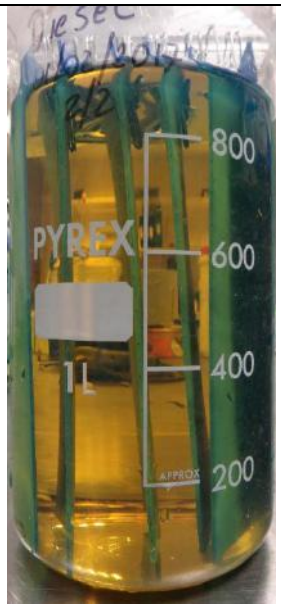
3.4.5.1. L_0 (starting length): 100mm

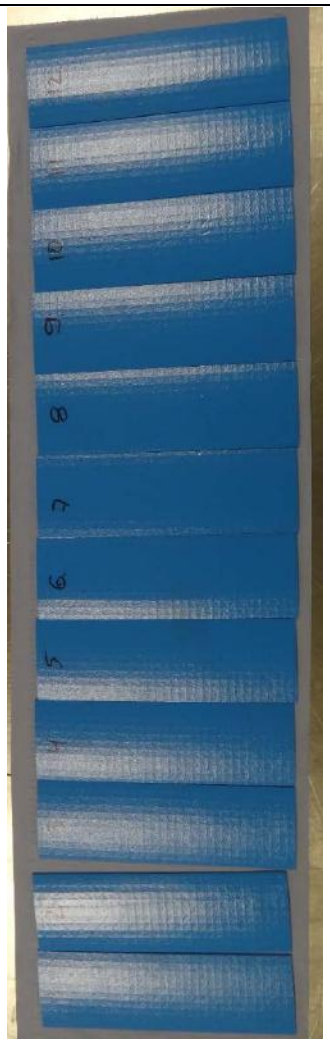
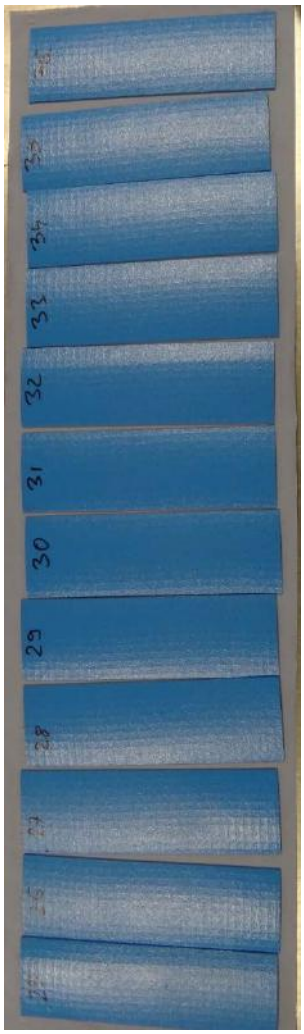
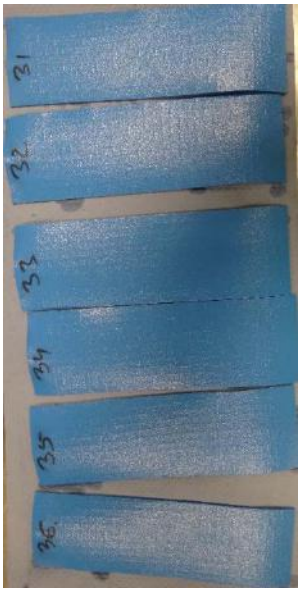
3.4.5.2. Travel speed: 200mm/min.

3.4.6. Control specimens were tested together with test samples.

4. RESULTS

4.1. VISUAL INSPECTION OF SPECIMENS AT THE END OF CURING STAGE.

	DIESEL AT 14 DAYS	PETROL AT 14 DAYS
TEST SOLUTION CHANGE - CCH LAMINATE		

SPECIMENS CHANGE	  	 

- Specimens cured in diesel are slightly discoloured.
- Specimens cured in the petrol have lost their gloss finish and became slightly textured.

CONTROL	DIESEL AT 14 DAYS	PETROL AT 14 DAYS	TYPICAL FAILURE
Specimens during testing:			
			
• All specimens failed in the same way – by rupture between clamped areas. .			

4.2. SPECIMENS DIMENSIONS:

4.2.1.**CCH LAMINATE**:

CC HYDRO	UNIT	CONTROL	DIESEL	PETROL
Average of Density	g/cm^3	1.28	1.30	1.29
Average of Width	mm	50.00	50.00	50.00
Average of CURED Weight	g	13.998	14.410	13.370
Average of THICKNESS CHANGE	mm	-0.004	0.020	0.075
Average of WEIGHT CHANGE	g	-0.006	0.180	-0.898
Average of RETAINED THICKNESS	%	99.68%	101.43%	105.32%
Average of RETAINED WEIGHT	%	99.95%	101.27%	93.71%

There is a very small, but measurable, change of dimensions after 14 days of curing:

- Specimens cured in diesel have increased in thickness by about 1.4% and in weight by 1.27%.
- Specimens cured in petrol have increased in thickness by 5.3% and reduced weight by 6.3%.

4.3. SPECIMEN TENSILE STRENGTH:

CC HYDRO	UNIT	CONTROL	DIESEL	PETROL
Average of Max Load	N	1051.1	1009.6	976.6
Average of Extension at Max Load	mm	27.17	26.85	30.65
Average of Laminate rupture	N	760.9	775.9	723.2
Average of Elongation at rupture	%	152%	207%	232%
Retained Tensile Strength	N	-	101.96%	93.21%
Retained elongation	%	-	135.45%	112.14%

- Specimens cured in diesel have retained 100% of their tensile strength at rupture but increased elongation by 35%.
- Specimens cured in petrol lost 6.8% of their tensile strength at rupture but increased elongation by 12%.

5. CONCLUSIONS

5.1. DIESEL:

5.1.1. The main effect of exposing CCH geomembrane laminate to diesel for 14 days is an increase in elongation at break by 35%. There are also small but measurable dimensional changes including a small increase in weight (~1%) and thickness (~1%).

5.1.2. Neither of observed changes should affect the CCH geomembrane laminate performance as a containment liner.

5.1.3. In summary, the CCH geomembrane laminate has very good resistance to diesel after 14 days full exposure.

5.2. PETROL:

5.2.1. The main effect of exposing CCH geomembrane laminate to petrol for 14 days is a small reduction in ultimate tensile strength elongation of 6.8%. There are also small but measurable dimensional changes including a small decrease in weight (~6%) and increase in thickness (~5%).

5.2.2. Taking into account the above factors the geomembrane laminate shall continue to perform in its capacity as a containment liner following 14 days exposure to petrol.

5.2.3. In summary CCH geomembrane laminate has good resistance to petrol after 14 days full exposure.