CC HYDRO™
Concrete Impregnated Containment

BUND LINING

Project Info

- 05 / 10 / 2015
- CCH5™ Bulk Rolls
- 1280m²
- Transverse layers
- Undisclosed, UK
- Celtic Lining
- CC Hydro™ used to line a secondary containment bund at an anaerobic digestion site. This was to provide a high level of impermeability to the berm faces to satisfy local Environment Agency conditions for the storage of digestate.

Completed section of berm

Project Background

In October 2015, CC Hydro™ was used to line a secondary containment bund at an anaerobic digestion facility in the UK. The green energy scheme produces 1.2 megawatts of energy an hour from hops and other farm waste. The project brief was to provide a secondary containment method that would prevent any of the tank contents infiltrating the groundwater should there be a tank failure. Conventional berm lining methods were considered, however CC Hydro™ offered an environmentally friendly, fast and cost effective install.

CC Hydro™

CC Hydro™ is a concrete impregnated geotextile that hardens on hydration to form a durable, fibre reinforced concrete layer for the containment of liquids including fuels, oils and other chemicals. The system provides a high performance, armoured, impermeable barrier for lining applications including berms, bund floors and drainage channels. CC Hydro™ consists of a 3-dimensional fibre matrix containing a specially formulated dry concrete mix. The fibre matrix acts to contain the dry concrete, aids hydration during wetting and provides fibre reinforcement once set. This concrete layer protects a hydrocarbon resistant geomembrane bonded to the rear surface which provides a minimum impermeability of $k = 1 \times 10^{-12}$ m/s. A 100mm welding strip allows for efficient thermal welding and rapid on-site quality control and testing.

*Geosynthetic Cementitious Composite Mat

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CC Hydro™ Technical Advantages

CC Hydro™ User Benefits

All-in-one Solution
CC Hydro™ combines the impermeability of a containment liner with the hard armour protection and durability of concrete, reducing install times and simplifying logistics.

No Top Cover
CC Hydro™ does not require a protective top cover. This removes the need for additional excavation, the treatment of contaminated arisings and the import of costly fill material.

Maintains Volume Capacity
CC Hydro™ can be laid directly onto existing profiles without loss of volume capacity for refurbishment projects, providing significant overall time and cost savings.

Reduced Life-Cycle Costs
CC Hydro™ provides effective weed suppression eliminating the ongoing maintenance cost of soil covered systems. CC Hydro™ also reduces the end-of-life costs associated with treatment of any contaminated top cover.

CC Hydro™ Key Properties

High Impermeability
CC Hydro™ has excellent impermeability and has been independently tested to BS-EN-1377 to have a hydraulic conductivity better than $1x10^{-12}$ m/s.

Durable
The concrete surface of CC Hydro™ provides a hard armour surface, protecting the geomembrane liner from puncture, abrasion, weathering, burrowing animals and UV degradation.

Chemical Resistance
CC Hydro™ has been shown to have excellent resistance to a wide range of chemical reagents, including hydrocarbons, digestates and acidic leachates.

Testible Joints
CC Hydro™ incorporates a high-visibility welding strip, allowing the joint to be thermally bonded with a twin-track or triple-track air channel for fast and simple on-site pressure testing.

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CC Hydro™ Thermal Welding

CC Hydro™ can be thermally bonded using similar welding and solvent methods to standard plastic liners and geomembranes to provide testable joints with the same level of impermeability as the material itself. For this installation, thermal welding with a twin track air channel was specified to allow the onsite testing of joints for quality control purposes. Welding rates of CC Hydro™ can vary from 3-6m/minute subject to site conditions and CQA requirements.

1: Alignment

CC Hydro™ is marked with two guidelines, 15mm and 30mm from the edge of the material. When overlapping layers for thermal welding, the upper most layer should line up with the 30mm guideline. This provides the necessary clearance between the thermal weld strip and CC Hydro™ to allow pressure testing.

2: Cleaning

The two geomembrane faces should be wiped down prior to welding to remove any dirt or moisture, to ensure an optimum weld.

3: Welding

Welding on this project was performed by TWI (UK Thermal Welding Institute) certified operators using Leister Twinny T and S models. The welding machines were individually calibrated at the beginning of each days phase of work to adjust to ambient temperature. Cut sample sections were also regularly welded and pull tested to destruction to check the integrity of the weld channels.

4: Testing

As per industry standards, regular pressure testing of welded seams was performed over the course of installation. In this instance, channel welds were clamped at the crest and toe of the CC Hydro™ layers, before pressurising to 2bar. A successful weld was determined if the pressure didn't decrease by greater than 10% over a five minute interval.

For more information please the *CC Hydro™ Thermal Welding Guide*.

Alignment

Cleaning the geomembrane faces to be welded

Welding

Testing

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Installation

The anaerobic digestion site

Services that needed to be accommodated

Overhead pipe and plant limiting access

The site had several access issues, including berm penetrating services and overhead pipework. The flexibility of CC Hydro™ made it quicker and easier to accommodate pipe plinths and upstands compared to poured and sprayed alternatives. The lower material volume compared to conventional solutions which require protective top cover provided significant reductions in plant movement, thereby increasing site safety.

To prepare for the deployment of CC Hydro™, the berm was first graded, loose rock removed and a sand blinding layer applied to fill any void space, ensuring intimate contact between the material and the surface of the berm. Bulk rolls of 5mm CC Hydro™ (CCH5™) were delivered to site in staggered deliveries to minimise onsite storage and to match the rate of installation.

Deployed via a spreader beam suspended from a telehandler, CC Hydro™ bulk rolls were unrolled both up and down the berm face depending on access. Providing the material in bulk roll format allowed the contractors to cut lengths of CC Hydro™ to match exactly the dimensions of individual sections of the profile to reduce wastage. The leading edge of the material was tucked into an anchor trench at the crest of the berm and fixed into position with steel ground pegs to prevent sagging. The toe edge of the lengths were lapped onto a cut step in the poured concrete base and made to form an interior drainage channel. Post welding, joints were then visually inspected and pressure tested. Following completion of each day's phase of works, the crest anchor trench was backfilled and welded overlaps compressed with sandbags to ensure a flat profile. The final step was to hydrate the material via a 10,000L water truck, ensuring that the last length of CC Hydro™ was covered in tarpaulin to allow for welding the subsequent day.

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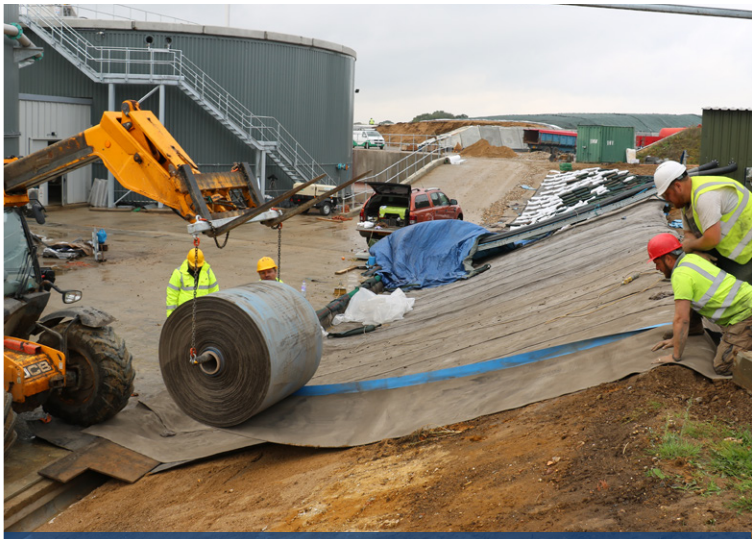
Ground preparation



Unrolling the CC Hydro™

Cutting the CC Hydro™ to length

Fixing into the anchor trench

Setting up the thermal welder

Welding

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Backfilled anchor trench


Hydration


CC Hydro™ placed under services


Toe drain details

Summary

In challenging weather conditions and areas of limited access, the entirety of the 1250m² of CC Hydro™ was installed onto the berm face over a six day period by a crew of 4 operators. The lining of the berms with CC Hydro™ satisfies local regulatory requirements for the safe containment of potentially hazardous pollutants in the event of tank rupture and will now provide greater flexibility on the media used to power the facility. Following the success of this installation, CC Hydro™ is now being considered for several other AD plants in the region with similar regulatory requirements.

"Despite challenging weather conditions, and that this was our first experience of installing CC Hydro, we were delighted with the successful outcome of this project. With our vast and varied experience of welding conventional plastic liners for landfill projects, we were comfortable with the processes involved, following similar methodologies and using similar equipment. Having experience of CC Hydro now give us another option to present to clients and we very much look forward to the next project."

Dyfed Jones
Project Manager
Celtic Lining

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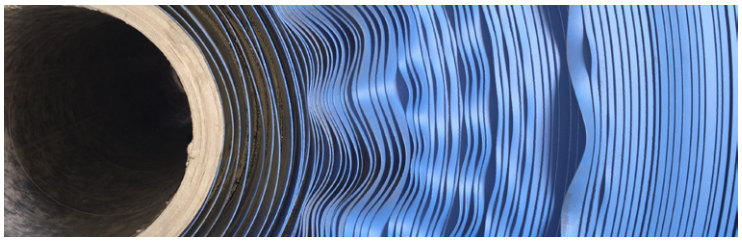
DATA SHEET

CC Hydro™ GCCM Material Data



CC Hydro™ GCCM Physical Properties*

Product	Concrete Thickness (mm)	Bulk Roll Size (m^2)	Roll Width (m)
CCH5™	5	150	1.0
CCH8™	8	100	1.0

Product	Mass (unset) (kg/m^2)	Concrete Density (unset) (kg/m^3)	Density (set) (kg/m^3)
CCH5™	9	1500	+30-35%
CCH8™	14	1500	+30-35%

Pre-Set CC Hydro™ GCCM Properties

Setting

Working Time

1-2 hours subject to ambient temperature

CC will achieve 80% strength at 24 hours after hydration.

Method of Hydration

Spray the fibre surface with water until it feels wet to touch for several minutes after spraying.

Re-spray the CC again after 1 hour if:

- Installing CCH5™
- Installing on a steep or vertical surface

Notes:

- An excess of water is always recommended. CC Hydro™ will set underwater and in seawater.
- CC Hydro™ must be actively hydrated. For example do not rely on rainfall or snowmelt.
- Use a spray nozzle for the best results (see CC Hydro™ equipment list). Do not jet high pressure water directly onto the CC Hydro™ as this may wash a channel in the unset CC Hydro™.
- CC Hydro™ has a working time of 1-2 hours after hydration. Do not move or traffic CC Hydro™ once it has begun to set.
- Working time will be reduced in hot climates and increased in very cold climates.
- CC Hydro™ will set hard in 24 hours but will continue to gain strength over time.
- If CC Hydro™ is not sufficiently wetted, or dries out in the first 5 hours, the set may be delayed and strength reduced. If the set is delayed avoid trafficking the material and re-wet with an excess of water.

Refer to the *Concrete Canvas Hydration Guide* for installation in low temperatures or drying conditions.

- Low Temperature Conditions occur the ground surface temperature is between 0 and 5°C and rising or is expected to fall below 0°C in the 8 hours following hydration.
- Drying Conditions occur when there is one or more of: high air temperature (>22°C), wind (> 12km/h), strong direct sunlight or low humidity (<70%).

Post Set CC Hydro™ GCCM Properties

Based on Concrete Canvas GCCM ® hydrated in accordance with the Concrete Canvas® Hydration Guide.

Strength

Very high early strength is a fundamental characteristic of CC Hydro™. Typical strengths and characteristics are as follows:

Compressive tests based on ASTM C109 – 02 (initial crack)
- 10 day compressive failure stress (MPa) 40

Bending tests based on BS EN 12467:2004 (initial crack)
- 10 day bending failure stress (MPa) 3.4

Impermeability

BS EN 1377 - Water (m/s) $7.5x10^{-13}$
BS EN 1377 - Diesel (m/s) $1.6x10^{-12}$

Reaction to Fire

CC has achieved **Euroclass B certification**:
BS EN 13501-1:2007+A1:2009 B-s1, d0

Flame Resistance: **MSHA ASTP-5011**
Vertical and Horizontal Certification Passed

Standard for Secondary Containment Liners
CAN/ULC S668-12 Passed

Age Testing (minimum 50 year expected life)

Freeze-Thaw testing (ASTM C1185) 200 Cycles
Freeze-Thaw testing (BS EN 12467:2004 part 7.4.1) Passed
Soak-Dry testing (BS EN 12467:2004 part 5.5.5) Passed
Heat-Rain testing (BS EN 12467:2004 part 7.4.2) Passed
Water impermeability (BS EN 12467:2004 part 5.4.4) Passed**

Other

Puncture Resistance CCH5™
Mean Max Puncture Force (kN) 2.4
Mean Max Displacement (mm) 94.1

Abrasion Resistance (ASTM C-1353)
Approximately 7.5x greater than 17MPa OPC Passed

Manning's Value (ASTM D6460) n = 0.011

Root Resistance (DD CEN/TS 14416:2005) Passed

Chemical Resistance (BS EN 14414)
- Acid (pH 1.0) (56 day immersion at 50°C) Passed
- Alkaline (pH 13.0) (56 day immersion at 50°C) Passed
- Hydrocarbon (56 day immersion at 50°C) Passed
- Sulfate Resistance (28 day immersion at pH 7.2) Passed

Impact Resistance of Pipeline Coatings
ASTM G13 (CC13™ only) Passed

Other Information

* Occasionally there will be a Beam Fault (fabric imperfection under 100mm wide running across the width) in a Bulk Roll. This fault is unavoidable due to the manufacturing process and the fault will be clearly marked with a white tag, there will be a maximum of (1) one Beam Fault in any Bulk Roll. A joint may need to be made on site where there is a Beam Fault as the material at a fault will not reach the performance specified in this Data Sheet. The maximum un-useable material due to any Beam Fault will be 100mm. There are no beam faults in standard batched rolls.

* Indicative values

** CC Hydro™ should not be used for the primary containment of liquids that would be detrimental to the environment.

CE
Concrete Canvas Ltd.
CF37 5SP, United Kingdom
11
EN12467:2004
Concrete Canvas: Fibre cement sheet
NT
Oversize sheets
Class 1, Category A
Reaction to Fire B-s1,d0

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