CONTINUOUS GEOMEMBRANES FOR ON SITE APPLICATION
CONTINUOUS GEOMEMBRANES FOR ON SITE APPLICATION

POLYMERIC GEOMEMBRANES ARE MADE OF:

- POLYOLEOFINS (HDPE, LDPE, LLDPE, TPO, VLDPE).
- EPDM.
- PVC
LIMITATIONS OF CONVENTIONAL POLYMERIC GEOMEMBRANES:

- REQUIRE WELDING AT JOINTS AND SEAMS (heat or ultrasound).
- DIFFICULTY IN ADAPTING THEM TO COMPLEX STRUCTURES.
- THERMOPLASTIC MATERIALS. SUFFER FROM HEAT / COLD CYCLES. CRYSTALISATION
- HAVE LITTLE RESISTANCE TO PUNCTURE (EPDM).
- LITTLE IMPACT RESISTANCE (NOT ELASTOMERIC - HDPE).
- MULTI-LAYER SYSTEMS (MEMBRANE + GEOTEXTILE/DRAINAGE,…).
  FRICTION VALUES ARE CRITICAL.
NEW CONTINUOUS GEOMEMBRANES:

- TOTAL CONTINUITY (JOINTLESS).
- EASY TO SOLVE TECHNICAL DETAILS
- HIGH PERFORMANCE

...
NEW CONTINUOUS GEOMEMBRANES:

ARE MADE FROM:

POLYUREA / POLYURETHANE ELASTOMERS

SPRAYED ONTO GEOTEXTILES ON-SITE.
CONTINUOUS GEOMEMBRANES FOR ON SITE APPLICATION

POLYUREA & POLYURETHANE ELASTOMERS
CONTINUOUS GEOMEMBRANES FOR ON SITE APPLICATION

Polyurea & Polyurethane Formation - Reaction of an Isocyanate Group with an Amine or Alcohol (polyol)

The reaction of an isocyanate groups with amines / polyols forms ureas / urethanes.
Polymer structure and resulting properties can be adjusted / tailored for specific applications.
Ureas are water insensitive during application. Urethanes are more water sensitive.
ATTRIBUTES OF POLYUREA / POLYURETHANE ELASTOMERS

• Cure rapidly (seconds) under most conditions and temperatures.
• Low crosslink density leads to flexible products (excellent crack bridging capabilities).
• Low crosslink density and flexible backbone structure leads to high elongation products for the final product.
• Low crosslink density and high hydrogen bond content gives excellent solvent resistance.
• Not sensitive to humidity or moisture during reaction (Polyurea).
CONTINUOUS GEOMEMBRANES FOR ON SITE APPLICATION

TYPICAL APPLICATIONS FOR POLYUREAS / POLYURETHANES

Primary Containment

Bodyworks

Swimming Pools

Roofing

Pipe Coatings

Liners / Secondary Containment

PDA Europe 2012 Annual Conference - Istanbul, 12-14 November
CONTINUOUS GEOMEMBRANES FOR ON SITE APPLICATION

WATERPROOFING WITH POLYUREAS / POLYURETHANES

• Approvals for use in ROOFING, per different standards. In Europe, ETA (European technical Approvals) for 10 & 25 Years, as per EOTA Guidelines (www.eota.be).
• Provide a fully bonded / continuous membrane with excellent properties (elasticity, puncture resistance, longevity).
• Water tanks: approvals correspond to EEC Directive 98/83/CE, which regulates polymers in contact with drinking water.
• Polyureas are an excellent / fast alternative to most other systems in water tank refurbishments.
CONTINUOUS GEOMEMBRANES FOR ON SITE APPLICATION

IMPERMAX POLYUREA H

INSTITUTO DE CIENCIAS DE LA CONSTRUCCIÓN EDUARDO TORROJA
C/ Serrano Galvache nº 4
28033 Madrid
Tel.: (34) 91 302 04 40
Fax: (34) 91 302 07 00


MIEMBRO DE LA EOTA
EOTA MEMBER

EUROPEAN TECHNICAL APPROVAL
ETA – 11/062

(English language translation, the original version is in Spanish language)

IMPERMAX POLIUREA H
KRYPTON CHEMICAL, S.L.
C/ Martí Franques nº 12, Pol. Ind. Les Tàpies

Sistema de Impermeabilización de Cubiertas Aplicado en forma Liquida, basado en Poliuretanos
Liquid Applied Roof Waterproofing Kit, based on Polyurethane

21 August 2010
21 August 2015

Computer...
CONTINUOUS GEOMEMBRANES FOR ON SITE APPLICATION

ROOFING CASE STUDIES:

CONTINUOUS GEOMEMBRANES FOR ON SITE APPLICATION

ROOFING CASE STUDIES:

Seville Airport
Roof Refurbishing
25000 m²
Impermax 2K system
CONTINUOUS GEOMEMBRANES FOR ON SITE APPLICATION

ROOFING CASE STUDIES:

Tenerife airport
Roof refurbishment
12000 m²
Impermax 2K system
CONTINUOUS GEOMEMBRANES FOR ON SITE APPLICATION

CASE STUDIES:

Seville Football Stadium
General refurbishment
16,000 m²
Impermax 2K System
CONTINUOUS GEOMEMBRANES FOR ON SITE APPLICATION

POLYUREA - POLYURETHANE / GEOTEXTILE COMPOSITES

- SPRAY APPLIED POLYUREAS/POLYURETHANES GENERALLY REQUIRE CLEAN / DRY / SOUND SUBSTRATES…
  … BUT IT IS ALSO POSSIBLE TO SPRAY ELASTOMERS ONTO WOVEN / NON-WOVEN GEOTEXTILES..
- THIS PROVIDES CONTINUOUS MEMBRANES FREE OF JOINTS AND OVERLAPS, IN DIFFERENT COLOURS AND HIGH PRODUCTIVITY.
- PROPERTIES DEPEND ON THE KIND OF ELASTOMER / GEOTEXTILE CHOSEN.
CONTINUOUS GEOMEMBRANES FOR ON SITE APPLICATION

- Interests for Polyurea/Polyurethane Geomembranes:
  - Continuous systems, without seams and overlaps.
  - Non thermoplastic. Excellent Durability.
  - Possible to lay on very awkward situations (verticals, details, etc).
  - Systems may be laid bonded when required (i.e. pipes and protrusions).
  - Excellent puncture resistance (Geotextile + Polymer).
CONTINUOUS GEOMEMBRANES FOR ON SITE APPLICATION

Polymer component:
RECOMMENDED POLYMERS BY APPLICATION

<table>
<thead>
<tr>
<th>Polymer Component</th>
<th>Roofing</th>
<th>Flooring</th>
<th>Tanking</th>
<th>2nd Containment</th>
<th>Liners</th>
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<tbody>
<tr>
<td>Polyurethane</td>
<td>XXX</td>
<td>X</td>
<td>X</td>
<td>X</td>
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</tr>
<tr>
<td>Hybrid Polyurea</td>
<td>XX</td>
<td>X</td>
<td>X</td>
<td>XX</td>
<td>XX</td>
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<tr>
<td>Pure Polyurea</td>
<td>X</td>
<td>X</td>
<td>XXX</td>
<td>XXX</td>
<td>XX</td>
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<tr>
<td>Flex Polyurea</td>
<td>XXX</td>
<td>0</td>
<td>X</td>
<td>XX</td>
<td>XXX</td>
</tr>
<tr>
<td>Polyasparticss</td>
<td>0</td>
<td>XXX</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

VERY FLEXIBLE PURE POLYUREA => LOW SHRINKAGE / HIGH ELONGATION
HARDER PURE POLYUREA => CHEMICAL RESISTANCE (ACIDS)
HARDER HYBRID POLYUREA => CHEMICAL RESISTANCE (BASES)
CONTINUOUS GEOMEMBRANES FOR ON SITE APPLICATION

GEOTEXTILE COMPONENT:
NOT ALL GEOTEXTILES ARE EQUAL…

MADE FROM PP (best) OR POLYESTER. (low
resistance to alkalynes, moisture, microbes,…).

NEEDLE FELT GEOTEXTILES:
GOOD PUNCTURE RESISTANCE & ELONGATION
BIG RESIN CONSUMPTION
MAY LEAVE LOSE UN-COATED FIBRES

THERMOBONDED GEOTEXTILES::
LOW ELONGATION
LOWER RESIN CONSUMPTION
ALLOW GOOD QUALITY FINISH AND ASPECT
CONTINUOUS GEOMEMBRANES FOR ON SITE APPLICATION

THE “PERFECT” GEOTEXTILE IS...

MADE FROM PP FIBRE

ONE SIDE **NEEDLE FELT**…
GOOD PUNCTURE RESISTANCE
“CUSHIONING” EFFECT
GOOD ELONGATION AND FLEXIBILITY

… OTHER SIDE **THERMOBONDED**:
LOWER RESIN CONSUMPTION
ALLOWS FOR EXCELLENT FINISH AND
LOWER RESIN THICKNESS.

**PATENTED** (registration number **P201231631**).
• Some possible combinations:

Polyurea onto Geotextiles (Woven/Non woven)

Polyurea onto Drainage Composites

Polyurea onto Reinforcement Geogrids
CONTINUOUS GEOMEMBRANES FOR ON SITE APPLICATION

The leading centre for research, innovation and advanced technical services available to the textile, manufacturing and technical textile sectors.

Collaboration with AITEX is allowing to set up a comparison between products and vs conventional Polymeric Geomembranes.

Tests conducted:

Pure, Hybrid and very flexible Polyurea elastomers sprayed at 1, 1,5 and 2 mm thickness onto different geotextiles.

Measurements conducted:

- Puncture resistance. UNE-EN ISO 12236:2007
- Tear strength. UNE-EN ISO 34-1:2011

Goal: determine the best Elastomer / Geotextile combination for every application.
CONTINUOUS GEOMEMBRANES FOR ON SITE APPLICATION

TESTING EXAMPLE: STATIC PUNCTURE RESISTANCE CBR (in kN/m) (UNE-EN ISO 12236:2007).
CERTIFICATION WORK IN PROCESS:

- CHEMICAL RESISTANCE (LEACHATE, ACID/ BASIC,…).

- AGEING:
  - HIGH TEMPERATURE (DONE FOR E.T.A.).
  - U.V. RADIATION (DONE FOR E.T.A.).

- NEW MEMBRANE / GEOGRIDS COMBINATIONS FOR MAXIMUM TENSILE STRENGTH.
CONTINUOUS GEOMEMBRANES FOR ON SITE APPLICATION

Shannon County Ireland
Storm water lagoon
4000 m2.
Spraying Polyurea / Geotextile allowed to deliver the job on time, working under extremely harsh circumstances before floodings arrived.
Grupo Iberpapel
Planta Zikuñaga (Guipuzcoa)
Secondary Containment
2500 m²
Polyurea / Geotextile combination allowed to cope with all protrusions passing through the system, and surrounding upstands.
CONTINUOUS GEOMEMBRANES FOR ON SITE APPLICATION

POLYUREA / POLYURETHANE SPRAY LINERS

TARGET APPLICATIONS

- LEACHATE COLLECTION / STORAGE BASINS.
- PRIMARY / SECONDARY CONTAINMENT.
- SMALL DECORATIVE LAGOONS / PONDS.
- STEEP / VERTICAL SLOPES IN LANDFILLS AND LAGOONS.
- CANNALS.
CONTINUOUS GEOMEMBRANES FOR ON SITE APPLICATION

SYSTEM APPLICATION

KEY ASPECTS:

1. THICKNESS MANAGEMENT.
2. HANDLING DETAILS.
3. ANTI SKID FINISH. TEXTURED MEMBRANES.
CONTINUOUS GEOMEMBRANES FOR ON SITE APPLICATION

SYSTEM APPLICATION
THICKNESS MANAGEMENT.

- POLYUREA / POLYURETHANE MEMBRANES ARE HAND SPRAY APPLIED THROUGH HIGH TEMPERATURE / HIGH PRESSURE UNITS.

- MACHINE THRUPUT MAY BE AS MUCH AS 12 Kg/min (720 kg/hr). TRAINED INSTALLERS CAN LAY 1200 m²/ day.

- THICKNESS IS MONITORED BY DESTRUCTIVE / NON DESTRUCTIVE METHODS.

- RESIN CONSUMPTION MUST CONTEMPLATE WIND AND PROVIDE % DEVIATION VS TARGET (+ 5%).
CONTINUOUS GEOMEMBRANES FOR ON SITE APPLICATION

SYSTEM APPLICATION

THICKNESS MANAGEMENT.

DESTRUCTIVE METHODS.

1. RANDOM SAMPLES MUST BE EXTRACTED DURING JOB EXECUTION.

2. IT IS EASY AND FAST TO RE-SPRAY OVER SAMPLES TAKEN.

3. SAMPLE SIZE AND QUANTITY OF SAMPLES MUST BE DETERMINED STATISTICALY.
SYSTEM APPLICATION

SAMPLE SIZE (assuming normal distribution of thickness / Gauss Curve).

<table>
<thead>
<tr>
<th>Universe</th>
<th>200,000,000 cm²</th>
<th>1 m² = 10,000 cm²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sample size</td>
<td>20,000 m²</td>
<td>400 cm²</td>
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<table>
<thead>
<tr>
<th>Confidence intervals</th>
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<th>99,0%</th>
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<tbody>
<tr>
<td>Maximum indetermination (P &lt; Q)</td>
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<td>1.960</td>
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</table>

<table>
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<tr>
<th>Accepted error</th>
<th>0,50%</th>
<th>0,75%</th>
<th>1,00%</th>
<th>1,25%</th>
<th>1,50%</th>
<th>1,75%</th>
<th>2,00%</th>
<th>2,25%</th>
<th>2,50%</th>
<th>2,75%</th>
<th>3,00%</th>
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<tr>
<td>Sample size</td>
<td>9.556</td>
<td>4.292</td>
<td>2.424</td>
<td>1.554</td>
<td>1.080</td>
<td>0.794</td>
<td>0.608</td>
<td>0.481</td>
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<tr>
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<td>1.532</td>
<td>1.126</td>
<td>0.863</td>
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<td>1.999</td>
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<td>0.890</td>
<td>0.721</td>
<td>0.596</td>
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<td>22.800</td>
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<td>2.640</td>
<td>1.943</td>
<td>1.489</td>
<td>1.177</td>
<td>0.954</td>
<td>0.788</td>
<td>0.663</td>
</tr>
</tbody>
</table>
CONTINUOUS GEOMEMBRANES FOR ON SITE APPLICATION

SYSTEM APPLICATION

THICKNESS MANAGEMENT.

• NON DESTRUCTIVE METHODS. ULTRA SOUND THICKNESS MEASURING DEVICES.

POLYUREAS / POLYURETHANES can be applied bonded when needed (upstands).

GEOTEXTILES can be cut to suit different diameters / match special requirements.

Details are easily solved.
TEXTURED MEMBRANES

It is very easy to obtain textured Polyurea / Polyurethane membranes. This is normally achieved just by over-spraying polymer in the air. It is possible to walk on the polyurea / polyurethane membranes after just a few minutes.
CONCLUSIONS

- Polyurea is a great liquid applied solution that solves many problems.

- Some limitations in the use of polyureas are due to the state of substrates, which can result in very costly treatments.

- It is possible to combine Polyurea and different kinds of woven / non woven materials, maximizing the benefits provided and widening the scope for polyurea applications, making them less substrate dependant.