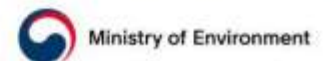


IWRA's XVII WORLD WATER CONGRESS

제 17차 IWRA 세계물총회

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EXCO, Daegu, Republic of Korea





BITUMINOUS GEOMEMBRANE (BGM)

The Blueprint to save water resources

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Introduction: Better water management strategies are needed

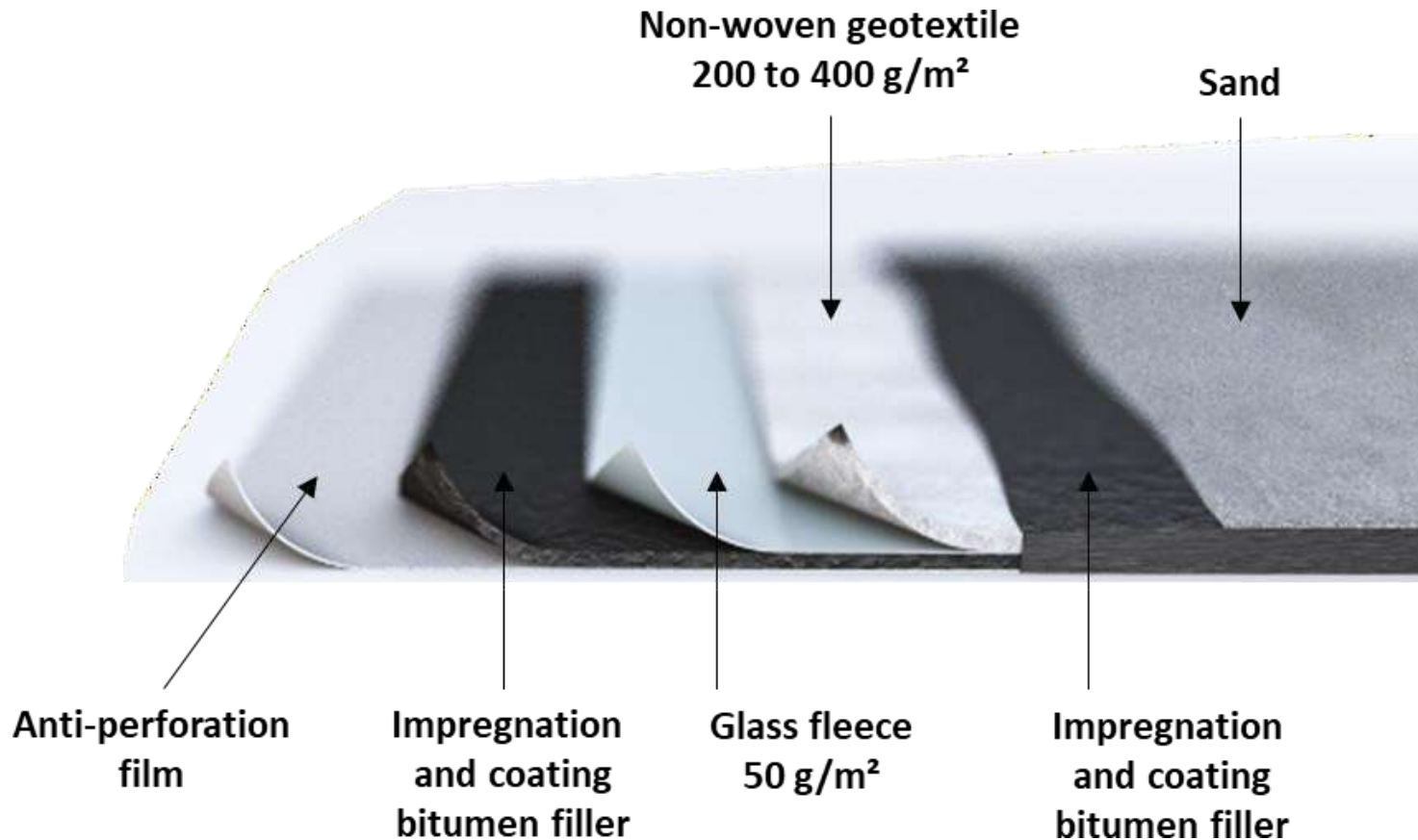
Water scarcity caused by climate change together with a constantly increasing population stress the global water demand.

Geosynthetic liners like Bituminous Geomembranes (BGM) are a **cost-effective and durable solution** that helps to waterproof any kind of hydraulic structure and prevent the loss of water by seepage

- Good permeable soil = 10^{-6} m/s
- Geomembrane = 10^{-14} m/s



BGM Cross-section



Prefabricated rolls



STANDARD LENGTH: 55 M TO 140 M

STANDARD WIDTH: 5,10 M

THICKNESS 2,2 TO 5,6 MM



**Technical advantages of
Bituminous Geomembranes (BGM)
for Waterproofing Hydraulic works**



Key characteristics of Bituminous Geomembranes (BGM)

- ✓ Very low permeability (6×10^{-14} m/s)
- ✓ Excellent puncture resistance
- ✓ Ability to remain exposed. Good dimensional stability and UV resistance
- ✓ Weldability to wide range of materials
- ✓ Good flexibility even at very low temperatures. It can be installed down to -40 °C
- ✓ Easy maintenance. Possibility of underwater repairs



1. Excellent Puncture resistance





2. Ability to remain exposed



Good dimensional stability and UV resistance

- ✓ **No induced wrinkles by changes of temperature**
- ✓ **Excellent durability even in exposed conditions**



3. Weldability to wide range of materials



Concrete



Steel



Rock



4. *High friction angle: Safety by non-slip surface*

People and animals can walk easily on the BGM surface without slipping





5. Installation even at very cold temperatures





6. Possibility of underwater repairs



Standard repairs

(Just welding a patch on top)

No need of external companies



Underwater repairs

(Density of 1,2 kg/L)

No need of emptying the water



7. Other beneficial properties

- ✓ Certified for Use in Drinking Water Systems : NSF/ANSI 61
- ✓ Low manning coefficient (0,012)
- ✓ High surface mass preventing wind uplift
- ✓ Direct compatibility with asphalt concrete
- ✓ Installation with common equipment and local installers (or own client workforce after an on-site training by the manufacturer)



Case studies in Hydraulic applications

- *Reservoirs*
- *Irrigation and Large Canals*
- *Dams*



Bel Air Reservoir (Maryland, USA)



DRINKING WATER RESERVOIR

Product: BGM 5,6mm thick

Quantity: 67 600 m²

Installation: 2018

Comments: Potable water reservoir to anticipate higher demand due to the increase of local population.

NSF/ANSI 61 certification for the storage of potable water



Reservoirs



Bel Air Reservoir (Maryland, USA)

Project during and after installation





Nagpur Left Pench bank Canal (India)



REHABILITATION OF DETERIORATED CONCRETE CANAL

Product: BGM 4,0 mm thick

Quantity: 34 000 m²

Installation: 2019

Comments: 13m bed width Canal

Canal network at Maharashtra State (Central India) that brings water from Pench River to agricultural areas in the region. The network has 1700km of canals of different dimensions and supplies water to 83000 hectares

Dikes broke over the years by the swelling clays under the concrete slabs. The canal was relined with flexible bituminous geomembrane to ensure a better waterproofing and no loss of water by seepage



Nagpur Left Pench bank Canal (India)



Before



After

Irrigation Canals



Nagpur Left Pench bank Canal (India)

Connections to singular points



Irrigation Canals



Canal de Provence (France)



Irrigation Canals



Canal de Provence (France)



Old repairs of cracks

Cracks with vegetation

Expansion joint





El Mauro Dam (Chile)



HIGH ROLLER COMPACTED CONCRETE (RCC) DAM

Product: BGM 4,0mm thick

Quantity: 186 000 m²

Installation: 2017

Comments: 23m high dam

BGM was installed to waterproof the upstream face of the dam. The upstream face has a very steep face of 1V:0.7H

Dams



El Mauro Dam (Chile)

Installation at very steep $1V:0.7H$ faces



Conclusions



Conclusions

- ✓ BGMs have proven to be a tough and effective waterproofing membrane on a wide range of hydraulic projects for the past 35 years.
- ✓ High physical and mechanical properties which allow:
 - Wide range of bedding and cover materials
 - No cushion geotextile required for protection
 - Possibility to leave the membrane exposed
- ✓ Easy and straightforward installation which can be done by local labor (e.g., personnel from the irrigation district).
- ✓ Very few maintenance and repairs (underwater repairs are possible)

Thank you for your attention!

