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Dynamic action of water is a heavy load condition which deteriorates canals



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**Geomembranes have been
used for rehabilitation and
new construction of canals
since the late 1940's**



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The main benefits of PVC geocomposite systems in canals are:

- ◆ They watertighten the entire surface, including joints
- ◆ They withstand action of UV, ice, debris
- ◆ They withstand differential settlements
- ◆ Because of their smoothness, they allow increase of water flow
- ◆ They allow monitoring the performance



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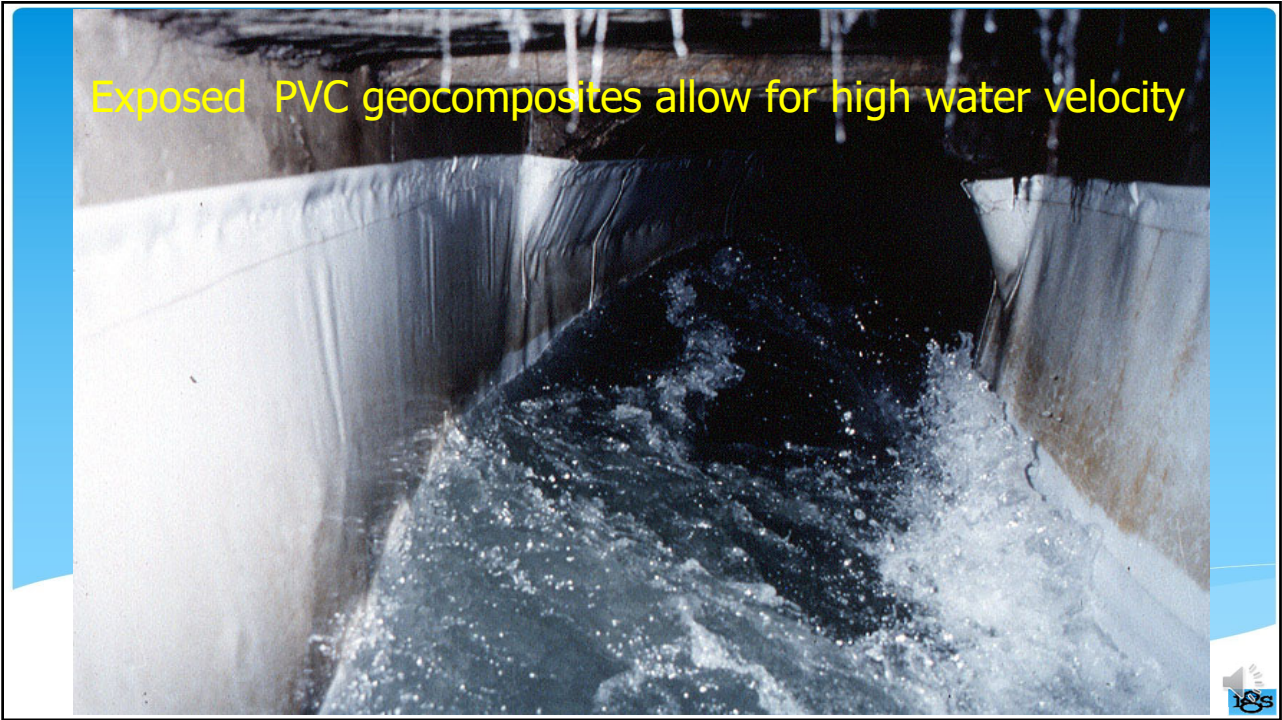
Exposed PVC geocomposites are smooth and allow increase of water flow



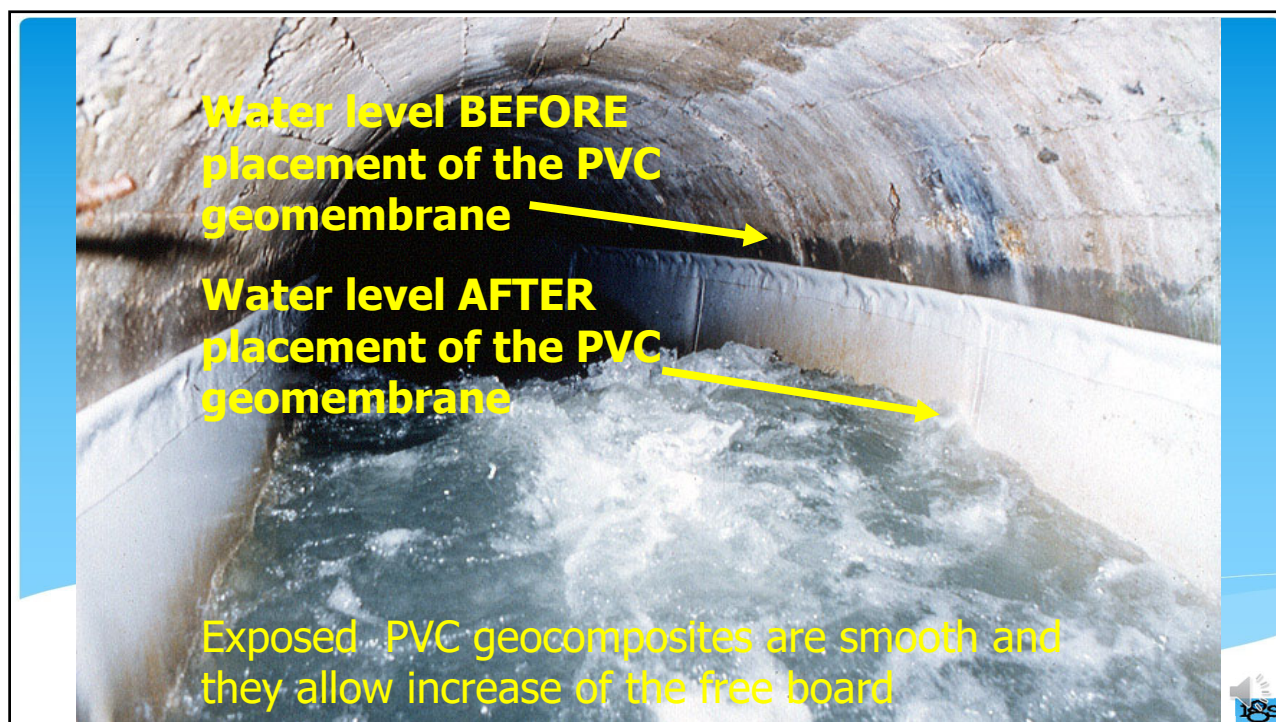
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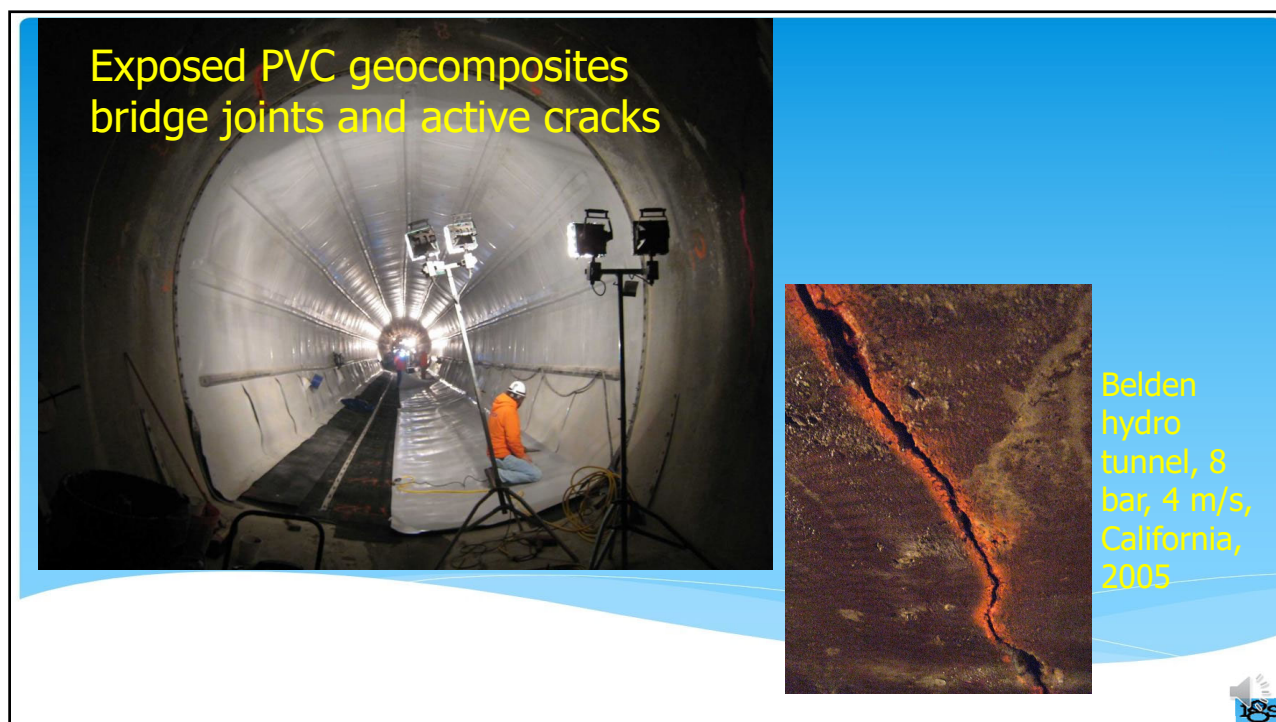
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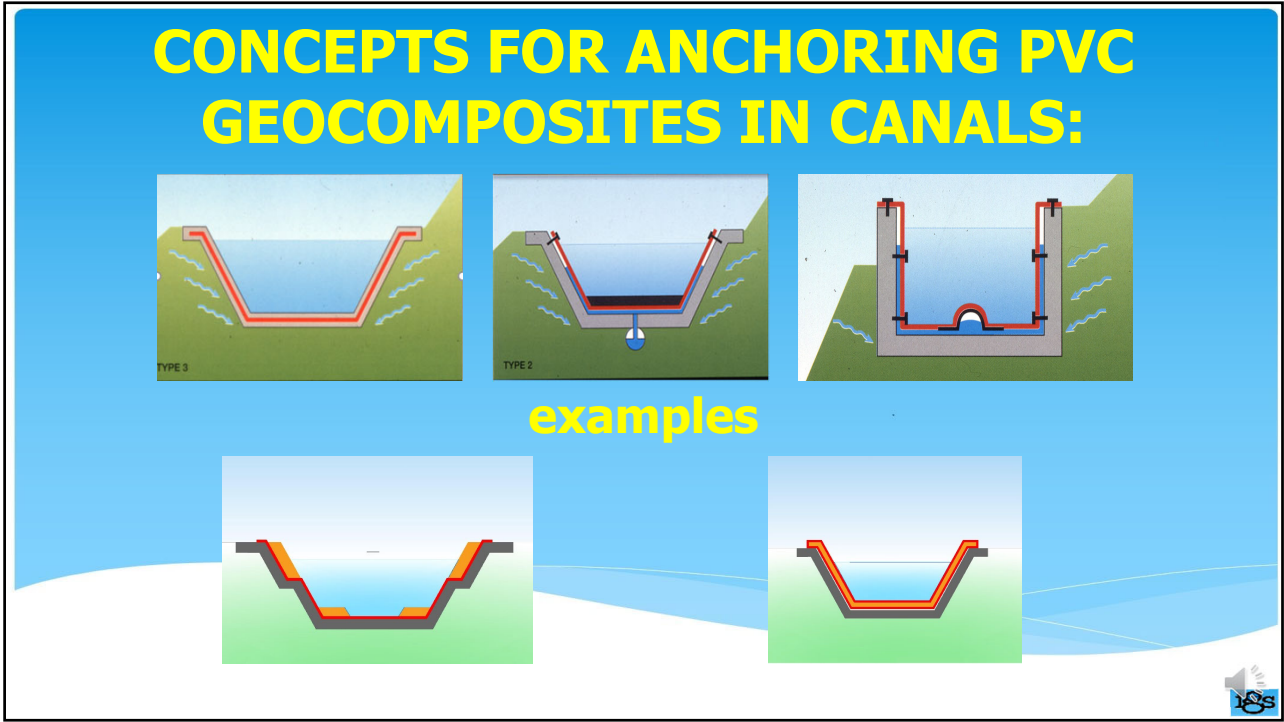
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The main criteria for designing a PVC geocomposite waterproofing system are:

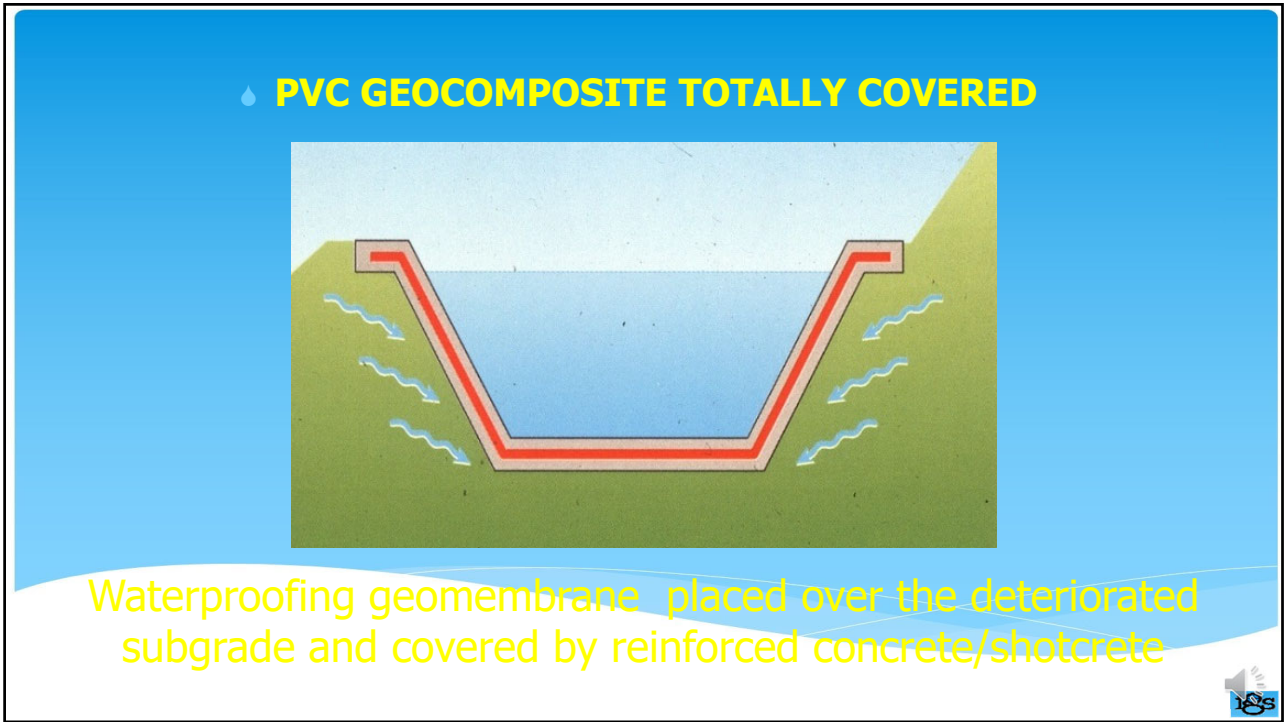
- For covered geomembranes, there shall be sufficient weight of ballast and puncture resistance to ballast
- For exposed geomembranes, they shall be strongly anchored to the subgrade to cope with water velocity, they shall be UV resistant, they shall have a drainage system



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GEOCOMPOSITE TOTALLY COVERED

Reinforced concrete cover on slopes and bottom

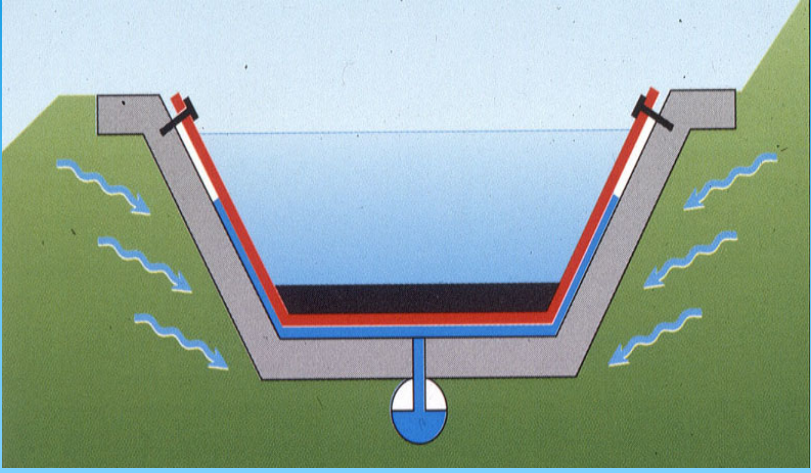
Ala Bussolengo, Italy 1973

Solution mainly used in pioneer projects, when there was less confidence in performance of exposed geomembranes




19

GEOCOMPOSITE COVERED ONLY ON INVERT



It applies to canals with heavy traffic for cleaning operations on invert



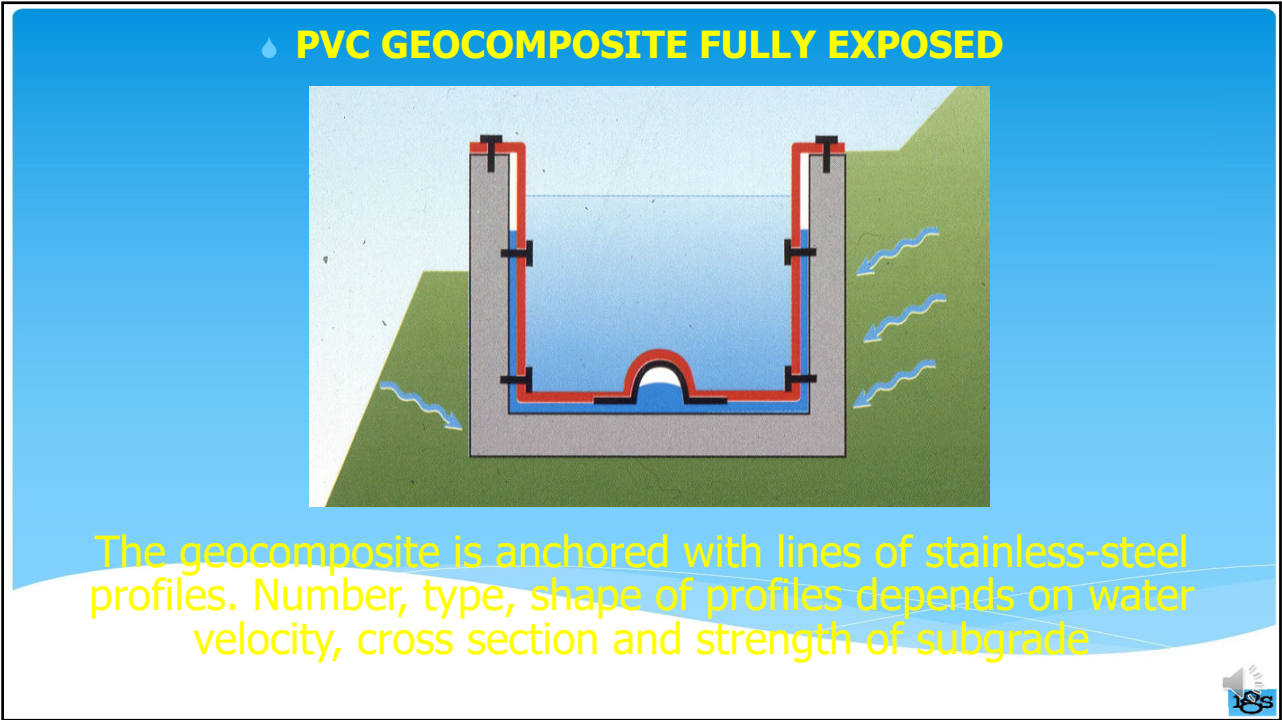
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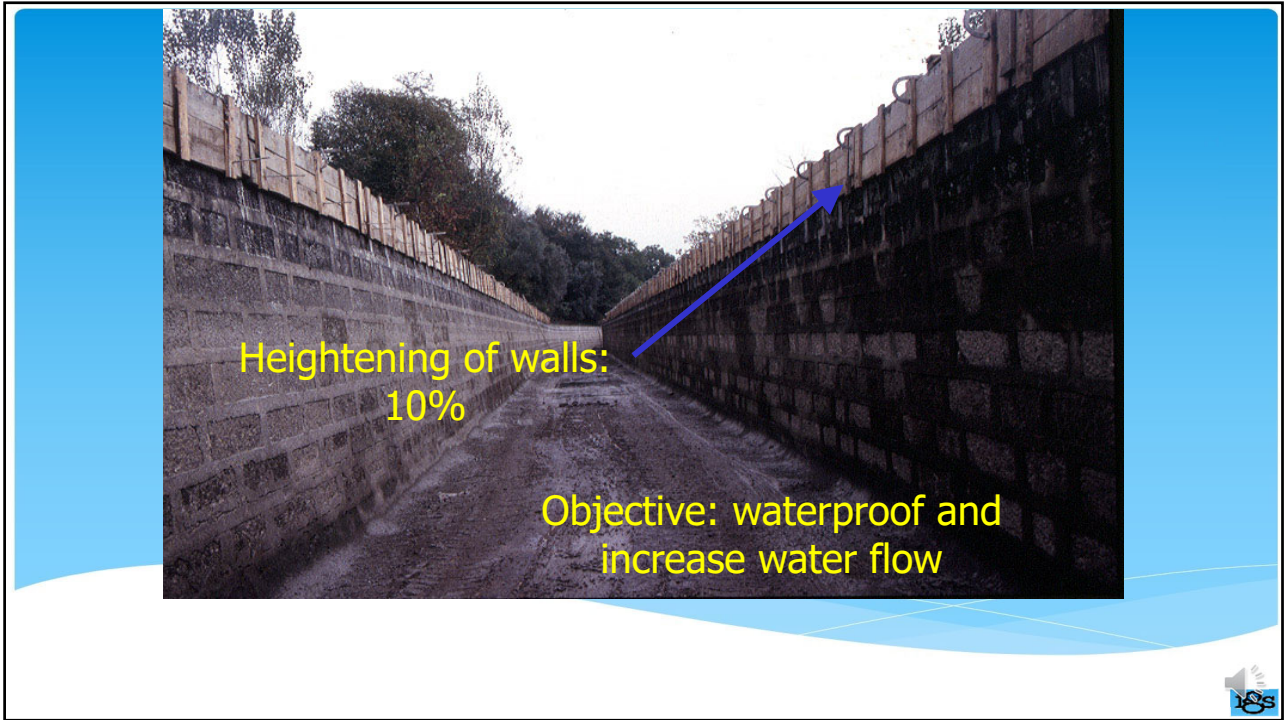
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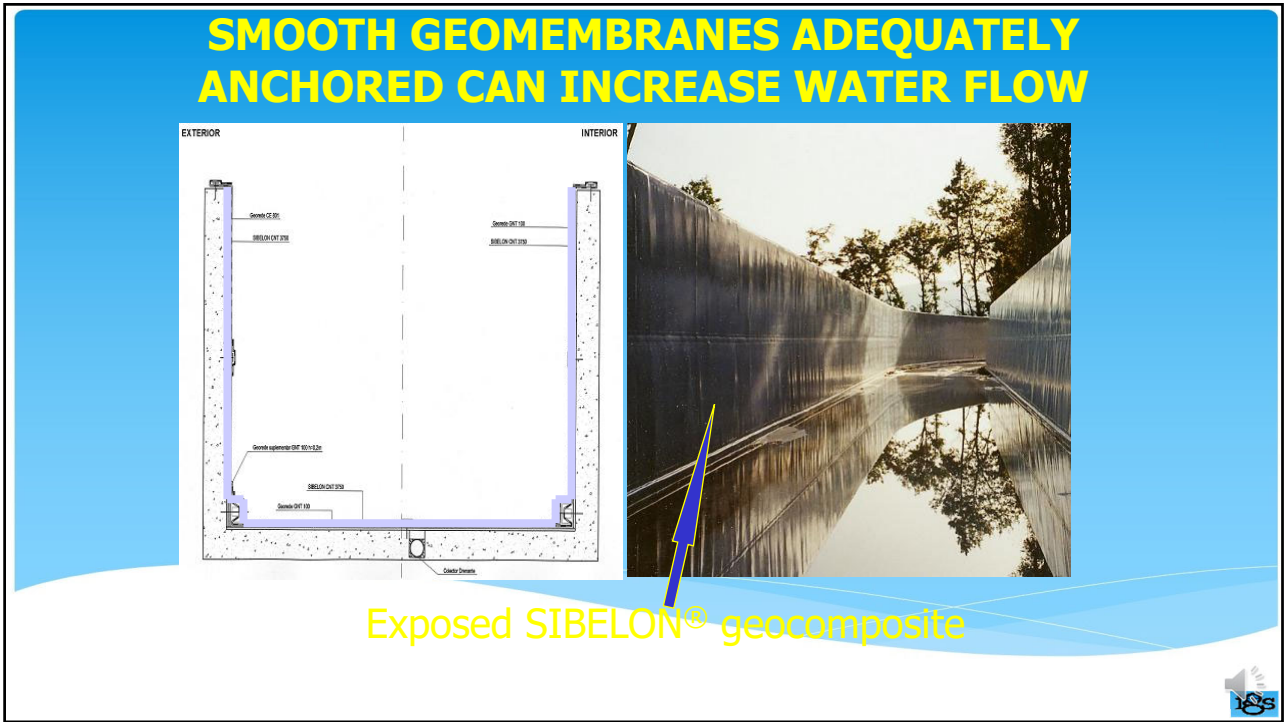
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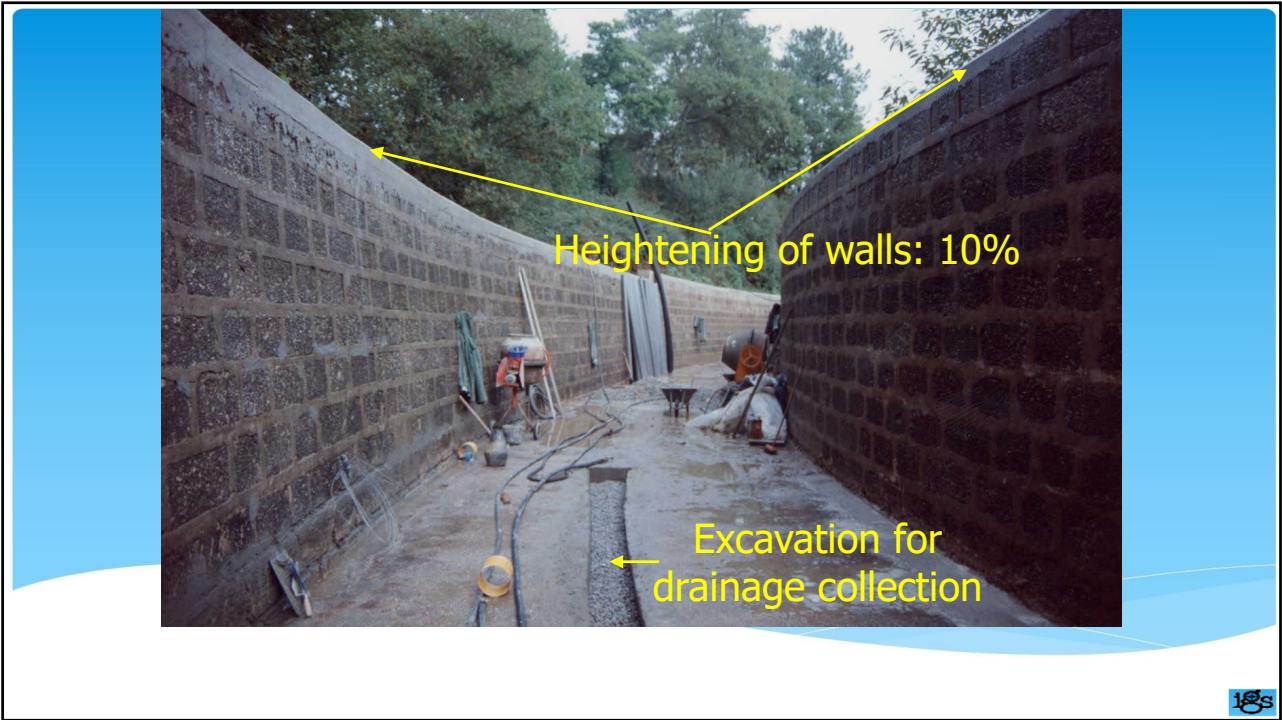
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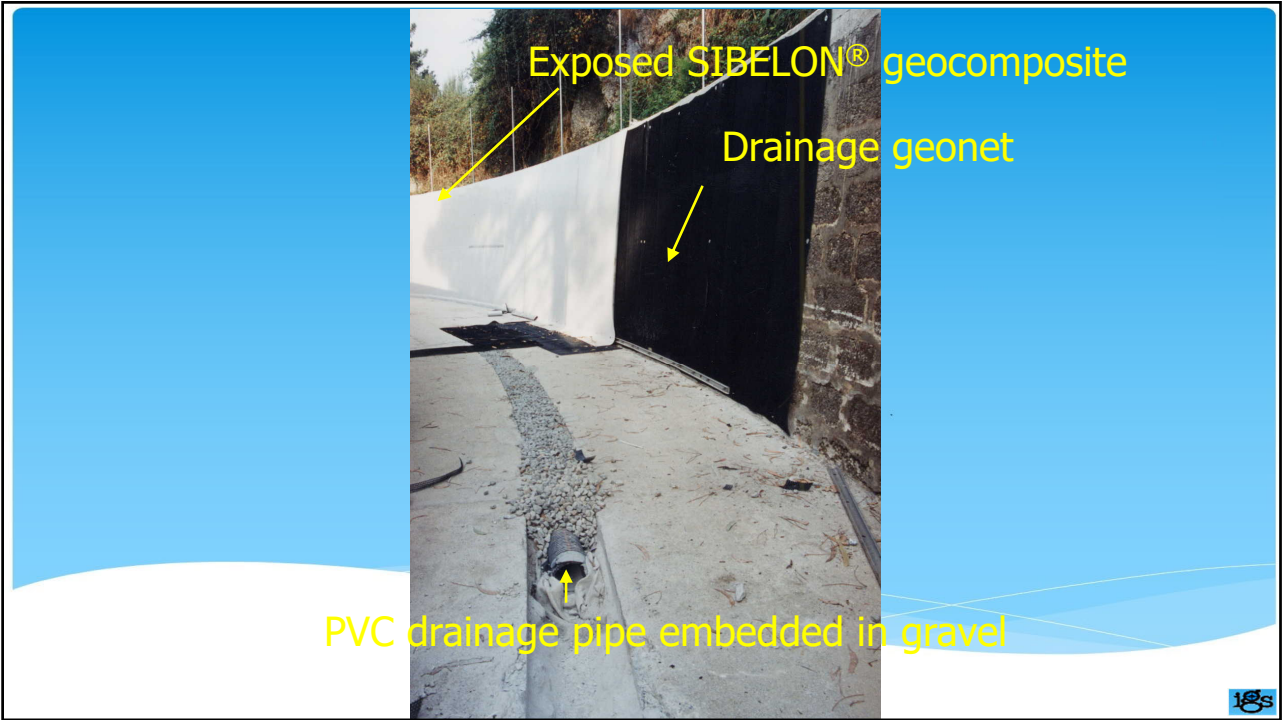
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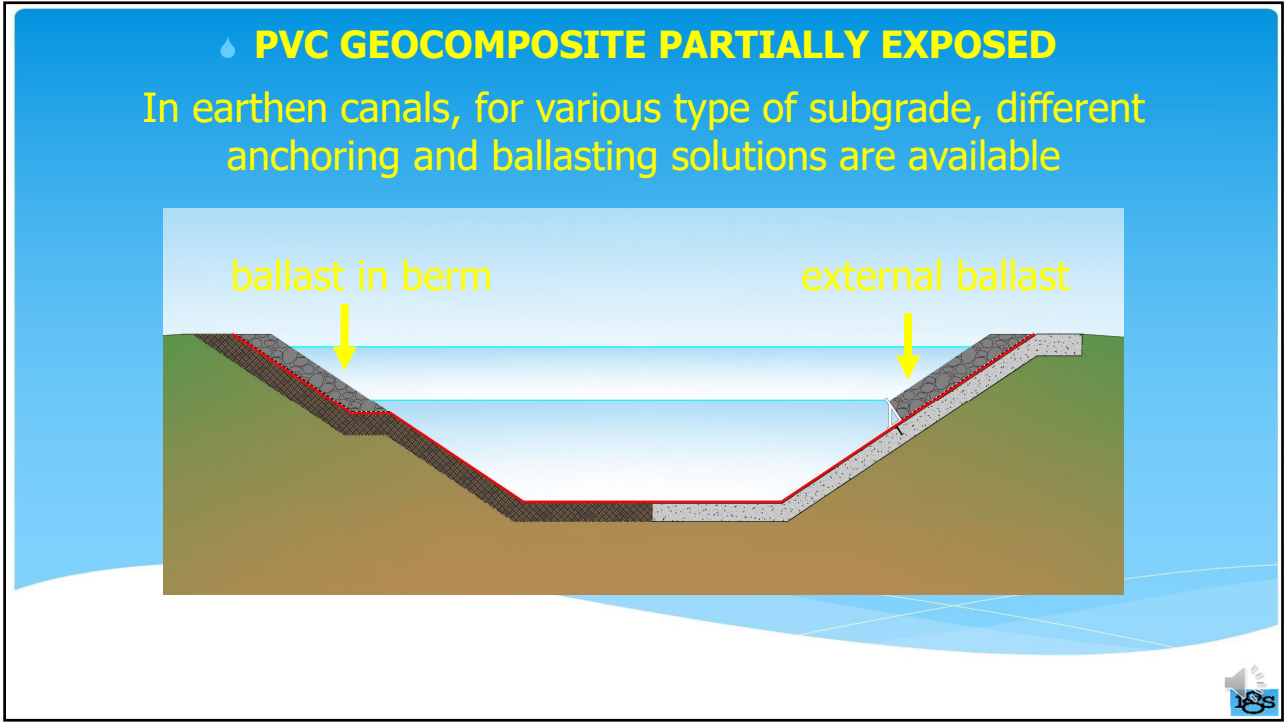
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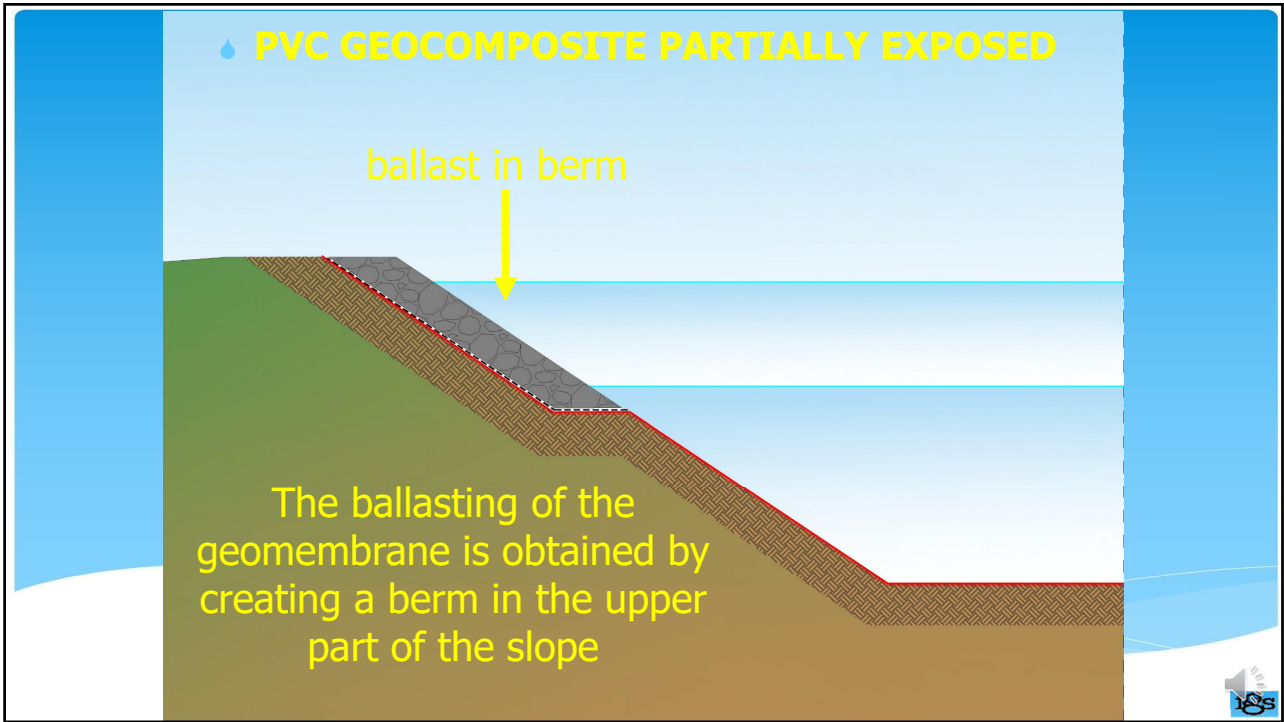
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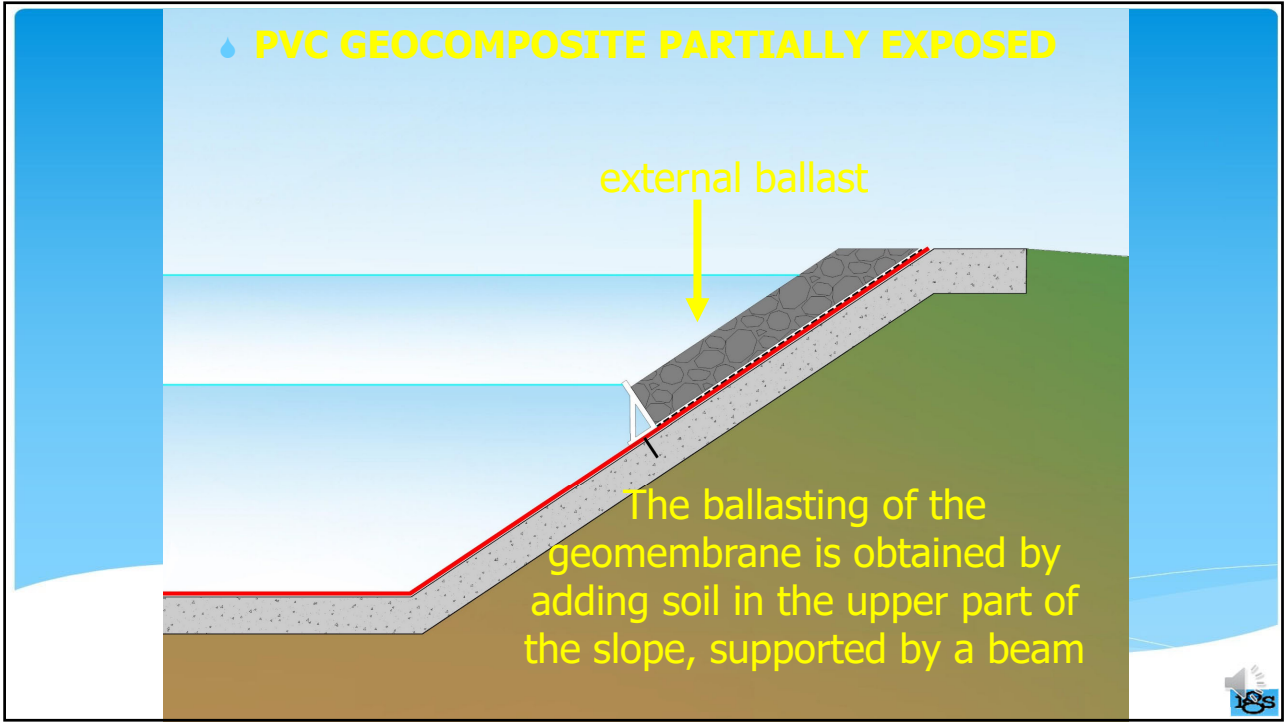


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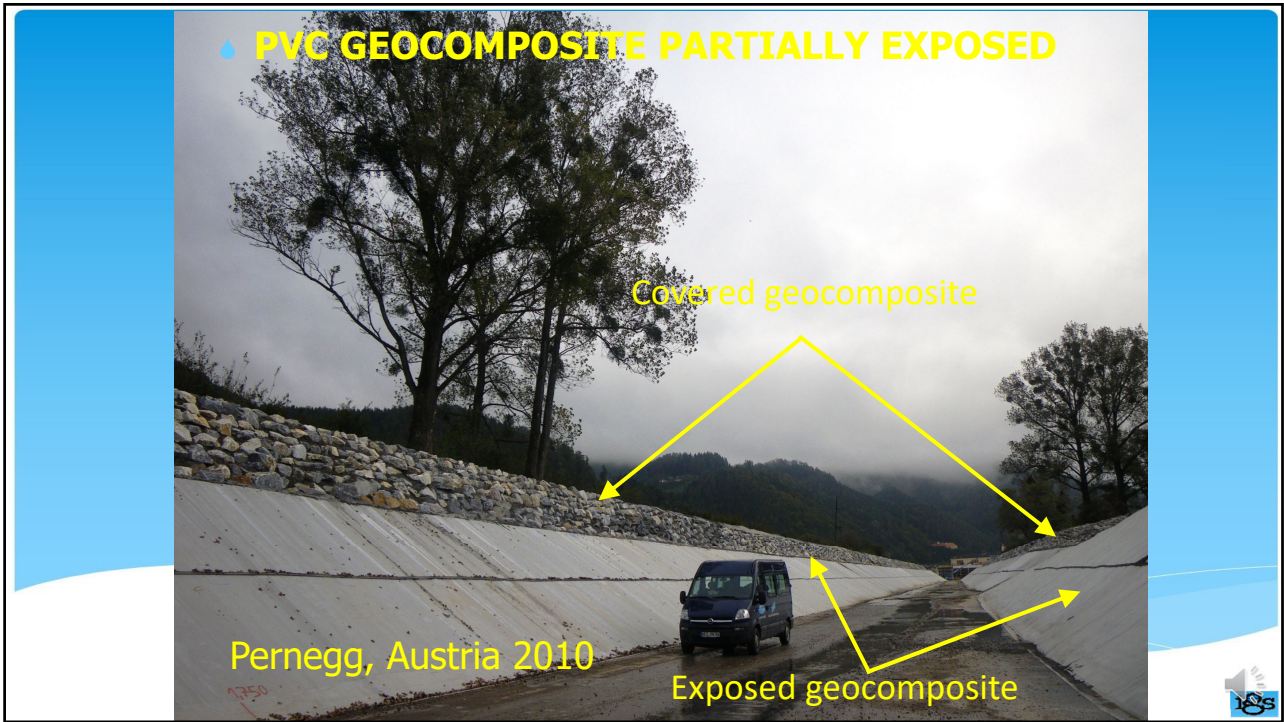
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**THE NEW FRONTIER:
UNDERWATER GEOCOMPOSITE INSTALLATION**

Conventional methods to repair canals
entail dewatering of the canal,
depriving people of the main source of
their supply

The new frontier is to install the geomembrane
underwater without emptying the canal or not even
stopping/decreasing the water flow



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- We at Carpi have been the first company in the world to install geomembranes underwater in dams, where the water is not moving
- So far, more than 15 underwater installations successfully completed

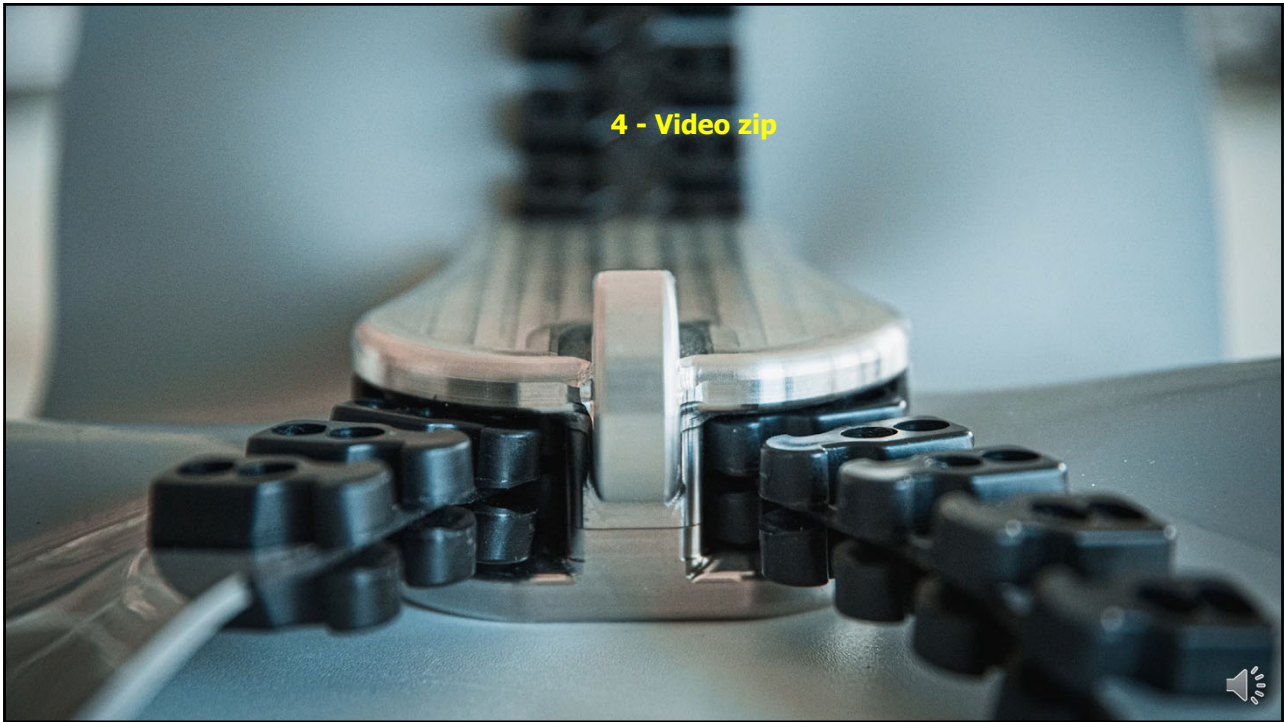
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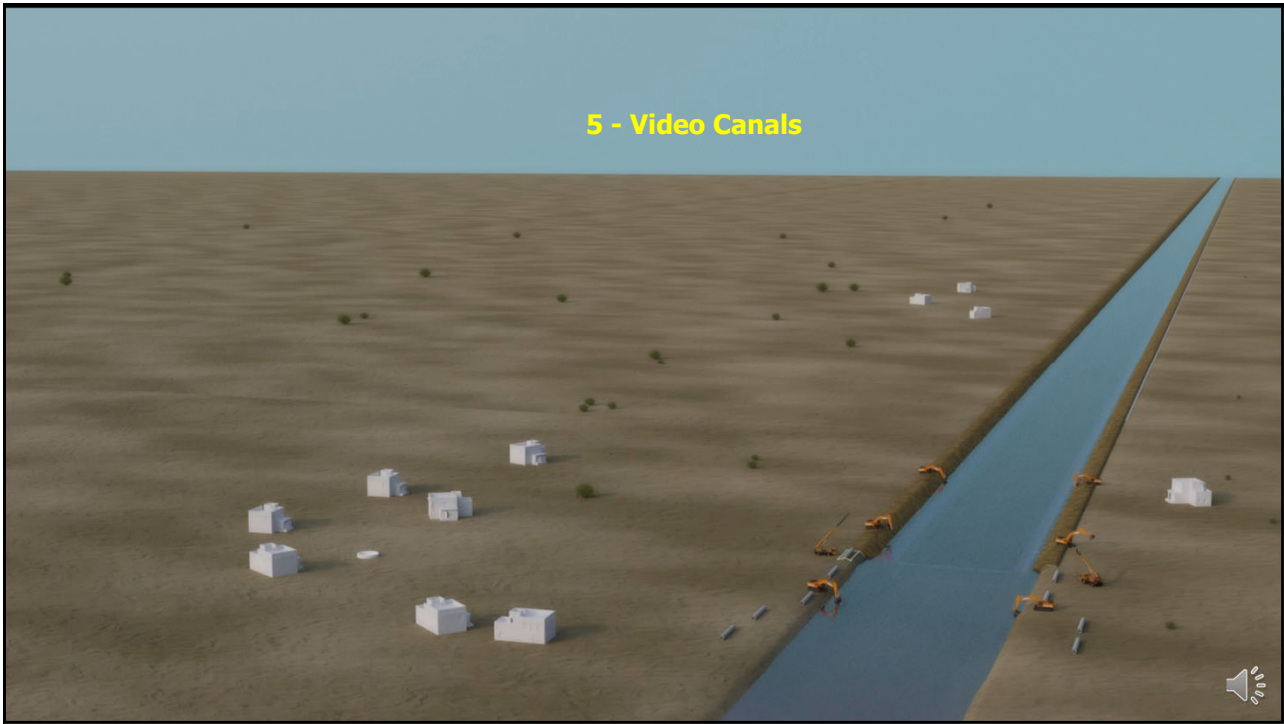
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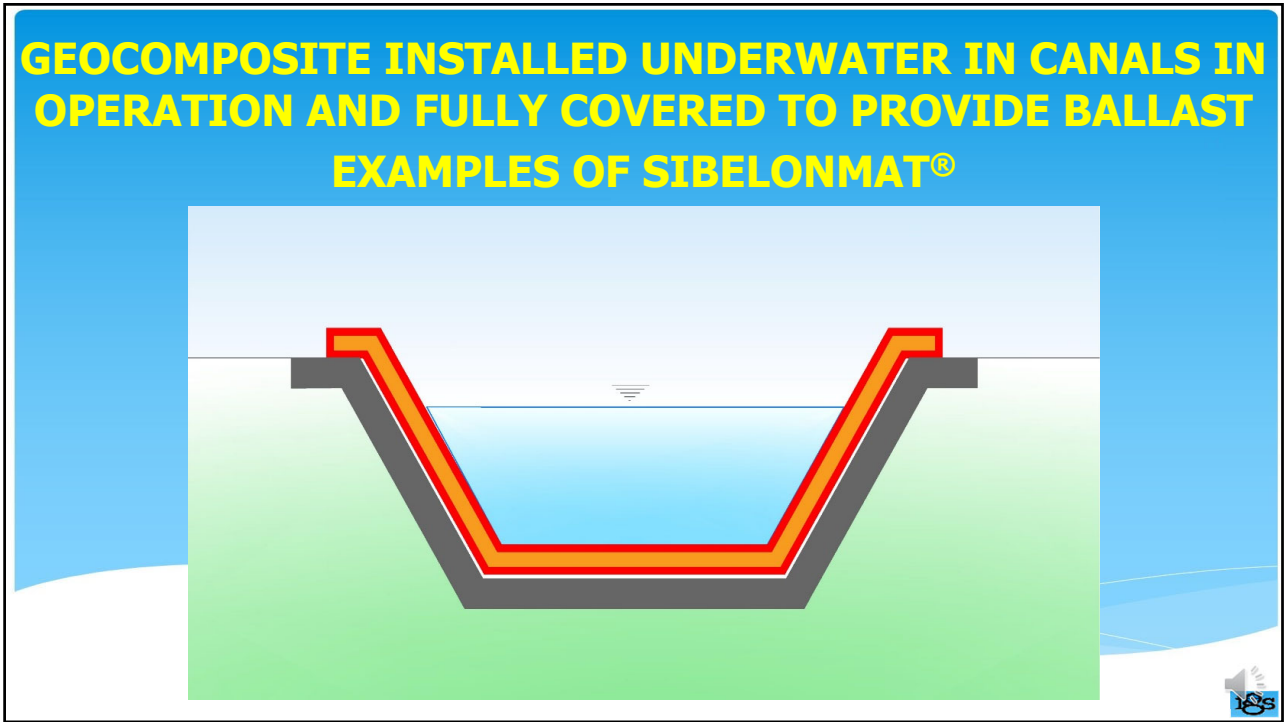
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Conclusions

- Installation of PVC geomembrane systems can be performed totally underwater
- At any depth, at water velocity up to 1 m/s, on the full section of the canal
- No impact on canal operation
- Effective long-lasting solution to stop leakage
- Can be installed to repair canals and embankment dams, or as upstream blanket
- Can be used in new construction of embankment dams and canals



57

Lower Maintenance Costs for Carpi geocomposites

- No scheduled or preventative maintenance for geocomposite system
- No moving components that can fail
- Monitoring system to locate any damaged area within less than 1 square meter.
- After more than 1,800,000 square meters of installations with more than 500 years of cumulated service history, Customers have experienced \$0 maintenance costs

58



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59