

An introduction to Geosynthetic Cementitious Composite Mats and Barriers – a new approach to lining canals.

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A new class of geosynthetic has recently emerged known as GCCMs (Geosynthetic Cementitious Composite Mats) defined by the ASTM D-35 committee in 2017 as ‘a factory-assembled geosynthetic composite consisting of a cementitious layer contained within a layer or layers of geosynthetic materials that becomes hardened’.

GCCMs consist of a three-dimensional fibre structure filled with a dry cement/concrete mix, overlain by a hydrophilic filter layer and underlain by a watertight membrane, which is typically a polymeric film. The material is delivered in its dry format and unrolled into place using similar installation techniques to traditional geosynthetics. Once in place, it is hydrated by spraying with water and the cement/concrete mix hardens. The result is a watertight polymeric film which is overlain by a protective fibre-reinforced concrete layer.

GCCMs have been in use since 2009 and are predominantly used for the lining of water channels for small scale drainage. More recently a variant of GCCMs has emerged which integrates a geomembrane liner onto the rear surface which allows the joints to be thermally welded. These are known as Geosynthetic Cementitious Composite Barriers (GCCBs).

It is estimated that Egypt has more than 110,000 kilometers of canals comprised of approximately 30,000 km of public canals (first and second level) and 80,000 km of private third-level canals (mesqas) and irrigation ditches. A common problem associated with canals, is seepage. Seepage can result directly in water loss through the network or result in waterlogging of adjacent land. In the case of land used for cultivation, waterlogging can reduce crop yields or cause salinization of the soils. This does not only occur in earthen canals, but also in concrete lined canals, particularly those that have experienced cracking, scour, panel separation or damage. It is also a common misconception that concrete lining of canals is an effective method of mitigating seepage losses.

The 25-year study performed by the USBR indicates that concrete over geomembrane has a 95% effectiveness at reducing seepage through canals¹. This abstract introduces a revolutionary new class of materials called Geosynthetic Cementitious Composite Mats (GCCM's), specifically Type II GCCM's to ASTM D8364 for lining of bulk water transportation canals. The Type II GCCM in question consists of concrete encapsulated by between two geotextile layers with a minimum 1mm thick LLDPE geomembrane backing which can be thermally welded to produce a testable and low permeability joint, per ASTM D5820, with air channel testing to ensure a leak free installation. Because it is a composite of concrete and geomembrane in a single application, installation can occur as a one-step process imparting both cost and time savings to the project. The abrasion resistance of the

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concrete layer is 3.5 times that of typical 20Mpa concrete typically used for canal applications. With a design life of more than 50 years, this new product classification will provide a feasible, long-term solution to help preserve and protect fresh, clean water, one of Egypt's most precious – and ever more scarce – natural resources.



Fig. 1. Atfih, Egypt Type II GCCM canal lining trial at completion