U.S. Military Exploring Benefits of GCCMs

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Geosynthetic Cementitious Composite Mat (GCCM) is a flexible, concrete-impregnated fabric that hardens on hydration to form a robust, durable, waterproof and fire-resistant concrete layer. These attributes make it attractive for military applications.

The U.S. Army Corps of Engineers (https://www.usace.army.mil/), U.S. Army Engineer Research and Development Center (https://www.erdc.usace.army.mil/) and U.S. Army Engineer Hydrologic Engineering Center (HEC) (https://www.hec.usace.army.mil/) have all been quick to embrace the potential of GCCM.

The US Military is presently investigating a myriad of application areas for GCCM products such as:

- Rapid Repair of Deteriorated Concrete Airfield Pavements
- Rapid Repair of Damaged Concrete Airfield Runways
- Emergency Repair of Roads Damaged by IEDs
- Bund Liner for Fast-to-Deploy (F2D) Diesel Fuel Depots
- Gabion Capping and Gabion Protection
- Fast to Deploy Combat Shelters
- Military Heliport Pads
- Aramid GCCM for Ballistic Protection

Rapid Repair of Damaged Portland Cement Concrete Airfield Pavements

GCCM products have been trialled for rapid runway repair (RRR) to protect aircraft from potential foreign object damage - known in the military as 'FOD'. Emergency repair of airfields have to be carried out at utmost priority. New development in weapon technology with deep strike and increased demands in aircraft operations make existing crater repair procedures inadequate. The use of GCCM over compacted aggregate to fill the crater damage allows for rapid emergency repair of runway damage. Expedient military repair methods are required for concrete airfield pavements and GCCM can fill that niche.

Figure 1. U.S. Air Force Engineer Inspecting Damaged Runway

Emergency Repair of Roads Damaged by IEDs

Improvised Explosive Devices can cause extensive damage to roads and pavement structures. GCCM are being trialled for rapid and temporary remediation of damaged roads.

Figure 2. Damage to concrete road by an Improvised Explosive Device (IED)

Bund Liner for Fast-to-Deploy (F2D) Diesel Fuel Depots

GCCM provides an easy to install bund lining and containment liner for diesel fuel storage and filling/emptying.

Military Fuel Depots using GCCM can be rapidly deployed and installed in conflict zones due to it small logistical footprint hence reducing time on site and allowing the refuelling depot to swing into operations quickly.

Figure 3. Bund Liner and Pad for Temporary Diesel Storage and Refuelling Facility in Conflict Zone

Gabion Capping and Gabion Protection

GMMCs are ideal for capping and protection of sand-filled gabions in arid conflict zones and prevent loss of sand from the gabion due to rain washing or from strong winds.

Figure 4. Sand-Filled Gabions being Filled with Sand. Gabions are used as military fortifications for protection against enemy fire and mortar attacks. Sand-Filled gabions can be installed and deployed quickly wherever needed. They are widely used today in military bases especially for protecting soldiers in mess halls and sleeping quarters.

Fast to Deploy Combat Shelters and "Pop-Up" Shelters for Field Hospitals

GCCMs enable rapid deployment of temporary and permanent structures in frontline and combat zones. The hard concrete armoured shell will not burn or melt.

GCCMs thus provide rapidly deployable concrete infrastructure solutions for combat environments. Furthermore, the polymer inner liner of GCCM allows for shelters that have clean and sterile environment for rapidly deployable front-line medical buildings. Additionally the inner-facing PVC polymer liner can be doped with micronized silver or Microban™ to provide resistance pathogen and harmful bacterial growth.

GCCM shelters can also be buttressed with sand filed gabions that themselves are capped and covered with GCCM to give a fortified protective shelter.

Military Heliport Pads

GCCM has been found to be ideal for military heliport pads particularly in the Middle East conflict zones where desert sand is whipped up into obscuring vortexes by the rotor wash. The high specific gravity of the cured GCCM gives a stable base for heliport pads. GCCM

offers durable landing zones for expeditionary military forces in operation theaters. The extremely durable of GCCM means it can deal with the heaviest helicopters such as the CH-47 Chinook or the CH-53 Super Stallion and prevents the "brown-out" effect due to sand and dust. GCCM helipads can be deployed and installed in a matter of hours.

Figure 5. Military Heliport pad to prevent "brown-outs" from rotor wash.

Ballistic Protection

Multiple layers of GCCM have even been found effective to disperse the energy of artillery rounds and IEDs. In particular experimental Aramid-based GCCMs are being evaluated for ballistic protection and protection from high-velocity shrapnel.

Adding Graphene

Scientists continue to be intrigued by the potential of graphene in GCCM materials. Reported to be many times stronger than steel, graphene's high strength-to-weight ratio makes it a desirable as an additive for GCCMs.

Summing Up

GCCM is a revolutionary construction material that has a myriad of potential military applications. Essentially it is a flexible, concrete impregnated geotextile that hardens by hydration to give a solid concrete layer that is both hard and tough as well as fire resistant.

Acknowledgements:

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