

Counteracting Climate Change

Cost Saving Sustainable Product Technology
for Construction of Transportation Infrastructure and
Earthwork Projects

2021

B R I E F



How Stabilization of Soil and Aggregate Materials Counteracts Climate Change at Net Zero Cost

Aggregate materials for road and highway construction projects are typically mined from nearby quarries and riverbed deposits. These sources are rapidly being exhausted and are often increasingly distant from the job sites. When you factor in the maintenance costs for the adjacent roads systems that are subjected to hundreds or even thousands of truck trips just to build one mile of new roadway or highway, it is obvious that the city, county, and state taxpayers are subsidizing the construction of new roads with their paved road networks that are being rapidly deteriorated by the aggregate hauls. This is a terrible waste of public resources. As the transportation costs, the air pollution, and road wear associated with these long hauls mount up, the built-in demand for proven stabilization treatment becomes apparent. The replacement of imported aggregate base rock materials by in-place stabilization of native soils or reuse of asphalt millings as stabilized base course materials can lower project expenses.

Through the past thirty years, the EMC SQUARED System stabilization technology has shown it can not only reduce initial costs, but also counter climate change by saving fuel and lowering the greenhouse gas emissions of the construction process. Most importantly, use of this stabilization technology can build roads and highways that last longer than traditional pavement systems. The

community committed to counteracting climate change should actively promote more widespread use of this generation's innovative stabilization products.

The innovative product technology covered in this Brief is a family of highly concentrated liquid stabilizers identified as the EMC SQUARED System. These liquid concentrates are applied as additives to the compaction water. The stabilizer solutions are mixed with soil and aggregate materials during the moisture adjustment processes preliminary to the compaction operations that are the standard construction procedures for any earthwork or road building project. The EMC SQUARED System stabilizer product technology has a profound potential for a global role in counteracting climate change. These green stabilizer products provide a unique package of valuable performance benefits not previously available from bulk applications of cement and lime products, the most widely used conventional chemical stabilizers.

EMC SQUARED System liquid concentrates can be applied at far lower installed cost than the traditional bulk cement and lime chemical products that often require applications of 50 to 100 times more product by weight in order to be of any benefit. In addition to the basic cost, performance and environmental advantages, the highly



**Stabilized Soil Eliminates Need
for Over 1 Million Tons of Aggregate**

Soil Stabilization with Disc Mixing of EMC SQUARED Stabilizer Treatment

concentrated nature of the liquid EMC SQUARED System products means they can be economically shipped worldwide, expanding opportunities for use in the global market. All nations can now take advantage of the economies of stabilization to reduce the costs and environmental impacts of construction activities.

As illustrated in the case studies available by visiting stabilizationproducts.net, there are many situations where use of the EMC SQUARED System stabilizer products can lessen or exclude the requirement for the mining, manufacturing, and transport of millions of tons of crushed aggregate materials. Far more expensive cement, lime, and asphalt products generate significant amounts of carbon emissions during their manufacture. These sources of greenhouse gas (GHG) emissions would be eliminated by use of this clean product technology. Equally important, it has been demonstrated that application of the economical EMC SQUARED System products to subgrade soils and aggregate base layers during initial construction significantly extends the service life of roads and highways surfaced with gravel, asphalt, and concrete pavements. Placing costly asphalt and concrete pavements on top of more stable road foundations reduces the frequent need for reconstructing roads and highways built according to dated and unsustainable practices. Thicker layers of aggregate, asphalt, and concrete, or applications of cement and lime to subgrade soils, are expensive measures. They consume nonrenewable resources, and they contribute vast amounts of carbon and toxic air emissions during the related mining and heated manufacturing processes. A change to more sustainable construction practice is now within reach, made possible through the development of innovative cold-manufactured stabilization technology that is more cost-effective than cement and lime stabilizer products.

Smoother Roads Increase Fuel Efficiency and Reduce Carbon Emissions

Federally mandated highway monitoring programs have shown that the application of the EMC SQUARED System stabilizer products improved and extended the smooth-running performance of roads, highways, and interstate freeways. This has been evidenced by ongoing monitoring of interstate freeway projects constructed above soils treated with EMC SQUARED System

products in New Mexico and Texas. Based upon research completed at the Massachusetts Institute of Technology (MIT) on pavement-vehicle interaction (PVI), reducing pavement deflection by improving the stiffness factor of pavement structural sections lessens fuel consumption of the cars and trucks driven on the roads, thereby reducing the amount of carbon emissions related to their operation. No costly modifications of cars and trucks, or driver behavior are required to reap these environmental benefits. These smoother running, more fuel efficient roads can be constructed at lower cost than conventional roads by using engineering designs that recognize the unique improvements in materials performance provided by application of the EMC SQUARED System products.

Building More Resilient Infrastructure

Using the San Francisco Bay Area and the Sacramento Delta Area in California as examples of two regions where mega-sized construction projects must be undertaken in anticipation of the effects of Climate Change, we can start with the problems of Sea Level Rise and the more recent extreme weather patterns with frequent flooding events that put the more antiquated California highway and levee systems at a high level of risk. These very real threats need to be addressed with massive earthwork projects. Earthen dikes must be constructed to protect existing infrastructure and planned new shoreline developments around the perimeter of San Francisco Bay. Hundreds of miles of existing levees in the Delta must be reconstructed, reinforced and enlarged. While in past years cement and lime (quicklime and hydrated lime) might have been added to soils to further strengthen soil structures to function as protective dikes and levees, the extremely high cost and negative environmental impacts of these calcium-based stabilizers and the huge amounts of carbon emissions related to their manufacturing processes make it apparent that more appropriate technology must be utilized. Dike and levee structures must be more resilient and less expensive to build and maintain. For such applications, the EMC SQUARED System products are uniquely appropriate. They are created with a clean cold manufacturing process that does not require the use of fossil fuel for heating or release of carbon emissions. The concentrated liquid stabilizers can be applied at much lower cost than cement or lime. They are environmentally friendly in composition and documented in a U.S. EPA funded study as being appropriate for use

in the vicinity of sensitive estuary and riparian areas. EMC SQUARED System products are formulated to reduce the permeability, or hydraulic conductivity (rate of moisture flow) of soil materials, as well as increase their strength and resistance to erosion.

While cement and lime products can be added to soils to increase strength values and reduce expansive characteristics, these calcium-based products are not economical answers when it comes to making earthen structures more impermeable and effective as barriers to water infiltration. This is a category where the EMC SQUARED System products clearly have a performance advantage in addition to the economic and environmental advantages. Add highway and railroad embankments to the long list of earthwork structures that need to be upgraded with more erosion-resistant measures in preparation for extreme weather events. As demonstrated by damaged infrastructures throughout the United States, unstabilized earthen embankments and aggregate base course materials under highway pavements and railways offer little resistance to the erosive forces of water when hit by major flooding events. Some crippled or collapsed transportation systems may take up to a decade to be fully restored after just one flooding event. The need to armor constructed earthworks is widespread, extending far beyond transportation infrastructure and protective dike and levee structures. The EMC SQUARED System products again can be of service at the lowest cost and least environmental impact.

What's to be excited about?

What's most exciting about the combination of benefits and reduced environmental impacts described above is that they can be achieved with modern green product technology that provides significant overall cost savings for project owners. **As addressed in referenced case studies that illustrate the success of the EMC SQUARED System product technology in reducing both construction costs and environmental impacts, this is a unique case where cost-saving product technology can be used to significantly reduce carbon emissions at Net Zero Cost.**

Necessity is the Mother of Invention

Stabilization Products LLC (SPLLC) is headquartered in the Central Valley of California, where highly expansive clay soils are prevalent. The destructive influence of these problem soils on the built infrastructure is a costly problem for public agencies and private parties with extensive paved areas or road systems. Counteracting the cyclical shrinking and swelling behavior, or volume changes, of expansive clay soils has traditionally required thick road structural sections using far more aggregate and hot mix asphalt or concrete pavement materials than roads constructed on top of less problematic native soils. Building less robust pavement structural sections on top of expansive clay soils, newly constructed roads can rapidly

Construction of Stabilized Soil Subballast Layer for New Rail Line in Brazil



Compaction of EMC SQUARED System Stabilizer Application

deteriorate and require frequent reconstruction. According to a study published by the American Society of Civil Engineers (ASCE), the cumulative deleterious effects that expansive clay soils have on constructed facilities in the United States alone total billions of dollars.

With a previous career background in the production of aggregate, asphalt, and concrete materials, and the use of these road building products as general engineering contractors in an area where expansive clays are the predominate native soils, the founder of SPLLC had first hand knowledge that these expensive problems were not cost effectively addressed by any of the conventional chemical stabilizers or geosynthetic products available on the national or international market. Based upon the belief that a better solution could be developed, they focused on solving the problem with a new approach. Soil stability, at its essence, has water as the common denominator. The engineering properties of all soil materials are governed by variations in their water content. Starting with the knowledge that the volume change of expansive clay soils is driven by fluctuations in the moisture content of the soil, the most cost-effective solution was to develop a product technology that could maintain the moisture content of soil materials in a “near optimum” or equilibrium state, shedding rain water and not soaking moisture up from below. The same holds true for aggregate base course materials. When subgrade soils and aggregate base course materials are maintained in an equilibrium state near what is known as their optimum moisture content, they retain their highest strength values and provide the most consistent support for the pavement. By directly addressing the moisture fluctuation problems of soil and aggregate materials, the EMC SQUARED System technology lowers the cost of soil stabilization and reduces the use of nonrenewable resources as well as the environmental impacts of construction. When locally available native soils can be stabilized in place, it eliminates the need to use aggregate materials that have to be mined, crushed, screened, hauled and placed. The reduction in the environmental impacts of the overall construction project are obvious.

While cement and lime were originally developed for other higher value applications, it was found that they could also be used to improve the strength of some types of soils. But

significantly, the improvements these products offered did not include stabilization of moisture content. The benefits of cement and lime applications typically do not reduce the permeability, or slow the rate of moisture flow through a soil. In fact, exactly the opposite is the case. Because they take an indirect path to counteracting the problems that are driven by fluctuations in the moisture content of soil and aggregate materials, cement and lime must be applied in massive quantities to be effective. The ability to directly address the moisture fluctuation problem is what makes the EMC SQUARED System products so unique and cost effective. It helps explain why it can take 50 to 100 times more cement or lime product than the concentrated EMC SQUARED System product to effectively treat the same volume of material. **This is truly a classic sustainability success story — finding a way to do more with less, and replacing very dirty conventional products that accelerate climate change with more cost-effective clean product technology that counteracts climate change.**

Big Cost Savings

The cost-savings realized by application of the EMC SQUARED System products are easy to measure. Among the thirty year history of projects is a one mile long city expressway where costs were reduced by 25%, resulting in savings of \$250,000.00 (<http://stabilizationproducts.net/docs/18687.pdf>), an access road for a federal penitentiary project where similar economies were realized (<http://stabilizationproducts.net/docs/18626.pdf>), a nine mile long county road project servicing North Dakota’s Bakken Field gas and oil boom (<http://stabilizationproducts.net/docs/18698.pdf>), and construction of over 116 miles of military roads for the U.S. Army’s training ranges at Fort Bliss, where costs were reduced by approximately \$20 million which allowed them to build an additional 46 miles of roads (<http://stabilizationproducts.net/docs/18676.pdf>). **For all these projects, it is easy to see that cost savings are closely linked with major reductions in the environmental impacts of construction. For the community concerned about counteracting climate change, the EMC SQUARED System is a breakthrough technology can reduce the environmental impacts and cost of construction.**



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HIGH PERFORMANCE • SUSTAINABLE