

Counteracting Climate Change

at Net Zero Cost with Sustainable Product
Technology for Construction of Transportation
Infrastructure and Earthwork Projects

2017

B R I E F



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Counteracting Climate Change with Sustainable Technology

We urgently need sustainable technologies that can dramatically reduce air pollutants and carbon emissions. Scientists predict very serious or even catastrophic global consequences if measures are not taken quickly to counteract climate change, and major investments are being made in renewable energy and in electric and hybrid vehicles. Lower profiled, sustainable, clean technologies, however, with equivalent potential to positively impact climate change, are still being widely ignored. This brief focuses on two clean technology products manufactured by Soil Stabilization Products Company, Inc. (SSPCo) that have unique capabilities to reduce carbon emissions from many types of transportation infrastructure construction projects.

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

Through the past thirty years, a new 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 consider the widespread use of this generation's innovative stabilization products.

The first innovative product technology covered in this brief is SSPCo's family of highly concentrated liquid stabilizers identified as the EMC SQUARED® System product line. These liquid concentrates are applied as dilute solutions using locally available water at the construction site. The stabilizer solutions are mixed with soil and aggregate materials during the soil 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.

The 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 concentrated nature of the liquid EMC SQUARED System products means they can be economically

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



Subgrade Stabilization with Disc Mixing of EMC SQUARED Stabilizer Treatment

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 study links further on, 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 frequency of constantly 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 an innovative cold-manufactured stabilization technology that is more cost-effective than the dirty conventional 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 (<http://sspco.com/docs/EMC/8455.pdf>) and (<http://sspco.com/docs/EMC/8468.012717.pdf>). 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 section lessens the 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. Returning to the subject of Net Zero Cost, these smoother running, more fuel efficient roads can be constructed at lower cost than conventional roads using engineering designs based upon the unique improvements in materials performance provided by application of the EMC SQUARED System products.

A 117 mile long system of stabilized Military Supply Routes, or Tank Trails, stretching across the border between the States of Texas and New Mexico, further illustrates the cost-savings and reduced environmental impacts when this sustainable product technology is employed (<http://sspco.com/docs/EMC/8676.pdf>).

Building More Resilient Infrastructure

Using the San Francisco Bay Area and the Sacramento Delta Area 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 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 cement and its manufacturing process 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 can be 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. 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. Appropriately, the 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 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 (<http://sspc.com/docs/EMC/8662.pdf>).

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 green and sustainable product technology can be used to significantly reduce carbon emissions at Net Zero Cost.**

Necessity is the Mother of Invention

Soil Stabilization Products Company, Inc. (SSPCo) 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 deteriorate and require frequent reconstruction. According to a study published by the American Society of Civil

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



Compaction of EMC SQUARED System Stabilizer Application

Engineers (ASCE), the cumulative deleterious effects that expansive clay soils have on constructed facilities in the United States is approximately \$13 billion per year, which exceeds the typical annual costs of all hurricanes, tornados, floods and earthquakes combined.

With previous career backgrounds 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 founders of Soil Stabilization Products Company, Inc. (SSPCo) had first hand knowledge that these costly 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, SSPCo 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” state, shedding rain water and not soaking it 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 (<http://sspco.com/emcsquared.html>). By directly addressing the moisture fluctuation problems of soil and aggregate materials, SSPCo’s 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 rate of moisture flow, through a soil. 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 with more cost-effective clean product technology.**

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://sspco.com/docs/EMC/8687.pdf>), an access road for a federal penitentiary project where similar economies were realized (<http://sspco.com/docs/EMC/8626.pdf>), a nine mile long county road project servicing North Dakota’s Bakken Field gas and oil boom (<http://sspco.com/docs/EMC/8698.pdf>), and construction of over 100 miles of military roads for the U.S. Army’s training ranges at Fort Bliss, where costs were reduced by approximately \$20 million (<http://sspco.com/docs/EMC/8676.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 that should to be implemented on a wider scale.**

How The Use of Green Pavement Products Counteract Climate Change

SSPCo's other product technology, NaturalPAVE® XL Resin Pavement, is a sustainable alternative to Hot Mix Asphalt pavement materials. NaturalPAVE XL Resin Pavement products are widely acknowledged as the only green alternative to Hot Mix Asphalt materials that can actually be placed with asphalt paving equipment and tools for vehicular as well as pedestrian and bicycle path applications (<http://sspco.com/docs/NPV/2181.pdf>). Based upon laboratory test methods standardized for evaluation of hot mix asphalt products, cold-manufactured NaturalPAVE mixtures actually outperform typical asphalt pavement materials (<http://sspco.com/docs/NPV/2182.pdf>). The cold manufacturing and cold application processes associated with the NaturalPAVE products eliminate the substantial toxic and carcinogenic air pollution and carbon emissions generated by the hot mix asphalt manufacturing process and the operation of the heated kilns required to manufacture the cement product required for production of concrete pavement mixtures. Once the NaturalPAVE XL Resin Pavement mixtures are installed as finished pavement surfaces, they provide further environmental benefits: they reduce impacts on water quality because of their nontoxic formulations, and they help lessen Urban Heat Island and global warming by being more solar

reflective than black heat absorbent asphalt pavement. Reflective pavements also require less night lighting, another climate-friendly aspect of this sustainable product technology.

Impacts on Human Health

The availability of cool pavement materials is important to human health as global warming increases the daytime temperature of black asphalt pavement surfaces to ever higher temperatures. With asphalt pavements reaching summertime temperatures nearing 180°F in hot climate areas such as Las Vegas and Phoenix, these heat absorbent pavement materials are no longer appropriate for places where people spend time outdoors or recreate, such as school playgrounds and pedestrian pathways. While the medical community has not yet established temperature red lines above which human health is placed at risk, pavement surfaces that reach temperatures 40°F to 60°F degrees hotter than afternoon air temperatures are clearly hazardous to human health as they radiate an excessive amount of heat back up from the pavement surfaces. Cool pavement protects our health and promotes quality of life.

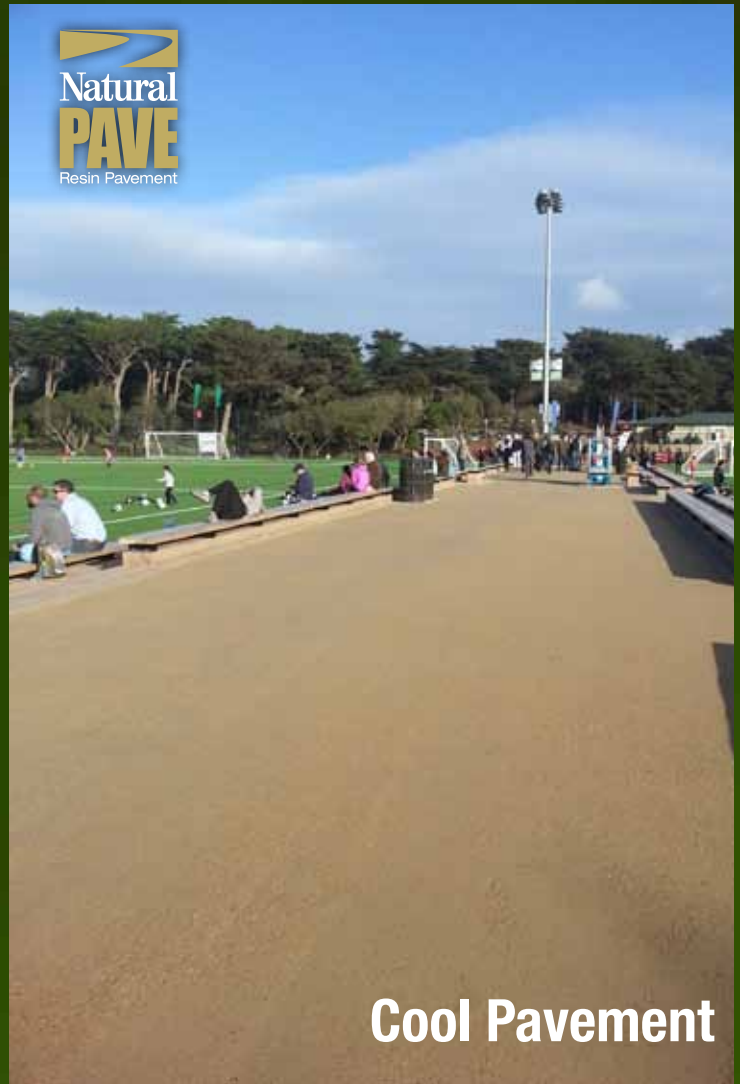


NaturalPAVE XL Resin Pavement Access Road to City Water Treatment Facility

Green Pavement

The significance of the NaturalPAVE® XL Resin Pavement™ technology is clear when the environmental advantages are factored in. There is no air pollution or fossil fuel burning required to heat the product during manufacturing, transportation, storage, mixing, or placement, and no toxic components to contaminate water supplies. SSPCo's clean pavement technology answers these concerns. Additionally, these light colored solar reflective pavements provide a cool alternative to black asphalt and its deleterious contributions to the Urban Heat Island Effect, smog formation, greenhouse gas emission and global warming.

Public interest in environmentally responsible design and building continues to motivate increased awareness and implementation of green construction technology. The U.S. Green Building Council (USGBC) and its LEED® program (Leadership in Energy & Environmental Design), a Green Building Rating System, has provided a vitally important standard format for agency personnel and design consultants who specify the materials for new construction and remodeling projects. Many facilities are now being constructed according to these standards. The LEED rating system has set the bar high and NaturalPAVE XL Resin Pavement is ideally suited for green building pavement requirements.



When different pavements are tested with infrared thermometers to evaluate their comparative surface temperatures, NaturalPAVE XL Resin Pavement typically tests similar in temperature to light colored concrete, while adjacent asphalt pavements are far hotter. This temperature difference is a health and comfort issue adjacent to residential areas, offices, theme parks, schools, and other public facilities. Heat absorbent asphalt pavements are gaining increasing criticism for their contribution to Urban Heat Island, increased air conditioning and energy demand, increased smog formation, greenhouse gas emission and global warming.



With body temperature in the range of 98.6°F, human health and comfort are noticeably affected as temperatures increase above 100°F. Given the news that hotter summer weather conditions are to be expected in the future, proven cool pavement is going to become increasingly attractive around our living environments.



ENERGY EFFICIENT • ENVIRONMENTALLY FRIENDLY
HIGH PERFORMANCE • SUSTAINABLE