ADVANCED SOIL STABILIZATION FROM SSPCO OUTPERFORMS GEOGRIDS AND LIME AT AUSTIN AREA MASTER-PLANNED COMMUNITY

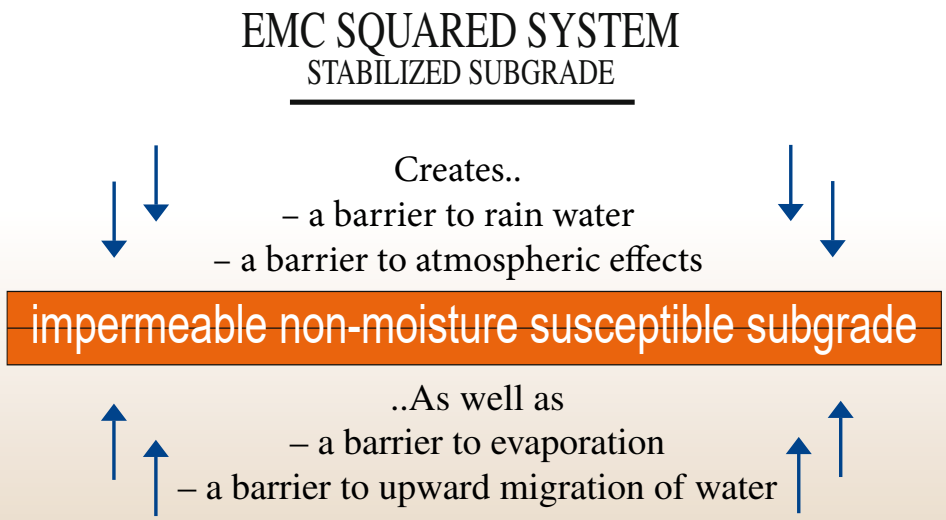
The Specified Standard After More Than a Decade of Continuous Success During Phased Build-Out

Teravista Development Case Study

EMC SQUARED

EMC SQUARED System

Stabilized Subgrade Performance Surpasses Conventionally Constructed Roads



The EMC SQUARED® System product technology can be focused on treatment of subgrade moisture susceptibility. The goal of the application is to create an effective moisture barrier layer that protects the native subgrade below the structured road sections from rainwater, and that resists saturation by the upward flow of capillary water from groundwater sources. Almost thirty years of laboratory and project case studies clearly addressed this aspect of moisture barrier performance of the EMC SQUARED System treatment.

The moisture barrier approach is not a new concept for construction over expansive clay subgrades. It has long been understood that there are two very different routes to stabilizing clay soils. Cement and lime are used in attempts to overwhelm volume change problems with cementation and reduction of plasticity. The moisture barrier approach instead controls volume change by maintaining the moisture content of the clay within the treated subgrade layer in a state of "near-optimum" condition.

Cement and lime treatment have been successful in providing rigid construction platforms, but less successful in addressing the increase in roughness over time of road and highway pavements. The interest in application of moisture barrier technology has in large part been driven by the desire to construct pavement structural sections that would retain smoothness longer in comparison to results with lime and cement treated subgrades. Historically, the limitation with the moisture barrier approach was that expensive, hard-to-install, flexible membrane liners (plastic liners) were the only moisture barrier technology on the market. The availability of the EMC SQUARED System technology, however, which is low cost and relatively simple to install, has changed this picture. Moisture barriers have an additional advantage over cement and lime treatment, as well as to geogrids and geofabrics, as they effectively stop the upward flow of capillary water from the groundwater sources by sealing off the underlying native subgrade soils from atmospheric contact. After treatment, the native subgrade is far less influenced by seasonal weather fluctuations, since soil volume change has been limited by reducing the fluctuations in soil moisture content. The net effect of the moisture barrier layer is improvement of the stability of the native subgrade and the treated subgrade.

Proof of concept are the many real world applications of the EMC SQUARED System for subgrade stabilization throughout the world. One of the most telling and useful case studies are the roads of a mixed-use development near Austin, Texas, an ongoing project for more than a decade as each new section is constructed. The story of this project, Teravista, follows.

Road Subgrade Stabilization Technology At The Teravista Community Proves Less Expensive, Easier-To-Apply, and Better Performing

The 1,550 acre Teravista master planned community located in rolling hills between Georgetown and Round Rock just north of Austin, Texas, incorporates a mix of residential, commercial, industrial, educational and recreational facilities as part of its build out, which has been in progress for over a decade. The highly varied and problematic soil conditions at this location presented a challenge for the project geotechnical engineers, Fugro Consultants, a top international firm responsible for the initial road and street infrastructure design for the development. While this large multi-use development was beginning its first phases of miles of road and street construction, highway research engineers were just beginning to identify the causative factors of serious pavement heave problems associated with the application of lime treatments and the other calcium-based chemical stabilizer products, cement and fly ash. Because of the concern about a possible pavement heave reaction caused by the application of calcium-based stabilizers, Fugro Consultant's senior geotechnical engineer in the Austin office, Mr. John Wooley, felt that the safest course of action was to completely avoid the use of cement or lime and instead use a conventional design based upon a thick layer aggregate base under the asphalt pavement. Unfortunately, fifteen-inch thick aggregate base (flexible base) layers, even when augmented with costly geogrid reinforcement products, were not mitigating the problems generated by the highly expansive clay soils. The asphalt pavements were still experiencing heaves and dips as well as extensive pavement cracking. The conventional design approaches to solving the problems were not working.

The Teravista project is situated within the boundaries of Williamson County, Texas. While the developer pays for the initial construction of the roads and street system, the County inherits the responsibility for long term maintenance and therefore has the authority to approve the engineering designs and to require appropriate design modifications. Noting that continuing pavement failures were being experienced in spite of the thick layers of flexible aggregate base course materials, even with the design modifications adding geogrid reinforcement within the flexible aggregate base course layer, the County encouraged application of subgrade stabilization products. The County was aware of the sulfate-induced heave problems being experienced in other areas but also aware that a new process had been introduced by the local lime industry, known as double lime treatment. The double lime treatment was represented as being able to eliminate the risk of heave in expansive soils with a low amount of sulfate content. This modified construction procedure is intended to generate the sulfate-induced heave reaction with the first application of lime. The first application of lime is followed by an extended mellowing period to react the sulfates, and then a second application of lime. The double treatment requires more extensive construction procedures and more lime product than the standard procedure (Fugro Consultants specified a total application rate of 7% lime), resulting in high costs and delayed construction schedules.

The high cost of the additional product and additional construction work related to the double lime treatment were a concern to the project owners. Searching for a more cost-effective alternative, Fugro Consultants reviewed the findings of a Texas Department of Transportation (TxDOT) funded research study, presented in the 3929-1 Research Report. The report describes a two year study conducted under the direction of Dr. Robert Lytton at the Texas Transportation Institute (TTI). The research showed that the EMC SQUARED System treatments lowered the permeability (hydraulic conductivity) of the expansive clays soils, creating an effectively impermeable moisture barrier layer that would stop rainwater from penetrating and wetting the native soils below the treated layer as well as providing an effective barrier to capillary water that otherwise would be suctioned up from the groundwater table by atmospheric effects into the constructed subgrade layer and flexible base course layers. For additional perspective, the two expansive clay soils treated with the EMC SQUARED System stabilizers were so impermeable that it took almost four full months to run the permeability testing to completion. The rate of moisture flow through the treated soils was less than one-thousandth of an inch per month. Serving as a testimonial to this moisture barrier performance, TxDOT's Luna Road Extension project in Dallas was built on top of a constructed embankment built through the middle of a permanent lake. Given an EMC SQUARED System moisture barrier constructed within the embankment just above water level, it is no surprise that the concrete pavement sitting on an EMC SQUARED System subgrade five feet above remains smooth running and essentially free of repairs sixteen years later.

As the conclusion of the extensive and sophisticated 3929-1 Study at TTI, the report recommended use of the non-calcium based EMC SQUARED System stabilizer products for treatment of sulfate-bearing highly expansive clay soils. The 3929-1 Research Report predicted the benefit of the moisture barrier would be in providing solid all-weather working platforms, eliminating risk of sulfate-induced heave in the event a zone of subgrade soils with high sulfate content was unexpectedly encountered and also reducing fluctuations in the moisture content of the native soils below the stabilized subgrade layer. The role of the moisture barrier subgrade layer is twofold. First to protect the native soils underneath the road structure against the swelling that would be expected during wet weather, and against the swelling that otherwise would be driven by capillary water rising upward from the groundwater table. Secondly, protecting the native soils during periods of extended drought conditions against desiccation. Desiccation results in skrinkage in the volume of clays soils, a phenomenon that can cause soil collapse and cracking that can reflect upwards through treated subgrades and base layers and damage pavements. As an example, desiccation of the native soils beneath a ten-mile long section of a recently constructed Texas State Highway 130 (SH 130), a four-lane toll road bypass around Austin, has been blamed as one of the causative factors in reflective cracking of the eight-inch thick hot mix asphalt surface course during drought conditions. The reflective cracking ramified upward through 36-inches of lime treated subgrade and 12-inches of aggregate base course and so severely damaged the pavement that a section of the newly constructed toll road pavement structure had to be completely removed and reconstructed, at a reported cost of $30 Million. Ten miles of the northbound and southbound main lanes were removed and replaced full-depth soon after the newly paved highway was put into service. A three-foot thick layer of lime treated soil under the pavement structural section was clearly not the right solution. The reconstructed highway included placement of a moisture barrier, installed in an attempt to better protect the lime treated subgrade against repeated failures during future drought cycles.

After reviewing the 3929-1 Research Report and touring a population of smooth running highways that were constructed on top of subgrades stabilized with the EMC SQUARED System products by TxDOT's Dallas District, project design engineer John Wooley recommended use of the EMC SQUARED System products to Newland Communities, the owner of the Teravista development,

and to Williamson County. Williamson County approved the use of the EMC SQUARED System products for an initial installation with a contingency that also included a section of subgrade treated with lime for sake of comparison. Over ten years later, as new roads and streets are being added, the Teravista development that now has a network of roads and streets that stretch out over an area of almost three square miles, www.teravista.com, the EMC SQUARED System products continue to be the stabilizer of choice for treatment of these highly problematic soils. Contractors were initially given the choice to bid either double lime treatment or the EMC SQUARED System Dual Component Treatment, until the superior performance and economics of the EMC SQUARED System products became clear to all. The EMC SQUARED System products are less expensive than the required lime product, faster to install and their use eliminates risk of heave generated by the calcium content of the lime product. Mr. Joe England, the County Engineer who monitored the Teravista street construction projects for a period of ten years, agreed that the addition of subgrade stabilization to the pavement design was key to reducing the differential settlement (dips) of the pavement, which was his primary concern, along with pavement cracking. Williamson County's Jerry Batten, the construction inspector who had been the County's on site representative since the very first street was constructed at the Teravista development, had the following commentary about the ultimate selection of the EMC SQUARED System treatment over all other products: "Over the past years, we have tried everything to address these problem soils. The EMC SQUARED System products have worked better than anything else." Speaking with the project manager of a local contractor who has completed at least sixteen out of the first twenty-six phases of road and street construction at the Teravista development where the EMC SQUARED products have been utilized, he commented that the cost for the installed EMC SQUARED System applications are approximately one-third the cost of the double lime treatment and so much faster and easier than lime treatment that there is simply no comparison. Along with the observed performance advantages, the installed cost differential clearly favors use of the EMC SQUARED System products over cement and lime treatment or geogrid reinforcement. Accordingly, EMC SQUARED System products are now specified exclusively for the new road and street construction projects that are ongoing at Teravista as of October 2019, the date of this case study update.

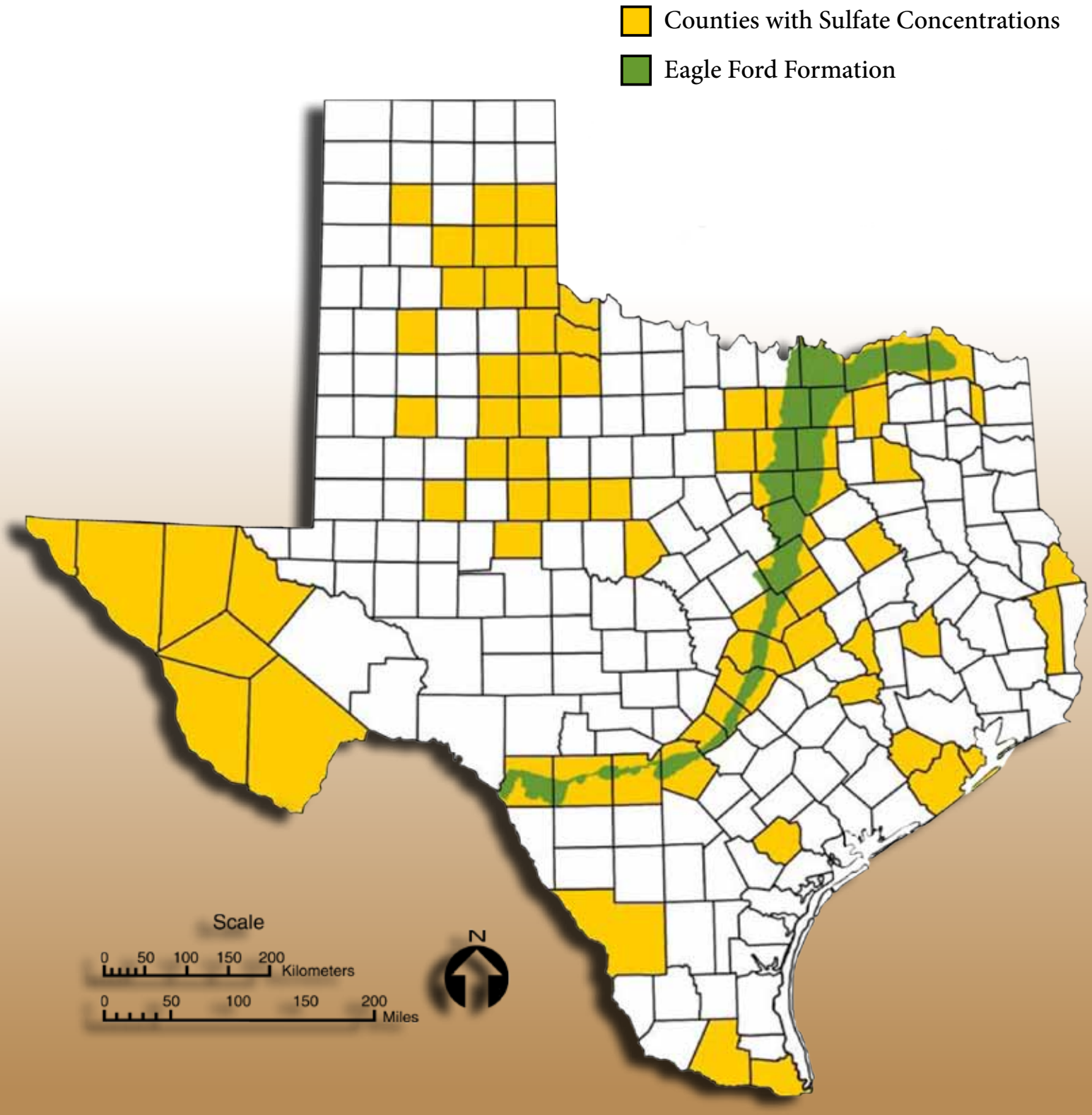
September, 2019

EMC SQUARED SYSTEM SUBGRADE STABILIZATION DELIVERS SMOOTHEST RUNNING STREETS FOR MIXED-USE DEVELOPMENT IN THE AUSTIN AREA

CEMENT AND LIME TREATMENT
BIG RISK

The Eagle Ford Shale formation in Texas is the source of the largest current oil and natural gas development in the world. It also presents one of the world's biggest soil stabilization problems as the clays derived from this formation are highly expansive and typically rich in concentrations of sulfate minerals such as gypsum that react almost explosively when treated with cement, lime, or fly ash chemicals (all calcium-based stabilizers). The calcium in these products generate what has been described as a man-made swelling reaction, known as sulfate-induced heave or sulfate swell. As illustrated in the pictures below, sulfate swell can create major uplifts and dips and cracking of pavements constructed above subgrades treated with calcium-based products. Pavement damage can be so extensive and rapid that pavement materials often need to be removed and replaced before the streets, roads or highways constructed above such chemically treated subgrades can even be opened for use by the public. Lime is so widely used in Texas that the problem is attributed to the presence of sulfates in the soil rather than to the inappropriate application of the lime product that causes the majority of the costly pavement damage. This problem is more properly described as lime-induced heave, rather than sulfate-induced, since this is a man-made heave phenomenon resulting from road construction specifications that require contractors to add lime to project subgrade soils. If the subgrade soils happen to have elevated levels of sulfate content, the lime treatment rapidly swells them up, along with the expensive pavement structural section on top. The more economical EMC SQUARED System products meet the project owner's requirements without risk of the heave reactions that deform and crack asphalt and concrete freeways, highways, roads, and streets.

EXAMPLES OF SULFATE-INDUCED DAMAGE


Counties with Sulfate Concentrations
Eagle Ford Formation
Scale
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