TEXAS DEPARTMENT OF TRANSPORTATION PROJECT

LUNA ROAD EXTENSION

Performance Through Flooded Wetland

Luna Road is a major arterial in the northwestern Dallas area which now connects with Old Denton Road via an extension project which added a new segment of six lane highway and an overpass above Interstate 35E Freeway. This construction project (TxDOT CSJ 8037-18-002) presented a classic soil stabilization challenge. Alignment requirements dictated construction through a wetland area and lakes created by gravel mining operations. Pavement designers were forced to plan for construction of a tall embankment over saturated ground conditions. Once constructed, the embankment would be subjected to deeply ponded water on both sides. Controlling moisture content within the embankment was a concern due to the risk of volume change and differential settlement in the highly moisture susceptible expansive clay soils.

After reviewing the recently completed research study conducted at the Texas Transportation Institute (TTI) under the direction of Dr. Robert Lytton, as summarized on the following page, the Project Engineer from consulting engineering firm HDR made the decision to stabilize two different layers with **EMC SQUARED**® System applications. The first stabilized layer was constructed just above the elevation of the ponded water. The second stabilized layer was constructed at the top of the embankment (the actual pavement subgrade). The intent was to provide stable construction work platforms and to partially encapsulate the layer of untreated embankment soils between the two stable moisture barrier layers. As an additional response to the ponded water, they specified a one-foot thick placement of a rock riprap cover to protect the embankment slopes against wave attack.

According to the report of the TxDOT Dallas District office "Even with the abundance of water along this roadway, no distress is evident in the pavement and the ride quality is very smooth. The conclusion could be drawn here is that the **EMC SQUARED** System treatment is effective in reducing and/or preventing water from entering the embankment." A study conducted after more than eighteen years of service rated the pavement surface condition of Luna Road as GOOD and ride quality evaluated as also remaining GOOD.

Moisture Barrier Performance

For highway engineers who have previously asked the question as to how well an EMC SQUARED System moisture barrier would perform with a lateral source of water ponded against the embankment below the moisture barrier, the Luna Road Extension project clearly answers this question with successful performance.

Soil stability, at its essence, has water as its common denominator. The engineering properties of any soil material are governed by variations in water content. The most direct and cost-effective route to stabilizing a soil is to stabilize its moisture content. This is the most fundamental benefit offered by the EMC SQUARED System in treatment of expansive clay soils. When moisture content in subgrade and embankment soils is maintained in a "near optimum" state, the soil platform is unaffected by volume change (expansion and shrinkage) and provides consistent support for the pavement. Key to this approach to stability is the selection of product technology that reduces soil moisture susceptibility and improves moisture barrier performance. This is not a benefit normally offered by cement, fly ash or lime treatment. TxDOT and other state transportation agencies have previously used plastic liners with some success to encapsulate expansive soils to control volume change, but the cost and complexities during construction are prohibitive. As indicated in the following summary of the research study that was conducted at the Texas Transportation Institute (TTI), and verified in the field monitoring, the EMC SQUARED System treatment is an effective moisture barrier.

LABORATORY TESTING

Beginning in 1996, the **EMC SQUARED®** System was evaluated in a two year laboratory study at the Texas Transportation Institute (TTI), which was funded by the Texas Department of Transportation (TxDOT). The principal author of the study was Dr. Robert Lytton, Research Engineer for TTI and Director of the Center for Infrastructure Engineering at Texas A&M University. The study focused on identifying effective treatment for sulfate bearing expansive clay soils. Soils used in the laboratory testing were sampled from problem locations on Interstate 635 Lyndon B. Johnson Freeway (the "LBJ"), and the Highway 161 section of the President George Bush Turnpike (PGBT). The study found that the EMC SQUARED System treatment was superior to lime in strength, stiffness, swell resistance and permeability, and recommended its use for subgrade treatment in areas where application of lime treatment has historically led to sulfate-induced heave and costly damage to pavements.*

The table and graph on the right show the results of TTI tests with the SH-161 project soils evaluating the effectiveness of lime treatment in comparison to the **EMC SQUARED** System in strength and stiffness, and in reducing moisture susceptibility, the most important difference between lime and the **EMC SQUARED** System product technologies. The **EMC SQUARED** System very directly targets moisture flow and moisture susceptibility problems. Research findings have clearly demonstrated that lime does little to impede moisture flow through treated subgrade soils and that lime, in fact, typically increases soil permeability.** Permeability, or "hydraulic conductivity" tests, were also conducted on the SH-161 soil specimens. At $8.9x10^{-10}$ cm/sec. permeability, the **EMC SQUARED** System treatment effectively reduced moisture flow to less than one thousandth of an inch per month. With the velocity of water flow reduced to this rate and soil moisture susceptibility effectively treated (see graph at right), the **EMC SQUARED** System is providing an effective moisture barrier. While the very low permeability is significant, keep in mind that it's the combination of lowered permeability and treated moisture susceptibility that creates a stable and effective moisture barrier layer. Without effective treatment of its moisture susceptibility (affinity for water), a low permeability clay (or lime treated clay) will still wet itself over time as it suctions water.

In translating the **EMC SQUARED** System laboratory findings to the actual field service environment, the TTI report went on to state, "The stabilized subgrade has a lower permeability and a lower suction than the untreated soil below it. This means that it will shed water and not soak up water from the soil below it...." The statement points out the fundamental advance in stabilization technology, which is achieved when upward and downward flow of water is controlled by a layer within the structural section that provides an effective barrier to moisture flow, and that helps further protect against pavement roughness by promoting a more consistent and stable moisture distribution in the untreated native subgrade soils below. This is the multiplier effect of the **EMC SQUARED** System subgrade treatments. It promotes greater stability in soils below as well as within the treated layer.

*Summary Of Research Report 3929-1 at http://stabilizationproducts.net/docs/18588.pdf

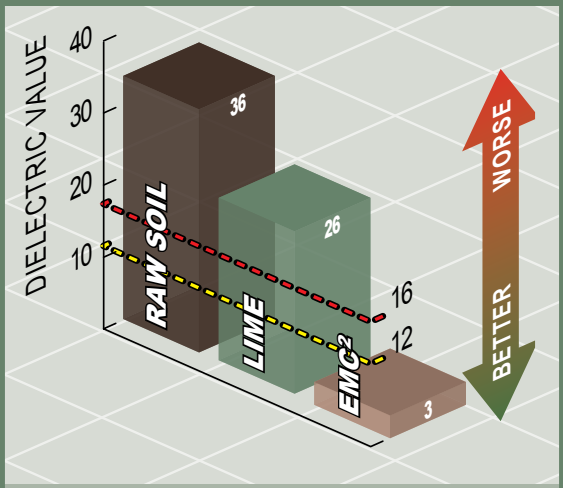
** Lime Treatment Tradeoffs at http://stabilizationproducts.net/docs/18392.pdf

President George Bush Tollway
SH 161
Testing by the Texas Transportation Institute

STRENGTH AND STIFFNESS

TREATMENT	STRENGTH psi (kPa)	STIFFNESS psi (kPa)
EMC SQUARED SYSTEM	399.04 (2,751.29)	5,000.00 (34,473.79)
LIME	341.55 (2,354.91)	3,166.67 (21,833.43)
NOT TREATED	232.56 (1,603.45)	588.24 (4,055.75)

REDUCTION OF MOISTURE SUSCEPTIBILITY



As indicated above, the dielectric measurements for the **EMC SQUARED** System treated specimens were well below 12, the value established by researchers as the upper limit for expansive clay soils if they are to be considered suitable for use as highway subgrade materials. This is also significantly below the dielectric value of 16, at which point it is predicted that plastic deformation will occur within the structure due to physical property changes in the soil which are driven by moisture infiltration and fluctuations in moisture content. Note also that the untreated or raw soil and the lime treated soil greatly exceed the upper limit for Dielectric Value. The test values indicate that both the raw soil and the lime treated soil are highly moisture susceptible.

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