EMC SQUARED® SYSTEM
"THE HAUL ROAD TO PRUDHOE BAY"

Stabilized Aggregate Running Surface After One Year of Service

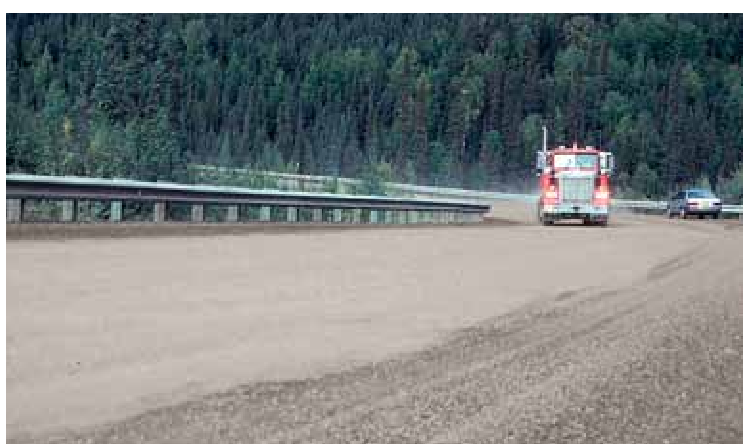
FHWA Experimental Feature Project

5 YEARS

The State of Alaska's Department of Transportation & Public Facilities (DOT & PF) maintains a unique highway – formerly famous as the "Pipeline Haul Road," approximately 450 miles of road running north across the Arctic Circle through "The Land of the Midnight Sun" to supply the huge oil production operations at Prudhoe Bay and neighboring oilfields. Views from the highway regularly include wolves, arctic fox, grizzly bear and caribou, as well as the parallel Trans-Alaska Pipeline. Intense year round truck traffic, severe climatic conditions, permafrost subgrades subject to melting and differential settlement, and hundreds of miles of gravel surfacing combine to truly set the standard for "worst case" conditions. The perpetual repair work and frequent reconstruction of the asphalt pavements north of Fairbanks testify to the severity of the problems. Further north, gravel road maintenance crews have reported maintenance grading as frequent as once every four days. A trip up this road had historically been notorious for blinding clouds of dust and rock flying in all directions, kicked up by trucks moving at high speeds, and often directly impacting your windshield and headlights.

Just north of Fairbanks is the section of road known as the Elliott Highway and this is where the asphalt pavement ended and transitioned to gravel road surfacing. State highway engineers and maintenance department staff selected this transition point as the location for placement of a five mile length of stabilized aggregate running surface utilizing product technology. The particular location was selected for its proximity to the state's regional office in Fairbanks and because it had the worst high-speed super elevated curves on the Elliott Highway. Alaskan truckers were utilizing the highway on a year-round basis, running over 17,000 heavy loads annually up to Prudhoe Bay. This section of the highway provided the most challenging conditions for field testing a stabilized aggregate running surface.

It had long since been determined that standard lime and cement chemical treatments did not have the performance capabilities to survive under truck traffic without being covered by protective asphalt or concrete pavements. The EMC SQUARED® product



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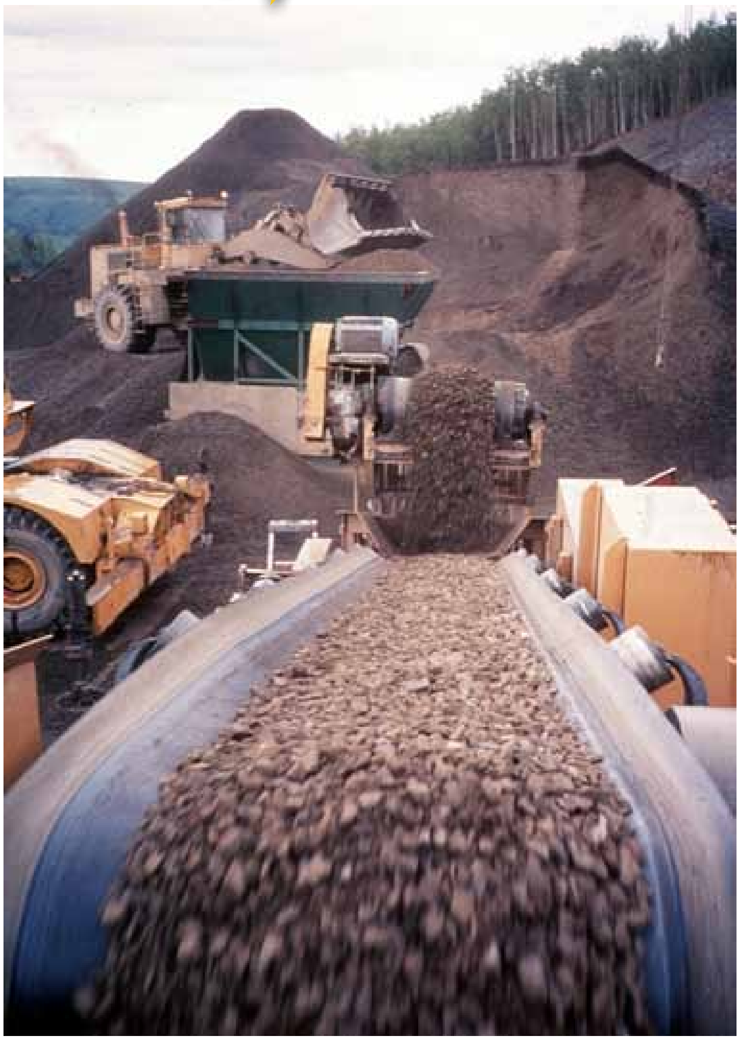

technology, on the other hand, was proving effective in severe cold climate service and unpaved road applications. Based upon existing performance histories, Alaska DOT & PF applied for special funding from the Federal Highway Administration (FHWA) to construct the new stabilized aggregate running surface as a FHWA Experimental Feature Project. The State of Alaska was dependent upon constant grading maintenance and dust palliative applications applied on a repeated basis through the summer season. Given the significant costs for this high maintenance road program and the marginal running surfaces that would still experience huge potholes following every rain event, FHWA approved funding for the project.

A portable crushing plant was set up twenty miles north of the project location the first summer to create the large stockpile of the specified ¾" maximum aggregate base rock to be used to resurface the Elliott Highway. The following summer a portable mixing plant was stationed at the same position where the crushing plant had been located. A two and a half mile section of road was surfaced with aggregate material treated with EMC SQUARED Stabilizer. The concentrated liquid stabilizer was metered into the water additive system as the aggregate was being processed by the mixing plant to its optimum moisture content. The treated aggregate was then loaded out of the stockpile into bottom dump trucks and hauled down the highway for placement as a six-inch (150mm) stabilized running surface. When stabilized aggregate mixtures are delivered to the jobsite from a mixing plant operation that preconditions the treated aggregate to the appropriate moisture content for placement and compaction, the contractor has the opportunity to place the material by paving machine, avoiding the need to set survey stakes and "blue tops" and the delays related to motor grader placement, shaping and trimming. In this case, the contractor chose to utilize the traditional motor grader placement operation. Once in place, the treated aggregate was compacted by large vibratory smooth drum rollers to a minimum of 95 percent ASTM D 1557 compaction effort. State regulations for this vital highway access to the Trans-Alaskan Pipeline and the Prudhoe Bay oilfields required that road construction and road maintenance activities not interrupt haul truck traffic more than eight minutes at any one time. With the EMC SQUARED Stabilizer treated aggregate mixture, the contractor was able to move truck traffic through the length of the project without concern that the treated aggregate would be subject to permanent damage by trafficking during the placement and compaction operations.

ASTM D 2166 Unconfined Compressive Strength testing was conducted on the stabilized aggregate in the Arctic Alaska Testing Laboratory of geotechnical consultants Shannon & Wilson. They reported 421 psi (2,900 kPa) strength results. This is a strength suitably high for service conditions under heavily loaded trucks, but without excessive strength and slab-like behavior that would leave the stabilized aggregate surfacing susceptible to layer cracking during the seasonal moisture fluctuations and movements in the subgrade soils below.

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The aim of the FHWA Experimental Feature Project was to compare the stabilized running surface to an adjacent section of road constructed during the same construction sequence with untreated aggregate from the same stockpile. This adjacent "control section" was placed as a six inch thick layer and then treated to a two-inch depth with a calcium chloride dust palliative treatment. Given the nature of the study, the state was only required to monitor the project for two years. The state's regional geotechnical engineer described the EMC SQUARED stabilized running service as virtually maintenance free during the two-year period, with only very minor touch up required in the super elevated curves. He also commented that the stabilized layer outperformed the calcium chloride dust palliative treatment in regards to dust control and was less expensive to apply. In contrast, the dust palliative control section was subject to constant potholing, washboarding and gravel loss and required regular grading maintenance.

In the third year of service, the laboratory supervisor for Arctic Alaska Testing Laboratory made two project site visits to inspect the condition of the stabilized running surface and to provide a video record of the stabilized running surface and the adjacent section of aggregate surfaced road maintained by regular grading and repeated dust palliative treatments. In the full length of the stabilized aggregate running surface he recorded only a few small potholes. They were located in the worst stress area of the super elevated curves and no larger than "half a grapefruit". He was easily able to drive the speed limit (55 mph) on the smooth running stabilized running surface, but had to reduce driving speed to less than 25 mph on the adjacent section of aggregate road maintained with ongoing grading maintenance and dust palliative treatment where he observed potholes ranging from six to ten feet in diameter.

In the fifth year of servicing high-speed truck traffic without any protection from a pavement surface or surface treatment, state maintenance crews applied an experimental bituminous surface treatment late in the summer after reworking the top two inches of the stabilized layer to prepare the surface. An inspection in early fall verified that the stabilized section of road retained its smooth running alignment following the application of the bituminous surface treatment, easily supporting driving speeds of 70 mph, whereas much of the three year old asphalt pavement immediately to the south was unsafe to drive at 55 mph due to the development of roller coasters and differential settlement. The roughness in the ride quality of the asphalt pavement is fairly typical for this area of Alaska, but still a surprising contrast to the smoothness of the adjacent six inch stabilized aggregate running surface. The asphalt pavement had been reconstructed full depth the year following construction of the stabilized aggregate running surface. The six inch thick asphalt pavement was placed on top of a six-inch thick aggregate layer treated with asphalt emulsion. The costly asphalt structural section had in fact developed severe roughness within a year of its construction, creating a situation where southbound truckers had to reduce driving speeds as they transitioned off the smooth running stabilized aggregate surfacing to the rough riding asphalt pavement.

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SUMMARY

FHWA Experimental Feature Project funding supports implementation of innovative technology to achieve better value in federally funded highway construction. The stabilized running surface on the Elliott Highway north of Fairbanks, Alaska, demonstrated an advancement in aggregate stabilization technology. The EMC SQUARED Stabilizer performed in service conditions beyond the capabilities of cement treated aggregate base (CTB) materials and it provided a far smoother running alignment than the adjoining asphalt pavement constructed with a much thicker structural section. The EMC SQUARED stabilization product technology provided excellent performance in severe service conditions, enduring high speed truck traffic and challenging seasonal variations in subgrade soil stability with almost no need for maintenance of the running surface and no cracking in the stabilized layer.

It is important to note that this high speed running surface was constructed to FHWA and Alaska DOT & PF standards with similar attention to road alignment, materials engineering and construction quality control as a paved state highway project. While the Elliott Highway has posted legal speed limits, haul trucks generally move at speeds more typical of a paved state highway and the road design facilitated safe operation at these speeds. The aggregate material specifications were specially developed for the unpaved road surfacing application, just as special aggregate mixtures are specified for particular asphalt pavement applications. State highway engineers required a center crown, good drainage, and strict tolerances for smoothness of the finished running surface. State quality control technicians monitored the moisture content of the stabilized aggregate mixture throughout the construction process and conducted compaction testing to verify adherence to specification requirements for placement of the stabilized surface course. The EMC SQUARED Stabilizer treatment was extremely effective and the stabilized aggregate mixture was manufactured to strict tolerances with a stationary mixing plant operation. The very high level of field performance recorded in this project application was also reliant on the good highway design, materials engineering and construction quality control that were incorporated in this project.

As demonstrated on this Alaskan project in both field performance and laboratory testing, the EMC SQUARED Stabilizer can be highly effective with aggregate materials in severe climatic and service conditions when applied with appropriate engineering controls. The product technology is user friendly as well as environmentally friendly. The cost advantages it offers and its unique performance capabilities open up a wider range of opportunity for the cost-effective application of stabilization treatment.

COMMENTARY

When a low cost aggregate stabilization treatment provides maintenance free performance in severe cold climate conditions under heavy truck traffic in a manner similar to costly asphalt pavement and in fact retains a smoother running alignment than the asphalt pavement, there is good cause to look deeper into the materials testing history. For perspective, it is helpful to see how the EMC SQUARED stabilization technology compares in materials testing with hot mix asphalt, which is a combination of high quality aggregate materials and asphaltic cement. The Marshall Stability Test is a standard laboratory procedure used for evaluating flexible pavement mixtures such as hot mix asphalt. The test measures the bonding strength, or stability, of the mixture and its elasticity or flexibility. Aggregate mixtures formulated with EMC SQUARED Stabilizer treatments have demonstrated flexibility similar to asphalt and significantly higher stability values in studies conducted by independent material testing laboratories. In more sophisticated Resilient Modulus testing conducted by independent materials testing laboratories, aggregate mixtures treated with EMC SQUARED Stabilizer have again provided flexible layers with load carry capacity similar to hot mix asphalt pavement mixtures.

In regards to resistance to moisture and frost susceptibility (freeze-thaw conditions), the particular aggregate material used for the stabilized and unstabilized portions of the Elliott Highway project was evaluated in the materials testing laboratory at the Texas Transportation Institute (TTI) in Suction and Dielectric testing. As would be evident in the field performance of the untreated aggregate surfacing on the Elliott Highway, the untreated aggregate proved to be highly frost and moisture susceptible in the materials testing laboratory. The same aggregate treated with the EMC SQUARED stabilizer proved to be as durable in materials laboratory testing as it was in highway service. Testing verified that the treated aggregate was non-moisture sensitive and non-frost susceptible. Not surprisingly, the treated aggregate provided test values in Suction and Dielectric testing that were very similar to the test values for hot mix asphalt and Portland Cement Concrete pavement materials.

The smooth running alignment of the stabilized aggregate surfacing on this FHWA Experimental Feature Project correlates well with highway and interstate freeway projects where the EMC SQUARED System has been utilized for subgrade stabilization under both asphalt and concrete pavements. The FHWA has promoted nationwide implementation of annual monitoring for highway smoothness. Pavement smoothness has become the most recognized international index for evaluating pavement performance. The rate at which a pavement develops roughness is used in predicting the remaining service life of a specific section of highway pavement. The EMC SQUARED System is proving to be a standout in this regard, providing smoother running highways over time than comparative applications of cement, fly ash and lime treatment in base and subgrade stabilization applications.

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