

# Stabilized Asphalt Millings Meet Asphalt Pavement Standards

Energy Efficient Sustainable Product Produces High Performance Base Course At Lower Cost

The EMC SQUARED® System provides the least expensive and most environmentally friendly treatment available for construction of stabilized or bound base course layers. As indicated in pavement materials laboratory testing and field service conditions, it also delivers better performance than asphalt emulsion products in binding recycled asphalt millings. As demonstrated in the laboratory testing series on pages 3 and 4, asphalt millings treated with the EMC SQUARED Stabilizer product surpassed the specified minimum standard of the Asphalt Institute for hot mix asphalt pavement mixtures used for Heavy Traffic pavement service requirements. While not a direct substitute for newly manufactured hot mix asphalt pavement mixtures, recycled asphalt millings treated with EMC SQUARED System treatments have shown impressive performance in surface course implementation. The brief case history on the following page presents an example. The City of Gallup, New Mexico, is located at relatively high altitude just west of the Continental Divide in the southern end of the Rocky Mountains. The area has severe winter conditions and frequent freeze-thaw cycling. In these conditions, the performance of the stabilized millings as a surface course pavement for five miles of city streets over a period of five years is particularly impressive. This is far above and beyond the capability of asphalt emulsion based treatments of asphalt millings as the resulting lower strength mixtures are suitable only for use as base course layers protected from traffic by new hot mix asphalt pavement overlays and surface treatments.

Addressing the comparative testing in the pavement materials laboratory as illustrated on pages 3 and 4, four different treatments were applied to asphalt millings taken from the same asphalt millings stockpile. The EMC SQUARED System treatment alone provided twice the strength as the 2% CSS-1h asphalt emulsion at one-sixth the cost. For reasons described below, two mix designs using a combination of CSS-1h asphalt emulsion and EMC SQUARED System were also tested, providing mid-range strengths and mid-range costs.

The purpose of the combined treatments was two-fold. The EMC SQUARED System treatment is a water based stabilizer solution that usually works best with dense graded asphalt millings that have 6 to 12 percent fines content (material passing the #200 sieve). For asphalt millings with less than 6 percent fines content, some modification of the millings gradation may be required or else the use of asphalt emulsion to help achieve a more densely graded highly bound matrix. The two mix designs incorporating both CSS-1h asphalt emulsion treatment and the EMC SQUARED System treatment are examples as the asphalt millings used in this testing series were borderline at just below 6% fines content.

Secondly, in the interest of reducing costs on projects already committed to the use of some amount of asphalt emulsion product, strengths could be increased and overall costs lowered by substituting the EMC SQUARED System treatment. The total treatment cost was reduced by one-third when asphalt emulsion

content was lowered to 1%, and by well over half when asphalt emulsion content was lowered to ½%. This is an excellent case history of doing more with less, and reducing the use of a petroleum based product with a green alternative.

## STABILITY TESTING

Concrete, with its slab-like behavior and requirement for expansion joints, is classified and tested as a “rigid pavement” material. Hot mix asphalt pavement and NaturalPAVE XL Resin Pavement, with more elastic behavior and joint-free construction, are classified and tested as “flexible pavement” materials. The Marshall Stability Test Method (ASTM D 1559) has long been a standard procedure used by materials testing laboratories for evaluation of hot mix asphalt pavement mixtures and other types of flexible pavement materials. The stability of a pavement mixture is tested after the pavement specimen is heated to 140° Fahrenheit temperature, which is representative of hot weather service conditions. Stability is the maximum load resistance that a pavement mix test specimen will develop under compression. Stability translates into the resistance of a paving mixture to distortion, to displacement, to shearing stresses, to rutting and to shoving. Stability is dependent upon both internal friction and cohesion. Internal friction is primarily a combination of the frictional and interlocking resistance of the aggregate in the mix. Cohesion is primarily a measure of the adhesive quality and binding force of the binder material and the efficiency of the specific application rate of the binder in relationship to the specific aggregate material.



Marshall Stability Apparatus

The Marshall Design Criteria provided by the Asphalt Institute requires minimum values for different traffic classifications starting at 750 pounds for light traffic, 1200 pounds for Medium Traffic and 1800 pounds for Heavy Traffic. A higher stability measure indicates greater bonding strength.

As part of the Marshall Stability test, a “flow” measurement is also taken to evaluate the relative flexibility of different pavement mixtures. The Asphalt Institute Criteria for the Flow characteristics of hot mix asphalt pavement mixtures for Heavy Traffic application is a range from a Flow of 8 to a Flow of 14, with the higher Flow measurements indicating greater flexibility.

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## EMC SQUARED® System Stabilization of Asphalt Millings

In 1998, two years after the stabilized aggregate surfacing was placed on the streets of the South Annex, the City was given access by the New Mexico Department of Transportation (NMDOT) to a large stockpile of recycled asphalt material milled off the surface of a nearby state highway. The street maintenance crew once again used their asphalt reclaimer machine to mix in the EMC SQUARED System treatment as they constructed a three inch thick pavement with the stabilized asphalt millings materials. After five years of maintenance-free performance the City allocated the budget to overlay the stabilized asphalt millings surface with hot mix asphalt pavement in April 2003. The City's Street Superintendent reported that they filled in no more than a dozen small potholes in the entire

five mile stabilized asphalt millings surface in preparation for placement of the hot mix asphalt overlay.

Several days prior to placement of the asphalt overlay local geotechnical engineering firm AMEC Earth & Environmental Inc. cored the stabilized asphalt millings pavement in a number of locations as well as coring through the stabilized asphalt millings layer and the stabilized base course layer at one location. As the core samples pictured here clearly illustrate, the EMC SQUARED System treatment was effective in producing well bound flexible pavement layers that were water resistant and wear resistant under vehicular and truck traffic.



Cores Extracted March 28, 2003 from  
Stabilized Millings Pavement  
in Gallup New Mexico

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Sample #10023



Sample #10022



Sample #10020



Sample #10021

## COMPARISON OF FLOW AND STABILITY VALUES IN STABILIZED ASPHALT MILLINGS PAVEMENTS

SAMPLE #	AGGREGATE SOURCE	AVERAGE STABILITY	AVERAGE FLOW
10023	EMC SQUARED ONLY	1863	9
10022	2% CSS-1h Asphalt Emulsion only	906	13
10020	0.5% CSS-1h Asphalt Emulsion + EMC SQUARED	1667	8
10021	1% CSS-1h Asphalt Emulsion + EMC SQUARED	1566	10

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PROJECT NO: 16653 PROJECT NAME: Soil Stabilization Products Co., Inc.

To: Soil Stabilization Products Co., Inc. Kleinfelder, Inc.  
1410 F Street  
Date: April 7, 2008 Fresno, CA 93706  
ph: (559) 486-0750  
Specimen #: 10023A, 10023B, 10023C fax: (559) 442-5081

Description: Technician: Kyle Kubik / Jason Ruiz  
Aggregate Source: EMC<sup>2</sup> Stabilizer only Lab Coordinator: Paul Geitner  
Pavement Type: EMC SQUARED Stabilizer (1000)

Marshal Flow and Stability (ASTM D-1559 / AASHTO T-245)			
Specimen Number	10023A	10023B	10023C
Thickness	2.1900	2.0300	2.1900
Correction Factor	1.25	1.47	1.25
Dial Reading	177	136	134
Measured Stability	1677	1293	1274
Flow	10	8	9
Corrected stability	2100	1900	1590
140 deg. air bath for 2 hours			
Average flow	9		
Average stability	1863		



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ph: (559) 486-0750  
Specimen #: 10020A, 10020B, 10020C fax: (559) 442-5081

Description: Technician: Kyle Kubik / Jason Ruiz  
Aggregate Source: 1/2% CSS-1h + EMC<sup>2</sup> Lab Coordinator: Paul Geitner  
Pavement Type: EMC SQUARED Stabilizer (1000)

Marshal Flow and Stability (ASTM D-1559 / AASHTO T-245)			
Specimen Number	10020A	10020B	10020C
Thickness	2.0100	2.1800	1.9900
Correction Factor	1.47	1.79	1.47
Dial Reading	104	119	108
Measured Stability	992	1133	1030
Flow	6	8	8
Corrected stability	1460	2030	1510
140 deg. air bath for 2 hours			

Notes: \_\_\_\_\_  
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Date: April 7, 2008 Fresno, CA 93706  
ph: (559) 486-0750  
Specimen #: 10022A, 10022B, 10022C fax: (559) 442-5081

Description: Technician: Kyle Kubik / Jason Ruiz  
Aggregate Source: 2% CSS-1h only Lab Coordinator: Paul Geitner  
Pavement Type:

Marshal Flow and Stability (ASTM D-1559 / AASHTO T-245)			
Specimen Number	10022A	10022B	10022C
Thickness	2.0000	1.9500	1.9700
Correction Factor	1.47	1.56	1.47
Dial Reading	70	58	60
Measured Stability	673	561	579
Flow	13	13	14
Corrected stability	990	880	850
140 deg. air bath for 2 hours			
Average Flow	13		
Average Stability	906		



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Date: April 7, 2008 Fresno, CA 93706  
ph: (559) 486-0750  
Specimen #: 10021A, 10021B, 10021C fax: (559) 442-5081

Description: Technician: Kyle Kubik / Jason Ruiz  
Aggregate Source: 1% CSS-1h + EMC<sup>2</sup> Lab Coordinator: Paul Geitner  
Pavement Type: EMC SQUARED Stabilizer (1000)

Marshal Flow and Stability (ASTM D-1559 / AASHTO T-245)			
Specimen Number	10021A	10021B	10021C
Thickness	1.8900	1.9000	1.8900
Correction Factor	1.67	1.79	1.67
Dial Reading	93	96	99
Measured Stability	889	917	945
Flow	8	10	11
Corrected stability	1480	1640	1580
140 deg. air bath for 2 hours			
Average flow	10		
Average stability	1566		

## Stabilization Products LLC

Ph: (209) 383-3296 or (800) 523-9992  
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Website: http://www.stabilizationproducts.net



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