ESCSI

FEATURED PROJECT 10-2002 Chandler Materials

41-Mile Kansas Chip Seal Project

LOCATION
Cowley County, KS

OWNER
Kansas Department of Transportation (KDOT)

PROJECT OBJECTIVE
To Extend Highway Life and Service

PROJECT SCOPE
41 Miles of 2-Lane State Road

PAVING CONTRACTOR
Hi-Plains Sand Co., Inc.

ASPHALT EMULSION
Koch Paving Solutions
El Dorado, KS

LIGHTWEIGHT CERAMIC AGGREGATE PRODUCER
Chandler Materials Company, Tulsa, OK

QUANTITY OF EXPANDED CLAY LIGHTWEIGHT AGGREGATE USED
5,542 cubic yards

STATE-OF-THE-ART EQUIPMENT USED

- Etnyre Hydrostat Chip Spreader with Variable-Width Hopper (9 -18 ft) yr. 2001
- Etnyre Oil Distributor – Model S2000
- Hypac Pneumatic Rollers: 9-Wheel Articulated Hydrostats – Model 530 AH

Chandler Materials' LITE-WATE Ceramic Aggregate Provides "Best Return" on Taxpayers' Road-Maintenance Dollar

by Bill Martin, PE

Kansas Hwy.15. Left side is 4 days old. Right side is 2 hours old.

CHANDLER SUPPLIES "LITE-WATE" AGGREGATE FOR 41-MILE KANSAS HIGHWAY PROJECT

Chandler Materials has been supplying LITE-WATE chip seal (bituminous surface treatment) aggregate in the state of Oklahoma since 1988, and just recently completed a 41-mile maintenance paving project in Cowley County, Kansas.

In Cowley County, the application rate of LITE-WATE aggregate in August of 2002 was 120 square yards per cubic yard of Expanded Shale, Clay and Slate (ESCS). According to Jason Johnson, sales representative, the application rate of the CRS-1HP Asphalt Emulsion provided by Koch Pavement Solutions of El Dorado, Kansas was 0.375 gallon per square yard on most of the project. Where the road was not "thirsty," as little as 0.35 gallon per square yard was used. The paving company was Hi-Plains Sand Company, Inc., represented by Bob Wacker and Mike Bush. Bob Wacker, the company's secretary-treasurer, has more than 30 years of experience in the chip-seal bidding and application process. Up to ten tankers of asphalt emulsion per day were consumed due to the skilled personnel and the equipment used. The equipment used on this project was state-of-the-art, and was designed for the most uniform application of both emulsion and chips.

Kansas Chip Seal Project 2

Due to the unusual configuration of the project, which includes portions of State Highway 15 and Federal Highways 160 (east of Winfield, KS) and 166, there were only two dumpsites (staging areas) where the LITE-WATE aggregate was stored. The 5,542 cubic yards of aggregate was delivered during January and February of 2002, but not installed until August. The amount required by KDOT was 5,527 cubic yards. Hi-Plains Sand Company only had a small amount left over, so the quantities turned out to be on-target. KDOT often purchases materials in advance of the paving season, so suppliers will not run short during the critical summer months, when the demand is sometimes higher than the producer's screening capacity. This practice could be used by other states where capacity may be exceeded by demand.

MORE ROAD FOR YOUR BUCK

Bob Wacker of Hi-Plains Sand was interviewed on the Cowley County project. He chose to use ESCS instead of the heavier natural aggregates years ago when the ESCS was an optional bid item in KDOT specifications. When asked why the State of Kansas DOT was so positive on ESCS rather than the less expensive natural materials such as limestone and sand-gravel, he said because it's cost effective and provides the following:

1. Excellent Performance
2. Reduced windshield damage claims
3. Reduced trucking cost
4. Better bonding to asphalt emulsion
5. Less dust
6. Better skid resistance

4-day-old placement on right shows emulsion has firmly "planted" the LITE-WATE aggregate. Chuck Loudermilk (foreground) is a visitor from ODOT, who is observing the Kansas-specified method of chip seal paving.

Several state DOT's, counties and cities are specifying lightweight chip-seal made with ESCS lightweight ceramic aggregate which meets the requirements of ASTM D1139 (*Standard Specification for Aggregate for Single and Multiple Bituminous Surface Treatments*) for these same reasons.

Excellent Performance – Chip seal paving in Kansas generally bids from $0.80 to $1.15 per square yard. The longevity of this surface protection paving method is considered to be 4 to 5 years or longer, according to Bob Wacker. KDOT believes this service life is quite cost effective. Dennis Weinrich, Assistant Bureau Chief, Bureau of Construction and Maintenance for KDOT in Topeka HQ said the 4 to 5 year schedule is common for higher volume highways. The chip seal is expected to extend the life of the higher volume road surfaces until major renovation of the road is needed. For low volume roads, 6 or more years may be expected.

In Tulsa County, Oklahoma, the paving is expected to last more than 6 years. Some county roads are now 10 years old and still performing well. For example, on Oklahoma State Highway 9A near Ft. Smith, Arkansas, the LITE-WATE chip-seal served from 1991 through 2001 without surface failure. This highway carries low volume suburban traffic into rural Oklahoma.

Windshield Damage Claims – Due to the fact that ESCS is about half the unit weight of limestone or gravel, it does not chip windshields or paint. Years ago, KDOT allowed ESCS as an option to natural aggregates. Hi-Plains Sand chose to use Buildex rotary-kiln produced lightweight ceramic aggregate instead of limestone or gravel. Amazingly, it stopped the constant harassment of windshield damage claims.

Gary Baker, paving superintendent for Tulsa County, said he could remember only one windshield claim that the county justified paying after switching from limestone in 1988 to Chandler Materials Company LITE-WATE aggregate.

Close-up view of LITE-WATE. 1-hour-old placement. CRS-1 HP @ 0.38 gal/sy. LITE-WATE @ 120 sy/cy

Trucking From the Plant to the Dumpsite (Project Staging Area) – The typical 25-ton trailer can haul a minimum of 36 cubic yards (depending on density) of ESCS to a dumpsite. The same trailer, by comparison, can only haul 19 cubic yards of limestone, or 18 cubic yards of some types of gravels. The same advantage exists for the smaller dump trucks that deliver from the dumpsite to the chip-spreading machine. Fewer dump trucks and fewer drivers are required. This provides a major savings in the in-place cost. For example, to transport 5,542 cubic yards of lightweight aggregate from the plant to the dump site, 154 trucks are required. To deliver the same quantity of normalweight aggregate would require 307 trucks. The use of about half of the number of trucks provides a safer construction project with less air pollution, and results in a measurable environmental significance.

Stockpiling some types of highway paving projects should be in advance of need. Materials suppliers often have little demand during the winter.

Traffic following a flag car on left. Road on right is 2 hours old, has been rolled, and will soon be broomed.

One example of the strain on material suppliers relates to the natural aggregate (limestone, etc.) processing industry. At times it is necessary for the water-washing system, which removes the majority of the dust, to be turned off because the washing slows down the production capacity during the peak summer months. Failing to remove this dust from natural aggregates leads to inadequate bonding of the stone to the asphalt binder.

Bonding to Asphalt Emulsion – From his experience, Bob Wacker cautions other pavers and specifiers that cutback asphalt should be used with the typical dusty limestone chips or old dusty roads. However, emulsions bond tightly to ESCS because of the unique surface texture, plus the ionic attraction. Oklahoma has used a "boil test," which demonstrates that an emulsion coating on an ESCS particle has more than a 95% retention over the timed boiling in water, while the limestones have a retention rate much lower, often around 70%.

LITE-WATE being installed in Tulsa County, OK, near Memorial Street on 191 St. South. Emulsion placement rate @ 0.35 gal/sy

Dust – Limestone dust often sticks tightly to the surface of the particle, thus minimizing the aggregate/oil bond. Rain on stockpiles drives the limestone dust down into the pile where it thickly coats the aggregate. In comparison, ESCS is essentially dustless. If fines are present, they do not bond to the surface of the aggregate particles, and tend to wash away in the stockpile during rainstorms. Surface moisture on the ESCS does not interfere with the asphalt emulsion/aggregate bond.

Skid Resistance – Heavily travelled old pavement made with limestone will polish. ESCS pavement does not polish with time and wear, and therefore maintains most of its original skid resistance even when wet. This has been shown in many tests by the Texas Department of Transportation, as well as in a study published by KDOT (*Polish Resistance of Selected Kansas Aggregates*, Dec. 1990 FHWA-KS-90/2). ESCS pavement surfaces are safer to drive on.

In-Place Cost – Vance Brothers Manager, Gary Lyons, states that the haul from dumpsite to the chip spreader should be figured into any cost difference between natural aggregates and ESCS. Because there are considerably fewer back and forth trips with ESCS, the cost savings of this haul is typically 4 cents per square yard installed.

ASPHALT EMULSION

More and more agencies are calling for the new polymer modified emulsions to enhance performance. In Kansas, Koch Pavement Solutions and Vance Brothers of Kansas City provide the hi-tech CRS-1HP asphalt emulsion designed for chip seal paving, and specified by the state. The following was supplied by Stan Fronckewicz of the Vance Bros. laboratory in Kansas City:

"*Vance Brothers, Inc. has manufactured a polymer modified CRS-1H since 1978, designated CRS-1HP. The base asphalt for our newest product is modified with 3 to 4% of a butadiene/styrene*

copolymer modified with a special package of chemicals, oils, and resins to enhance the performance properties of the cured asphalt. Since the asphalt is polymer-modified before being emulsified, it is far superior to non-modified CRS-1H. The most notable differences are in adhesion, softening point, cold weather ductility, and elastic recovery. These improvements allow the asphalt to survive temperature extremes far better, increasing the installed performance of chip-seal paving. Examples are the elastic recovery at 50°F, which improve from 0 - 3% to 80 - 90% for the polymer modified product."

LITE-WATE aggregate on right is 4 days old.
LITE-WATE aggregate on left is 1 hour old.
Temporary center-line tab shown (lower center).

SMALLER CHIPS

Several states and counties have learned of the advantage of using a smaller chip size. For nearly thirty years the KDOT specification for the product has been as follows:

1/2 "	0 - 5% retained
3/8"	0 - 15% retained
#4	70-100% retained
#8	90 - 100% retained
#200	Maximum 2% passing

Any aggregate bonds best when it has less than 2% dust.

This smaller size chip provides a quieter road surface, and will use less asphalt emulsion than the larger size chips. The larger size (called minus 5/8") will use an average of 0.40 gallons per square yard. There is no loss of pavement performance when using the smaller size, as demonstrated in Kansas and Oklahoma. Gary Baker of Tulsa County, Oklahoma, had an emulsion coverage rate of 0.40 for the 5/8" size chips, and 0.35 for the 3/8" size chips. This means a tanker goes 14% farther. This is clearly a benefit to the taxpayer.

ESCS LIGHTWEIGHT CERAMIC AGGREGATE SUPPLIERS

The high quality ceramic aggregate (ESCS) is supplied in Kansas by Buildex, Inc., Ottawa, KS, TXI Western Aggregates, Boulder, CO, and Chandler Materials Company, Tulsa, OK. For suppliers in other parts of the U.S. and the world, see the ESCSI website at www.escsi.org.

SPREADING THE WORD

Over the last 30 years Buildex, Inc. has been successfully educating engineers on the advantages of using ESCS cover aggregate. They also supply most of the Kansas market. Their efforts on behalf of the taxpayer are well known and they are to be commended for their continuous efforts. Most of the chip-seal (also known as surface treatment, armorcoat, etc.) work in Kansas is done by independent contractors. Two of these are Hi-Plains Sand of Kanopolis, KS, and Vance Brothers of Kansas City, MO. Both of these contractors have been active in educating various agencies to the benefits of ESCS in the chip seal market. KDOT does a considerable amount of main-line ESCS

chip seal maintenance work because it's cost effective and nuisance free.

Texas has been the leader in the use of ESCS. Approximately 400,000 cubic yards of ESCS are used annually, equating to approximately 3,400 miles of chip-seal paving each year. The beginning of the Texas experience goes back 40 years, when Bob Gallaway of the Texas Transportation Institute demonstrated the value of using ESCS in paving applications.

Surface moisture on just-laid LITE-WATE at bottom is darker than that above which has lost some of its moisture after 1 hour.

REFERENCE LITERATURE

The design reference manual, *Expanded Shale, Clay and Slate Reference Manual for Asphalt Pavement Systems*, was written by Bob M. Gallaway P.E., Professor Emeritus at Texas A&M University and published in 1997. Section 6 of this manual is titled "Chip-Seal: Asphalt-Aggregate Surface Treatment." This manual will aid a designer in the use of ESCS in various types of paving applications. Lightweight aggregate for paving applications is referenced in ASTM standard specifications D 692 (*Standard Specification for Coarse Aggregate for Bituminous Paving Mixtures*), D 1073 (*Standard Specification for Fine Aggregate for Bituminous Paving Mixtures*), and D 1139 (*Standard Specification for Aggregate for single or Multiple Bituminous Surface Treatments*).

For Additional Information About ESCS Applications for Pavement Contact

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