HIGHLIGHTER

CHIP SEAL COVER AGGREGATE SPECIFICATION BASED ON AGGREGATE IMAGING SYSTEM (AIMS) ANGULARITY, SHAPE, AND TEXTURE

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PROJECT TITLE
DEVELOP DRAFT CHIP SEAL COVER AGGREGATE SPECIFICATION BASED ON AGGREGATE IMAGING SYSTEM (AIMS) ANGULARITY, SHAPE, AND TEXTURE TEST RESULTS

FINAL REPORT ~ FHWA-OK-14-01
ODOT SP&R 2239

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OVERVIEW Chip seals are widely used for preventive maintenance of pavements. While there has been extensive research on the various parts of the surface treatment, there is little research on how to combine the various materials and methods. Hence, chip sealing continues to be considered an art rather than a rationally engineered composite system. While some systematic methodology exists for design and installation of chip seals, the methods are quite dated. In most cases, the Oklahoma Department of Transportation (ODOT) maintenance engineers use empirical design based on trial and error. However, additional technical information is needed that defines aggregate gradation and selection based on performance characteristics and binder compatibility. The goal of this study was to enhance ODOT chip seal design and performance through introducing new criteria for the selection of cover aggregate and binder. It included laboratory testing, in addition to construction and performance (field) evaluation of chip seal test sections (Figure 1).

Figure 1 Chip Seal Installation on SH39

RESULTS Criteria were developed for the selection of cover aggregate and binder based upon the recent technological advances in the characterization of aggregate shape and texture as well as aggregate-binder compatibility. Specifically, the study included evaluation of aggregate index properties obtained from the Aggregate Imaging System (AIMS) and performance-based uniformity coefficients (PUC) in tweaking ODOT chip seal cover aggregate specifications. It also used the surface free energy (compatibility ratio) approach in evaluation of the aggregate-binder compatibility. Moreover, the chip seal construction practices followed by ODOT Maintenance Divisions were documented and effective practices were identified.

The AIMS testing results showed a correlation between AIMS properties (sphericity) and Micro Deval results: essentially, aggregate that exhibits greater sphericity (cubical shape) may exhibit greater resistance to degradation due to impact and abrasion. AIMS testing also showed statistically significant differences between aggregate sources in Oklahoma that may impact chip seal performance. Testing has provided further support for potential links between AIMS results and field performance. There was no difference in AIMS gradient angularity and texture output for the aggregate obtained during construction of the various test sections. This is consistent with the similar skid numbers exhibited by all test sections. There was a difference in AIMS sphericity output for the aggregate obtained during construction of the various test sections (Figure 2). The larger size fractions provided higher sphericity indices. This is consistent with the greater macrotexture performance of the single size (PUC) chip seals, which contain approximately twice as much of the larger aggregate than the traditional chip seals. In general, the newly developed performance-based uniformity coefficient, which requires single size gradations, appeared to enhance chip seal performance in Oklahoma.

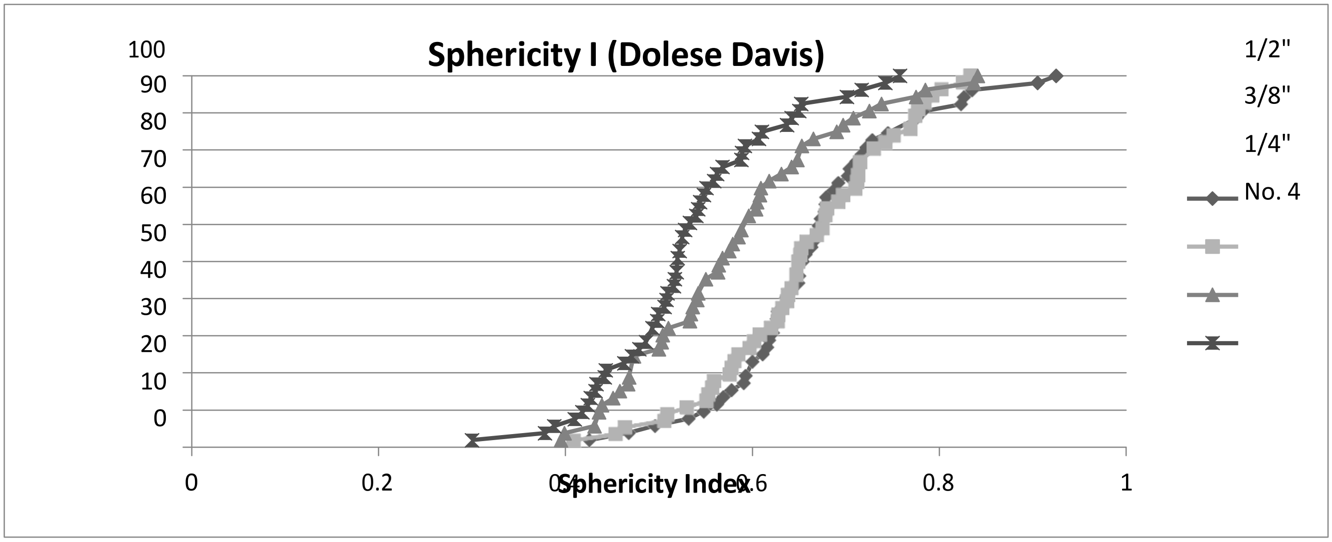

Figure 2 AIMS Output: Sphericity for Test Section Aggregate

The compatibility ratios indicated that the aggregate and emulsion materials from the listed sources are compatible and will not be the cause of short term failure in Oklahoma chip seals (Table 1).

Table 1 Compatibility Ratios for Aggregate-Binder Compatibility

Material	Compatibility Ratio	
	Ergon (Lawton)	Coastal (MO)
Dolese Cooperton	2.60	2.84
Dolese Davis	2.74	3.04
Dolese Hartshorne	5.14	5.88
Martin Marietta Mill Creek	2.08	2.23
Hanson Davis	3.08	3.37
Kemp Stone Pryor	4.29	4.78

All of the chip seal field test sections were performing satisfactorily on the basis of microtexture (skid resistance) after seven months of service and on the basis of macrotexture (aggregate retention) after twelve months of service. Based upon the Transit New Zealand Performance Specification (P/17), all test sections should exceed 6 years of service life on the basis of macrotexture ("drainability" and aggregate retention).

ODOT divisions were surveyed regarding their chip seal operations. Field test construction was also evaluated. ODOT chip seal construction practices were found to be consistent with best practices as noted in *NCHRP 342: Synthesis Chip Seal Best Practices*.

POTENTIAL BENEFITS This study provides a repository of information that is a useful resource for ODOT maintenance divisions. A methodology was provided for inclusion of these characteristics for shape and texture-related index properties and durability of commonly used cover aggregates in chip seal programs in Oklahoma and as a metric in future chip seal specifications. This could permit ODOT engineers to specify appropriate chip seal gradations and enhance chip seal specifications and design methods.