Kansas Department of Transportation

TECHNICAL SUMMARY

Evaluation of Carbon Char in Hot-Mix Asphalt Mixture

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Carbon Char Sample

Introduction

Carbon char is a by-product of the pyrolysis of waste tires. The use of carbon char would promote sustainability and economy. Carbon char is similar to carbon black, a potential additive for hot-mix asphalt (HMA). Previously carbon black in HMA showed the potential to reduce rutting potential, temperature susceptibility, and low-temperature cracking.

Project Description

The primary objective of this study was to evaluate carbon char, resulting from the pyrolysis of waste tires, in Superpave HMA. Carbon char was blended with the Superpave performance grading (PG) asphalt binder at various percentages (5%, 10%, 15%, and 20%). A rotational viscosity test was performed on the blend to see what percentages of carbon char by mass of asphalt binder would be workable. Five percent and 10 percent were found to be viable. Those carbon char percentages were used with a PG 58-28 binder in a Superpave HMA mix design. Modified Lottman and Hamburg wheel tracking tests were then conducted on this Superpave mixture.

Project Results

The following conclusions were drawn based on the analysis of the test results. Modified Lottman test results illustrated that all mixtures achieved a higher tensile strength ratio (TSR) than the minimum 80% KDOT requirement. Moisture resistance slightly decreased with 5% carbon char, but TSR increased with 10% carbon char in the HMA. The Hamburg wheel tracking device (HWTD) test results showed that all mixtures failed at 20-mm rut depth. However, based on number of wheel passes to failure, we can also conclude that the mixture without carbon char has a higher rutting resistance than the mixtures with it. HWTD output parameters of creep slope, stripping slope, and stripping reflection point also indicate a low moisture resistance of HMA mixtures with 5% carbon char. The HWTD test results of 3% air voids mixtures showed that all mixtures failed at 20-mm rut depth. As carbon char content increased, rutting and moisture resistance slightly improved. However, the mixtures with 3% air voids are less rutting and moisture resistant than the mixtures with 4% air voids.

Project Information

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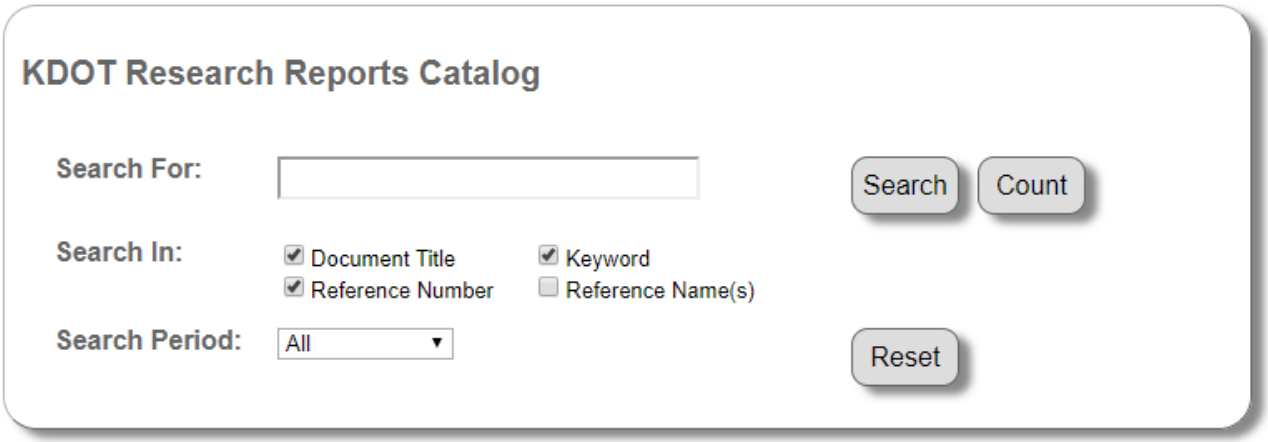

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