

JOINT TRANSPORTATION RESEARCH PROGRAM

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Maximizing the Use of Local Materials in HMA Surfaces

Introduction

Like most other highway agencies in today's economy, the Indiana Department of Transportation (INDOT) needs to search for ways to reduce construction costs. One approach to this issue is to maximize the use of locally available materials, specifically local aggregates. INDOT specifications already allow widespread use of local aggregates in deeper courses of hot mix asphalt (HMA) pavements, but surface mixes (especially for high volume traffic) typically require high friction aggregates such as steel slag, blast furnace slag or sandstone for safety. These types of aggregates are not readily available in all parts of the state, requiring long haul distances from limited sources in Indiana or even out of state. These premium aggregates are more expensive plus have the additional cost of transportation.

The main concern with using local materials is pavement friction. Most efforts to control HMA surface friction are based on specifying and/or testing the aggregate. For example, INDOT's standard specifications allow only certain aggregate types to be used in HMA and Stone Matrix Asphalt (SMA) surfaces depending on the expected traffic level. HMA surfaces for high volume roadways may include either air cooled blast furnace slag (ACBF), steel furnace slag (SF) or sandstone (SS). Other coarse aggregates may be used if they are demonstrated to be "polish resistant" according to Indiana Test Method (ITM) 214. Steel furnace slag and sandstone are allowed for SMA surfaces regardless of traffic level; crushed dolomite and polish resistant aggregates (PRA) may be used if blended with sandstone or steel slag.

The study summarized here was conducted to investigate the feasibility of using greater quantities of local, less polish resistant aggregates, specifically limestones, in asphalt surfaces. Samples of blends of various quantities of polish susceptible aggregates with high friction aggregates were prepared, polished to simulate the action of traffic, and tested in the laboratory for their frictional properties. The variables considered include mix type

(HMA and SMA), coarse aggregate type (two polish susceptible aggregates blended with steel furnace slag, blast furnace slag and sandstone), polish susceptible aggregate content, and amount of limestone fine aggregate (in HMA).

Findings

In short, the evaluation of various blends of coarse aggregates showed that adding local, polish susceptible coarse aggregate to a mix with high quality friction aggregates does cause a decrease in friction. As the amount of local aggregate increases, the friction decreases. Some local aggregate, however, can be added and still produce a mixture with adequate frictional properties. The amount of local coarse aggregate that can be added and still provide adequate friction varied between 20% and 30%. As the amount of local aggregate increased, however, the friction values began to approach the estimated friction flag value of about 0.20. In SMA mixes, perhaps higher amounts of local aggregate could be used from a frictional point of view, but there are other considerations, such as particle strength, that may limit aggregate choices.

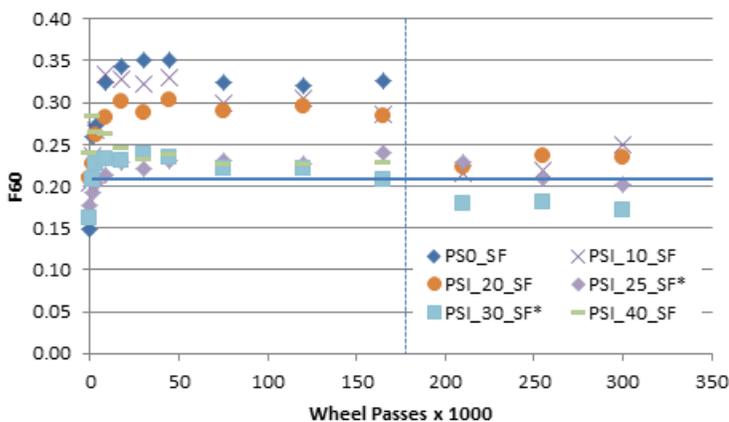
In the evaluation of fine aggregate, there were some testing issues that may reduce the reliability of the results. Specifically, the mixes seem to show excessive changes in the surface texture during polishing. It is not clear if this is related to the specimen fabrication or if these mixes are more sensitive to the shearing action of the tires on the polishing machine. This should be studied in future research. Given that caveat, however, the results generally show that adding a small amount of local fine aggregate may reduce the friction level. If the amount of local fine aggregate is limited and high quality coarse aggregate is used, the friction level may still be adequate.

This study evaluated only one size of mix, 9.5 mm. Previous research has shown that larger nominal aggregate size mixes may provide higher friction levels. There is

also evidence that smaller nominal aggregate size mixes may require higher frictional quality aggregates, in part at least, because of their reduced macrotexture. Extension of these findings and recommendations to other mix sizes should be done cautiously, and preferably should be guided by additional research in the lab and/or field.

Another previous study evaluated the potential effects of poor quality aggregate in reclaimed asphalt pavement (RAP) if the RAP is reused in high volume surface mixes. The final report on that project suggests that up to 20%–25% poor frictional quality RAP could be used in surface mixes without detrimental effect on the friction level. The possible allowable local aggregate levels recommended in this study are in substantial agreement with that other study. This is reasonable since, once in the mix, the aggregate behaves the same whether it came from RAP or was virgin aggregate, at least in terms of friction.

The laboratory techniques used in this study are definitely useful since trial mixes or new materials can be evaluated without risk to the public. Additional refinement is recommended, however, to develop them more fully and address some of the problems noted in this study. Particularly, there is a need to examine the compaction process, equipment calibration and data interpretation. Further comparisons of the lab and field measured friction levels to further refine the friction flag value would also be extremely useful. The procedures could then be used as a screening test to approve new aggregates or mix types for field trials, similar to the approach in the current ITM 214.



Effect of local coarse aggregate content (0% to 40%) on frictional properties of dense graded asphalt with steel slag coarse aggregate.

Implementation Recommendations

The results of this study demonstrate that local, polish susceptible aggregates can be used to replace a portion of high quality friction aggregates in HMA and SMA surface mixtures without detrimental effect on friction. Replacing some of the premium materials with locally available aggregates will help to reduce costs while maintaining safety. In addition to reducing material costs (by using less of the “premium” high quality aggregates), hauling costs and energy consumption will be reduced by using more materials from the local area.

Based on the results of this study, an allowable threshold of 20% local coarse aggregate and 20% local fine aggregate could be allowed for high volume surface mixes when blended with high quality friction aggregates, namely steel furnace slag, air cooled blast furnace slag or sandstone. This finding could be implemented by revising section 904.03 of the standard specifications. In addition, the laboratory evaluation procedures used in this study could be implemented as a screening test for new materials or new types of mixtures. An ITM could be written similar to ITM 214 to evaluate whether new materials should be placed in field trial sections. Such a screening test would allow contractors, material suppliers and INDOT to ascertain whether a material warrants further investigation before the effort and funds are invested in construction of a field trial.

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