SUMMARY

FIELD EVALUATION OF USE OF WASTE SHINGLES IN ASPHALT MIXTURES

In the United States, approximately ninety million asphalt roofing shingle squares, weighing in excess of ten million tons, are manufactured each year. Two thirds of the shingles are used for re-roofing houses and the other third is used on new houses. For the houses that are re-roofed, an equivalent amount of old shingles is removed and, in most cases, dumped in landfills.

It has been estimated that asphalt shingles represent the third largest source of construction waste landfilled after wood and wallboard. Because shingles take many years to break down, they are not considered a suitable material for landfills. However, shingles contain some of the same materials as a hot mix asphalt (HMA) mixture. These materials include: (1) thirty to forty percent asphalt cement which is considerably harder - about 25 penetration than paving asphalt, (2) forty to sixty percent hard rock granules (minus No. 10 sieve) and fillers (minus No. 100 sieve); and (3) one to twelve percent fiber (0.50 to 4.5mm long fiberglass or cellulose), felt, and miscellaneous materials. In many ways, asphalt shingles closely resemble reclaimed asphalt pavement (RAP). Furthermore, because of the relatively high asphalt content of shingles, using waste shingles in Hot Mix Asphalt may reduce the amount of virgin asphalt binder required. It is for these reasons that recycling shingles into hot mix asphalt could prove to be a better option than placing it in landfills.

For this project, a South Carolina Department of Transportation Surface Type 1C hot mix asphalt surface course containing 8% waste shingles was used to pave approximately one mile of road section (two lanes). SC 135, also known as Dacusville Highway, in Pickens County, South Carolina was chosen as the project site. The project scope included the laboratory mix design, development of specifications, monitoring of the actual work performance, testing of in-place pavement cores, and assessment of the results.

The recycled roofing shingles for use on this project were obtained from the Pickens County Landfill. The resulting mix design, which was
performed by the Clemson University Civil Engineering Construction Materials Lab, contained 8% shingles by weight of aggregate and was found to have an optimum binder content of 6.60% (including the asphalt from the shingles). This is approximately 1.50% higher than the normal optimum binder content for a Surface Type 1C mix for this aggregate source. The virgin binder content of the mix was 4.20% (without asphalt from the shingles), which is approximately 0.9% to 1.0% lower than the normal optimum binder content for a Surface Type 1C mix for this aggregate source.

The shingles were introduced into the asphalt mix using the existing RAP system at the asphalt plant. No modifications were made to either the asphalt plant or lay down equipment used to place the mix containing shingles. Relatively few problems were encountered during the production and placement process. The only problem noted during the paving process was the appearance of a small amount of oversize shingle material in the mix. It is suspected that a few loads of the shingles may have contained these oversize pieces. These pieces would generally protrude from the fresh pavement and could be easily removed by hand. The damaged areas were repaired with extra material taken from the paver hopper and a lute.

Several sets of cores were taken from the finished pavement and used to determine Bulk Specific Gravity (BSG), percent air voids, Indirect Tensile Strength (ITS), Tensile Strength Ratio (TSR), Maximum Specific Gravity (MSG), asphalt content, and gradation. South Carolina Department of Transportation officials also tested the finished pavement for Rideability (Smoothness) and Friction (Skid Resistance). Results indicate that all properties tested were within acceptable limits of South Carolina Department of Transportation specifications. Rideability (smoothness) results, although within specifications, were somewhat worse for the mix containing shingles than for surrounding control sections.

Results from this project indicate the following:

- Waste shingles, if properly produced, can be used in Hot Mix Asphalt at a rate of 8% by weight of aggregate.
- The existing RAP system at most asphalt plants can be used to introduce waste shingles into Hot Mix Asphalt.
- The asphalt content of recycled shingles may reduce the amount of virgin asphalt binder required in Hot Mix Asphalt.

Several follow-up research projects are recommended to evaluate the use of shingles in hot mix asphalt using different mix design procedures, materials, and paving scenarios.