

TABLE OF CONTENTS

INTRODUCTION	1
APPROVED WASTE MATERIALS	2
Fly Ash.....	2
Water Granulated Blast Furnace Slag.....	2
Chrome and Steel Slag.....	3
Recycled Asphalt Pavement (RAP)	4
Glass.....	4
RECENTLY COMPLETED PROJECT	5
SPR 586	5
CONTINUING INVESTIGATION.....	6
SPR 617.....	6
NEW INITIATIVE	7
Use of Waste Materials in Construction of a Rest Area	7
REMARKS	8

Appendix A “Field Evaluation of Use of Waste Shingles in Asphalt Mixtures”

Appendix B Supplemental Specifications for Utilization of Shingles in Asphalt
 Mixtures

INTRODUCTION

In a continuing effort to meet the requirements set forth by the “Intermodal Surface Transportation Efficiency Act” (ISTEA) of 1991 and the “South Carolina Solid Waste Management Act,” also of 1991, the South Carolina Department of Transportation (SCDOT) investigates, evaluates, and utilizes waste materials in highway construction. Both Acts encourage highway engineers to search for safe and economical methods to use solid waste products and recycled material in building and maintaining highway structures. By incorporating recycled material into highway applications, SCDOT helps reduce the problem with disposing of solid waste in South Carolina. This annual report has been prepared for the Governor and the General Assembly to document the Department’s continuing research efforts to find applications for recycled products in the highway industry.

APPROVED WASTE MATERIALS

Several waste materials have been approved for use in highway construction on a routine basis. These materials include: fly ash in flowable fill and portland cement; water granulated blast furnace slag in portland cement concrete; chrome slag in asphalt concrete for low volume routes; reclaimed asphalt pavement (RAP) in asphalt concrete; and glass in embankments, aggregate underdrains, and asphalt concrete for low volume routes.

FLY ASH

This material is approved as a replacement material for certain cements in portland cement concrete and flowable fill. When fly ash is used to replace a portion of the cement, the replacement ratio shall not be less than 1.2 to 1 by weight and shall not replace more than 20 percent of the cement originally called for in the mix. Fly ash is also a very important ingredient in the Department's Class "E" high performance concrete mix design. This mix design has characteristics of being extremely impermeable due in part to the specified use of fly ash. Typically, use of fly ash as a replacement material is left to the discretion of the contractor except in the Class "E" mix design.

WATER GRANULATED BLAST FURNACE SLAG

Water granulated blast furnace slag has also been approved as a replacement for certain cements in a portland cement concrete mix. However, the replacement ratio for

cement is 1 to 1 and up to 50 percent of the original cement can be replaced with water granulated blast furnace slag.

CHROME AND STEEL SLAG

In South Carolina, chrome slag has been used successfully for many years in asphalt concrete on low volume routes where a lack of quality crushed stone aggregates make the use of chrome slag economically feasible. South Carolina has two sources of slag, one for steel slag in Georgetown and one for chrome slag in Charleston. In April 1994, the SCDOT contracted with the National Center for Asphalt Technology (NCAT) at Auburn University to investigate the feasibility of using both chrome and steel slag in Hot Mix Asphalt (HMA) for high volume roads. Through laboratory testing, NCAT compared asphalt mixes with the slag sources to mixes using crushed stone. NCAT concluded in the report that both chrome and steel slag aggregates can provide satisfactory HMA mixtures if the expansive nature of steel slag is adequately treated and if the stripping potential of the mixture is evaluated and addressed. The final report for the study titled, “Study to Improve Asphalt Mixes (Volume 2 – A Study of Crushed Slag Aggregate in Hot Mix Asphalt)” was included in Volume 6, November 1996. Chrome and steel slag has been approved for use as both fine and coarse aggregates in certain types of asphalt roadway courses. Crushed chrome and steel slag must meet the Department’s quality and gradation requirements when used as an aggregate.

RECYCLED ASPHALT PAVEMENT (RAP)

Recycled asphalt pavement (RAP) is a viable alternative for virgin materials used in asphalt mixtures. The use of recycled asphalt pavement is approved, through a supplemental specification, in uniform surface mixtures on certain low and medium volume roads, in binder courses, and in asphalt aggregate base courses. The RAP must be tested and approved by the Department before being used. The mix design for the asphalt course with RAP is then modified to account for the amount and quality of the materials found in the RAP. The amount of RAP allowable in each of these applications varies, however the maximum allowable is 30 percent of the total mixture when used in an asphalt base course.

GLASS

Another waste material to be approved for use by the Department is recycled glass aggregates in embankments, aggregate underdrains, and asphalt concrete. The Department has written specifications for the use of recycled glass in these applications. A supplemental specification for use in embankments and underdrains was approved in April 1998. The specification allows glass to be mixed with fill material up to 25 percent by weight. The specification also allows recycled glass aggregate as a replacement for stone in underdrain. The asphalt specification limits the use of glass to 15 percent by weight of total aggregate in Asphalt Aggregate Base Types 1 and 2 and Binder Types 1 and 2.

RECENTLY COMPLETED PROJECT

SPR 586

SPR Research Project 586, “Field Evaluation of Use of Waste Shingles in Asphalt Mixtures”, was completed in March 2001. Dr. Serji Amirkhanian of Clemson University, Principal Investigator for the project, developed an asphalt mix design utilizing 8% waste shingles by weight of aggregate in a Type 1C Surface Course. A one (1) mile section of SC 135, Dacusville Highway, in Pickens County was paved with the mix. The shingles used on the project were obtained from the Pickens County landfill.

Production of the mix at the asphalt plant and placement on the roadway were monitored. Relatively few problems were encountered though a small amount of oversize pieces of shingles were noted protruding from the mix during placement. These were removed by hand and the areas patched with mix out of the spreader’s hopper. Several tests were conducted on cores taken from the finished pavement and all properties tested were within specifications. A copy of the final report is included as Appendix A.

Based on the findings of the study, the SCDOT now permits shingles in Asphalt Aggregate Base Types 1 and 2, Binder Types 1 and 2, and Surface Types 1 and 2. A copy of the Supplemental Specifications, “Utilization of Shingles in Asphalt Mixtures”, is included as Appendix B.

CONTINUING INVESTIGATION

SPR 617

As indicated last year in Volume 10 of this report, a work plan was being developed to investigate the use of a rubber-polyester fiber blend in hot mix asphalt. Clemson University is conducting the study, SPR 617, “Laboratory Mix Design and Field Evaluation of Modified Asphalt Binders.” The overall objective of the project is to investigate the use of modified asphalt binders in flexible pavements. Specifically, plans are to design an asphalt mixture utilizing crumb rubber and polymer fibers from Martin Color-Fi, located in Edgefield, South Carolina, and then place a test section to evaluate the performance of the mix.

Initially, plans were to place test sections on a project to be let on I-20 in Aiken County. However, the project was postponed and another location for a test site is currently being sought. Laboratory testing is being conducted. It is anticipated that a test section utilizing polymer modified asphalt will be placed in the very near future.

NEW INITIATIVE

USE OF WASTE MATERIALS IN CONSTRUCTION OF A REST AREA

As indicated in Volume 10, December 2000, Research Project SPR 586, “A Laboratory and Field Evaluation of Use of Waste Materials in Construction of a Rest Area,” was contracted with Dr. Serji Amirkhanian of Clemson University in 1998. However, due to problems with obtaining the necessary environmental permits, the letting of the rest area project was delayed. Another project was located to allow the research to proceed and that work is described in this report under the heading “Recently Completed Project.”

The contract for construction of the rest areas on I-95 in Colleton County was recently let. The facility adjacent to the southbound lanes contains landscaping products made from waste tires. The products include loose mulch around the restroom building and waste tire mats used as tree rings at selected locations as well as walkways to picnic shelters. The project also includes recycled concrete base and permits the use of shingles in asphalt mixes. The performance of these waste materials will be monitored in-house.

REMARKS

The South Carolina Department of Transportation is continuously trying to find safe, economically feasible, and environmentally sound applications for waste and recycled materials in the highway industry without compromising the engineering integrity of the State's roadways. In addition to the Department's research initiatives, the New Products Committee is putting special emphasis on products composed of recycled materials.

APPENDIX A

“Field Evaluation of Use of Waste Shingles in Asphalt Mixtures”

APPENDIX B

Supplemental Specifications for Utilization of Shingles in Asphalt Mixtures