

# ARTS Quarterly

## Three Demonstration Projects Successfully Completed

Inside this issue:	
ARTS Research Facility Opens	2
Demonstration Project Summary	3
Infrared Technology Used in Asphalt Industry	4
Fall Seminar Registration	5
Upcoming Projects	7
Welcome to Students and Staff	7
Asphalt Terminology	7
Sincere Thanks	8

One of the ongoing goals of the Asphalt Rubber Technology Service (ARTS) is to design and construct several demonstration projects each year utilizing recycled tire rubber. This May, ARTS completed three of these projects around the upstate of South Carolina.

One of the projects involved both resurfacing and new construction of roads using rubber-modified hot mix asphalt (HMA) at the South Carolina Botanical Gardens. The second project was the first stress absorbing membrane interlayer (SAMI) constructed in South Carolina by ARTS. It involved placing a surface course of rubberized HMA over the existing rubberized pavement on the access road for Clemson University’s Outdoor Laboratory. The existing pavement had been placed several years ago using a dry blending process, while the new surface course utilized wet blending techniques. The third project included paving both parking lots and access roads for the newly constructed ARTS research facility. This project included both intermediate and surface courses made of rubber-modified HMA.

Additionally, waste tire chips were utilized in the septic tank drain field and as rubber mulch for flowerbeds at the ARTS facility.

### According to Sources:

- It is estimated that by the time you reach 50, you will have walked 75,000 miles
- In 2010, we will encounter the end of technological advancements
- In 2030, PC’s will be 1,000,000 times more powerful than today
- By 2030, PC’s will reproduce themselves

All three of the projects used rubber-modified HMA mixes designed by ARTS. These mixes, which were specified as 9.5 mm Superpave mixes, used PG 64-22 binder modified with 10% ground tire rubber



Paving at the SC Botanical Garden.

*(Continued on page 3)*

## ARTS Research Facility Opening

After several months of construction, the brand new ARTS Research Facility officially opened its doors on July 1, 2002. The 6500 square foot building is located in the civil engineering research park off the campus of Clemson University and houses office space for the ARTS staff along with two training rooms, a conference room, and four research laboratories.

The labs are fully equipped and are currently being utilized to perform various research projects with rubberized asphalt. These

projects address issues including the effect of particle size, percentage of rubber, particle shape, and reaction time on rubber modified asphalt. Additional research projects in the near future will examine other properties of rubberized asphalt, such as resistance to rutting, cracking, and aging.

The training rooms at the new building are being used for technology transfer to educate people about rubberized asphalt. In fact, the ARTS staff already hosted both the Recycled Materials Development Advisory Council (RMDAC) and the Solid Waste Advisory Committee (SWAC) from the South Carolina Department of Health and Environmental Control (SCDHEC) for their quarterly

meetings on July 18, 2002. The attending members of RMDAC and SWAC utilized the training rooms for their meetings before hearing a presentation from Dr. Serji Amirkhanian about the mission and progress of the ARTS program. Before departing for the day, both groups were also treated to a catered lunch and a tour of the new lab facilities.

Although the new facility is now up and running, its completion would not have been possible without the hard work and leadership of Dr.

Serji Amirkhanian and the many additional contributions of both time and resources from various other parties. ARTS would like to thank all those who helped bring this vision to life, including Dr. Amirkhanian, W. Frank Eskridge, Sr., P.E., SCDHEC, City of Clemson, Clemson University, Square D, Carrier Corporation, South Carolina Steel, SMI, Inc., Thrift Brothers Construction, and Ashmore Brothers Paving.



These projects address issues including the effect of particle size, percentage of rubber, particle shape, and reaction time on rubber modified asphalt

### ARTS Staff:

Serji Amirkhanian, Ph.D., Director

Frank Eskridge, P.E., Assistant Director

Mary Corley, Program Administrator

Wendy Franzese, Program Coordinator

ARTS Research Facility, 2002 Hugo Drive, Clemson University, Clemson, SC 29634

PH: 864.656.6799

FAX: 864.656.6197

E-mail: arts@ces.clemson.edu

Website: www.ces.clemson.edu/arts

**ARTS Quarterly** is published four times each year by the Asphalt Rubber Technology Service at Clemson University. ARTS is funded through a grant from SC's Department of Health and Environmental Control and the City of Clemson. Any opinions, findings, conclusions or recommendations presented in **ARTS Quarterly** are those of the authors and do not necessarily reflect the views of Clemson University, DHEC or the City of Clemson.

## Demonstration Projects Considered Successful

*(Continued from page 1)*

(#40 mesh). The design compaction level of 75 gyrations for each of the three projects was based on the expected traffic loading.

With a few exceptions, plant production of these mixes proceeded as with conventional asphalt mixes. All three projects utilized terminally blended asphalt rubber. The asphalt binder supplier simply blended the asphalt binder and tire rubber at the terminal and shipped it to the HMA contractor on heated trucks. At the asphalt plant, this pre-blended liquid was stored in a heated, agitated tanker until it was needed. Although it was a little more expensive than the on-site method used in



SC Botanical Garden resurfacing provided stunning scenery for the paving crew.

some of last year's projects, this terminal blending method worked well and caused little to no disruption of the HMA contractor's normal procedures.



The Outdoor Laboratory access road on Clemson's campus is the first stress absorbing membrane interlayer (SAMI) constructed by ARTS.

The rubber-modified HMA for all three projects was mixed at approximately 330° F to 340° F, stored in silos, and loaded into dump trucks for delivery to the project. Normal production rates allowed the plant to produce as much as 1,000 tons per day. As seen in last year's projects, calibration of the plant's binder pump was necessary to accurately meter the highly viscous asphalt rubber.

After production, the HMA mix was hauled to the project site in dump trucks. The mix was then placed at a thickness of two inches using conventional paving methods and equipment.

Compaction on each project was generally attained through the use of three steel wheel rollers, both vibratory and static. Pneumatic tire rollers were not utilized due to the tendency of the asphalt to adhere to the tires. In general, the compaction requirements were met for all three projects.

One interesting characteristic of the rubber-modified HMA was that it appeared to cool at a slower rate than traditional HMA mixes. This characteristic, which could be attributed to the insulating effects of the ground tire rubber, was observed to help in extending the allowable time for compaction. Another characteristic visible in this project was a tender zone between the temperatures of 250°F and 200°F. This tender zone is a commonly experienced phenomenon with Superpave asphalt mixes.

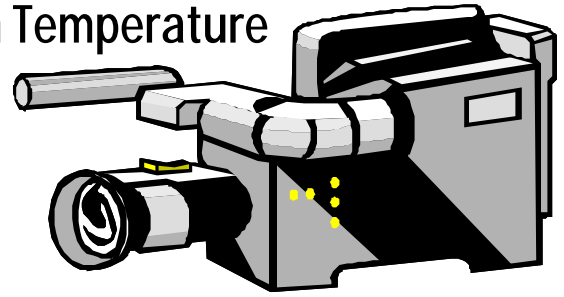
For more information on these projects and those still pending for this fall, visit the ARTS website at [www.ces.clemson.edu/arts](http://www.ces.clemson.edu/arts).



ARTS Research Facility parking lot. Intermediate and surface courses are rubber-modified hot mix asphalt.

## Infrared Technology Used in Temperature Segregation Study

A new research project, supported by SC DOT and conducted by Dr. Serji Amirkhanian, has begun to examine the effects of temperature segregation on asphalt. Many paving projects with various types of asphalt will be involved in this study, including conventional, polymer-modified, and rubber-modified HMA mixes. The project utilizes cutting-edge technology in the form of an infrared camera that measures temperature to create thermal images. These thermal images show temperature variations within a chosen range with different colors, and the thermal data gathered can be downloaded to a computer for further examination.



trucks, which allow the outer “crust” to cool much more than the mix beneath. Another cause of temperature segregation is the practice of dumping the wings of the paver into the auger at the end of each load. The mix in the wings cools drastically while the rest of the mix is laid. Although dumping the wings before receiving a new load can also cause other problems like end load segregation, it is a major cause of temperature segregation, leaving very definite cold spots in the mat.



Simply speaking, temperature segregation in asphalt is the existence of “hot spots” or “cold spots” in the pavement surface.

Temperature segregation is not a new problem in the asphalt industry. However, it has not been studied in great detail in the past. Temperature segregation in asphalt is defined as large temperature variations existing in close proximity to one another in the asphalt mat. Simply speaking, it is the existence of “hot spots” or “cold spots” in the pavement surface.

Temperature segregation has several potential causes. It can be caused by transporting hot mix asphalt (HMA) to the jobsite in uncovered

Temperature segregation can result in large variations in compaction over a very small area of pavement. These differences in compaction can in turn cause variations in mix properties like air voids, voids in the mineral aggregate (VMA), and voids filled with asphalt (VFA). Because little is known about the long-term effects of these variations, this project will examine this aspect as well as the effectiveness of various preventative methods like utilizing covered transport trucks and shuttle buggies.

## Anderson County, Phase IV

ARTS has completed the final phase of the 3-project proposal received last year. Phase IV of Michelin Boulevard was completed in August and consisted of 1.5 miles of 4-lane roads near the Anderson County Airport off SC 24. Approximately 4,700 tons of rubber-modified HMA was paved on the surface course. This was the first opportunity to use our new portable blending unit. The blender (pictured right) was hooked up to the Ashmore Brothers Anderson Asphalt Plant where training took place for both the ARTS staff and the contractor. The unit will be available for lease for use on other ARTS projects. For information on the unit, contact Mary Corley, 864-656-6427 or mcorley@clemson.edu.





# ARTS 2002 Project Review Seminar

ARTS Director, Serji Amirkhanian and Program Administrator, Mary Corley, will review projects completed this year.

These include:

- SC Botanical Garden.
- Clemson's Outdoor Laboratory
- ARTS Facility
- Greenville County
- Anderson County Phase 4
- Dillon County – Pee Dee Regional COG
- Richland County
- Research Projects

**Tuesday, November 19 - Florence**

**Wednesday, November 20 - Charleston**

**Thursday, November 21 - Columbia**

**Friday, November 22 - Clemson**



This workshop is best suited for local government personnel: recycling coordinators, SCDOT personnel, city and county engineers, as well as contractors and other members of the engineering design community who are interested in learning about ways to reuse waste tires.

Registration for all seminars begins at 8:00 a.m.

Seminar length: 8:30 a.m. to 3:30 p.m.

See [www.ces.clemson.edu/arts](http://www.ces.clemson.edu/arts) for directions to the locations.

**Florence  
Holiday Inn**  
1819 West Lucas St  
Located  
I-95  
(843) 665-4555

**Charleston  
Radisson Inn  
Charleston Airport**  
5991 Rivers Avenue  
Located  
Aviation Ave and I-26  
(843) 744-2501

**Columbia  
Ramada Plaza Hotel**  
8105 Two Notch Rd  
Located  
I-77 and US 1  
(803) 736-5600

**Clemson  
ARTS Facility**  
2002 Hugo Drive  
Located  
Rt. 93  
(864) 656-6799

**CANCELLATION POLICY** –The registration fee is fully refundable 10 weekdays prior to the workshop. If you are unable to attend, you are welcome to send someone in your place. Please notify the ARTS office of the substitution prior to the workshop if at all possible.

**SPECIAL NEEDS** –ARTS is dedicated to making program activities accessible to all persons. If you are a vegetarian or have another special dietary need or a physical limitation that requires certain access needs, please note these on the registration form, or call ARTS before the workshop.

# 2002 ARTS Project Review Registration

Sign up for:	Number of Persons	Price per Person
<input type="checkbox"/> Florence—November 19, 2002	_____	\$45.00
<input type="checkbox"/> Charleston—November 20, 2002	_____	\$45.00
<input type="checkbox"/> Columbia—November 21, 2002	_____	\$45.00
<input type="checkbox"/> Clemson—November 22, 2002	_____	\$45.00
<b>Total:</b>		_____

\$45.00 fee includes breaks, lunch and handout materials.

Name \_\_\_\_\_

Organization \_\_\_\_\_

Title \_\_\_\_\_

Mailing Address \_\_\_\_\_

City, State, Zip \_\_\_\_\_

Email Address \_\_\_\_\_

Phone \_\_\_\_\_ Fax \_\_\_\_\_

## Method of Payment


- Check- Enclosed: payable to **Clemson University**   
  Bill Me   
  Invoice Required  
 Visa   
  MasterCard


Credit Card # \_\_\_\_\_ Exp. date \_\_\_\_\_


Signature \_\_\_\_\_


**Fax** completed form to 864-656-6197.  
**Mail to:**  
 ARTS Research Facility  
 2002 Hugo Drive  
 Clemson University  
 Clemson, SC 29634

## Upcoming 2002 Projects

 **Greenville County**  
 4 miles of various county roads  
 6,200 tons  
 Potential use of 0.5 miles of SAMI

 **Town of Kingtree**  
 0.5 miles of rubberized HMA  
 surface course along a recreation  
 path in downtown Kingtree  
 250 tons

 **Dillon County**  
 1.5 miles of various county roads  
 1,900 tons

 **Richland County**  
 4 miles of various county roads  
 6,000 tons

*The above figures are approximate paving distances and tonnage. The actual amounts may vary at time of paving.*

### Asphalt Terminology

Aggregate - any hard, mineral material such as gravel and crushed stone.

Asphalt, aka—Asphalt Binder, aka—Asphalt Cement— a refined brown to black cementitious material that is used widely in the paving industry. It is a semi-solid at room temperature and a liquid at hotter temperatures.

Hot Mix Asphalt—(HMA) is a combination of aggregates and asphalt binder used as a paving material

Rubberized Asphalt - a broad term to describe Hot Mix Asphalt that contains recycled rubber

## ARTS Welcomes New Lab Manager and Research Assistants

Some new faces will be seen in the ARTS laboratory.

The lab will be managed by Brad Putman, a doctoral student in the Civil Engineering Department. Brad will be heading up the ARTS research projects on particle size, reaction time, rubber content and



Brad Putman

rubber-modified binder grading. Brad has already completed the Michelin Tire Company project which involved research designed to determine potential opportunities and economic feasibility of using post-consumer scrap tires and derivatives in new tires.

These graduate and undergraduate students pictured below will be involved in the research conducted by ARTS.



Eric Hartman



Jay Thompson



Jennifer Aune



Billy Evans



Matt Hayes

Asphalt Rubber Technology  
Service

ARTS Research Facility  
2002 Hugo Drive  
Clemson University  
Clemson, SC 29634

Phone: 864-656-6799  
Fax: 864-656-6197  
Email: arts@ces.clemson.edu

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## ARTS Extends Sincere Gratitude

*ARTS would like to thank the following individuals and companies for their contributions to the completion of the new  
ARTS Research Facility:*

Dr. Serji N. Amirkhanian  
W. Frank Eskridge, Sr., P.E.  
SCDHEC

City of Clemson  
Clemson University

Square D (Electrical Apparatus)

Carrier Corporation (Air Conditioning Equipment)

South Carolina Steel, SMI, Inc. (Structural Steel and Steel Roof Deck)

Thrift Brothers Construction (Site Work and Grading)

Ashmore Brothers Paving (Asphalt Paving)

*Thank you for all the time and hard work that  
made this vision become a reality.*