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The Recycled Materials Resource Center: a new partnership promoting the wise use of recycled materials in the highway environment

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The Recycled Materials Resource Center (RMRC) was formed in late 1998 as a partnership with the Federal Highway Administration (FHWA) to help reduce barriers to the use of recycled materials in the highway environment. The Center has large research and outreach components to its mission. Ongoing research activities are introduced and outreach activities of interest to a European audience are summarized. The Center will be working diligently over the next five years to develop specifications and evaluation methods, transfer appropriate technology, and make information available to the highway community.

1. INTRODUCTION

The Recycled Materials Resource Center (RMRC) is a new national center created to promote the appropriate use of recycled materials in the highway environment. Recycled materials are generally defined as recycled bituminous and concrete pavement materials as well as secondary, byproduct, and waste materials. Situated within the Environmental Research Group at the University of New Hampshire (UNH); the RMRC will soon be moving to a new Environmental Technology Building in the Entrepreneurial Campus at UNH. The Center was formally established on September 4, 1998 in close partnership with the Federal Highway Administration (FHWA) and in coordination with the FHWA Pavement Management Coordination Group. The Center was created through authorization in section 5117(b)(8) of the Transportation Equity Act for the 21st Century (TEA-21). The RMRC is initially funded for a period of six years.

The Center has a unique role in the growing field of recycled materials use in highway construction --- to serve as a catalyst to reduce barriers to the appropriate use of recycled materials in the highway environment. The Center is a culmination of a number of diverse,
but integrated efforts by FHWA, other federal and state agencies, and academia to provide a cohesive approach to the complex engineering and environmental issues surrounding the use of recycled materials. The Center not only will serve as a principal evaluator of information for the FHWA in this area, but also will focus on outreach activities and provide a main point of contact for information.

The Center is staffed with a Director, Associate Director, Outreach Program Project Director, Information Technologist, Program Assistant, research faculty, and graduate and undergraduate students. An Advisory Board comprising state and national experts with interests in recycling issues has been established, which provides guidance and connections to many highway constituencies. The Center has prepared a strategic plan, annual work plans, a practices and procedures manual, self-evaluation plans, performance measure plans, and cost sharing and financial plans to assist in operations.

As stipulated in TEA-21 and in the cooperative agreement between FHWA and UNH, the mission of the Center involves:

(i) systematically testing, evaluating, and developing appropriate guidelines,(ii) making information available to its clients,(iii) encouraging the increased use of recycled materials by analyzing potential long-term considerations that affect performance,(iv) working cooperatively with Federal and State officials to reduce the institutional barriers and ensure sustained environmental and physical integrity.

In order to fulfill this mission, the Center has identified the following seven principal areas of focus:

(i) testing and evaluation guidelines and specifications,(ii) material specific research and development,(iii) economics and institutional issues of secondary materials,(iv) new materials and innovative technologies,(v) field trials of secondary materials,(vi) technical services,(vii) technology transfer and training.

The RMRC is concentrating on both research and outreach activities to help accomplish its mission, with State Departments of Transportation (State DOTs) and State Environmental Regulatory Agencies (State EPAs) being the Center's principal clients. Ongoing research and outreach activities at the RMRC are discussed in the following sections.

2. RESEARCH

Approximately 30 research projects will be conducted by the Center over the six years of operation. The majority of these will be awarded through a national request for proposal and peer review process. From the eleven research projects identified for the first two years, four will be conducted internally by Center personnel, while the remaining eight will be undertaken externally by sub-contractors. Scheduled to commence between October and
December 1999, a summary of a number of these research projects is given in the following sections. Further updates about their progress will appear on the Center=s web site (details given below).

Project 1: Mitigating Alkali Silicate Reaction in Recycled Concrete. This project, conducted by Dr. David Gress of UNH, will take place during years 1-3. Its focus is on the production of concrete containing recycled concrete aggregate (RCA), where the recycled concrete is suffering from alkali silica reaction (ASR). The project succeeds previous work undertaken at UNH to develop test methods capable of identifying the occurrence of ASR. The current project will look at ASR mitigation strategies to control and/or eliminate ASR in concrete containing RCA. A new test procedure for evaluating the use of RCA in concrete with and without mitigation will be proposed to the Association of State Highway and Transportation Officials (AASHTO) for their consideration as a recognized test method. Guidelines will also be developed to allow DOTs to evaluate a given RCA for recycling in concrete. Numerous State DOTs and industrial partners are involved in this project.

Project 3: Environmental Weathering of Granular Waste Materials: Impact on Environmental Performance. Dr. Kevin Gardner of UNH will conduct this project during years 1-3. Work will involve the environmental evaluation of a variety of granular wastes from high temperature industrial processes and will allow an understanding of the geochemical aging and weathering characteristics of these materials. Chemical and physical changes will be assessed using a variety of techniques to enable the prediction of the long-term environmental performance of these materials when used in the highway environment. The project will develop techniques to accelerate the weathering of the material to produce a more physically and chemically stable product. State EPAs and industrial partners are involved in this project.

Project 11: Leaching from Granular Materials Used in Highway Construction during Intermittent Wetting. Dr. David Kosson of Vanderbilt University will conduct this research during years 1-3. The goal of this project is to develop testing and interpretation protocols to estimate constituent leaching from granular waste materials that are utilized as aggregate in unbound highway construction applications (embankments, sound barriers, fill, base course). The resulting test methods and interpretation protocols developed, including appropriate mathematical models, will then be used to evaluate environmental impacts of specific proposed secondary material utilization applications. The primary focus of this work will be on leaching conditions that occur as a consequence of intermittent infiltration (wetting and drying, CO₂ uptake, O₂ uptake) into the granular material. Motivation for end-users to adopt the protocols will be based on the need to evaluate potential environmental impacts for both liability and regulatory assessment. State DOT, State EPAs and industrial partners are involved in this project.

Project 13: Development and Preparation of Specifications for Recycled Materials in Transportation Applications. Dr. Warren Chesner of Chesner Engineering, Inc. will conduct this project during year one. It will address the need for appropriate specifications for using recycled material in the highway construction environment. Fourteen State DOTs from around the nation have agreed to participate to develop common specifications for a number of types of secondary materials within these States. The final output will be the submittal of draft specifications to AASHTO for consideration as formal specifications.
Project 15: Determination of $N_{\text{design}}$ for CIR Mixture Design Using the SGC. Dr. Stephen Cross of the University of Kansas will conduct this research project during year one. Work will be carried out to determine the number of compaction revolutions ($N_{\text{design}}$) required in the SHRP gyratory compactor (SGC) in order to duplicate field unit weights of cold in-place recycled (CIR) asphalt mixtures. This work will result in the development of compaction protocol for CIR materials and should remove the final barrier to the further adaptation of CIR technology. State DOTs and industrial partners are involved.

Project 16: Monitoring of a Township Road Constructed with Recycled Tires. Dr. Andrew Heydinger of the University of Toledo will conduct this project during years 1 and 2. It will monitor a township road constructed with recycled tires for climatic effects and pavement deformations. The intention of this work is to determine if there are any early indications of adverse or beneficial effects from using scrap tires in basecourse. Various aspects of the project will include pavement design, pavement construction, and pavement performance. Preliminary guidelines and specifications for constructing asphalt concrete pavements with tire shreds will be drafted and cost-benefits strategies will be evaluated. Ohio DOT and a solid waste district are involved.

Project 17: Development of a Rational and Practical Mix Design System for Full Depth Reclamation (FDR). Dr. Rajib B. Mallick of Worcester Polytechnic Institute in collaboration with members of the National Center for Asphalt Technology (NCAT) at Auburn University will conduct this project during years 1 and 2. It aims to develop a rational and practical mix design system for FDR. Specifically, the objectives are to develop methods for determining curing periods, number of gyrations required in the SGC to produce in-place densities, and to compare the effectiveness of four different types of additives used for FDR at a specific location in the state of Maine. The resulting mix design system should be able to produce mixes with consistently good performance, thereby enhancing confidence in the use of FDR and encouraging the increased use of recycled materials. Maine DOT is also a principal investigator with the project.

Project 18: Fatigue Durability of Stabilized Recycled Aggregate Base Course Containing Fly Ash and Waste-Plastic Strip Reinforcement. Dr. Khaled Sobhan of New Mexico State University is conducting this research project during year one. The project will evaluate the technical performance of a new composite base course made from crushed RCA, Portland cement, high volumes of coal fly ash, and strips of shredded reclaimed plastics. The primary motivation of this project will be to identify an innovative reuse for recyclable materials in highway pavements by conducting systematic characterization studies aimed at providing valuable insights into the long-term performance and durability issues of such composites. State DOTs and industrial partners are involved in this project.

Project 19: Light Weight Synthetic Aggregate From Fly Ash and Waste Plastics. Mohsen Kashi of GEI Consultants, Winchester, Massachusetts will conduct this project, in collaboration with colleagues from the University of Massachusetts at Lowell and Tufts University during year 1. It will develop a new product from two materials currently sent to the disposal facilities; namely fly ash and waste plastic. The final product, a light weight synthetic aggregate, will be a granular material to be used in such applications as light weight fill, precast concrete elements, concrete structures and insulation for utility pipelines. This
project will consider the use of various fly ash to plastic ratios, plastics of different thermal properties and various production methods. The project includes State DOTs and industrial partners.

3. OUTREACH

There are number of outreach activities that have taken place during the first year of the Center or are planned for the near future. Those activities of pertinence to an overseas audience are highlighted in the following sections.

RMRC Web Site: One of the principal information and outreach mechanisms for the Center is its web site http://www.rmrc.unh.edu, which was launched on February 15, 1999. This key component of the Center’s mission is intended to keep the highway community up to date about (i) developments in the field of recycled materials use, (ii) resources, and (iii) Center activities. It features links to international, federal, state, association, corporate, and university web sites as well as links to state specification web pages. The Center’s research projects are featured and will be updated as progress is made. The site also contains a link to the FHWA’s AAUser Guidelines for Waste and By-Product Materials in Highway Construction. In order to make information available to those who would benefit, the site also features a registration form to become a client of the Center and a form to request information.

FHWA International Scanning Program: In September, 1999, the RMRC participated with an FHWA delegation that visited Sweden, Denmark, Germany, the Netherlands and France. The purpose was to review and document innovative policies, programs and techniques in Europe that would help to reduce barriers to recycled material use in the U.S. The delegation met with over 100 representatives from Transportation and Environmental Ministries, research organizations, contractors, and material producers involved with recycled materials in the five countries visited. The delegation was assembled under the FHWA’s International Technology Scanning Program and was sponsored by FHWA, AASHTO (through the National Cooperative Highway Research Program (NCHRP)), and the RMRC. A summary report has been issued to FHWA, a final report is being drafted, and a broad implementation program for the U.S. delegation on significant findings and recommendations is underway. The final report as well as a Power Point presentation about the trip will be made available on the RMRC web page.

Virtual Demonstration Sites: A virtual demonstration site has been established on the RMRC web site where viewers can visit recycled materials demonstration projects and look at photographs, video clips, report summaries, important summary data of laboratory and field testing, together with lists of contacts, sponsors and related publications. This feature will grow over time so that many recycled materials and highway applications will be featured. It should help State DOT and State EPA personnel to visit demonstration sites and kick the tires right from their offices. The Center will be soliciting for additional demonstration sites to add to the database.

Quarterly Electronic Newsletter: The RMRC will develop a concise and informative
electronic newsletter to be distributed to all clients who have registered with the Center and to all hyper links associated with the Center’s web page. The newsletter will update research, outreach and training activities coordinated by the Center. By registering with the Center’s web page, individuals will automatically receive the quarterly newsletter.

National/International Conference: The Center will be co-sponsoring a national/international conference in 2001. The likely venue is in the United States. This conference will focus on specifications, accelerated testing, new applications, recycled materials beneficiation, performance modeling, prediction and evaluation, and specific recycled materials and their applications.

4. SUMMARY

Over the next few years, the RMRC expects to make significant advances in the area of recycled materials use in the highway environment. The Center has a broad constituency and will be reaching out to its clients via specifications development, R&D, technology transfer, outreach (web site, newsletters, conferences, training), and information transfer.