FY 2010 RESEARCH PROBLEM STATEMENT

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TITLE

GHE-10-04 Life Cycle Analysis of Impacts of Recycled Materials on Costs, Energy, and Greenhouse Gas Emission

PROBLEM (Description of need)

The transportation infrastructure can have a significant impact on the sustainability of our society by incorporating recycled materials into infrastructure construction. The use of recycled materials will reduce the amount of virgin materials to be quarried, processed, and transported and protect the environment and scarce natural resources. In addition, energy consumption and greenhouse gas emission could be potentially reduced as a result of the use of recycled materials. However, there is a lack of quantification of impacts or potential benefits of using the recycled materials for infrastructure construction on engineering performance and costs, energy, and greenhouse gas emission, when compared to virgin materials. The proposed research aims to address the need to quantify the impact of the use of recycled materials on engineering performance and costs, energy and greenhouse gas emission. The recycled materials will include recycled asphalt and recycled concrete used in surface layer and base courses.

PROPOSED RESEARCH, DEVELOPMENT OR TECHNOLOGY TRANSFER ACTIVITY

The proposed study will focus on: (1) engineering performance assessment for life cycle costs analysis; (2) life cycle analysis of energy and greenhouse gas emission impacts; and (3) design guide for a deterministic design of green pavement. Each of these items is discussed below.

1. Engineering performance assessment for life cycle cost analysis

The performance of recycled materials needs to be evaluated from two aspects, the engineering properties, and the effects on the pavement performance as the basis for life cycle analysis. The engineering performance can be evaluated, based on history performance of pavements with recycled materials.

2. Life cycle analysis of energy and greenhouse gas emission impacts

Determine the impacts of the use of recycled materials on the life cycle energy and greenhouse gas emission, based on currently available analysis tools or a tool developed by the team, if needed.

3. ***Design guide for a deterministic approach to assist green pavement design***

Develop a deterministic approach to assist green pavement design by quantifying the impact/benefits on costs, energy, and climate, focusing on the use of recycled materials. A guide documenting the deterministic approach will be developed so that a pavement designer, as well as non-technical staff, would be able to know to what degree of the sustainability a pavement design is.

BENEFITS

In the Environmental Resources section of the 1999 Oregon Highway Plan, it is Oregon State policy as stated in Action 5A.12 to "Prevent hazardous substances encountered as a result of construction and maintenance activities from entering the human and natural environment." Goal 4 of the 2006 Oregon Transportation Plan on Sustainability says explicitly that Oregon's transportation system will strive to achieve objectives including to "Minimize raw material use and disposal during construction and maintenance". Under Goal 4, it is also the

policy of the State of Oregon to develop and maintain an environmentally responsible transportation system through a set of strategies which include the objective, "In the construction and maintenance of transportation infrastructure and facilities, reduce the consumption of non-renewable construction materials, promote their efficient use and reuse, and reduce other environmental impacts such as storm water impacts where appropriate." By developing effective tools to determine life-cycle cost effectiveness of methods to recycle and reuse pavement materials, the research proposed in this problem statement helps address the needs as outlined in Oregon's Highway Plan and Transportation Plan to keep otherwise hazardous substances (used asphalt and concrete) out of the waste stream and the environment and to reduce the consumption of non-renewable construction materials.

The benefits of this research are: (1) the impacts of recycled materials on costs, energy, and greenhouse gas emission will be quantified in a life cycle; and (2) a design guide for deterministic design of green pavement will be developed and this will facilitate the sustainable design and be instrumental to pavement designer and industry. The results of this research will also provide scientific basis for green highway design and rating which warrants quantified benefits of the use of recycled materials. The deterministic approach developed by this study can be easily implemented for pavement design with recycled materials and other green technologies.

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