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Project Title

Development of Sustainable Material in Asphalt-mix Pavement: Warm Mix Asphalt

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Project Summary

Technology Transfer Outreach Publication

New Technologies for Producing Asphalt Pavement Mixes

Problem

This project will study the relevance and applications of Economic Input-Output Life Cycle Assessment (EIO-LCA) and Life Cycle Costing methods in computing the environmental and economic impacts of Warm Mix Asphalt (WMA). Specifically, we will investigate the life cycle cost analysis using EIO-LCA in order to recommend the most beneficial pavement construction processes and designs in an environmentally challenged world.

Global environmental awareness has increased rapidly in recent years and extensive measures like air pollution reduction targets set by the EU under the Kyoto Protocol have encouraged efforts to reduce greenhouse gas emissions. Large quantities of greenhouse gas are emitted by the asphalt industry when it heats aggregate during the mixing process. The asphalt industry is concerned about energy savings as well as environmental benefits in the production of cold or warm asphalt. Warm mix asphalt (WMA), a new paving technology that originated in Europe, appears to allow a reduction in the temperature at which asphalt mixes are produced, and is a promising alternative to Hot Mix Asphalt (HMA). However, some information about WMA is missing, such as a complete life cycle cost analysis, and a better understanding of its environmental impact. Such information will help to ensure that WMA is produced economically and safely.

Research Objectives

Select the most sustainable pavement process and design from HMA and WMA based on EIO-LCA and LCCA.

Methodology

This research will be conducted using the following methodologies:

- Perform literature reviews to investigate the use of EIO-LCA in different sectors and study its applicability to material/acquisition, construction, maintenance phases.
- Create an inventory for material/ acquisition and construction processes.
- Create a life cycle inventory for use and maintenance phases.
- Evaluate the environmental impact using EIO-LCA based on the available information.
- Evaluate the economical impact using the Michigan Engineer's Resource Library (MERL).
- Using the Life Cycle Cost Analysis (LCCA) to estimate the net present value of the HMA and WMA.



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Future Work

Future work will focus on collecting material and equipment inventory data from actual highway construction project scenarios, and further calibrating the proposed decision-making framework to reflect expected and actual long term pavement performance metrics.

Research Findings

The anticipated research finding will include the following deliverables:
 Comparative analysis of life cycle performance of WMA and HMA
 Decision-making framework for choosing pavement technologies (HMA and WMA)
 Recommendations for both HMA and WMA processes to different stakeholders (such as University Transportation Center, government, engineers, and contractors)

Anticipated Implementation

A recommendation report will be submitted to stakeholders so they have a better understanding of the life cycle costs and the life cycle assessment of WMA and HMA. This will also help researchers and engineers to identify problems in the life cycle of WMA and HMA, thus improving the sustainability of pavement construction and maintenance.

Related Publications

- Muga, H., A. Mukherjee, and J. Mihelcic, "An Integrated Assessment of the Sustainability of Green and Conventional Roofs," submitted to Journal of Green Building, 2008. 3(2): p. 1-22.
- Mukherjee, A., H. Muga, and T. Van Dam, "Towards Building Sustainable Concrete Pavements." Proceedings of 1st. International Construction Speciality Conference. 2006. Calgary Canada: Canadian Society of Civil Engineering (CSCE).
- Shu Wei Goh, Zhanping You, Thomas J. Van Dam, "Laboratory Evaluation and Pavement Design for Warm Mix Asphalt," Submitted to Proceedings of the 2007 Mid-Continental Transportation Research Symposium, 2007
- Goh, S.W. and You, Z., "Resilient Modulus and Dynamic Modulus of Warm Mix Asphalt," Submitted to ASCE Proceedings, GeoCongress 2008: The Challenge of Sustainability in the Geoenvironment, Annual Congress of the Geo-Institute of ASCE, March 9-12, 2008, New Orleans, Louisiana, USA, in press, American Society of Civil Engineers
- You, Z. and Goh, S.W., "Laboratory Evaluation of Warm Mix Asphalt: A Preliminary Study," Submitted to International Journal of Pavement Research and Technology, 1(1): pp.34 - 40, 2008, ISSN 1996-6814

University Facts

Total Enrollment	6,550
Graduate Enrollment	916
Number of Faculty	417
Placement Rate	95%

Michigan Tech is located in Houghton, MI on the south shore of Lake Superior. This rural area is known for natural beauty, pleasant summers, abundant snowfall, and numerous all-season outdoor activities. In addition, the University maintains its own downhill and cross-country ski facilities and golf course. There are numerous cultural activities and opportunities on campus and in the community. Michigan Tech has also been rated as one of the safest college campuses in the United States, and the local community provides excellent resources conducive to an outstanding quality of life.

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