Innovative Materials and Design for Sustainable Transportation Infrastructure

Selected Papers from the International Symposium on Systematic Approaches to Environmental Sustainability in Transportation

August 2–5, 2015
Fairbanks, Alaska

ASCE

Edited by

Sheng Zhao, Ph.D.; Jenny Liu, Ph.D., P.E.; and Xiong Zhang, Ph.D., P.E.

CONSTRUCTION INSTITUTE

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Preface

The transportation industry and its agency partners are constantly looking for ways to improve infrastructure performance, increase construction efficiency, conserve resources, and advance environmental stewardship. Innovations in materials and design are continuously being developed regarding this effort. This Special Technical Publication (STP) entitled *Innovative Materials and Design for Sustainable Transportation Infrastructure* selects 37 technical papers that represent the recent innovations and advances in materials and design to meet the challenges of sustainable development. Among these 37 papers, 14 papers focus on context sensitive solutions in pavement materials such as asphalt, concrete, and other recycling and reusable transportation materials, 12 papers on geo-materials, soil stabilization and ground improvement techniques, and 11 papers on sustainable design in underground space, tunneling and railway engineering.

Two or more reviewers along with the editors evaluated each paper published in this ASCE STP. The authors of the accepted papers have addressed all the reviewers' comments to the satisfaction of the editors. All published papers are eligible for discussion in the *Journal of Materials in Civil Engineering*, and are eligible for ASCE awards.

The papers included in this publication were presented at the *International Symposium on Systematic Approaches to Environmental Sustainability in Transportation* held in Fairbanks, Alaska, USA from August 2 to 5, 2015. This conference was hosted by the Center for Environmentally Sustainable Transportation in Cold Climates (CESTiCC), Chinese Society of Civil Engineers, and Tongji University, China in collaboration with Environmental UTC Network, International Association of Chinese Infrastructure Professionals, the Infrastructure & Climate Network (ICNet), University of Alaska Fairbanks in USA, University of Kansas in USA, University of Tennessee in USA, and Wuhan Polytechnic University in China. The conference was co-sponsored by ASCE Construction Institute (CI), Transportation Research Board (TRB), and Frontiers of Structural and Civil Engineering in China. The Conference was chaired by Professor Jenny Liu and co-chaired by Professor Hehua Zhu.

We would like to acknowledge the assistance from Donna Dickert of ASCE, and Laura Ciampa and Paul Sgambati of ASCE CI that makes it possible for this high quality peer reviewed STP. The editors wish to thank the following individuals who reviewed one or more papers submitted for consideration of publication in this STP:

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Editors:
Sheng Zhao, Jenny Liu, and Xiong Zhang, University of Alaska Fairbanks, USA

Contents

Context Sensitive Solutions in Pavement Materials

Effect of Conductive Filler Size and Type on Thermal Properties of Asphalt Mixtures

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Abstract

This paper focuses on the improvement of thermal properties such as thermal conductivity, thermal diffusivity, and specific heat of asphalt mixtures using conductive fillers, and investigating the conduction performance by one-dimensional (1-D) simulation on pavements. Different asphalt mixtures used in this study was modified with milled carbon fiber, chopped carbon fiber, flake graphite powder and synthetic graphite powder individually. The conductivity properties of graphite and carbon fibers modified asphalt mixtures was measured and calculated to evaluate their conduction effects in order to obtain the appropriate kind and quantity of carbon fiber and graphite. The 1-D simulation was performed on a typical pavement design using finite difference method to comprehend the conduction performance taking place in pavement structure. Thermal testing and analysis results indicated that carbon fibers and graphite basically increase the thermal properties of asphalt mixtures. The simulation results presented the reliable heat conduction correlated with each conductive fillers.

INTRODUCTION

In winter, traffic accidents can easily happen because of the accumulated snow and freeze leading to difficulty of vehicles travel. Therefore, removing the snow and ice and making roads, bridge decks and airport runways snow ice-free in the winter become one of the most critical problems to be solved in Korea. The addition of conductive fillers or additives to improve the conductivity of asphalt concrete is feasible to melt and remove snow and ice on asphalt pavement surface (Sherif and Christopher 1999). This method is environmental friendly, safe, efficient, and sustainable to keep asphalt pavement free from snow (Tang et al. 2001).