Monday 3/13/2017

9:45–11:15 a.m.

Roadway Materials, Monitoring and Testing 1

Chairs: Burak Tanyu, George Mason University; Bora Cetin, Iowa State University

The Influence of Curing Regime on Geotechnical Properties of Ladle Furnace Slag as Used in Pavement Applications

Farshid Maghool, Arul Arulrajah, and Hamed Haghighi, Swinburne University of Technology; Suksun Horpibulsuk, Suranaree University of Technology; Yan-Jun Du, Southeast University

Ladle Furnace Slag (LFS) is a solid waste by-product from the secondary stage of steel making process in ladle refining furnace. An extensive suite of engineering and geotechnical tests was undertaken on LFS aggregates to evaluate its potential to use as a road construction material. The chemical composition and microstructure of LFS samples were evaluated using X-ray Fluorescence analysis (XRF) and Scanning Electron Microscopy (SEM). The effect of different curing regimes on the strength of unbound LFS was also investigated. It was found that both duration and temperature of the curing had a vital role in the strength development of LFS samples, which could be attributed to the relatively high lime content of the LFS material. The suitable engineering properties of LFS materials could make it a reliable substitute for quarry produced pavement materials, which may result in diverting large amount of LFS from landfills.

Leaching Behavior of Concrete Containing Municipal Solid Waste Incineration Bottom Ash

Jinwoo An and Boo Hyun Nam, University of Central Florida; Jongwan Eun, University of Wisconsin-Madison

The object of this study was to investigate the impacts of municipal solid waste incineration (MSWI) bottom ash (BA) regarding cement hydration and leaching when used cement-based materials. As a mean of cement hydration assessment, Energy Dispersive X-ray (EDS) and X-ray diffraction (XRD) analysis were conducted on MSWI BA 'as is', hydrated BA, and BA-combined cement paste. The results show that MSWI BA led to small amount of cement hydration. In addition, the leaching characteristics of major alkaline and trace elements from concrete containing varied amounts (10%-50%) of BA were investigated by Synthetic Precipitation Leaching Procedure (SPLP) batch testing. The results reveal that the release of highly alkaline elements increases with increasing the BA content. However, the release of selected alkaline and trace heavy metals is reduced when mixed with PCC properly due to the binding effect in cement mixtures and consuming from cement hydration. Results show that crushed PCC mixed with the MSWI BA demonstrated significant reduction of Al and Si. Moreover, Mg ranged from 475.9 μg/L for the 100% BA to 181.3 μg/L for the PCC with 50% BA and Cu ranged from 45.5 μg/L to 15.1 μg/L.

Performance of Overlay Tester in Cyclic Loading Mode

Victor M. Garcia, Jose L. Garibay, Imad Abdallah, and Soheil Nazarian, University of Texas at El Paso

The premature cracking of asphalt concrete (AC) layers in flexible pavements is one of the major concerns of the pavement community. The Overlay Tester (OT) is considered by several highway agencies to evaluate the cracking resistance of AC mixes. The variability of OT results is expressed as a major concern in reliably characterizing the cracking potential of AC mixes. The main objective of this paper is to evaluate the variability of the number of cycles to failure (currently the main output

parameter of OT test) and propose alternative parameters that can be measured for characterizing the cracking potential of AC mixes. Three AC mixes were used to evaluate the uncertainties associated with the performance of the OT tests. The OT can be employed with more certainty if cracking parameters measured from the first hysteresis loop and load reduction curves are implemented on a data interpretation method.

Effect of Various Warm-Mix Technologies on Stiffness and Rutting Characteristics of Asphalt Concrete
A.S.M. Rahman and Rafiqul Tarefder, University of New Mexico; Matias M. Mendez, Roca Engineering Inc.
Viscoelastic material functions of warm-mix asphalt are not well defined yet for reasons like relatively newer technology in United States and also varies with different technologies. The rutting performances of warm-mix asphalt are also relatively new. This study evaluates the effects of different warm-mix agents on the viscoelastic material functions and rutting performance of asphalt concrete. A control hot-mix asphalt and three warm-mix asphalt mixtures were collected from manufacturing plant with identical aggregate type, size distribution, and binder grade. The loose asphalt-aggregate mixtures are compacted, cored and sawed to cylindrical specimens for dynamic modulus and rutting resistance testing. A numerical method is used to convert complex modulus function to relaxation modulus and creep compliance. In essence, the warm-mix asphalt with water-free chemical agent showed higher stiffness characteristics. However, the warm-mix asphalt with surfactant-based WMA technology is found to be superior in terms of rutting performance, whereas, the warm-mix asphalt with water-free chemical agent is found to be inferior.

RAP and Aging of Asphalt Concrete
Hasan M. Faisal, A.S.M. Rahman, Umme Mannan, and Rafiqul Tarefde, University of New Mexico
The primary reason for limited use of Reclaimed Asphalt Pavement (RAP) is the uncertainty of the long-term pavement performance. Understanding the response of virgin material and RAP material to oxidative aging is important to the selection of virgin and RAP binder. Five different percentages (0%, 15%, 25%, 35% and 40%) of RAP included asphalt concrete (AC) were designed to compare the effects of aging on hot mix asphalt (HMA). To assess the effect of aging on AC, the samples were subjected to oven aging following AASHTO R30 protocol. Successive aging the samples were conducted to quantify which RAP percentage is more susceptible to long-term aging. Dynamic modulus tests were conducted on control and aged AC samples. Results show aging of the material increases the complex modulus of all the samples irrespective of RAP percentages. The master curves indicates that as more RAP is added to the mixes, the curves shift upwards at the high frequency and a slight upward shift at the low frequency end of the curve.