Pollutant Releases during the Initial Aging of Asphaltic Pavements

Sree Usha Veeravalli and Robert Pitt

The University of Alabama, Department of Civil, Construction and Environmental Engineering, Tuscaloosa, AL 35487-0205, USA.

Introduction

Prior studies (such as those conducted by the USGS) have identified that PAH releases associated with coal-tar sealants applied to asphaltic pavements are significant toxicant sources to receiving water sediments. Others (such as conducted by NCHRP) have examined aged highway construction materials as pollutant sources. This project is examining the role of freshly constructed asphaltic materials as pollutant sources during the initial exposure period, when releases of materials are expected to be most significant. With the aging of the asphalt, the pavement undergoes physical and chemical changes which are expected to affect the quality of the runoff.

Methods and Materials

Three square pavement slabs are being examined during this project. Two (a hot-mix asphalt pavement and a warm-mix asphalt pavement) were freshly constructed, while the third is a two year old pavement which was freshly coated with asphalt sealant. The test slabs have a surface area of 0.25 m^2 and are 5 cm thick. They were prepared for this project by the National Center for Asphalt Technology (NCAT), at Auburn University, in Auburn, AL. The pavement slabs are set up outdoors in mostly full sun and exposed to rains. They are therefore being aged under natural conditions. During the project period, a 0.5in rain (using prior collected roof runoff) is being simulated on each of the pavement

slabs by continuously re-pouring the water over the slabs for a 30 minute period. The resulting runoff is being collected once every two weeks for a period of six months and analyzed for: PAHs, heavy metals (Zn, Cd, Cr, Pb, and Cu) and nutrients (total phosphorous, total nitrogen, nitrate plus nitrite, ammonia, and COD), anionic MBAS detergents, and toxicity. The toxicity tests are the Microtox screening procedure which makes use of bioluminescent bacteria, *Vibrio Fischeri*.

Results and Discussion

Results are available from the first two months of exposure of the test slabs. This was the hot and dry summer months. The later exposure period, when the asphalt and sealant is longer aged, are being exposed to cooler and wetter conditions. The resulting concentrations are being examined for trends with time, and will be compared to antecedent dry periods before the samples, temperature, and age. The following comments pertain to the initial samples only, while the conference presentation will present the results for the complete study.

Although no obvious pattern was observed in the toxicity of the runoff from the warm mix asphalt, these samples showed the highest average toxicity level for these initial samples (about 94% decrease in produced light levels indicating highly toxic conditions), while the asphalt sealant showed the least toxicity in these initial months (about 57.7% decrease in produced light, indicating moderate toxicity).

The samples are being analyzed for Cd, Cr, Pb, Cu and Zn. However, Cd and Cr were found to be below detection limits in the runoff. Copper levels varied from, 0.02 mg/L to 0.15 mg/L, as shown in the graphs below, indicating weak trends with time for these initial exposure periods. Lead ranged from 0.006 to 0.017 mg/L and Zn ranged from 0.03 to 0.1 mg/L.

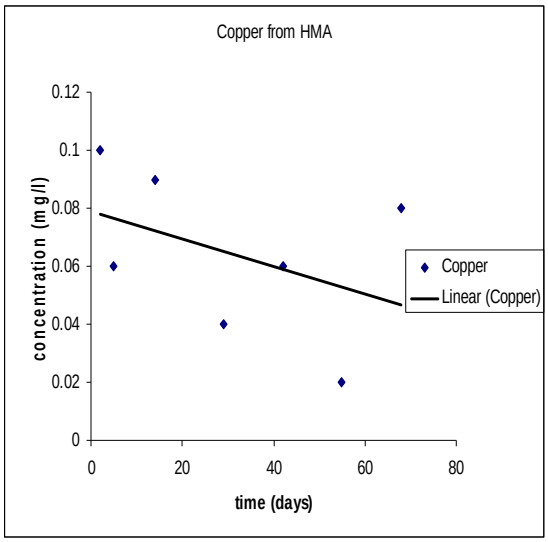

Fig. 1. Copper levels from Hot mix asphalt with respect time.

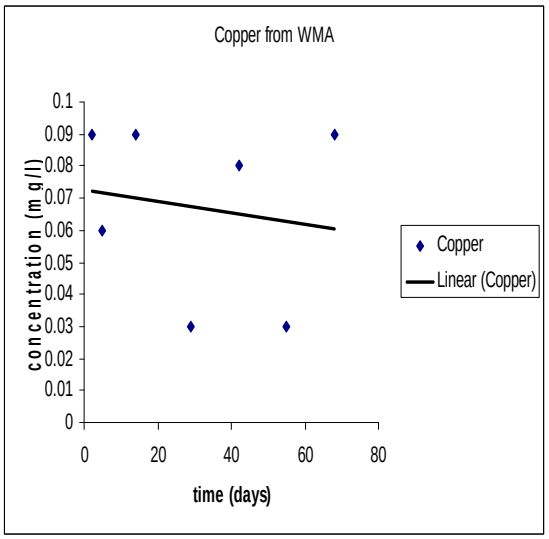

Fig. 2. Copper levels from Warm mix asphalt with respect to time.

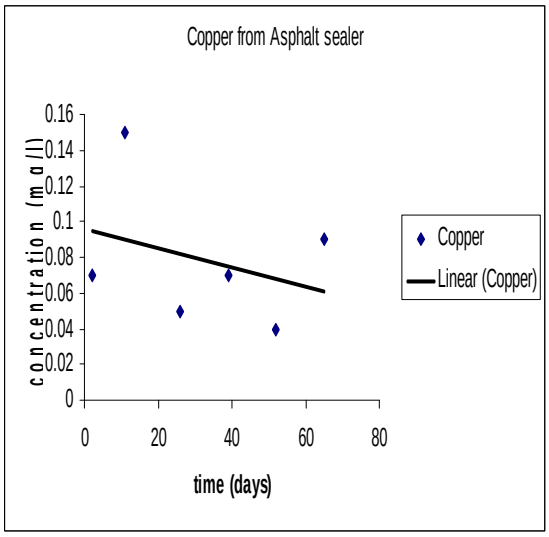

Fig. 3. Copper levels from Asphalt sealer with respect to time.

Rainfall having high intensities flows off the surface of the pavement faster, has reduced contact time, and is expected to result in lower levels of contaminant. To avoid these variations, the samples are being collected at regular time intervals and the rainfall being simulated is similar in each event (duration, depth and the rainfall intensity). As noted, a factorial analysis will be performed on the data and the factors that will be taken into consideration will include age (< 3 months – new, 3-6 months - relatively older) and seasons (summer and fall). The findings from this study should give us an understanding of the variation in the leaching of contaminants with the age of these asphaltic materials.