UNIVERSITY TRANSPORTATION RESEARCH CENTER

RESEARCH BRIEF

PROJECT TITLE: INNOVATIVE ROADWAY LIGHT SOURCE AND DYE COMBINATIONS TO IMPROVE VISIBILITY AND REDUCE ENVIRONMENTAL IMPACTS

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Sky glow light pollution is caused largely by reflected light off of roadway and other surfaces. The authors investigated the feasibility of a system consisting of a specialized LED streetlight and a dye-based roadway surface coating that would reduce sky glow, but still provide adequate illumination of objects in the road.

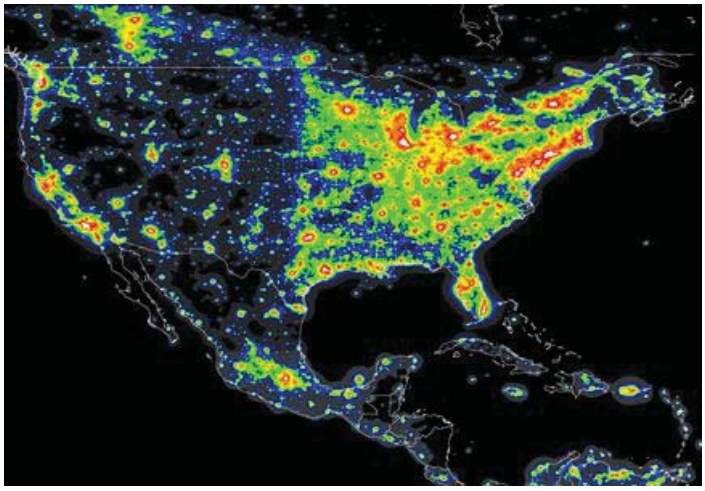

Figure 1: Artificial Night Sky Brightness. Colors correspond to ratios between the artificial sky brightness and the natural sky brightness of: <0.01 (black), 0.01-0.11 (dark-gray), 0.11-0.33 (blue), 0.33-1 (green), 1-3 (yellow), 3-9 (orange), 9-27 (red), <27 (white).

As envisioned, the streetlight would produce white light with narrow-band LEDs of red, green, and blue wavelengths. The roadway surface coating would use three dyes that would selectively absorb the specific wavelengths produced by the streetlight. This investigation examined the optical properties of green and blue absorbing dyes. The dyes, when in their liquid states, did selectively absorb light at the expected wavelengths. However, the dyes did not selectively absorb light when applied as a surface coating, so appropriate encapsulants would need to be developed for subsequent implementation. Also, issues of stability over time, cost, and safety were identified.

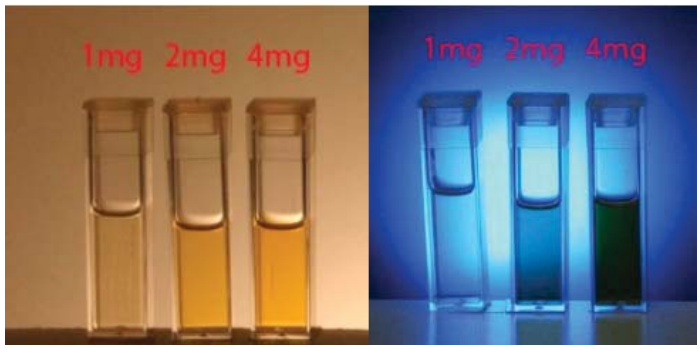

Figure 2: Photographs of cuvettes filled with Eosin Y liquid dyes illuminated by white, blue, and green light.

Although the tested dyes were able to selectively absorb light in particular wavelength bands, a number of significant hurdles would need to be overcome before this could become a practical method of reducing sky glow from roadway lighting systems.

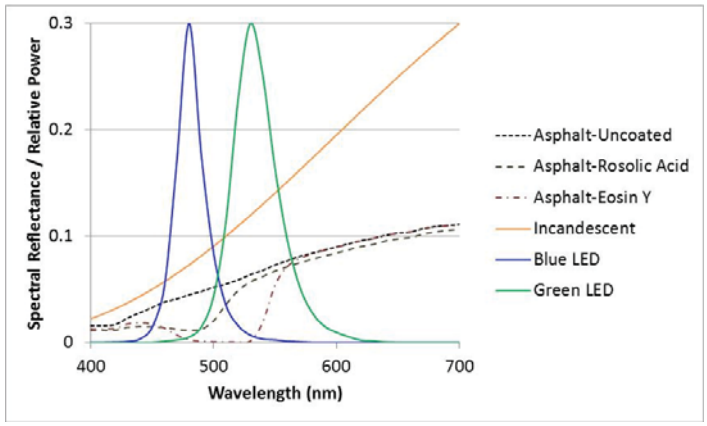

Figure 3: Spectral reflectance of untreated asphalt and asphalt filtered by each dye, and relative spectral power distributions of incandescent, blue LED and green LED sources.