Cool Science: Cool Pavements

The Problem

Like conventional dark roofs, dark pavements get hot in the sun because they absorb 80-95% of **sunlight**. Hot pavements aggravate urban heat islands by warming the local air, and contribute to global warming by radiating heat into the atmosphere - pavements can aggravate urban heat islands because they comprise about one third of urban surfaces.[4] Hot pavements can also raise the temperature of storm water runoff.[5]

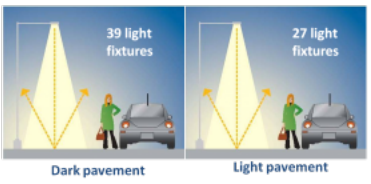
Thermal infrared (left) and visible (right) images of a road with light and dark segments. The infrared image shows that the light segment (bottom) is about 17°C (30°F) cooler than the dark segment (top). (Image courtesy of Larry Scofield, APCA)

A Solution: Cool Pavements

Definition

Solar reflective "cool" pavements stay cooler in the sun than traditional pavements. Pavement reflectance can be enhanced by using reflective aggregate, a reflective or clear binder, or a reflective surface coating.

Benefits



Reflective pavements can reduce the need for street lighting at night. (Image courtesy of Stark 1986)

- **Energy savings and emission reductions**. Cool pavements lower the outside air temperature, allowing air conditioners to cool buildings with less energy. Cool pavements also save energy by reducing the need for electric street lighting at night.
- **Improved comfort and health**. Cool pavements cool the city air, reducing heat-related illnesses, slowing the formation of **smog**, and making it more comfortable to be outside. Pedestrians also benefit from cooler air and cooler pavements.
- **Increased driver safety**. Light-colored pavements better reflect street lights and vehicle headlights at night, increasing visibility for drivers.
- **Improved air quality.** By decreasing urban air temperatures, cool pavements can slow atmospheric chemical reactions that create smog.
- **Reduced street lighting cost.** Cool pavements can increase the **solar reflectance** of roads, reducing the electricity required for street lighting at night.
- **Reduced power plant emissions.** By saving energy on street lighting and A/C use in surrounding buildings, cool pavements reduce the emission of greenhouse gases and other air pollutants at power plants.
- **Improved water quality.** Cool pavements lower surface temperatures, thereby cooling storm water and lessening the damage to local watersheds.[6,7]
- **Slowed climate change.** Cool pavements decrease heat absorbed at the Earth's surface and thus can lower surface temperatures. This decrease in surface temperatures can temporarily offset warming caused by greenhouse gases.

Technology

Cool pavements can be made from traditional paving materials, such as cement concrete. New cement concrete has a solar reflectance (SR) of 30–50%. There are also novel **cool-colored** coatings for asphalt concrete pavements that reflect about 50% of sunlight. Another approach is to use a clear binder that reveals highly reflective (light-colored) aggregate.


Clear resin binder


Cement pavers

As with all materials exposed to the atmosphere and use, the solar reflectance of pavement can change over time. For

example, as cement concrete pavement ages it tends to get darker with tire and grease stains (new SR 30-50%; aged SR 20-35%), but asphalt concrete lightens (new SR 5%; aged SR 10-20%) as it ages because the asphalt binder oxidizes and more aggregate is exposed through wear.


Emerald Cities coating


Light chip seal

Notes

4 Akbari H, Rose LS, Taha H. 1999. **Characterizing the fabric of the urban environment: A case study of Sacramento, California.** Lawrence Berkeley National Laboratory.

5 **U.S. EPA Heat Islands Cool Pavements Page**

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7 James W and Shahin R. 1998. Pollutants leached from pavements by acid rain. In W. James (ed.), Advances in Modeling the Management of Stormwater Impacts. Vol. 6: 321-349. Guelph, Canada: Computational Hydraulics Int.

Related Publications

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