Urban Heat Island: Not a Black and White Issue

By Howard Marks, PhD, MPH

The urban heat island (UHI) effect was first identified in the early 1800s when observers noted that the urban center of London was warmer than the immediately surrounding countryside. UHI results from the built environment's urban fabric when it retains heat. There has been significant debate and research to determine the various causes of UHI, which are still not well understood.

Recent comments by the U.S. Department of Energy (DOE) suggesting that reflective pavements, similar to reflective roofs, will help lessen the effects of UHI have lent credence to a solution – whitewashing the urban fabric – that is unproven and even disputed by many in the scientific community.

The basis for the DOE statements appears to be a modeling effort at Lawrence Berkeley National Laboratory using data comparing roof color and building temperatures. This analogy, however, is inconsistent for several reasons.

First, roofs and pavements are not equivalent in terms of their impact on urban heat. Roofs are thin and transfer heat into a dwelling or other structure readily, thereby increasing the need for air conditioning. Roofs are also at the highest point in the urban landscape. Pavements, at the lowest point, function in the exact opposite manner.

In addition, increased pavement reflectivity poses potential safety and health risks, including increased glare and increased UV radiation scatter. The latter is discouraged by the Centers for Disease Control (CDC) (CDC, 2002). In fact, the CDC recommends against using reflective pavements in schoolyards due to potential childhood exposure.

Finally, it is recognized that when solar radiation is reflected off pavements, it has the potential to heat up adjacent buildings and contribute to heating of the upper atmosphere.

The leaders of a highly respected laboratory, supported by the U.S. EPA specifically to look at the UHI effect, reviewed the science on this issue and published their findings in *Public Works* magazine. The authors indicated that "to simplify the UHI approach by committing to planting more trees, increasing reflectivity, or changing pavement types in a region is to grossly overstate and simplify the value of those mitigation strategies…" (Golden and Kaloush, 2005).

Pavement design can certainly assist in reducing potential urban summertime heat. Pavement thickness, density, and several other physical properties related to both pavement and landscape design should be considered when determining strategies to reduce urban summertime temperatures.

Open-graded asphalt pavements have been shown to be effective in reducing pavement surface temperatures as well. Belshe et al (2008) showed that surface temperatures of open-graded pavements are similar to surface temperatures of light-colored or reflective pavements. In fact, one can see this phenomenon depicted in a satellite image of Phoenix (see sidebar). The open-graded pavement has the added benefits of improving the quality of stormwater runoff and reducing highway noise (see Barrett and Shaw, 2007; Smit, 2008).

But strategies used to reduce summertime urban temperatures should also be balanced with strategies that help reduce wintertime cold, including the ability of pavement to assist in roadway snow melt and the ability of pavement to temper urban winter temperatures and building heat requirements.

There is no question that the UHI is an important consideration for quality of life issues in highly urbanized areas in the southern latitudes. It is important, however, to distinguish between UHI and global warming. An article in Scientific American (2007) points out that "the urban 'heat island' effect, although

real, is only local…Indeed, it is found to be negligible in hemispheric or global averages."

It is also worth noting that UHI was first documented in the early 1800s, in urbanized London, when there were neither automobiles nor pavements – just a densely populated area, indicating that the causes of this phenomenon stem from factors other than just pavement color.

Although pavement color may be one indicator of surface temperatures, it is not a good indicator of potential impact on overall UHI. In addition, there is great uncertainty regarding the impact of pavement reflectivity alone on UHI. More research is needed to explore the causes of UHI and technologies to mitigate this phenomenon. The urban heat island effect is not a pavement issue and it is not black and white. HMAT

References

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