Dustup Over Pavement Coatings

Texas city tracks stream pollution to sealant, then bans coal-tar-based coating

Cheryl Hogue

Freshly sealed, uniformly black pavement is pleasing to the eye. Beyond its aesthetics, the sealer helps the macadam beneath last longer, protecting it from the ravages of freeze-and-thaw cycles that erode pavement in colder climes.

City of Austin

APPLIED Austin, Texas, has banned pavement sealants that contain coal tar. At least two other jurisdictions are weighing similar action.

But gazing over a parking lot at an Austin, Texas, shopping center, Mateo Scoggins, an aquatic biologist for the city, sees the black, sealed surface as a source of pollution threatening organisms in local streams. He points out gray areas on the lot, by the exit to the busy street in front of the strip mall and at the heavily used parking spaces in front of a check cashing store where customers come and go in the space of a few minutes. In these spots, the friction from tires of the vehicles plying the pavement has worn the sealer off, exposing the gray asphalt beneath.

Scoggins walks to the far side of the parking lot, which is slightly downhill from the strip of stores. He examines a small pile of black flakes—which he says are composed primarily of worn-off sealant—piled against a curb along with some dried leaves. Then he follows a black trail of bits along the concrete curb.

The curb dips to the pavement level for several feet. The track of the black flakes, carried by storm water running off the parking lot, veers through the curb cut to bare ground on the perimeter of the shopping center. From here, the trail leads to a gully that descends several yards into one of Austin's streams.

Cheryl Hogue/C&EN

SCOGGINS

Scoggins knows that this parking lot's sealant, which was made with coal tar, is heavy with polycyclic aromatic hydrocarbons (PAHs). Some PAHs are carcinogenic. And some PAHs, including those in coal-tar-based sealant, can harm aquatic organisms—and that's what is worrying Scoggins.

The sealed parking lot he is checking out is a dying breed in Austin. In January 2006, the city banned the sale of **coal-tar-based pavement sealants**. This parking lot got its coating before the ban was enacted. If

the shopping center parking lot gets sealed again, it will be with a coating based on asphalt, which contains a far lower concentration of PAHs than coal-tar sealants, or perhaps with one of the newer sealants on the market whose makers claim contain virtually no PAHs.

PAHs are a group of more than 100 substances. They are generated during the incomplete burning of coal, oil and gas, garbage, tobacco, meat, and other organic substances, according to the **Agency for Toxic Substances & Disease Registry**. They are ubiquitous in the environment, especially in urban areas where they are known to come from vehicle exhaust, particles worn off tires, and atmospheric deposition. PAHs are also found in coal tar, crude oil, creosote, and roofing tar; some are used in pharmaceutical products and to manufacture dyes, plastics, and pesticides, ATSDR adds.

The **National Toxicology Program** classifies 15 PAHs as "reasonably anticipated to be human carcinogens" and says at least eight of these are present in coal tar.

The **Environmental Protection Agency** regulates PAHs discharged by industrial sources into waterways. But under the federal Clean Water Act, EPA can't regulate individual pollutants carried by storm-water runoff. The agency has to use educational and voluntary programs to address problems posed by polluted runoff, explains Dale Kemery, an EPA spokesman.

City of Austin

SPLASH Austin closed Barton Springs Pool for three months after high levels of PAHs were found just upstream of this popular swimming spot.

When they wash into waterways, PAHs end up attached to particles of sediment, because the compounds do not dissolve easily in water. According to ATSDR, microorganisms can break down PAHs in soil or waterways in weeks to months. A number of studies have shown that PAHs harm freshwater species, including amphibians.

Scientists have known for years that PAHs are present in the sediment of urban waterways. But it was in Austin that researchers first fingered parking lots coated with coal-tar-based sealants as a potentially major source of these compounds in urban waterways. Makers of coal-tar-based pavement coatings, however, dispute this conclusion.

Some 85 million gal of coal-tar-based sealants is sold each year in the U.S., accounting for about $100 million to $130 million in annual sales, says Geoff Crenson, chairman of the **Pavement Coating Technology Center**. The center is a joint project of the **University of Nevada**, Reno, and several companies, mainly manufacturers of coal-tar-based sealers. Crenson works for one of those firms, Bonsal American, at its White Marsh, Md., facility.

Most coal-tar-based pavement coatings are manufactured in the U.S. east of the Rocky Mountains, according to Crenson. The raw material for these sealers, coal tar, is derived primarily from the coking of

coal for use in steel mills. In regions without steel mills, mainly west of the Rockies, manufacturers base their pavement sealants on asphalt, he explains.

Especially in colder climates, sealants help preserve and extend the useful life of pavement, Crenson says. Water that penetrates into cracks in pavement will freeze and thaw during wintery weather and cause deterioration of the surface. Road salt increases the number of freeze-thaw cycles, he says.

Summer temperatures and the sun's ultraviolet rays also can cause cracks in pavement. "Some of the lighter oils and compounds are cooked out" of binders in asphalt, Crenson says, leading to fissures in the pavement where water can seep. While both coal-tar- and asphalt-based sealers coat pavement and help keep water out, the coal-tar product has an advantage, according to Crenson. It provides a barrier to UV rays that lead to fractures in macadam, he says.

Most coal-tar-based coating is sold to commercial applicators, not retail outlets that sell to do-it-yourselfers wanting to seal their driveways, he says. Home Depot discontinued the sale of coal-tar-based sealers in 2004, a spokesman for the retailer tells C&EN. And Lowe's stopped carrying them as of this year, a spokeswoman for that chain of home improvement stores says. Neither explained why their corporations took this tack.

The reported link between coal-tar-based sealants and PAH levels in Austin streams started with the city's routine environmental monitoring of its streams.

Cheryl Hogue/C&EN (Both)

ON THE TRAIL Scoggins, right, and colleague Andrew Clamann examine the path of pavement sealer bits that have washed off a parking lot.

In late 1994, city workers were surprised to find PAHs at high levels—161 parts per million—in the sediment of a stream called Barton Creek, which runs through a heavily used city park, Scoggins says. They also found the PAHs just upstream from a popular public swimming hole.

That facility, Barton Springs Pool, is fed by springs deep in the pool. Those springs harbor the endemic and endangered Barton Springs salamander. PAHs were never previously detected in the water of Barton Springs Pool, Scoggins adds. A small dam keeps water from the upper reaches of Barton Creek from reaching the pool, except during floods that overtop the dam once or twice a year.

Over several years, the city continued its stream monitoring.

In January 2003, the *Austin American-Statesman*, the city's daily newspaper, publicized the PAH pollution entering the Barton Springs Pool area. Public outcry about the pollution led Austin officials to close the popular swimming spot for three months while researchers hunted for the source of the hydrocarbons.

Austin scientists found that the concentration of these hydrocarbons dropped off in the creek not far from the place where they were first detected near Barton Springs Pool, a fact suggesting a nearby source of PAHs rather than one farther upstream. The researchers investigated a gully, eroded by runoff into a steep hillside along Barton Creek. That dry channel, locally described as a "draw," empties into the stream near where PAHs were found at high levels in the creek's sediment.

Sediment in the gully 500 feet up from the creek had PAHs at 100-400 ppm, according to Scoggins. At the top of the draw, PAH levels were 1,000-3,000 ppm, he says.

Investigators discovered that a concrete drain directed water into the gully from the parking lot of an apartment complex on the hill above Barton Creek. Sediment in the drain held concentrations of PAHs at 4,000 ppm.

At the top of the drain, researchers looked around for a source of PAHs and considered the parking lot.

"We were thinking, 'What is in this asphalt?' " Scoggins says. A colleague, Tom Bashara, who works for Austin's Spills Division, noted that the parking lot was uniformly black with sealant, Scoggins says. Following a hunch, Bashara drove to some building supply stores and checked the ingredients in sealant; he found that one type was based on coal tar. Further research confirmed that coal tar contains PAHs, up to 50% by weight.

City researchers then teamed up with the **U.S. Geological Survey** scientists for further investigation. Together, they published a paper in *Environmental Science & Technology* that showed for the first time that parking lot seal coats can be a significant source of PAHs in urban environments. Sealants may be the dominant source of these widespread contaminants in urban water bodies in the U.S., the report concludes (***Environ. Sci. Technol.* 2005, *39*, 5560**).

City researchers, including Scoggins, conducted field and laboratory studies of the effects of PAHs on some aquatic organisms that live in Austin's waterways. The creeks that drain the city's watersheds have few fish but are home to an assortment of bugs, such as midges, which are small gnats, and scuds, which are small, shrimplike crustaceans called amphipods that live in freshwater, Scoggins explains. The laboratory studies showed that sealant-derived PAHs in sediments were toxic to these and other invertebrates at levels observed in Austin waterways.

On the basis of these results, Austin's City Council enacted a ban on coal-tar-based sealants that took effect on Jan. 1, 2006, affecting both retail sales and businesses that seal parking lots. According to Scoggins, coal-tar-based products were the primary sealants available for purchase in Austin before the ban. According to industry estimates, the city says, more than 600,000 gal of coal-tar-based sealants was applied annually in Austin before the ban.

Makers of coal-tar-based seal coats are skeptical about Austin's actions. "This has not been driven by good science," Crenson says.

Crenson tells C&EN that adverse environmental effects from coal-tar-based sealants are "not really proven." Austin's ban was "driven more by public relations than anything else" because of public outcry over contamination so near Barton Springs Pool, he says.

The Pavement Coating Technology Center sponsored its own studies, conducted by the environmental consulting firm Environ. Robert P. DeMott, principal toxicologist at the firm's Tampa office, says those studies found that the average concentration of PAHs in Austin streams is comparable with that found in urban waterways across the U.S. "Austin is not out of the ordinary," he tells C&EN.

DeMott says the studies also examined contaminant levels in ditches alongside highways and in streams for which roads, but not parking lots, were the only significant contributor to PAH concentrations. In these areas, PAH levels were about half of what they were in Austin's more heavily contaminated urban streams, he says. This finding, DeMott says, suggests that about half of the PAHs found in Austin's urban streams comes from highways, where particles from vehicle exhaust, flakes of worn tires, and oil drips accumulate.

In addition, DeMott takes issue with the PAH levels found in the gully that led Austin investigators to the sealed parking lot of the apartment complex. He says the hill is composed of fill including crushed asphalt—crumbled up old road material—that could account for the high PAH levels.

According to Scoggins, city officials at first thought that the broken-up pavement was the source of the PAHs. But they found the concentration of PAHs in the asphalt binder of the old pavement was much lower than the level of PAHs found in the gully's sediments. The PAH concentrations in the old road material, Scoggins says, "were much lower"—by orders of magnitude—"than what we were seeing coming off the parking lot."

Monica Gilbert/C&EN

View Enlarged Image

JOURNEY Over time, pavement sealer (left) wears off. Runoff carries bits of the coating from pavement into waterways..

DeMott says Austin officials "leapt to conclusions" on the basis of the paper published in ES&T. "Enacting a ban on the basis of this study was premature," he says. Before taking this legislative action, the city needed to know what percent of PAHs came from sealed parking lots and what portion came from a variety of other sources, including roadways, he says. Parking lots with sealant, he contends, "are nowhere near the sources [of PAHs] the city portrays them to be." The city should focus on controlling all sources of PAHs found in runoff, he says.

While industry raises these questions, at least two other U.S. jurisdictions are investigating the possibility of following Austin's lead to protect their waterways. Dane County, Wis., which includes the city of Madison, and Jacksonville, Fla., are studying the Austin ban. The Wisconsin county hosts a number of lakes, and Jacksonville is dissected by the slow-flowing St. Johns River and its many tributaries. Officials from both Dane County and Jacksonville are concerned about PAH contamination.

Roger T. Bannerman, a researcher with the **Wisconsin Department of Natural Resources**, says that aquatic organisms living in urban areas are stressed by the pollutants washed off city streets and buildings. Banning pavement sealants based on coal tar would "not mean the end of PAHs" in waterways, but it may significantly reduce the loading of these pollutants into these ecosystems. "If we can eliminate one source [of PAHs] without a lot of fanfare, great," Bannerman tells C&EN.

Meanwhile, entrepreneurs who have formulated PAH-free pavement coatings are lobbying Austin to go even further and to ban products with PAHs, including asphalt-based sealants. Scoggins surveys the shopping center parking lot and says he is skeptical about the use of sealants in general.

For one thing, "sealant is probably more important in places where there's a strong freeze-thaw cycle," which is not the case with Austin's warm climate, Scoggins says, adding that this opinion is his own. Plus, during the city's long and scorching summers, pavement covered with black sealant contributes more to urban heat than does unsealed gray asphalt, he says.

In the end, sealants "wear off no matter what" and end up in waterways, Scoggins points out. He peers at the black crumbs at his feet, next to the curb. He looks up and wonders aloud what potential pollutants could lurk in coatings made without coal tar.

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