

# Toxic Roads Are Paving the Way to Trouble

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## STORY AT-A-GLANCE

- > Coal-tar-based pavement sealants contain polycyclic aromatic hydrocarbons (PAHs) that are 1,000 times more toxic than comparable products, contaminating waterways and endangering both aquatic life and humans
- > “Toxic sludge” from stormwater runoff is so poisonous in parts of the Pacific Northwest it can kill an adult coho salmon in just 2.5 hours, before it has a chance to spawn
- > Gas and wastewater used to de-ice roads were found to contain radioactive radium and barium, as well as ammonium in concentrations 50 times greater than recommended by the U.S. Environmental Protection Agency (EPA)
- > Municipalities concerned about road toxicities got creative to alleviate the problem and came up with some very innovative solutions

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You've probably smelled it – the overpowering, nostril-burning stench when new coal-tar pavement or sealant is being laid on a driveway, street, parking lot or playground. And you may have idly wondered how toxic the shiny, black liquid spray might be, but moved on to other things because, after all, what can you do about it? As it turns out, it is toxic. The substances contain polycyclic aromatic hydrocarbons (PAHs).

One study<sup>1</sup> by the U.S. Geological Survey (USGS) and Milwaukee Metropolitan Sewerage District identified coal-tar sealants as the primary source of PAHs and called them "a

major source of contamination in urban and suburban areas and a potential concern for human health and aquatic life."<sup>2</sup>

The problem finally made headlines when toxic coal-tar sealants were found to be responsible for up to 94% of the PAHs found in 40 samples of streambed sediment – aka muck – collected from 19 creeks and rivers, along with dust from six parking lots in metropolitan Milwaukee.<sup>3</sup>

According to lead study author and USGS hydrologist Austin Baldwin, "Fully 78% of the samples contained enough PAHs to be considered toxic and capable of causing adverse effects in aquatic animals."<sup>4</sup>

How it happens is fairly straightforward. Over time, PAHs and other contaminants from sealed and blacktopped surfaces wash into stormwater storage basins and storm sewers from rain and melting snow. From there, the toxins are washed straight into the closest [waterways](#), essentially poisoning them.

Coal-tar sealants used for paving in commercial, residential and industrial areas are preferred by many due to aesthetic reasons. However, they contain up to 1,000 times more PAHs than asphalt emulsions, which do a comparable job but cost more.

As far back as 2007, Dane County, Wisconsin, banned both the sale and use of coal-tar sealants, but prior to the cut-off, 300,000 gallons of the stuff were estimated to have been used, every year, on driveways and parking lots in that county alone.<sup>5</sup>

## **PAHs 'A Thousand Times More Toxic' Than Asphalt**

However, the problem in Milwaukee is not isolated. Besides the toxic materials used to build roadways and other surfaces, similar issues are emerging around the U.S. Another study says stormwater runoff is so poisonous in parts of the Pacific Northwest, it can kill an adult coho salmon in just 2.5 hours.<sup>6</sup> Additionally:

*"The [USGS] study also reveals a costly consequence of regulations in Wisconsin and many other states requiring developers to excavate stormwater*

*storage basins next to massive parking lots. PAHs cling to dirt, sand and other particles in the stormwater that settles to the bottom of the basins."*<sup>7</sup>

The Milwaukee Wisconsin Journal Sentinel reported:

*"Coal tar, a byproduct of converting coal to coke is a solid-carbon fuel and carbon source for the steel-making industry, and it's a known human carcinogen. As coal is heated to produce coke, coal tar vapors are released."*<sup>8</sup>

On December 12, 2016, the Milwaukee County Intergovernmental Cooperation Council, composed of area mayors and city officials, took steps to alleviate the problem when they unanimously approved a resolution supporting restrictions or outright bans on coal-tar products, and contractors' use of coal-tar for sewer district work was prohibited.

However, while none of those communities is considering an outright ban on coal-tar sealants, the city of Milwaukee took the first step, banning PAHs in February 2017.<sup>9</sup>

## **PAHs in the Water Are Not an Isolated – Nor a New – Problem**

Elsewhere, communities in the Minneapolis-St. Paul area believe costs will soar to \$1 billion to clean up PAH problems in stormwater ponds. A federal study had already found as early as 2013 that PAHs in area streams were worse for aquatic life than other chemicals. Baldwin said:

*"This study shows that PAHs pose a very real threat to aquatic organisms at the base of the food chain ... Among the adverse effects are fin erosion, liver abnormalities, cataracts and immune system damage. Exposure to the chemicals also can cause high rates of tumors in fish."*<sup>10</sup>

In fact, research on salmon killed by runoff began in the 2000s. Projects to restore the salmon's habitations had brought a slow but steady stream of coho back to urban streams in Puget Sound, but many died before they could spawn, notably right after rainstorms, including 90% of the females in a waterway called Longfellow Creek.

Trying to reproduce the toxic solution with oil and other chemicals didn't negatively affect the few **salmon** used in experiments (in order to save many more), but when researchers from Washington State University's Puyallup Research and Extension Center used PAHs collected from a downspout draining Highway 520 near Montlake, it did.

"When we brought out the real urban runoff: Bang! They were down, they were sick, they were dead," said another study author, Jenifer McIntyre.<sup>11</sup>

Sadly, at the Suquamish tribal hatchery near Poulsbo, Washington, every one of the exposed salmon died, some almost immediately, but not before becoming lethargic, rolling around and swimming to the surface as if gulping for air, McIntyre said.

Interestingly, the National Pollutant Discharge Elimination System (NPDES) Stormwater Program has been in place since 1990, regulating "discharges from municipal separate storm sewer systems (MS4s), construction activities, industrial activities and those designated by [Environmental Protection Agency (EPA)] due to water quality impacts."<sup>12</sup>

Internationally, one study reported that just under half the PAHs in the Klang Strait in Southeast Asia originate from pyrogenic sources (coal combustion, vehicular emissions and petroleum), but petrogenic PAHs from oil spills, urban run-off, tanker operation and shipping activities were found to leave "no adverse biological effects."<sup>13</sup>

## **Toxic Materials, Right Up Close and Personal, Are Nothing New**

The Atlantic tells the story of a 27-year-old man who was committed to Hudson River State Hospital for the Insane in April of 1887. Less than two weeks later, another man showed up in similar condition.

Then a third showed up. It turned out they all worked at the same rubber factory. Knowing it couldn't be a coincidence, an investigation ensued.

The culprit causing the men's bizarre, incoherent and erratic behavior, according to the chief of the Nervous Department at New York's College of Physicians and Surgeons, was

carbon disulfide, a colorless liquid that evaporates rapidly at room temperature and was linked to some "acute insanity" cases in Europe.

Connecting the dots, one study shows carbon disulfide to be a solvent in manipulating PAH materials.<sup>14</sup>

Carbon disulfide was invented as a means to render rubber pliable enough to make tires using a process called vulcanization. To forego the necessary heating process in huge factories like Goodyear, this solvent treated rubber in a cold vulcanization process for superior wear and probably hundreds of uses. The Atlantic notes:

*"In England, the new term 'gassed' had arisen, defined in the Liverpool Daily Post as 'the term used in the India rubber business, and it meant dazed.'*

*... It's impossible to say how many people today have benefited from this discovery – billions of users of rubber products, from shoe soles to hoses to tires – while a lower but not insignificant number suffer because of it."*<sup>15</sup>

A doctor, Paul Blanc, who chairs the department of occupational and environmental medicine at the University of California, described carbon disulfide as a "very unique toxin; in its manifestations, truly protean," meaning unpredictable in its effects to the nervous system, as well as birth defects and interference with menstruation.

"Some of them are quite startling, especially its capacity to cause insanity, but also atherosclerosis in the heart and the brain, as well as Parkinsonism," he said.<sup>16</sup> His investigation found mention of the toxin as early as 1849, along with warnings to workers in regard to its vapors.

## **Carbon Disulfide – A History of Manufacturing and Testicular Hysteria**

Century-and-a-half-old evidence seemed ample warning to producers that this substance wasn't something to mess with. One researcher in 1856 noted everything

from weird dreams to memory gaps; premature aging to "abolished" sexual desire. Ironically, many victims worked in condom factories.

The illnesses were associated with "hysteria," usually assigned to women, but more than 60 case histories of male "hysterics" were logged in Paris in the 1880s.

One man in particular, a "sober, tranquil" individual, worked in the rubber industry for 17 years. When he began cleaning vulcanization vats containing carbon disulfide, he had a bad reaction, diagnosed with "toxic hysteria" from carbon disulfide poisoning. He first experienced an acute burning sensation in his scrotum:

*"... [A]nd then collapsed on the job, fully anesthetized. He was unconscious for half an hour and bedridden for two days, which were filled with nightmares and hallucinations of 'terrible animals.' He did not recover fully, but remained weak and given to twitching."<sup>17</sup>*

## **Carbon Disulfide and Compromised Federal Standards**

While carbon disulfide isn't in tires anymore, it's still a problem. A study<sup>18</sup> in 2014 cited an "unnamed" plastic and rubber manufacturing plant in New York where workers exposed to carbon disulfide between 1946 and 2006 had more than double the rate of fatal heart disease compared to other workers. However, it's used in other industries, such as cellophane and rayon, sometimes referred to as "fake silk" or viscose.

Farmers have also used it liberally to fumigate grains and kill gophers, and it's also been used in a Tecumseh, Kansas, plant for "skinless" sausage casings and sponges. The manufacturing process is potentially harmful to workers exposed to it via air pollution, as the carbon disulfide levels in the air are 50% higher in urban than rural areas, an EPA report<sup>19</sup> says.

Blanc called federal standards for carbon disulfide "among the worst in the world – the most non-protective, worse than China and Europe, and comparable to India."<sup>20</sup> States have the authority to put more stringent laws in place, but only California has actually

done it. Even federal standards have been fought tooth and nail by lobbyists connected to the chemical industry.

## **Gas and Wastewater Used to De-Ice Roads**

While scientists say it might be dangerous, many states still spread roads with brine from oil and gas operations, believing it's a safe way to recycle it. But the wastewater is tainted, not just with **chloride**, but radium and barium, which are radioactive. While they're not from fracking, the toxins are similar.

Newsweek<sup>21</sup> said brine in Pennsylvania's waterways from runoff also contains "significant concentrations" of iodide, bromide and ammonium, the latter potentially toxic to anything living, and in concentrations 50 times greater than recommended by the EPA. But there's no oversight and, similarly, New York was found to have multiple permits to spread the same radioactive substance, which can leach into water supplies.

## **Salt on Roadways Is Toxic to Humans, Animal Life**

The usage of road salt has been found to damage food sources for insects.<sup>22</sup> In higher concentrations, it can kill amphibians as well as plants, USA Today<sup>23</sup> reported.

Roger Haro, Ph.D., a former biology professor at the University of Wisconsin-La Crosse, said even experts believed that salt spread onto roads would be washed into storm drains and dissipate without causing much of a problem. They didn't realize it could build up in soil alongside roads, creating a salt bank and cause worse trouble — and for a longer time — than first thought.

Over time, chronic salt concentrations can damage algae that are food sources for the insects eaten by local fish, but in high concentrations, Haro said, the salt can kill amphibians and plants and leach into wells where people get their drinking water. As it is, more than 22 million tons of salt are thrown onto roads every year throughout the U.S. That's around 137 pounds of salt for every person in the U.S.<sup>24</sup>

## **Solar Panels to Heat Roads – From Concept to Reality**

Salt problems may be a thing of the past before too long, as at least two companies are developing unique solar-powered systems using sun energy to help clear snow-covered and icy roads. A team at Worcester Polytechnic is working on harvesting energy in pavement by storing hot liquid in insulated pipes or chambers to melt snow and ice.

The second concept, from Solar Roadways, has a \$750,000 research contract to work with, awarded by the Federal Highway Administration, to replace traditional roadways with sturdy solar panels that would keep roads just warm enough to prevent the accumulation of ice and snow.

As it happens, the first paved, solar-panel road opened in the small town of Tourouvre-au-Perche, France, measuring just over half a mile (1 km) long, coated in a special silicon film to help protect the panels from excess vehicle weights.

It was an expensive project, however, costing about \$5.2 million to build.<sup>25</sup> Solar panels also now cover 18 miles of road at the Georgia Visitor Information Center in West Point, the first in the U.S., which was created to be a "regenerative highway ecosystem."<sup>26</sup>

The hope for many is that generated electricity can help handle costs over time, but also that solar panels, with designs still being developed, will help cut down on salt usage that at the present time is used on 22 million miles of road, according to Seeker.<sup>27</sup>

## **What Can Be Done and What's Being Done**

In the Pacific Northwest, scientists had a bad feeling about the potential of toxins from run-off for a long time, but the salmon study opened a door that would allow them to not just study the problem but help fix it. According to The Seattle Times,<sup>28</sup> they intend to use a simple, soil-based filtration system.

In 2013, municipalities concerned about road toxicities got creative to alleviate the problem and came up with a few innovative solutions – free cheese brine in Wisconsin



(saving around \$40,000), sugarcane molasses in Minnesota and beet juice in Illinois, mixed in with road salt to act as alternate de-icing agents.

Julann Spromberg, Ph.D., a research fish biologist for the National Oceanic and Atmospheric Administration (NOAA) and co-author of the coho salmon study, said that in many cases, all that can be done for many of these problems is to basically "let the Earth do what it does so well, what it has done for eons: clean things up."

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