From: Geoffrey Butler
To: City Council, Springfield, MO
Date: January 14, 2010
Subject: What I have learned about Coal Tar Sealers

When I first got into this issue I was concerned that we were seeing a reaction to an unidentified problem presented as a potential human health hazard. It sort of popped up on the radar screen and seemed to be moving rather quickly and could end up with some sort of action that might or might not be good.

As an Architect, I design projects which have parking lots. Due to the economics in this region asphalt parking lots are probably 90% of the market. Concrete lots have a longer life (if well done) and can have lower maintenance. Asphalt lots require periodic maintenance – mostly a sealer which basically protects the structural integrity of the lot for the ravages of the environment – petroleum spills, heat, freezing weather and rain/sleet/snow. Generally, sealers in this market are the coal tar based sealers. They work well, last a long time and are cost effective.

As a developer and property owner, I have experience with both the coal tar sealers and the asphalt based sealers. As a partner in the ownership and the architect and builder of the Galleria on East Battlefield, I have used both products. I have only used an asphalt based sealer once. That was not a very good experience. It tracked terribly and we, as the landlord, had to spend thousands of dollars cleaning up the carpets of our tenants. It wore off rather quickly lasting only two years. It also re-emulsified in those areas where the roof drains provided a continual source of water beyond the normal rain fall. In those areas it basically washed away. I would not use it again if given the choice.

On the other hand, I have used coal tar sealers since then very successfully. It lasts 4 – 6 years per application, does not track (at least on my project it did not), and has never re-emulsified.

So my concern was that there was a movement afoot to take that very effective product off the market and I needed to try to get to the bottom of this movement as it affects me professionally and as an owner of property.

So here is what I know (not in any order of importance):

- Coal tar sealers have the majority of this market tied up.
- It is an effective sealer and is a good value for the people who use it.
- Coal tar sealers last 4 – 6 years.
- Asphalt sealers last 2 years – may be three.
- Coal tar sealers are less costly than asphalt based sealers.

- Given the above, asphalt based sealers will cost easily twice the cost of a coal tar based sealer to get the same results.

- Coal tar sealer is highly resistant to gas and oil, an it will protect asphalt from automotive fluids that dissolve and soften asphalt. Because it does not readily oxidize, it will not combine with water and dissolve, making it last longer and be much less of a threat to wash away. If it is worn off of the surface, it will not dissolve and become liquid, therefore, it cannot flow as a liquid.

- Some asphalt coatings will combine much more easily with water and wash off the lot.

- A typical asphalt lot is 3-4" of asphalt on a 4-5" base rock.

- Asphalt parking lots built as per above can last thirty years or more if properly maintained and sealed regularly.

- Asphalt lots that are not sealed regularly will deteriorate over time and eventually will fall apart and need to be replaced or have significant repairs and overlays in about 15 years.

- The cost to properly repair or replace an asphalt parking lot exceeds the cost to build it in the first place.

- Asphalt pavement is a mixture of graded stone aggregate and asphalt. The asphalt is the binder or glue that holds the pavement together. If left unprotected, asphalt is subject to degradation from oxidation and water penetration. Ultraviolet rays from the sun begin to break down the asphalt binder, changing the pavement surface color from black to gray. Gas, oil and other petrochemicals will dissolve the asphalt binder, causing holes and raveling.

  As the asphalt binder is further broken down from the sun's rays, water begins to penetrate the surface. Water begins to erode the binder between the individual stones in the pavement. If cracks are present, water will begin to erode the base beneath the asphalt, causing the cracks to enlarge and eventually causing base failure in the form of potholes.

  In the northern climates, pavement is subject to further damage from normal freeze thaw cycles. Water, in the form of melted snow and ice, enters the pores and cracks in the pavement. When temperatures fall below 32 degrees the water freezes, expanding and causing additional surface erosion and widening of cracks.

  Regular application of pavement sealer prevents damage by sealing in the asphalt binder that holds the driveway together and sealing out ultraviolet rays and water penetration. The black color of pavement sealer provides a like new appearance. The sealed surface is easier to clean gas and oil resistant and helps to melt snow and ice faster.

Source: FAA Engineering Brief No. 44A-Coal-Tar Sealer/Rejuvenator Specification

- The cost of asphalt is sensitive to the cost of oil on the open market. Asphalt based sealers are therefore more volatile in their pricing.

- The energy expended to build an asphalt parking lot includes the energy to quarry the rock, crush the rock, transport the rock to the plant, heat the asphalt, mix the asphalt and the rock, truck the asphalt to the site and to lay it down and roll it in. It is an energy intensive effort. Not only does it expend a lot of energy getting it laid, the majority of that energy includes the emission of pollutants into the environment in the way of diesel fumes, tire abrasion, oil spills, etc (all of which put PAHs into the environment). It is an energy hog and polluting process.

- PAHs (polycyclic aromatic hydrocarbons) seem to be the "ugly" that everyone is concerned about. They "*arise mainly from the incomplete combustion of fossil fuels, organic materials, and wood and are also found in petroleum. Because of their high concentrations and widespread occurrence in the environment, as well as carcinogenic and mutagenic properties, PAHs have been a major concern regarding public health and environmental impact. Input of PAHs from stationary sources has been decreasing since the 1940s due to change in fuel usage from coal to petroleum and enhanced emission control. PAHs from mobile sources such as vehicle operation, however, may be responsible for recent increase of PAH input to aquatic sediment especially from the early 1980s in most urban areas. Population growth with increased urban sprawl showed a strong positive correlation with increased traffic activity, which is responsible for high levels of PAHs in urban runoff and the consequent degradation of water quality*." C**haracterization of polycyclic aromatic hydrocarbons in urban stormwater runoff flowing into the tidal Anacostia River, Washington, DC, USA by** Hyun-Min Hwang, Gregory D. Foster - 6 August 2005

- There are many sources of PAHs including, the incomplete combustion from diesel engines, tire abrasion, oil spills and leakage from older vehicles and the use of coal tar based sealers. There are tests available that allow for the identification of the types of PAHs found to be traced to possible sources but they are not inexpensive.

- A great deal of focus has been placed on the carcinogenic nature of the PAH's. Here is some added information on that:

In the United States, Congress gave the authority and responsibility for identifying and classifying carcinogens to the Department of Health & Human Services (DHHS), which, through its National Institute of Environmental Health Services (NIEHS), periodically updates and publishes something called "The Report on Carcinogens" (RoC) which consists of lists of the identified & classified substances. The current RoC is the Eleventh edition and this is the link (http://ntp-server.niehs.nih.gov/?objectid=72016262-BDB7-CEBA-FA60E922B18C2540).

The RoC has two classifications (it's really three, because "not listed" is a classification): "known human carcinogen" and "reasonably anticipated to be a human carcinogen." Back of the envelope, known human carcinogens are usually those substances for which there is direct evidence that the substance causes cancer in humans. There are **NO PAHs** classified as known human carcinogens. Some of the common substances that are classified as "known" include aflatoxin (found in peanut butter), wood dust, environmental tobacco smoke, alcoholic beverage consumption, crystalline silica (that's quartz sand), solar radiation and, yes, dioxin. Coal tar and coke oven emissions are also on the "known" list - more about that below.

The second classification - "reasonably anticipated to be a human carcinogen" - generally is applied to substances for which there's some evidence of tumors in laboratory rats and/or mice exposed to the substance **for two years at high concentrations**. In the US, the substances on the "reasonably anticipated" list are all lumped together. Internationally, there's a classification that divides the "reasonably anticipated" substances into "probable human carcinogens" and "possible human carcinogens." But that's getting too far into the weeds. Bottom line: EPA has identified 16 PAHs as Priority Pollutants. Of these, 7 are listed as "reasonably anticipated to be human carcinogens" based on laboratory animal testing in just 2 of the seven.

It's DHHS' responsibility to identify and classify the carcinogens. EPA, however, has the responsibility to evaluate the extent of the hazard through assessing actual risks to human health and the environment. The simple way to think of this is **Risk = Hazard x Exposure** or, as toxicologists say, "the dose makes the poison." EPA does this for both "known" and "reasonably anticipated" carcinogens. It's a frustratingly long and imprecise process. EPA has not issued an updated assessment of PAHs in many years, and is in the final stages of doing so right now. EPA is right now putting together a panel of outside experts to review their draft updated assessment. EPA's schedule for this review is available at this link: (http://cfpub.epa.gov/ncea/iristrac/index.cfm).

Back to coal tar... We all remember the photographs of Pittsburgh in the late 19th and early 20th centuries - it's hard to make out anything but smokestacks and polluted air. The problem was the open coke ovens and uncontrolled coke oven emissions used by the steel industry back then. Coal tar is a byproduct of iron and steel production in coke ovens. So, in the bad old days, people who worked in and around the coke ovens and uncontrolled coal tar operations were exposed at very high levels and occupational cancers were the result. We're seeing the same thing in parts of China today. To bring it back to the first paragraph of this primer, there is direct human experience of developing cancer among workers exposed in places like Pittsburgh a century ago and China today to high concentrations of coke oven emissions and coal tar. For more modern experiences, the creosote industry commissioned an epidemiological study of their workers. Here's the conclusion of that study

> Conclusion: Based on the present investigation and other studies, there was no evidence that employment at the 11 wood-treating plants or exposure to creosote-based wood preservatives was associated with any significant mortality increase

from site-specific cancers or nonmalignant diseases. Some results should be interpreted with caution because they were based on small numbers. (J Occup Environ Med. 2005;47:683–697

- PAHs can be classified into two classes : *Low molecular weight (LMW) PAHs and High molecular weight (HMW) PAHs. The ratios of low molecular weight (LMW) PAHs (2e3 ring PAHs) to high molecular weight (HMW) PAHs (4e6 ring PAHs) can be used to attempt to discriminate the origins (petrogenic vs. pyrogenic) of PAHs. A large proportion of HMW PAHs is a typical characteristic of a combustion origin (pyrogenic), while the enrichment of LMW PAHs is common in petrogenic sources (pavement sealers using coal tar as its base) (Boehm and Farrington, 1984).* ***Storm flow samples were dominated by HMW PAHs.*** Characterization of polycyclic aromatic hydrocarbons in urban stormwater runoff flowing into the tidal Anacostia River, Washington, DC, USA by Hyun-Min Hwang, Gregory D. Foster - 6 August 2005

- PAHs resulting from coal tar based sealers are a higher specific gravity than the granules resulting from asphalt based sealers. They are heavier than water and they are not water soluble. They bond to organic elements and then settle out if given the opportunity. This means that they will fall to the bottom of the stream if the flow rate is slow enough.

- It seems logical that the PAHs can be managed by using BMPs (Best Management Practices) in storm water control. They will not be transported to the streams and rivers if given a way to settle out in sedimentation basins.

- There are no sites in Springfield which have been tested and a human health hazard has been identified directly related to PAHs with any specific source identified.

- Our water supply has not been compromised by PAHs:

  Mr. Twitty,

  Regarding the question of detection of Polycyclic Aromatic Hydrocarbons (PAHs) in City Utilities source and/or Drinking Waters - We have reviewed our monitoring records at the Blackman Lab and have also conferred with Missouri Department of Natural Resources, who does much of the regulatory analyses of these compounds in our finished waters, and have not found any "hits" for these compounds in either our source waters or finished drinking waters from the Blackman or Fulbright Water Treatment Plants.

  If you need more detailed information, please do not hesitate to call or e-mail.

  Best Regards,

  Todd Brewer

- The streams in this community which have been identified as challenged have not been tested for specific toxins and sources identified. One, Jones Spring on Catalpa was listed and it turns out that just to the west and north of it was the old Springfield Landfill. Coincidentally, during the lifespan of that landfill, there was a Manufactured Gas Plant downtown (near my office building) and the residue from that process (basically a coal tar

mix) was disposed of off site – do you suppose it could have been taken to the land fill? There was also a lead mine nearby. Yet Jones Spring's condition is being blamed on coal tar sealers with no testing.

- With the many sources of pollutants and the uncertainty of the respective percentage and source of each, it seems logical that we would be best served by addressing the storm water management systems we have and attempt to manage all of those pollutants rather than ban on and ignore the others.

- Now for some math exercises. Mr. Ennis says: "*As a result of our ban, about 800,000 pounds of PAHs have been removed (200,000 lbs per year) from the Austin environment while the sealant industry has continued to apply products in much the same manner as before. After our initial research, the cost to get this environmental benefit through enforcement has been a small percentage of staff time. We have strategically used other city staff to be our eyes on the street for potential violations.*

  In Austin, sealant use is about 1 gallon per person per year. I understand in Springfield it is more like two per person per year. If that is the case, Springfield can expect to remove about 100,000 pounds of PAHs per year."

  Let's look at the amount of PAHs realistically. The table below shows that the mean weight of all PAHs (the ones suspected of being a carcinogenic and those not) is roughly 6.34% of the weight of the Coal Tar in a gallon of the coal tar based sealant as applied.

PAH Analysis of RT-12 Refined Coal Tar				**Resultant PAH Content in Cont'r Concentrate Slr.**		
PAH Compound	**Wt.% (Min)**	**Wt.% (Max)**	**Wt.% (Mean)**	**Wt.% (Min)**	**Wt.% (Max)**	**Wt.% (Mean)**
Naphthalene*	0.21	3.11	1.39	0.06	0.95	0.42
Acenaphthylene	0.00	0.04	0.02	0.00	0.01	0.01
Acenaphthene	0.82	1.31	1.05	0.25	0.40	0.32
Fluorene	0.87	1.32	1.02	0.26	0.40	0.31
Phenanthrene	3.17	5.41	4.26	0.96	1.64	1.29
Anthracene	1.08	1.53	1.32	0.33	0.47	0.40
Fluoranthene	2.54	4.05	3.23	0.77	1.23	0.98
Pyrene	1.92	2.94	2.35	0.58	0.89	0.71
Benz(a)anthracene*	0.99	1.34	1.17	0.30	0.41	0.36
Chrysene*	0.94	1.30	1.13	0.29	0.40	0.34
Benzo(b)fluoranthene*	0.60	0.85	0.71	0.18	0.26	0.22
Benzo(k)fluoranthene*	0.40	0.57	0.48	0.12	0.17	0.14
Benzo (a) pyrene*	0.91	1.22	1.05	0.28	0.37	0.32
indeno(1,2,3c,d)pyrene*	0.63	0.87	0.74	0.19	0.26	0.23
dibenzo(a,h)anthracene*	0.16	0.21	0.20	0.05	0.06	0.06

benzo(g,h,i)perylene	0.61	0.86	0.73	0.19	0.26	0.22
Total PAH Compounds	15.85	26.93	20.87	4.82	8.19	**6.34**

The total of all potentially carcinogenic PAHs is only 1.75% of every pound of sealer. The sealer weights 10 pounds per gallon. If we use two gallons per person here (twice that of Austin) that is 300,000 gallons of sealer weighing 3,000,000 pounds and of that only 52,500 pounds of it are PAHs. Not the 100,000 pounds that Mr. Ennis claims. On what basis does he think we use twice as much sealer than Austin? If we use the same as Austin, we only have 26,250 pounds of PAHS.

Now lets think about that, those PAHs and the sealer does not all wear off. Probably only 20% wears off before a new coat is applied. So if we use the same as Austin and only 20% wears off that means that 5,250 pounds leaves the site. We have already talked about how the PAHs cling to the organic material (dirt) and settle out. Only a small percentage of that washes into the rivers and streams where it settle to the bottom. Remember, it is not water soluble.

- PAHs are ubiquitous and have multiple sources in urban environments. As a result, PAHs are common constituents in storm water and in urban sediments. While the atmospheric deposition of combustion products is typically the most significant pathway that introduces PAHs to urban sediments, a number of other point and non-point sources also contribute. Because PAHs are regulatory compounds of concern, their presence often raises issues and drives sediment remediation under both state and federal law, and as a result may result in the need for storm water treatment and source management. Successful management requires an understanding of the critical sources within a watershed. A number of environmental investigation and forensics tools are now commonly used to identify and apportion PAHs in sediments to component sources. **While pavement seal-coating can introduce PAHs into runoff and have measureable localized contributions, the available literature suggests that other sources, especially combustion sources, represent the vast majority of PAH inputs to urban sediments.**

- The EPA has been studying this matter and is due to issue a report on it this year for public comment. No one knows what that report might say or what measures might be recommended relating to the PAHs in coal tar sealers. Would we not be wise to suspend action until we see what the EPA says? DNR will act based on what EPA requires or recommends. We then will need to do what is required.

- Mr. Ennis (from Austin) offers a matrix for discussion relating to whether this should be banned:

1. Is it a recognized toxic chemical or family of chemicals? *This is an interesting question in that there are lots of toxic chemicals which are used everyday in various situations. The toxicity relates to the exposure. So the answer is "yes" if the exposure is excessive*

and "no" in small exposures. Remember that aflatoxin commonly found in peanut butter meets that criteria too.

2. Does it enter the environment at significant concentrations, above recognized effect levels? *There is no evidence that the PAHs from coal tar sealers enter the environment here at levels which creates a health hazard. The testing done in Austin at Barton Springs was not found to be exclusively from coal tar sealers and it is suspected that PAHs from oil spills and pyrogenic sources contributed a large part of what they found.*
3. Does it have known effects on our health and environment? *Again, the effect on our health and environment has a great deal to do with the exposure.*
4. Can its use be effectively reduced or eliminated? *The answer here is that it can be reduced but not eliminated. PAHs come from many sources and the only way to manage that is to deal with all the sources where it enters the environment. The management of that is key. Banning only one source with a questionable percentage and ignoring the other sources is not going to get the job done. I believe that tests in Barton Springs three years after their ban has shown no reduction in the levels of PAHs found. Improving the storm water management systems and incorporating BMPs for water quality is a better approach over a ban of only one small source.*

- One last thought:

  You cannot ban a product without regulating it.

  This means that you have to have a means of tracking the parking lot sealer applications, who, what, where and when.

  This requires permits, staff to process the paperwork, inspectors, and a means of enforcing the ban. You probably need to license the applicators so that means testing and license management, renewals, etc.

  What happens if someone comes into town with a truck full of it and seals a bunch of lots? How do you catch them? What happens when you do? What penalties? Do you make them take it up?

  What is the cost of this licensing and regulation? Where does this money come from? Fees? How much fee per SY of asphalt? This is a fee on the community. Is there any stomach for that at this time?

  Remember that Austin has a storm water utility that taxes the community based on storm water. I recall we visited the storm water utility issue several years back when PW was looking for funding for storm water improvements and the Community voted for either 1/8 cent or maybe a 1/4 cent sales tax. The Utility idea was determined to be too ugly and unpalatable. Check with Jim Anderson on his recollection.

Someone needs to answer these questions before a ban is proposed. This would also be something that would need to go out to the development community through DIGG for comment as well.

The safe thing might be to wait until the EPA or the Feds and DNR act on this and then do it because you have to. Community support for this might be marginal in today's economic times. We are cutting budgets and not hiring staff for services many feel are important.

A conservative guess of the cost of regulating and administering that ban by the City could be about $250,000. For that $250,000 we get a slight reduction in the potential PAHs in the community BUT do nothing with all of the other sources. Would we be better served if we took that same $250,000 and did storm water system improvements relating to sediment basins?

Sorry for the length of this, I tried to keep it short. Really.

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