Forensic Analysis and New Regulatory Limits Testing PAH Content in Coal Tar Sealcoat Products Used on Driveways and Parking Lots

Presented By: Steve Greason
Sitelab Corporation
West Newbury, Massachusetts

What is Pavement Sealcoating?

Used to improve look and longevity of asphalt surface.

Sold in buckets at retail stores used by homeowners on driveways or…

Applied by contractors on parking lots - everywhere!

Sealcoats are made with: Coal Tar,
Ethylene Cracked Residue (ECR),
or Asphalt Emulsion

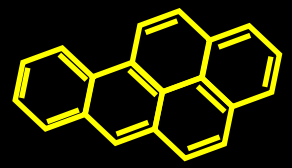
Coal Tars Contain Really High PAHs

It's highly toxic, smells bad too!

Total Polycyclic Aromatic Hydrocarbons include:

17 Regulated compounds analyzed by Method 8270

Ring-shaped molecules in C10 to C22 carbon range



1. Naphthalene
2. 2-Methylnaphthalene
3. Acenaphthylene
4. Acenaphthene
5. Fluorene
6. Phenanthrene
7. Anthracene
8. Fluoranthene
9. Pyrene
10. Benzo(a)anthracene
11. Chrysene
12. Benzo(b)fluoranthene
13. Benzo(k)fluoranthene
14. Benzo(a)pyrene
15. Indeno(1,2,3-cd)pyrene
16. Dibenz(a,h)anthracene
17. Benzo(g,h,i)perylene

2022 Parking Lot Sealcoat Certification Program

U.S. EPA Funded Grant with Chesapeake Bay Trust for DOEE in Washington DC

QA Protocol developed for manufacturers to test their products for regulatory compliance

“Gold” Total PAH Limit = 1,000 mg/Kg

“Silver” Total PAH Limit = 10,000 mg/Kg

Where Is It Regulated?

Coal Tar Bans with 1,000 ppm Limit

Federal Districts
Washington, D.C.

Counties & Cities
Wisconsin: 21
Michigan: 13
North Carolina: 2
South Carolina: 1
Maryland: 1
Texas: 1

Coal Tar Bans with 10,000 ppm Limit

States: 4
Maine
Maryland
New York
Virginia

New!

Counties & Cities
Wisconsin: 1

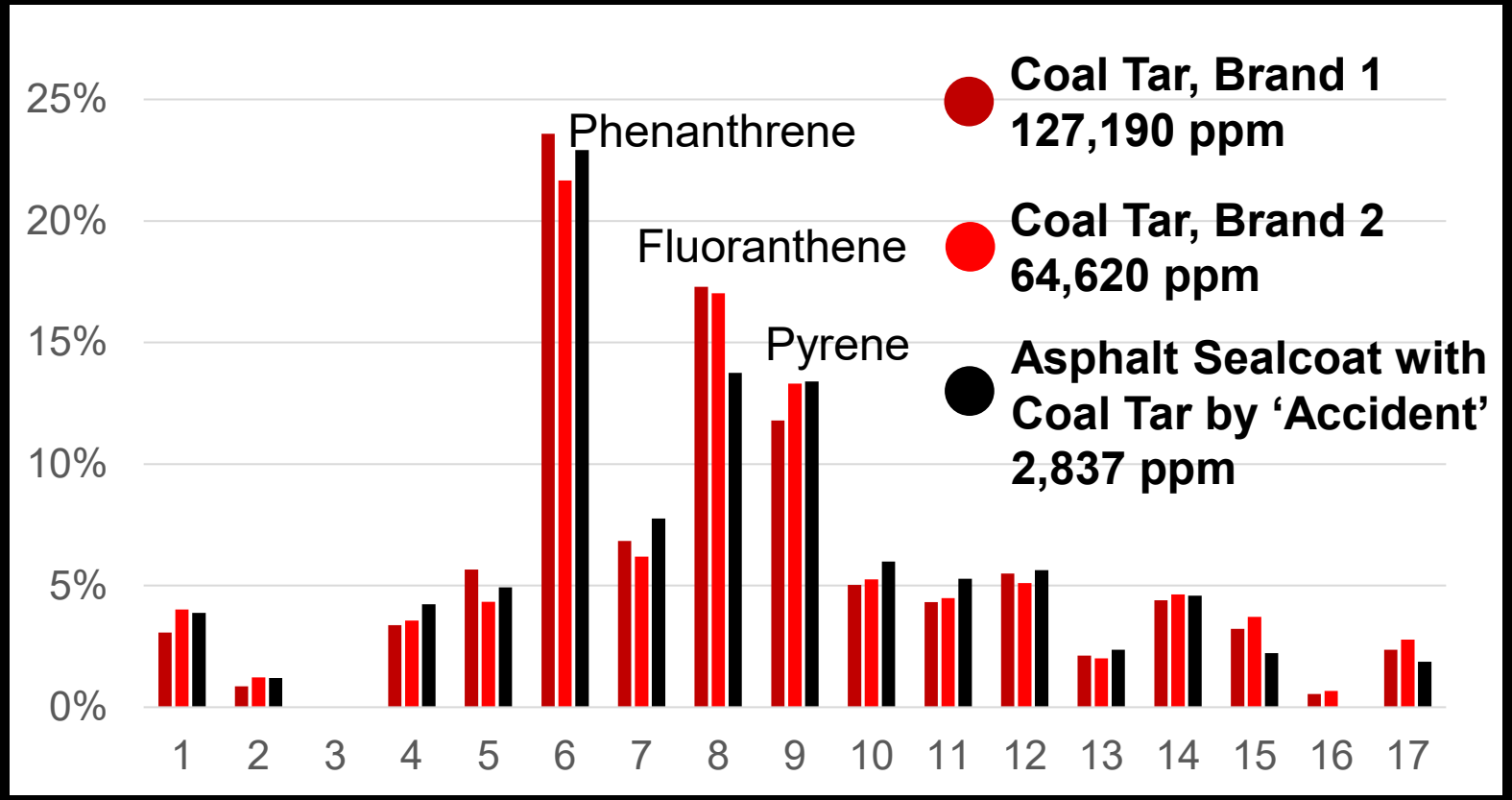
Coal Tar Bans Without a Limit

States: 2
Minnesota
Washington

Counties & Cities
Illinois: 15
Pennsylvania: 9
Michigan: 3
Texas: 3
Wisconsin: 2
Kansas: 1
Massachusetts: 1
South Carolina: 1

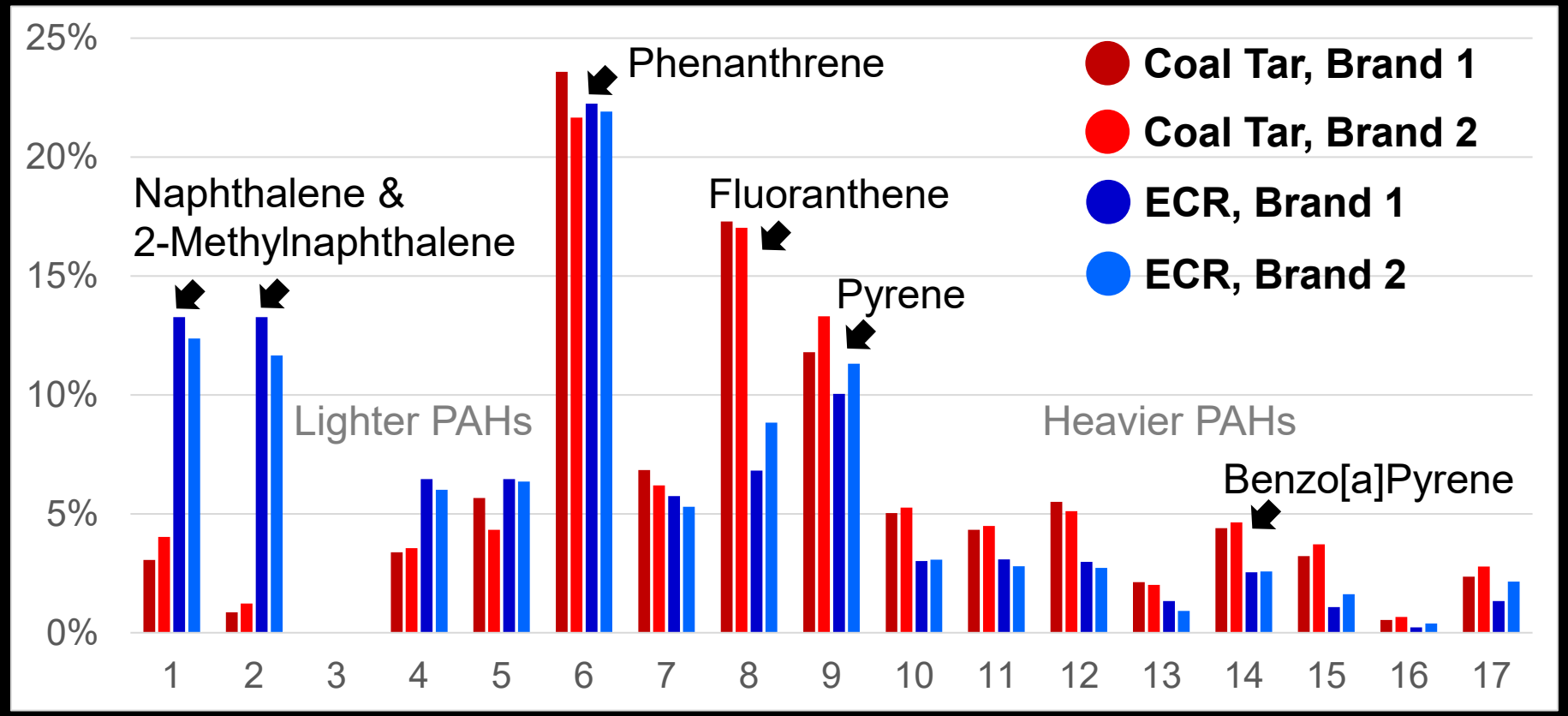
New! Canada Nationwide Ban with 1,000 ppm Limit

Graph Shows PAH Signatures



Sample Data	Conc. PPM	%PAH Content
Naphthalene	2,600	4 %
2-Methylnaphthalene	790	1 %
Acenaphthylene	0	0 %
Acenaphthene	2,300	4 %
Fluorene	2,800	4 %
Phenanthrene	14,000	22 %
Anthracene	4,000	6 %
Fluoranthene	11,000	17 %
Pyrene	8,600	13 %
Benzo(a)anthracene	3,400	5 %
Chrysene	2,900	4 %
Benzo(b)fluoranthene	3,300	5 %
Benzo(k)fluoranthene	1,300	2 %
Benzo(a)pyrene	3,000	5 %
Indeno(1,2,3-cd)pyrene	2,400	4 %
Dibenz(a,h)anthracene	430	1 %
Benzo(g,h,i)perylene	1,800	3 %

Signatures in Coal Tar and ECR Sealcoats Vary



Concentrations in Sealcoat Products

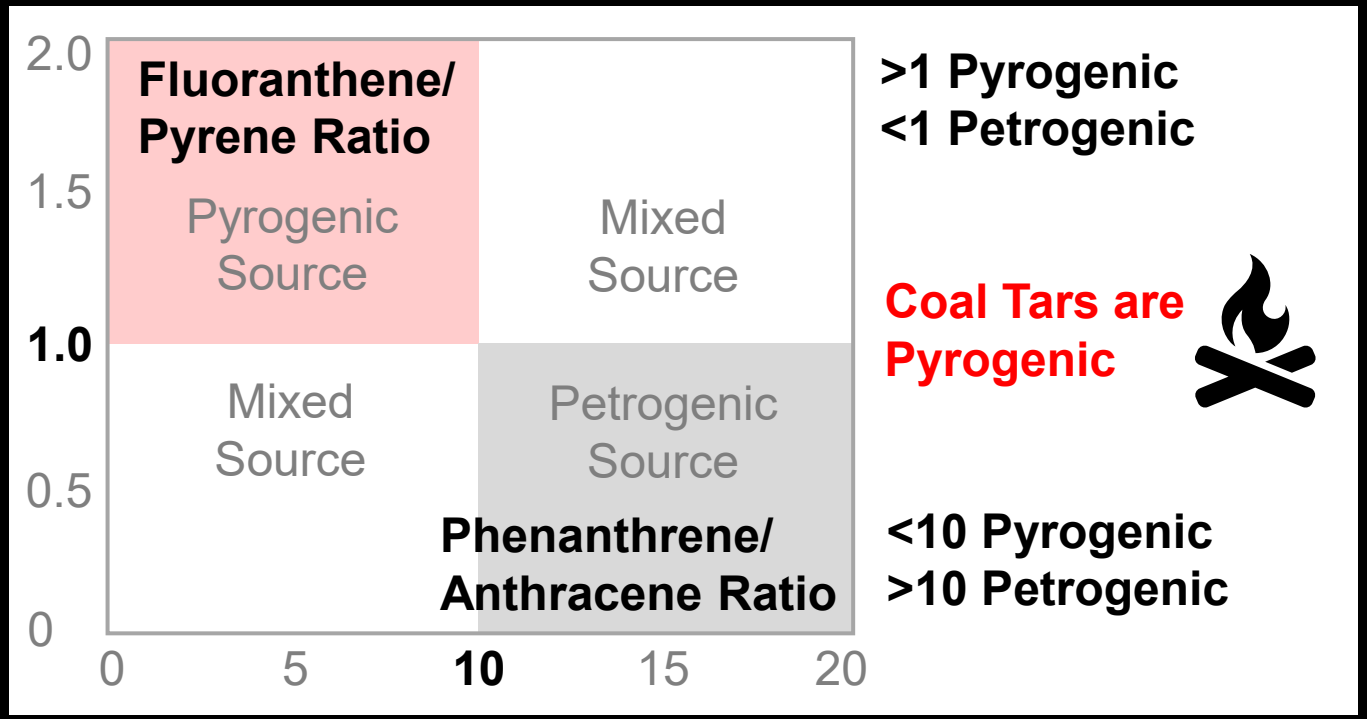
Coal Tars (ppm)
50,000 – 180,000

ECRs (ppm)
20,000 – 30,000

Asphalt-Based
No PAHs Detected

Use of Double Ratio Plots Digs Further Into Data

Lighter PAH Compounds



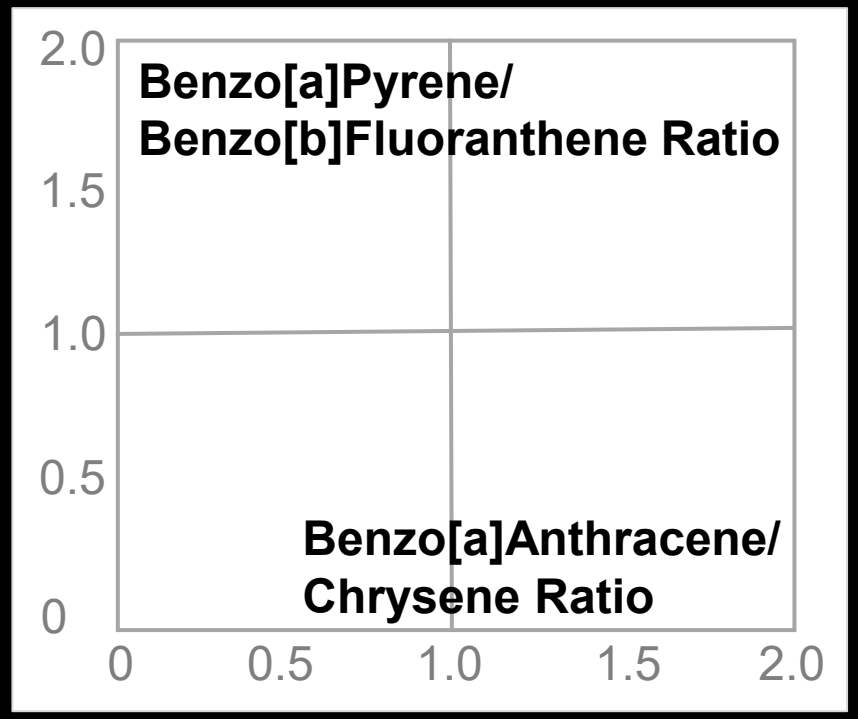
Source Type

>1 Pyrogenic
<1 Petrogenic

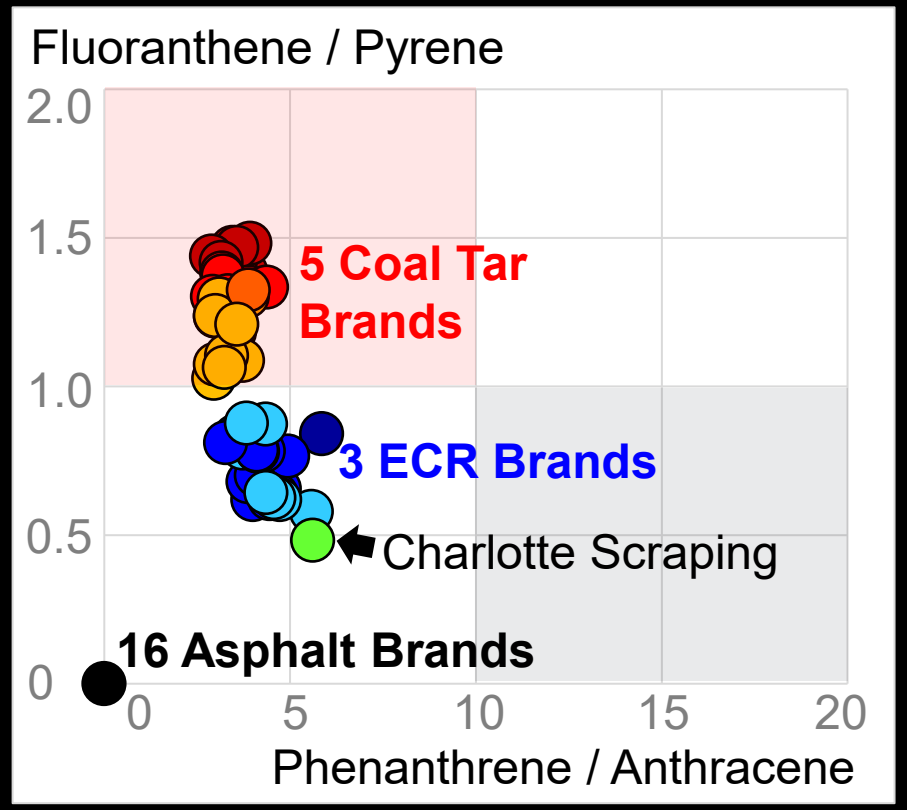
Coal Tars are Pyrogenic

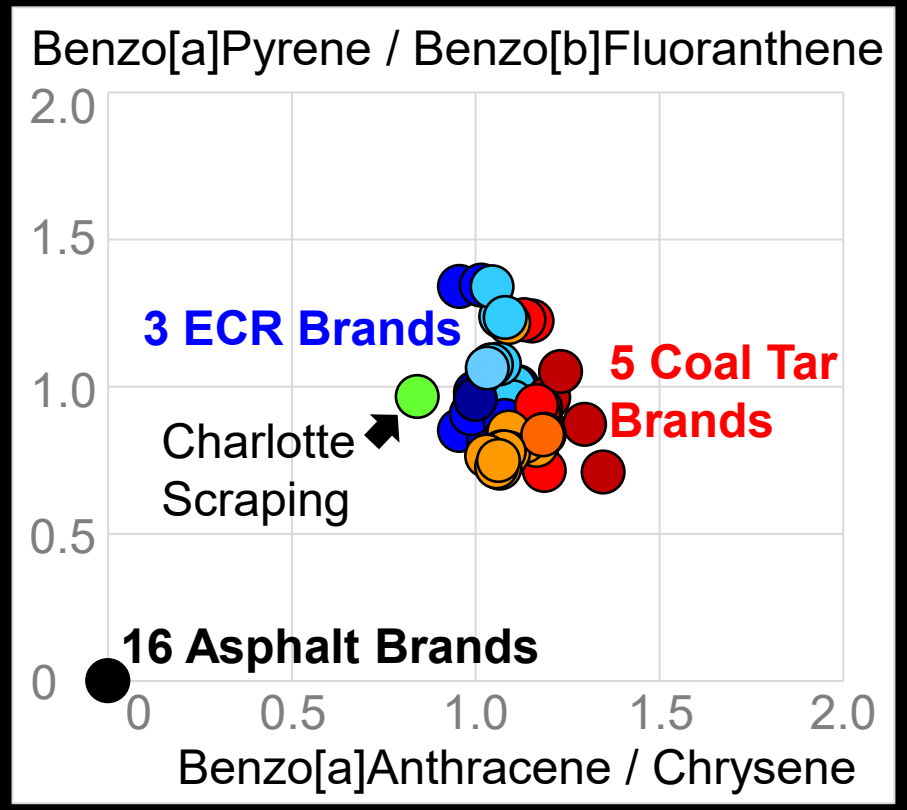
<10 Pyrogenic
>10 Petrogenic

Heavier PAH Compounds



Double Ratio Plots Comparing 3 Types of Sealcoats



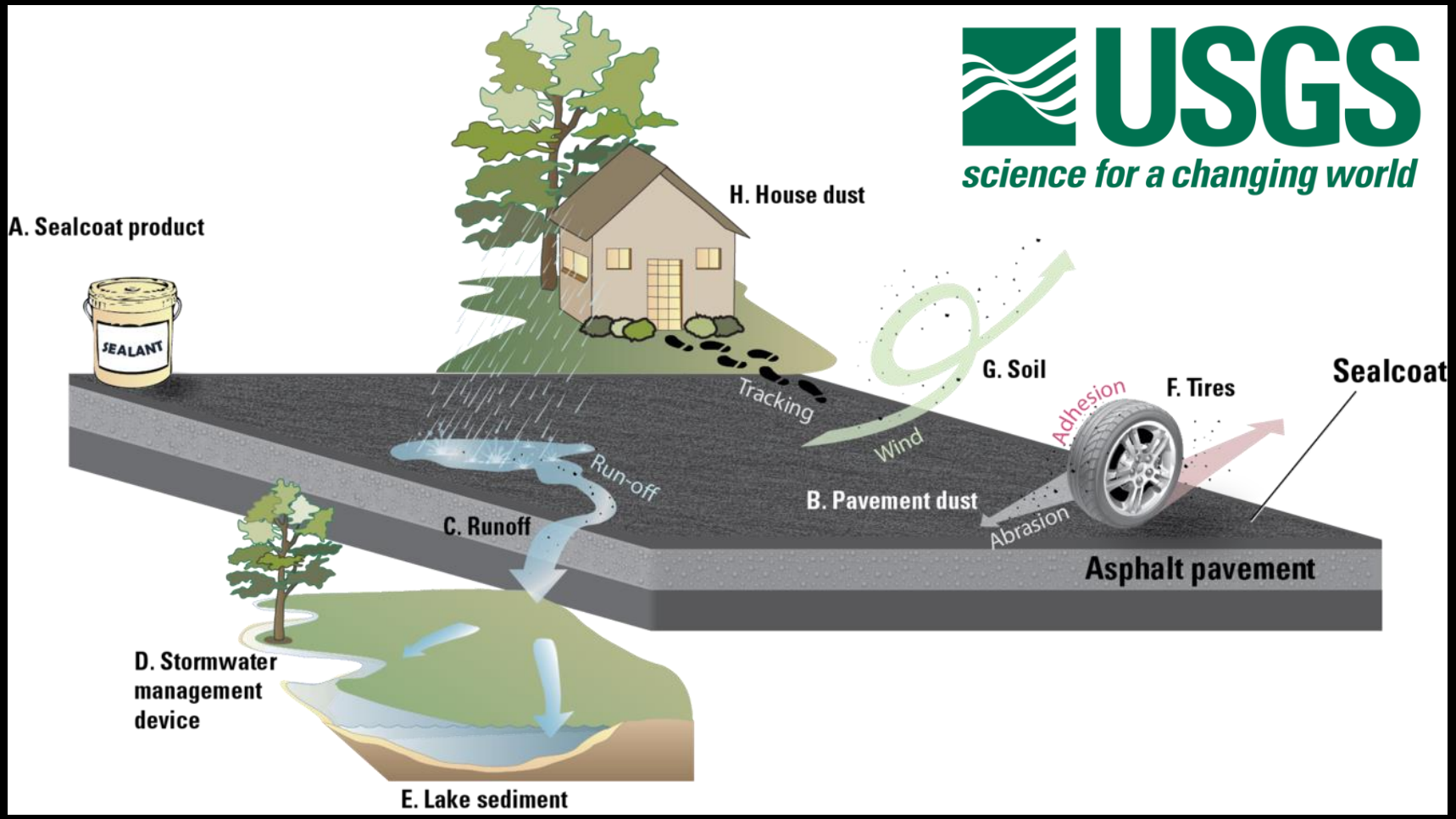


Products Available in US Market, 2022

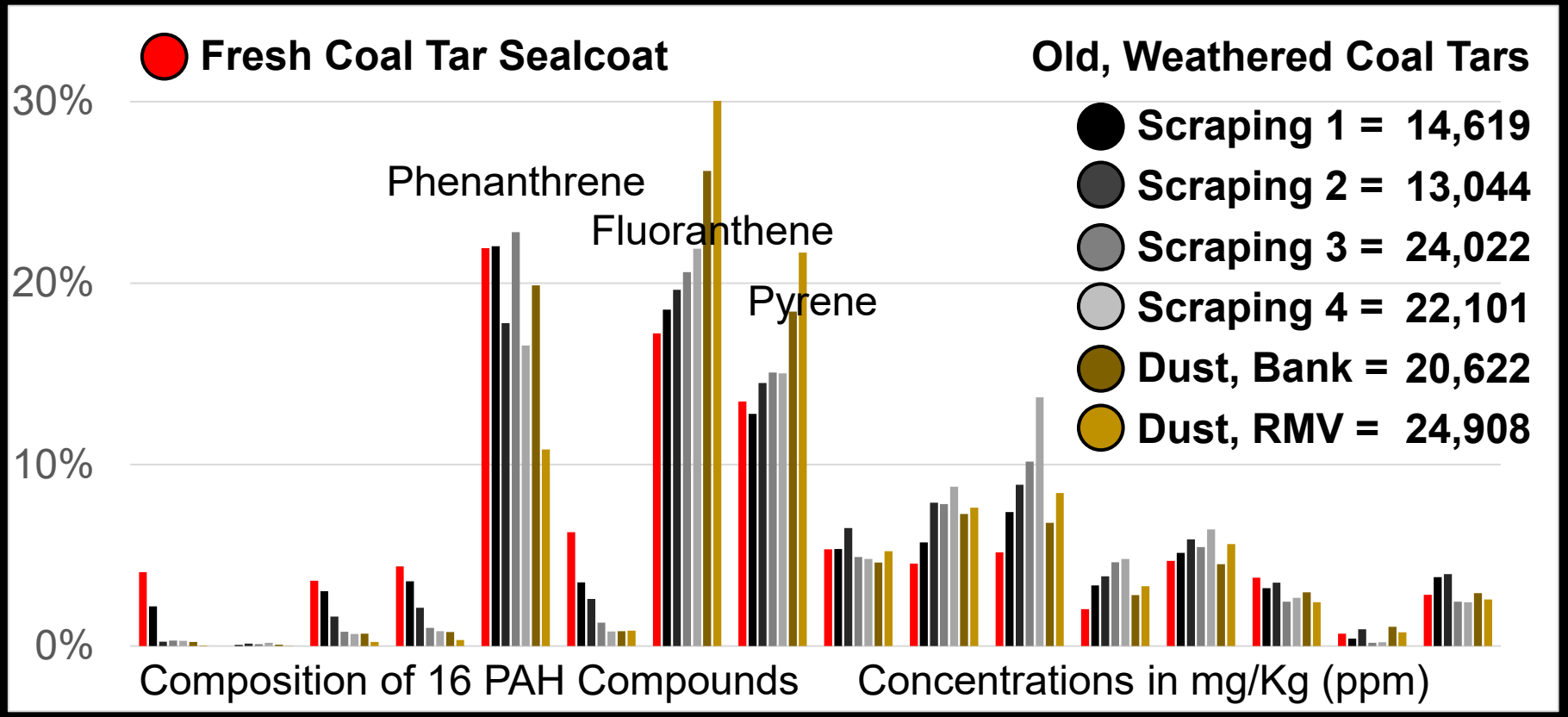
- Asphalts = 86
  CAS# 8052-42-4
- Coal Tars = 29
  CAS# 65996-93-2
- ECRs = 9
  CAS# 64742-90-1
  Sold as “coal tar alternative”

Wet and dry sealcoat samples were analyzed, performed by multiple laboratories

United States Geological Survey Studies

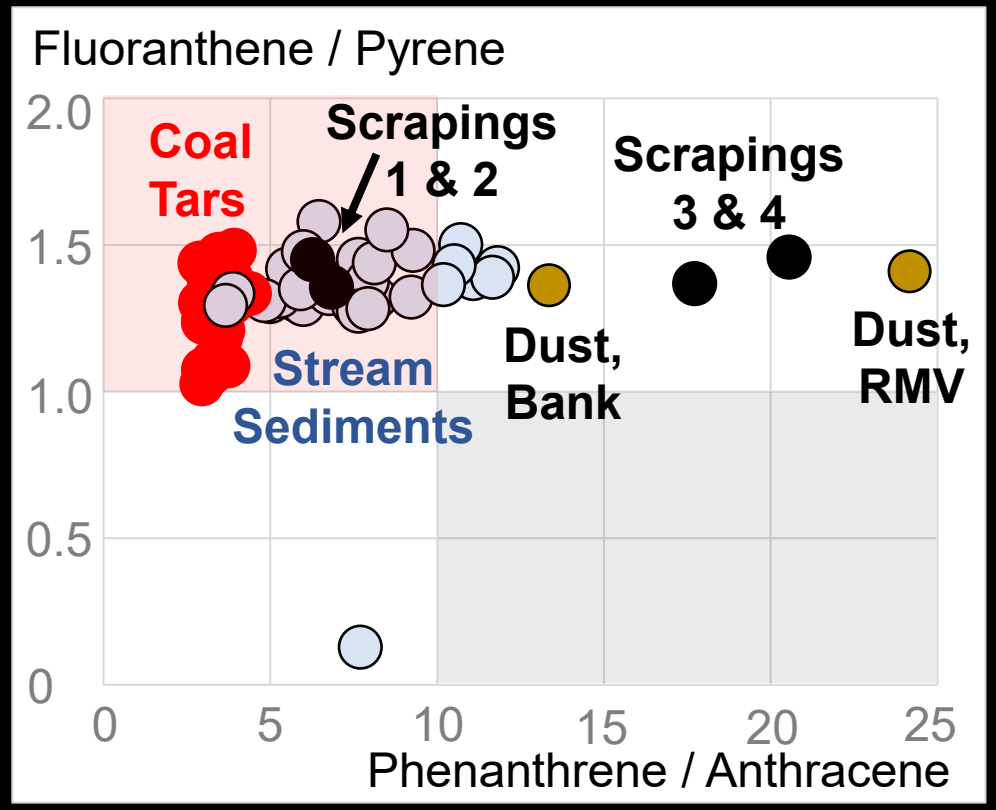


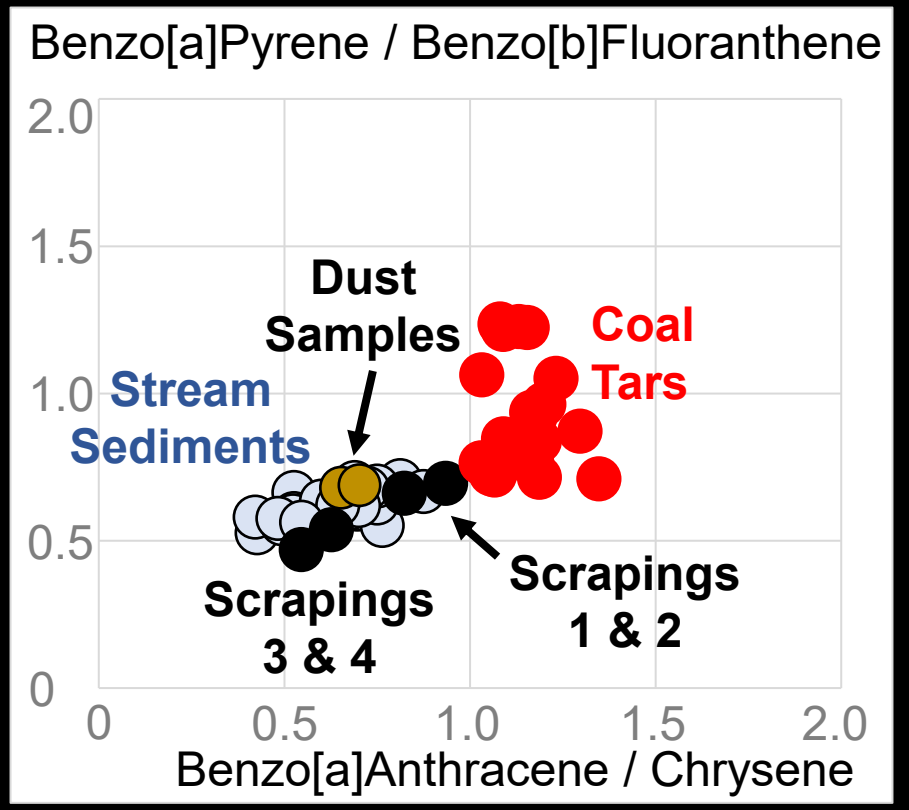
USGS: Parking Lot Scrapings & High Dust Samples

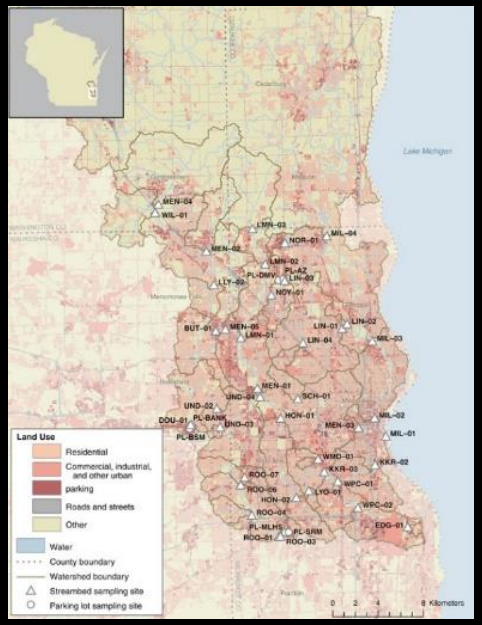


Samples collected by USGS, Milwaukee, Wisconsin

Ratio Plots in Dust, Scrapings & Stream Sediments

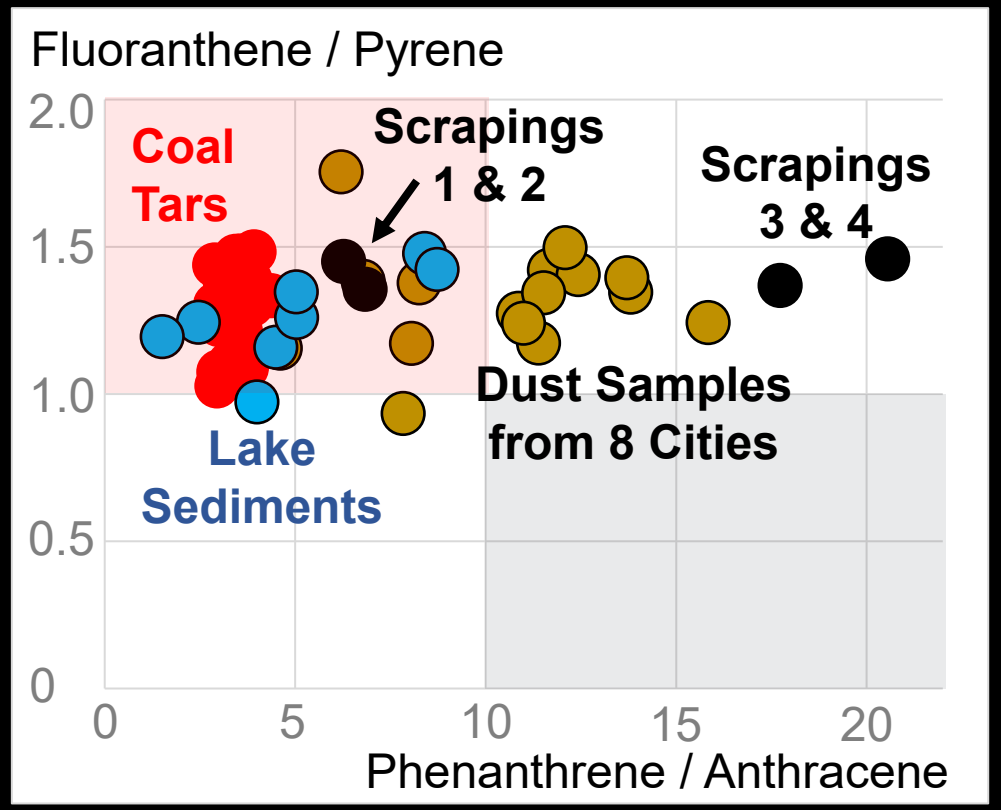


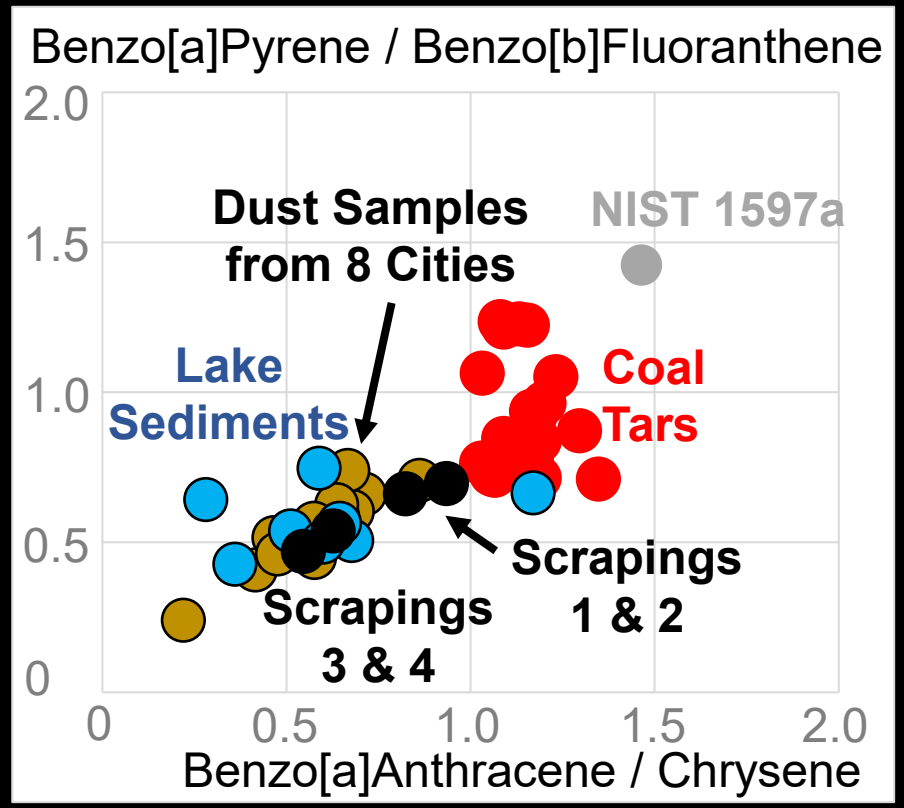




Map with 35 stream sample locations

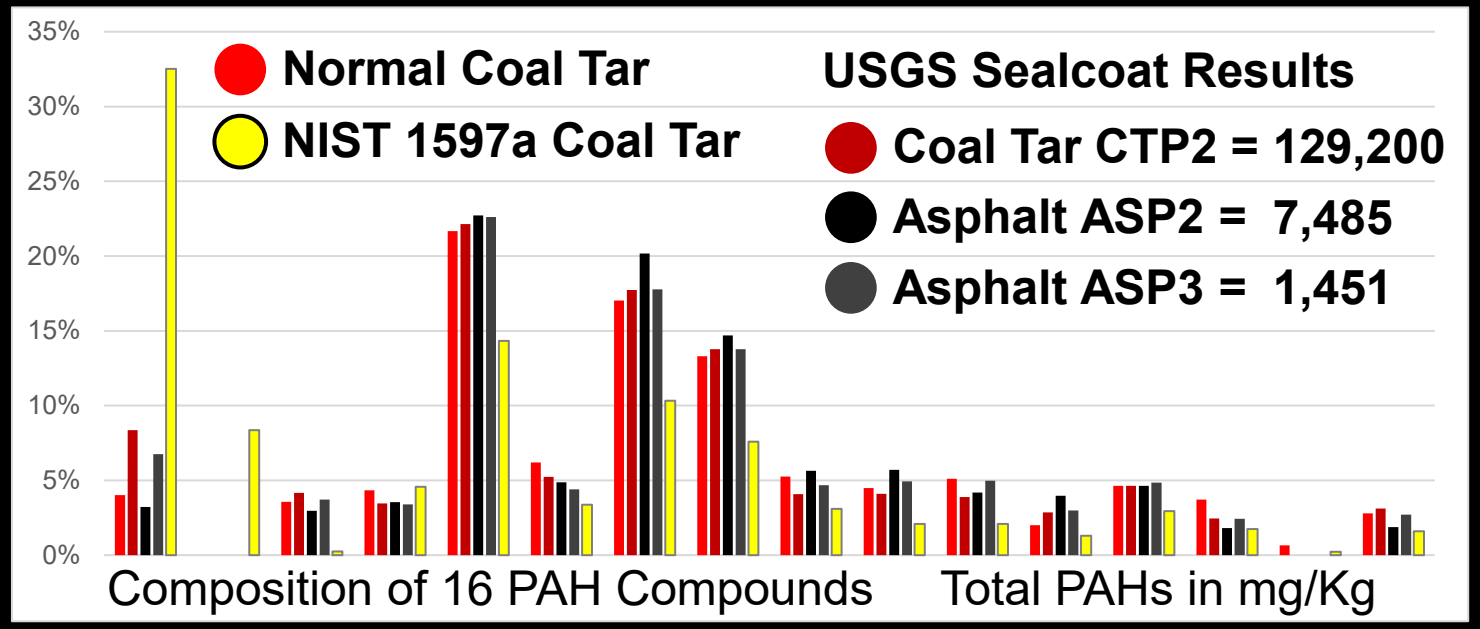
USGS: Parking Lot Dust & Urban Lake Sediments





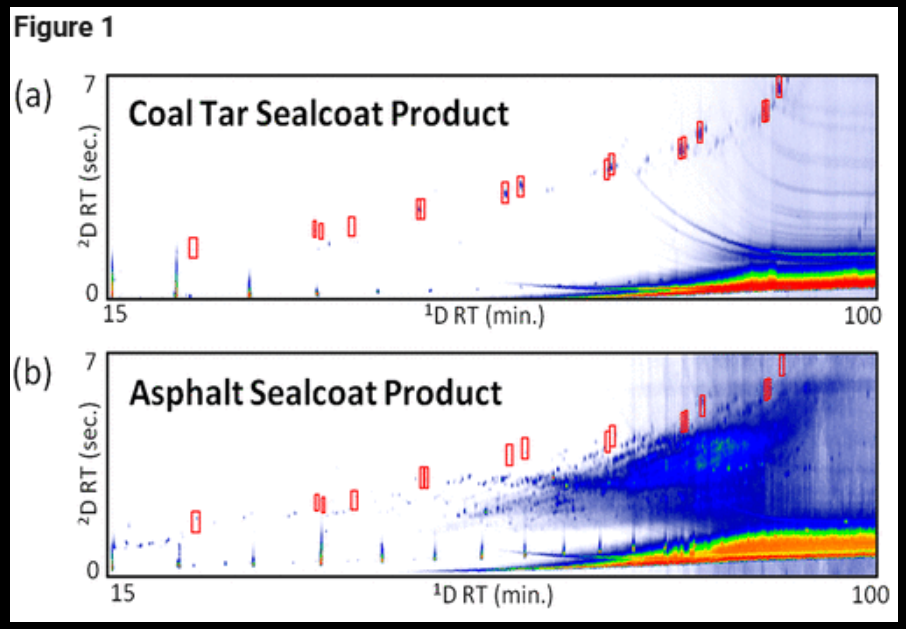
USGS Lake Locations	16 PAHs PPM
Austin	11.8
Chicago	19.3
Detroit	6.0
Wash, DC	20.1
Seattle	21.9
Minneapolis	33.3
Minneapolis	41.3
New Haven	47.9
EPA's PEC Aquatic Toxicity Limit	22.8

Source Identification? Be Wary of What you Read



USGS, Austin (2005) shows examples of asphalts contaminated with coal tars. Sealcoats provided by same manufacturer.

NIST SRM 1597a – now discontinued – and good riddance!



Ontario, Canada (2019) study shows red boxes with same PAH signatures. Their asphalt product is contaminated with coal tar, same as USGS!

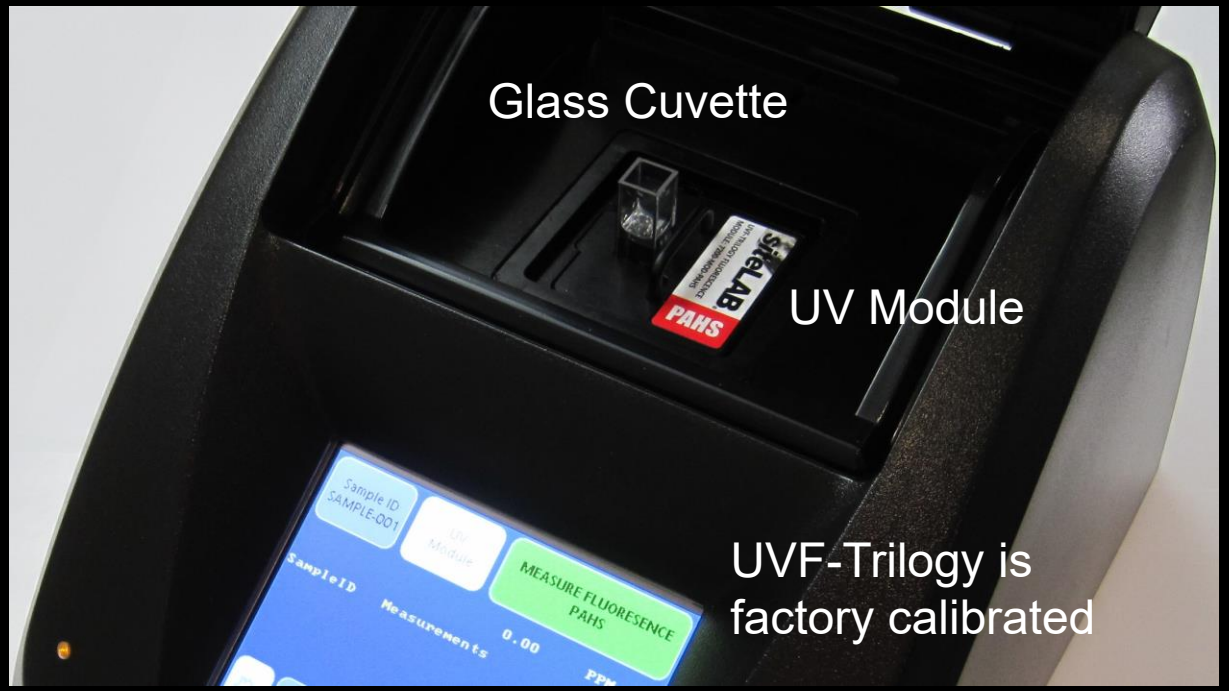
Forensic Analysis by Ultraviolet Fluorescence (UVF)

Screening method uses methanol and hexane to extract samples

Sitelab UVF-Trilogy analyzer is highly sensitive to aromatic hydrocarbons

Detects PAHs at 3 different wavelengths

Uses UV Modules fitted with UV LED light, excitation and emission optical filters



UV Modules Used For Hydrocarbon Fingerprinting

Module	Excitation	Emission	Hydrocarbons Detected
GRO	254 nm	270-290 nm	C6-C10 Range
EDRO	254 nm	300-400 nm	C10-C36 Range
PAHS	254 nm	400-420 nm	C12-C22 Range
TPHOIL	365 nm	420-600 nm	C14-C50 Range

Heavy PAHs

EPH Aromatics Target PAHs

Fluorescence Response Testing 8 PAH Compounds

Response (%)	EPH Aromatics	Target PAHs	Heavy PAHs
Phenanthrene, C14	320	12	0.3
Anthracene, C14	370	475	40
Fluoranthene, C16	24	13	168
Pyrene, C16	17	14	1.0
Benzo[a]Anthracene, C18	36	94	8
Chrysene, C18	240	38	0.1
Benzo[k]Fluoranthene, C20	80	645	460
Benzo[a]Pyrene, C20	33	330	290

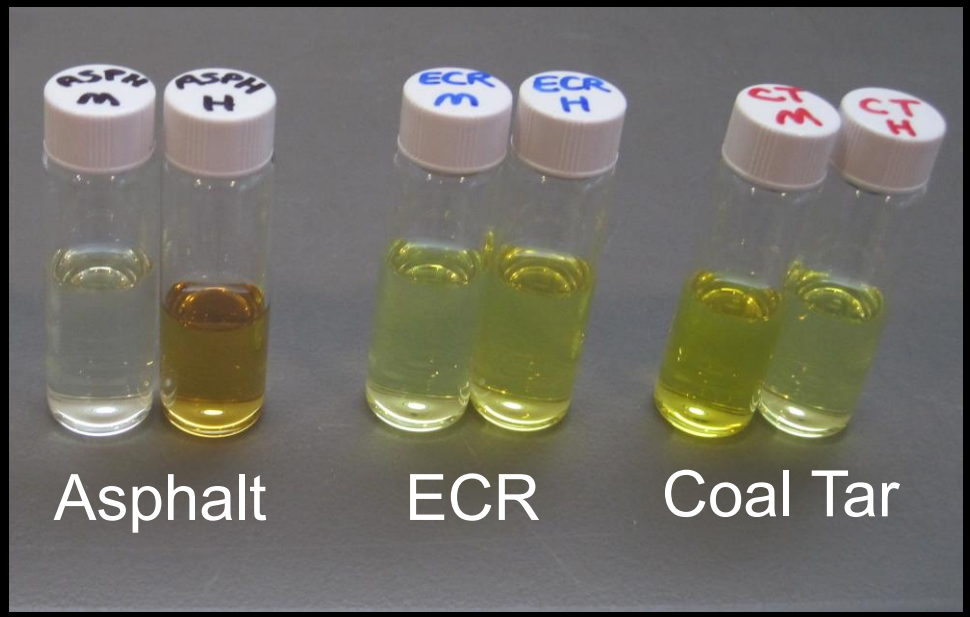
Sitelab CAL-060M

PAH calibration kit used for analysis

Sample Preparation and Extraction

Wet sealcoats dried indoors for 24 Hours

Crushed fragments prepared for labs



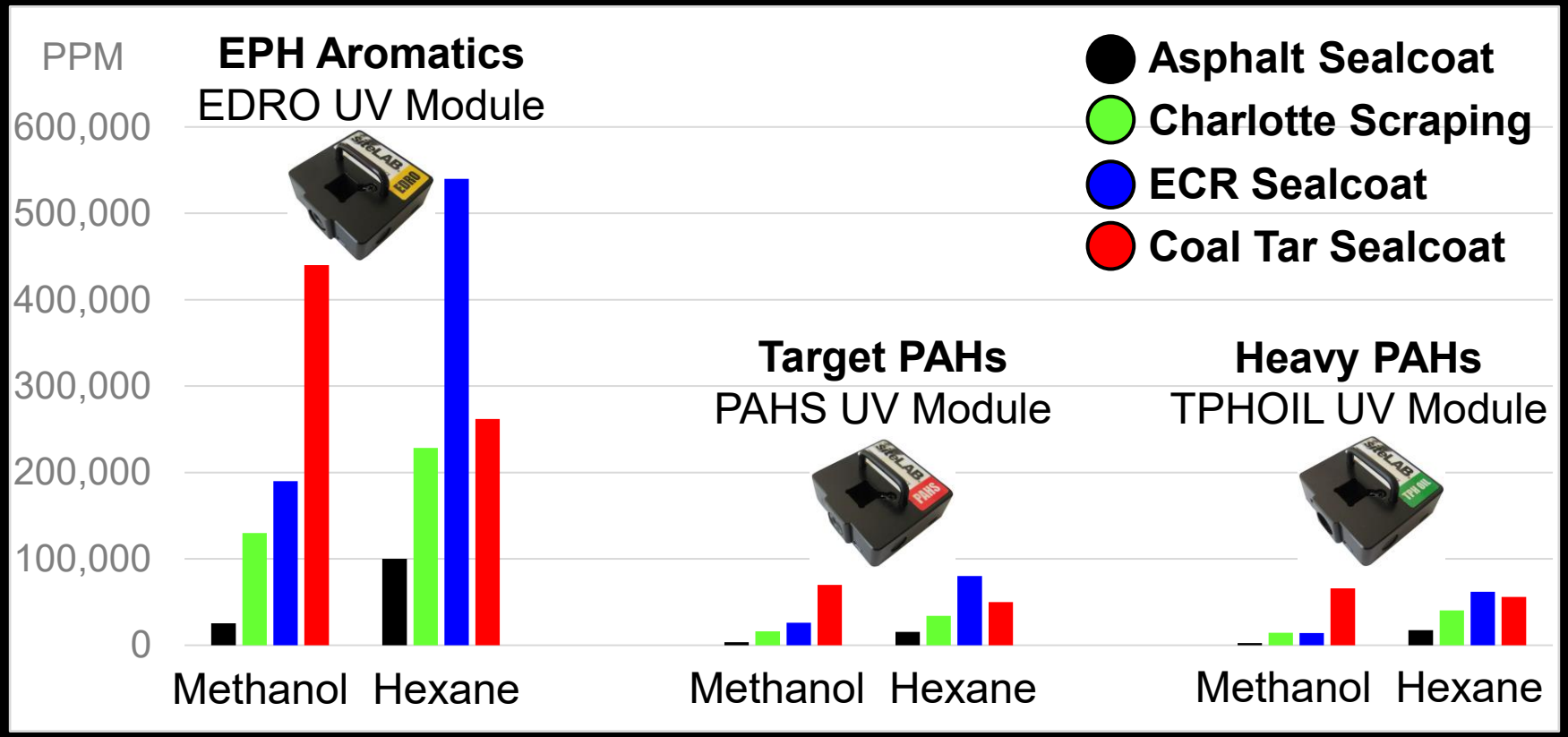
Filtered sample extracts in methanol and hexane solvents

Concentrations Detected in Sealcoating Products

ppm (mg/Kg)	Solvent	EPH Aromatics	Target PAHs	Heavy PAHs
Asphalt	Methanol	22,800	3,100	2,300
	Hexane	100,000	15,000	17,000
ECR	Methanol	190,000	26,000	14,000
	Hexane	540,000	80,000	62,000
Coal Tar	Methanol	440,000	70,000	66,000
	Hexane	262,000	50,000	56,000
Charlotte Scraping	Methanol	130,000	16,000	14,600
	Hexane	228,460	34,000	40,380

Samples extracted 24 hrs using 1 g with 20 mL solvent

Graphed Signatures in Sealcoats Using Two Solvents



Methanol is polar

It's weaker than hexane, but not in coal tars

More suitable, more accurate compared to EPA Method 8270

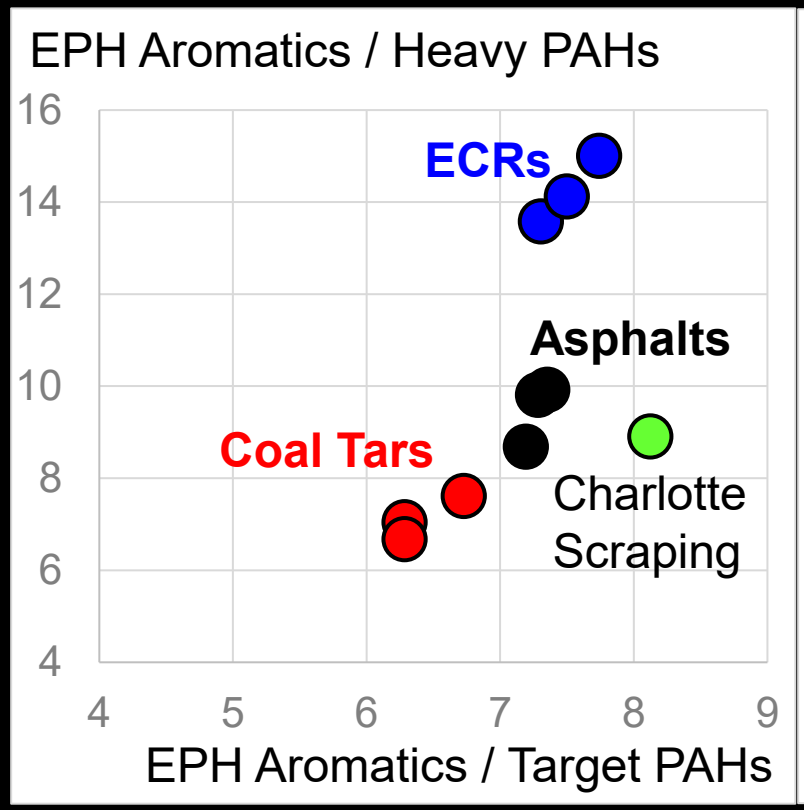
Hexane is non-polar

Extracts all the asphaltenes, methanol does not

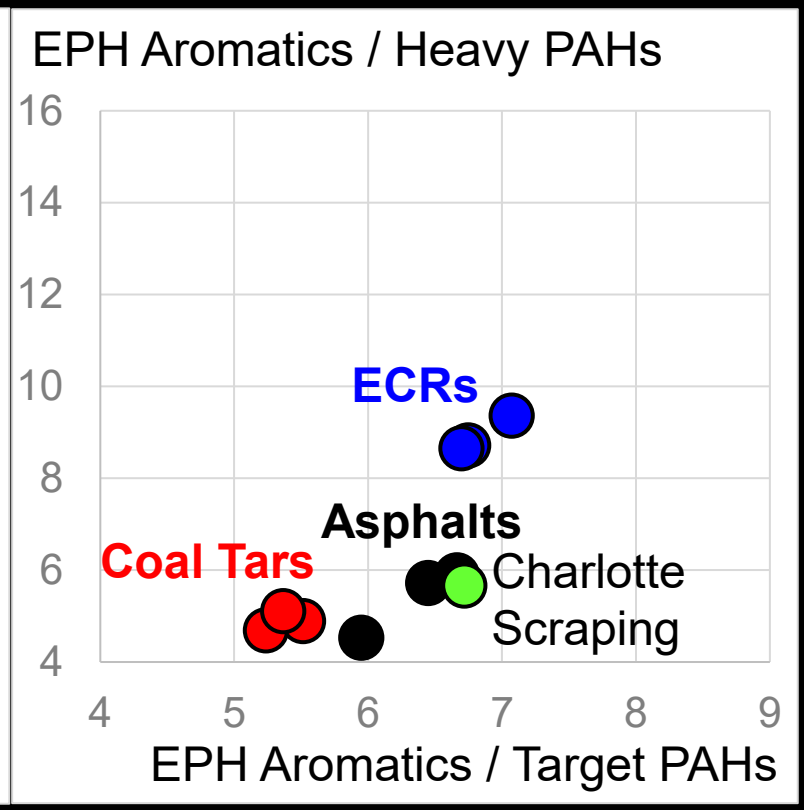
Over quantifies results, but is useful for fingerprinting

Double Ratio Plots Using UVF Data

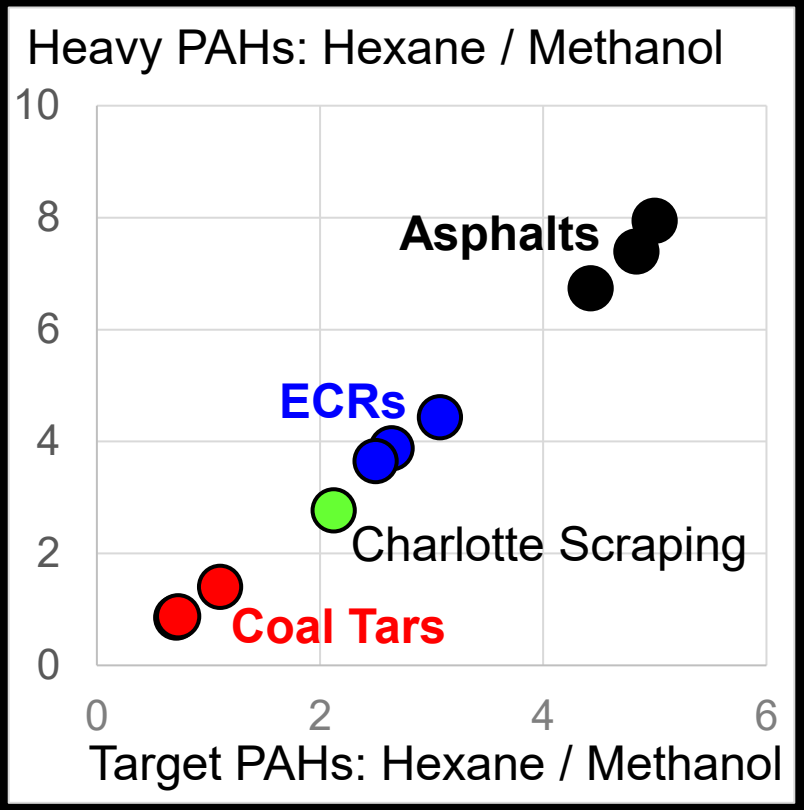
Methanol Extracts



Hexane Extracts



Heavy vs. Target PAHs



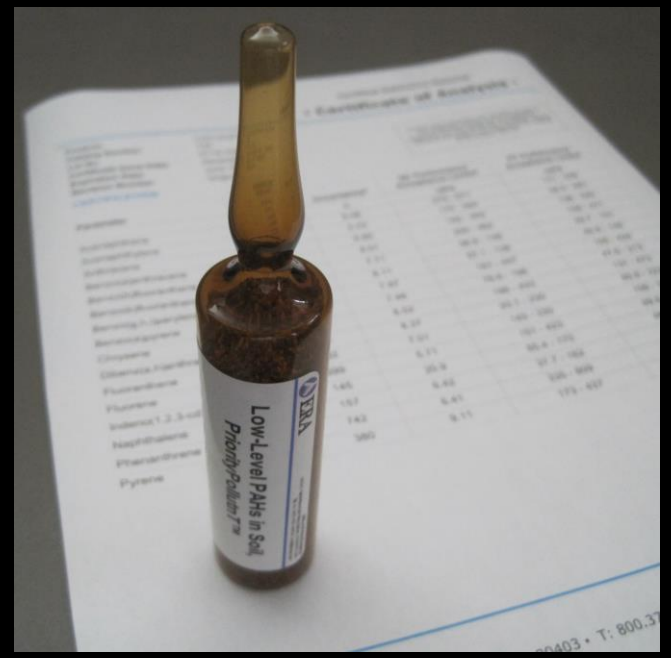
Correlation to Lab Results Testing Methanol Extracts

Results in mg/Kg	Lab 8270 Total PAHs	UVF-Trilogy Target PAHs
Asphalt	0, ND	3,100
ECR	25,585	26,000
Coal Tar	77,779	70,000
Asphalt with and without Coal Tar	2,387 0, ND	5,900 - 3,300 = 2,600

Original sample contained coal tar by ‘accident’

Performance Testing PAH in Soil Proficiency Sample

Results in µg/Kg Total 16 PAHs	Test Result	Certified Value	Recovery
UVF-Trilogy, Target PAHs	4,700	5,838	81%
ERA PAHs, Study Mean	4,029	5,838	69%
Benzo[a]Pyrene			**RPD**
UVF-Trilogy, BaP Coal Tar	235	194	19%
ERA BaP, Study Mean	126	194	43%
Acceptance Limits		48 – 213	



ERA 722 PAHs in Soil
Lot D115-722

Benzo[a]Pyrene Analysis in Reclaimed Asphalt

Sitelab CAL-BAP-COALTAR calibration standard

Used with UVF-Trilogy or handheld UVF-500D model

Developed to meet ADEPT UK guidelines testing BaP in reclaimed asphalt for reuse

Emerging Contaminants Tree:
Move Over PFAS… This Stuff is Low Hanging Fruit!

PFAS Chemicals
$$$$$

Expensive, if not impossible, to fix the problem.

Coal Tar Sealcoats
$

Cheap to fix, easily preventable. PAH-friendly asphalt-based sealcoats already exist.

The End, Thank You

Contact Info: Steve Greason
Sitelab Corporation
Website: www.site-lab.com
Phone: 978-363-2299
Email: sgreason@site-lab.com