The chemistry of stormwater runoff

Over 10,000 unique chemicals are present in urban road runoff

Du et al. 2017. Env. Sci. Processes and Impacts

Relatively few of them are identified

The chemicals that we know don’t appear to cause the toxicity

Sources of Toxics in Road Runoff – Isolating Haystacks

- Tire Wear
- Exhaust
- Brakes
- Washer Fluid

Automobile Leaks:
- Fuel
- Engine Oil
- Brake Fluid
- Engine Coolant
- Transmission Fluid

Which are most toxic? Which contribute most to toxicity?
Vehicle ‘Leaks’ in Road Runoff
Chemical Fingerprinting ‘Leaks’

Groups of unique non-target features can act as source signatures

Fluid or Leachate

Gear oil
Used motor oil
Transmission fluid
Antifreeze
Wiper fluid
Brake fluid
Power steering fluid

Ed Kolodziej & Kathy Peter; University of Washington - Tacoma
Sublethal effects in zebrafish embryos

- Pericardial Area (PCA)
- Periventral Area (PVA)
- Eye Area
- Length
- Runoff
- PCA/PVA
- Heart Rate
- Cardiovascular abnormalities

Control Runoff Relative to Controls
Transmission and brake fluid are the most acutely lethal.
TF and BF only seriously impair sublethal metrics > LC50.
UMO effect on heart is the most sensitive sublethal impact.
Tire dust tested on zebrafish embryos

- LC50 >100 g/L
- Severe HR reduction at 10 g/L
- CVA at 0.1 g/L
Fingerprinting Sources with qTOF HRMS at UW-T

- Antifreeze
- Used motor oil
- Washer Fluid
- Transmission Fluid
- Brake Fluid
- Urban road runoff
- Tire Dust
- Exhaust Particles

Proportion of sources

Validate mixture
Looking for toxic needles in source haystacks

- Antifreeze
- Transmission Fluid
- Brake Fluid
- Used motor oil
- Washer Fluid
- Urban road runoff
- Exhaust Particles

Proportion of sources

E.g. Explains most toxicity

Look for needle in this haystack
Could the needle be in the tire haystack?

Experiments Fall 2017

• Are coho sensitive to chemicals in tires?
• Are coho uniquely sensitive (e.g. vs chum)?
• Is the pathophysiology similar to urban runoff?
Generating Tire Powder for Testing
Generating Tire Powder for Testing
Tire Powder Leachate

50 g powder
100 µm filter sock
25 L water
24 h at 12 °C
Exposé fish 24 h
Range-finding tire toxicity with juv coho

Start adult pilot with same concentration range (0.1-1.0 g/L)
Pilot tests of tire toxicity with adult coho

- 650 g powder
- 100 µm filter sock (2)
- 650 L water
- 24 h at 8 °C
- Expose fish 24 h
Range-finding tire toxicity with adult coho

Adults showed similar acute toxicity as juveniles
Could the needle be in the tire haystack?

Similar to urban road runoff, **coho are sensitive** but **chum are not**
Next Steps in Sources Study

Analyze blood metrics for pathophysiology comparison with urban road runoff

Fractionate the heck out of the tire leachate (Ed Kolodziej UW-T)

Test other sources of toxics to road runoff