Sorption of PAH to humic acid and ironcarbonate particles - passive dosing vials for investigating the transport of organic contamination in stormwater runoff

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SORPTION OF PAH TO HUMIC ACID AND IRONCARBONATE PARTICLES
- PASSIVE DOSING VIALS FOR INVESTIGATING THE TRANSPORT OF ORGANIC CONTAMINATION IN STORMWATER RUNOFF

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Introduction

Growing urbanisation and increasing anthropogenic activities in urban areas have turned urban stormwater runoff into a surface water quality contamination problem.

Particles (often defined as > 0.45 µm) in stormwater runoff has been found to facilitate transport of organic contamination and metals, but little is known about the role of colloidal fractions including nano-sized particles (0.001-0.45 µm).

There is a risk that colloids and nano-sized particles will affect the efficiency of engineered treatment systems. This is due to high sorption potential as a result of large specific surface area and anticipated high abundance of colloids and nano-sized particles in stormwater runoff.

Aim

Investigate sorption of PAH's (Polycyclic Aromatic Hydrocarbons) to nano-particles by using:

- Organic and inorganic nano-particles as indicators of stormwater particles
- Passive dosing vials[1] containing ^{14}C PAH's:
  - Fluoranthene
  - Phenanthrene

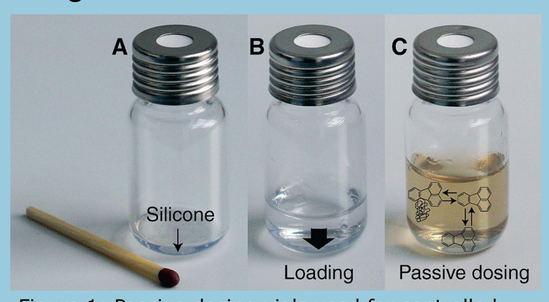


Figure 1: Passive dosing vials used for controlled release of ^{14}C PAH's into solutions containing particles.

Method

Two standard solutions containing humic acid- and iron(III)carbonate particles were prepared in pH range 2-9 and a dilution-series containing 6 dilutions were made. Measurements was conducted using passive dosing vials[1] and liquid scintillation counter (Figure 1).

Humic acid carbonate solution: **14.4 mgC/L** particle size: **80 nm**

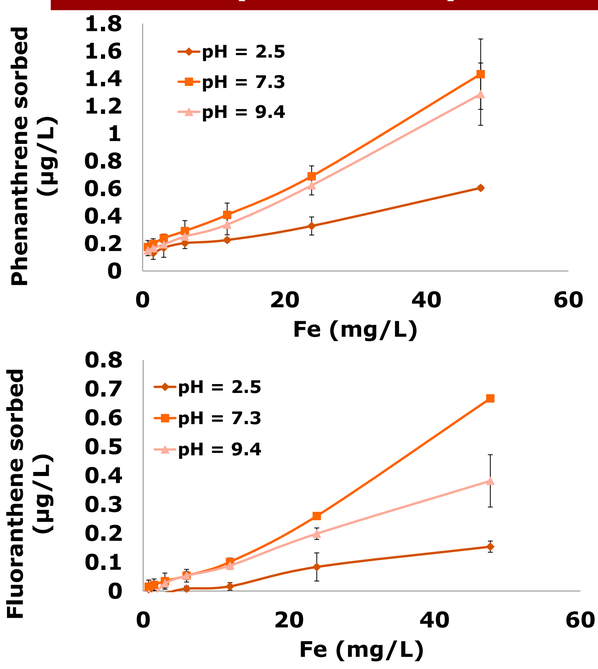
Iron(III)carbonate solution: **47.6 mg Fe/L** particle size: **22 nm**

Stormwater sample

A stormwater sample was filtered through a 1.7 µm glass fiber filter. This sample along with a non filtered stormwater sample (pH 6.75; NVOC of 3.19 mgC/L) were tested for there ability to sorb PAH using the passive dosing vials.

Filtered sample: 0.56 mg Fe/L
Non filtered sample: 7.2 mg Fe/L;, Suspended solid (SS) 241 mg/L

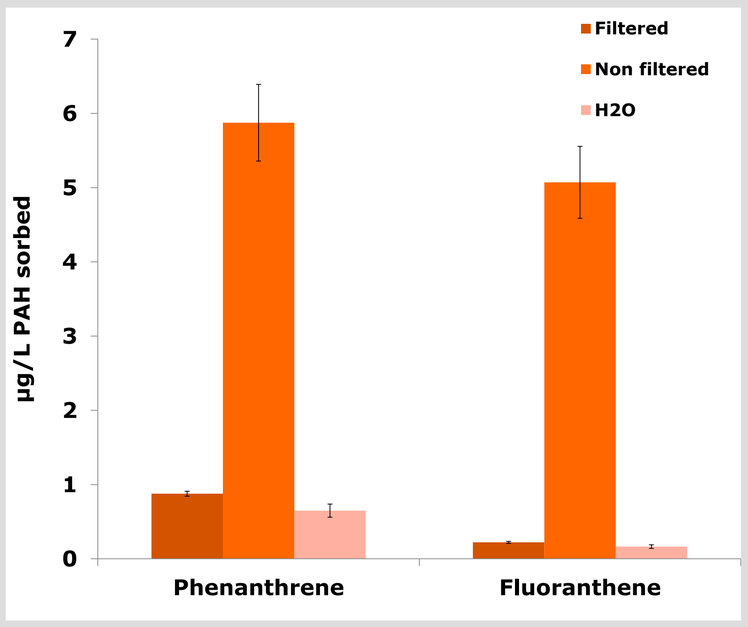
Results (Indicator particles)



- **Increasing concentration** of Fe(III)carbonate particles resulted in **increasing release** of **phenanthrene** and **fluoranthene** from the silicone membrane
- The sorption to the particles are **pH-depending** given **highest release** of PAH from silicone **at neutral pH**
- **Similar** sorption patterns were **observed** for solutions containing **humic acid carbonate** particles

Results (Stormwater samples)

- **Non filtered** sample contains particles **able to sorb PAH's**
- **Filtered** sample (1.7 µm filter) shows no difference to background
- The **higher sorption** of **phenanthrene** indicate the **presence of non-polar particles** in the sample



Conclusion

- Both PAHs were found to sorb to humic acid- and iron(III)carbonate nanoparticles
- Increasing concentration of particles gives increasing sorption of PAH's in the water phase
- A higher sorption of PAH to particles was observed at pH 7.3 than at pH2.5
- Phenanthrene is sorbing in a higher extent than fluoranthene for both particle solutions
- The highest sorption of fluoranthene was observed for humic acid particles

(1) Birch H. et. al,. **2010**; Anal. Chem.; *82*; 1142-1146