Automatic Sampler Efficiency for Suspended Solids
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Introduction
- Accurate capture and measurement of stormwater solids is crucial in evaluating the effects of stormwater runoff in aquatic environments and in determining the performance of various stormwater control devices.
- The rapid settling of large particles (>100 µm) in drainage systems raises concerns over whether an autosampler in the water column can adequately collect a representative sample of the water and solids during flow events.
- The literature indicates issues with autosamplers’ ability to capture the larger particles that may be in stormwater runoff from certain sites (e.g., highways).

Questions to Be Addressed
- Can autosamplers adequately capture the solids found in urban runoff?
- Does this capture ability extend over the entire range of particle sizes found in urban runoff?

Methods
- Sampler: American Sigma 900Max (purchased 2005) (Figure 1).
- Solids Mixture: Sil-Co-Sil® 250 and Sand (sieved < 1.7 mm) (Figs. 2, 3).
- Test concentration: 500 mg/L.
- Analytes: Suspended sediment concentration (SSC), wet-sieve SSC at 20, 38, 63, 106, 250, 500, 1000 µm.
- SSC Analysis Method: ASTM D3977.

Results and Discussion
- Effect of median particle size of mixture on solids recovery.
  - For the Sil-Co-Sil 250® only (d50 = 100 µm), sampler bottle concentrations were approximately 400 mg/L, while for the Sand + Sil-Co-Sil mixture, the bottle concentrations were approximately 200 – 250 mg/L (Figure 4).
  - Location of the sampling port in the continuously-stirred barrel had no effect on the bottle concentrations.
  - Statistically, no difference was seen between the samples sieved at 250 µm and the unsieved samples. Uncertain if due to lack of particles in mixture or inability of the sampler to capture those particles.

- Effect of sampler elevation on solids recovery (Figure 5).
  - A particle size distribution (PSD) analysis indicates that the autosampler bottles reflected the influent PSD at the lowest sampling elevation, but it began to diverge at the higher elevations, indicating a concern over the ability of the sampler to capture the larger solids in the mixture.
  - Question remained regarding why larger solids not captured. Was it due to mixing of the original sample or due to the autosampler?

- Additional testing was performed at two elevations of the autosampler (1.75 m and 6.75 m) to further refine an evaluation of the effects of elevation on recovery.
- Grab samples were collected from the water barrel spigot at the elevation where the automatic sampler intake was located. Challenge solution was only Sand + Sil-Co-Sil 250® since poorer recoveries seen with mixtures with larger particles.
- At smaller particle sizes (<63 – 106 µm), sampler recoveries match measured grab sample concentrations (Figure 6).
- At larger particle sizes, sampler recoveries slightly less than grab samples but not statistically significant.
- Percent recoveries are relatively consistent across the particle size range (Fig. 7).
- Substantial variability noted at larger particle sizes. Unsure if a result of few particles in the mixture at the sampling point.

Conclusions and Future Research
- The results seen here appear to indicate concerns in accurately measuring large particles in stormwater runoff flows.
- This is particularly critical in flow streams that are not well mixed and where the particles are traveling along the bottom of the pipe below the intake location.
- It is potentially likely that sampler elevation affects slightly the ability of autosamplers to repeatedly capture larger particles.
- This confirms past work showing that autosamplers may under-predict mass loadings at stormwater outfalls by about 5 to 10%. Larger under-predictions seen at certain source area monitoring locations where larger particles are in the flow stream (and have not settled in a lengthy drainage system).
- Future research: Repeat elevated sampler tests with wet-sieve analysis using a mixture that contains only large particles (>100 µm and <1700 µm).

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