Disinfection Byproduct Precursor Removal through Granular Activated Carbon at the SWSC West Parish Filtration Plant

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Disinfection Byproducts (DBPs)
- Potentially carcinogenic compounds formed when natural organic matter (NOM) in water, reacts with free chlorine disinfectant.
- NOM + Br₂ + HOCl → Cl₂, Br₂-DBPs
- Trihalomethanes (THMs) & Haloacetic Acids (HAA5) regulated in distribution systems by EPA at 80 ppb and 60 ppb respectively.
- Can be controlled by removing NOM through coagulation & particle filtration prior to disinfection.
- Removal of additional NOM by sorption is also utilized

US EPA Stage 2 DBP rule
- Enforces DBP regulations based on annual averages at several locations in distribution system, rather than annual averages over the entire system.
- Prompted Springfield Water & Sewer Commission to seek higher levels of NOM removal at the West Parish Filtration Plant.

Introduction

COAGULANT TRIALS
Full-scale plant coagulant trials conducted February 2011 – October 2011. Coagulants tested included aluminum sulfate (Alum) and PC-H180, a polyaluminum chloride (PACl).

Performance: assess time trending of turbidity, head loss (pressure drop across filter), and flow data. UV254 data collected to assess NOM removal.

Typical Filter Performance

PACl Trials (February, March, November 2011)
- Average reduction in UV254 absorbance: 37%

Alum Trials (February, March 2011)
- Average reduction in UV254 absorbance: 34%

Conclusions
- PACl and alum exhibited reductions in UV254 absorbance of 37% and 34% compared to control filters respectively, indicating increased removal of NOM (and DBP precursors).
- Operational problems were encountered during trial periods
- High head loss rates necessitated a frequency of backwashing which would not be feasible under current NPDES permit.
- Early turbidity breakthrough occurred during all trial periods.
- Due to operational challenges, other options being examined.

MEDIA PILOTING
Beginning July 2012, use of granular activated carbon (GAC) as filter media will be examined for removal of NOM.
- Current filter bed conditions at plant are 24 inches anthracite over 15 inches sand.
- 30 inches Calgon FILTRASORB® 300 GAC over 9 inches sand will be piloted to assess NOM removal potential and filtration performance.

Experimental Method: Pilot Filtration
- Parallel 6” diameter PVC columns (control and pilot) filled with appropriate depth of media to simulate bed conditions.
- Plant-flocculated water run through at design hydraulic loading rate (flow/area).
- Effluent turbidity, head loss data collected to analyze filter performance.
- UV254 total organic carbon (TOC) data collected to assess NOM removal.

Expected Results: NOM Breakthrough Curve
- As GAC’s adsorption capacity is used up, filter effluent NOM will approach constant level maintained by anthracite filter.
- Area between GAC breakthrough curve and control effluent curve represents removed DBP precursors

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