DBP Control in a Sludge Blanket Water Treatment Clarification Process Using Pretreatment Chlorination

Presented by: Stan Szczpanek and Sandy Weiss
17,000 wastewater customers
1% Industrial/other
7% Commercial
92% Residential
638,000 water customers

Customer base:

More than 1,000 employees

Serving approximately 2.2 million people in 36 counties

Largest regulated water and wastewater service provider in PA

Roots date back to early 1800s, incorporated in 1904

Subsidiary of American Water Works Co., Inc.

Our Company
Our Pennsylvania Infrastructure

- 11.2 MGD permitted wastewater capacity
- 202 MGD average daily delivery water capacity
- Sewer pipe 10,115 miles of water and distribution system
- 253 booster pumping stations
- 279 water storage tanks
- Transmission storage & transmission

Serving 17 percent of the 6 wastewater plants Partnership for Safe Water Directors Award from 30 facilities received 36 surface water plants Treatment Facilities

- 121 groundwater well sources
- 54 regulated dams
- 1% purchased water
- 7% groundwater
- 92% surface water

Source of Supply

AMERICAN WATER
PENNSYLVANIA
Drinkings Directors Award: Received 10-Year Partnership for Safe

Employees: 1 Full Time

Storage tanks: 8 With 9.1 MGD total Storage

Booster stations: 8

Population served: 90,000-plus

Average daily delivery: 10.5 MGD

Plant's design capacity: 18 MGD

Primary source of supply: Schuylkill River

Norristown Water Treatment Plant - Overview

American Water Pennsylvania
Second plant built on the site in 1966
American Water Works Co. bought The Norristown Water Co. in 1962
Chlorination was started during the second decade of the 20th century
The first filters were installed in 1901
Turbidity during rain events
Initially, water was unfiltered
In 1875, the intake was relocated over a natural spring in the river to clear

Historic Retrospect of the Norristown Treatment Plant

Founded as The Norristown Insurance & Water Co. in 1847

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Historic Retrospect of the Norristown Treatment Plant
- Pressed on site
- Sludge thickened and discharged
- Plant becomes zero control
- Potassium permanganate
- Sedimentation basins
- Conventional clarification
- Super pulsators replace

Plant upgrades included:
- Retiring two older structures phased in over 5 years
- A new $50 million plant is

1996 Groundbreaking
Norristown Water Treatment Plant – Treatment Process

- Clarification:
  - Four Superpulsator® units for clarification
  - Ferric chloride is the primary coagulant
- Filtration:
  - Seven granular activated carbon filters
- Disinfection:
  - Gas chlorine applied prior to Superpulsators and after filtration
  - Chlorine contact time (CT) is met primarily in post filtration treatment
  - Gaseous ammonia is used to form monochloramine prior to distributing the water from the treatment plant
- Aesthetics:
  - Potassium permanganate is added for oxidation of iron and manganese
Norristown Water Treatment Plant Schematic
Treatment Challenge – Increasing TTHM Levels
Treatment changes were required to meet new regulations.

Compliance sampling begins October 2012.

For Horistown:
- New high THM sites to be used for compliance determination
- Location (LRQA)
- Established meeting compliance requirements at each sample

Stage 2 DBP Rule
The Superpulsators #4 with the ammonia addition
Results showed a significant drop in THM formation in
Superpulsators #3 and #4
Comparative THM samples were collected from
Superpulsators clarifiers (SP #4)
Applying chloramines to the inlet of one of the four
In September of 2009, we conducted a small scale trial by
Superpulsators to post clarification
Moved pre-chlorine from receiving directly into the
Superpulsators
Found majority of THM formations were being created in the
Conducted mini trials throughout 2009
Taking measures to lower THMs

[Logo: American Water Pennsylvania]
### TTHM Results (ug/L)

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<th>Plant Effluent</th>
<th>Transfer Clarwell</th>
<th>Filter Effluent</th>
<th>Superplasductor Effluent</th>
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<td>18.8</td>
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### Process Changes

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<td>25 mg/l</td>
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</tr>
</tbody>
</table>

- Carbon Feed
- Powdered Activated Carbon
- Permutite Dose
- Permutate Dose
- Chlorine Feed Prior to Superplasactors
- Chlorine Feed at Top

Looking at the Data
Chemical Company.

The time frame chosen to conduct a full plant trial was during the 3rd quarter where water temperatures are traditionally the warmest and THM formations are traditionally the highest.

The Las product is AQUA AID-E-40TM which is NSF 60 Certified.

A full plant trial was conducted from July 13 through Oct 13 2010.
clear well thus meeting all required contact times. Achieving break point chlorination prior to the 2.6 MG. All other plant processes remained the same including watch for possible plant process nitification. Filter effluent samples were analyzed for nitrate to check for septic conditions. HPC samples were analyzed on a weekly basis to concentrations. Monochloramines, total and free ammonia, and THMs chlorine and ammonia ratios, total and free chlorine, parameters monitored were iron and manganese levels.

Sample Analyses Conducted
- Plant effluent
- Superpulsator effluent
- Sample streams: capable of testing two separate and total chlorine, ammonia, monochloramine
- Measured free ammonia, total
- 5-week trial
- For an on-site demonstration
- Online analyzer with 2 sample lines
- Provided a Chemscan Chlormination
- In a joint cooperative, ASA Analytics

Chemscan Analyzer Demo
The graph on the right shows the possible Stage 2 sites collected in quarter in two different years. Comparing two sampling quarters in the same year and comparing the same sampling samples collected July 2010, Oct 2009, and Oct 2010. Comparing two.

Additional Supporting Information
Tropical Storm Nicole drops 5.5 inches of rain in 12 hours.

Sufficient enough to oxidize manganese.

Traditional lower pH ranges utilized by the plant were not

Manganese issues

Need to elevate ferric feed to increase organic removal.

Chloramine/manganese interferences with the DPD free chlorine

Operators maintained a 1.50 Total Chlorine Residual.

No flow backwash. Chemical feed changes based on residual.

Hotest summer and one of the driest on record.

Challenges Faced During the 2010 Trial
What We Evaluated

1. Is chlorine application prior to the Superphosphatators effective?
2. Can manganese levels be controlled throughout the plant?
3. If chloraminated water is applied for an extended period of time, does it change the bacterial quality of the GAC filters?
4. Measure the effects of nitriication in the treatment plant.
5. WILL prechloramination impact ability of GAC filters to remove

HAAS?
Septic conditions from forming.

Disinfectant residual maintained was sufficient to prevent 2 MPN, which is dramatic evidence that the chloramine 2 MPN ranged from 40 most probable Number (MPN) down to 1 in the sludge blanks. The range of counts found on the HPC Plate is the sludge blanks. The range of counts found on the HPC give additional confirmation in determining septic conditions. The Superpulseator effluent HPC analysis was conducted to blankers.

- No evidence of septic conditions being formed in the sludge.
- Soluble manganese levels remain consistently low showing effluent every 4 hours.
- Soluble manganese was analyzed on the Superpulseator manganese and HPC.
- Two analyses were performed which included soluble manganese levels.

Becoming septic?

Effective at preventing the sludge blanks from forming septic conditions prior to the Superpulseators.

1. Is chloramine application prior to the Superpulseators
October 1. The raw water manganese levels peaked at a level of 1.86mg/L at 0400.

Nicole which impacted the Norristown area between September 30 and October 1 was due to tropical storm

**NOTE:** 0.323 mg/L spike found on October 1 was due to tropical storm

Superpulsator Effluent Soluble Manganese Results
In addition to optimizing the potassium permanganate, manganese was also increased to approximate \( \text{pH} \) to approximately 7.2 s.u.

During the trials, an alternate way to treat for the high levels of free chlorine.

Treatment of manganese through the pre-prior to the application of the LAS, the Norristown plant manganese tests.

Effluent through a combination of total and soluble Superpulsator effluent, combined with effluent and plant throughout the entire process including raw water.

During the trials, manganese levels were monitored 0.250 mg/L to 3.0 mg/L pre-trial: On average, the raw water manganese results are

 Chlorine?

2. Can manganese levels be controlled throughout the plant process without the use of pre-chlorinated free plant?
Counts recorded were minimal.

Once the filter was backwashed and put into service HPC
counts

The greater the number of hours, the greater the HPC
hours on the filter itself.

MPN counts of the HPC, changes with the number of
The GAC filters' bacterial quality, measured through the
HPC to monitor bacterial growth.

The individual filter effluent water was used to analyze for

3. If chloraminated water is applied for an extended

period of time, does it change the bacterial quality

of the GAC filters?
Properly treated, nitrate concentrations fluctuate up and down and not continually increasing in levels. The deviations recorded are minimal with nitrate levels from July 20 which resulted in a concentration of 3.80 mg/L. The highest recorded nitrate result was a concentration of 3.75 mg/L. The last sample collected had a concentration of 3.00 mg/L, and the last sample collected had 3.60 mg/L nitrate. The first nitrate sample collected July 26, resulted in a concentration of 1.60 mg/L. A combined filter effluent sample was tested for nitrate 7 times over the trial period to monitor the plant process for indications of nitrication due to the added loadings of ammonia in the process.

4. Does it increase the levels of nitrites in the plant?
Contaminants

All HAAS5 results document prechloramination has no effect on the ability of the GAC filters to remove HAAS.

A 6.5 ug/L with an average HAAS5 result of 6.5 ug/L.

1.0 ug/L, while in 2010 the highest HAAS5 single result was 1.0.6

Single result was 14.0 ug/L with an average HAAS5 result of 5.8.

Results collected in August of 2006. In 2008, the highest HAAS5

Tests collected from 2010 were compared to the HAAS5.

Lastly, Stage 2 DBP samples were collected in August 2010.

Those four sites was 4.5 ug/L.

During the trial, the four Stage 1 compliance samples were

collected and analyzed October 6. The average HAAS5 result of

15.2 ug/L in 2008.

2000, the highest HAAS5 running annual average (RAA) was

Since the GAC filters were installed and put into service in

5. Will prechloramination impact ability of GAC filters?
The first sampling conducted on July 20 is prior to the start of October 26, 2011.
The 2011 Trial officially began July 24, 2011 and ended.

2011 In-House Plant Trial Samples
Challenges Faced During the 2011 Trial

- Insufficient enough to oxidize manganese
  - Traditional lower pH ranges utilized by the plant were not

Manganese Issues

- Need to elevate ferric feed to increase organic removal
- Residual. Operators maintained a 1.50 Total Chlorine Residual.
- Still no flow packing. Chemical feed changes based on Hurricane Irene hits Norristown August 28, 2011
  - One month after Hurricane Irene hits Norristown.
  - One of the wettest months on record. A total of 14.4 inches in
  - Very hot end of spring beginning of summer and August was

Pennsylvania American Water
LATS should begin feeding something in May.

- Received approval for operating permit amendment to feed LATS.
- Purchased the Chemscans online chloramination analyzer.
- Utilization of an onsite bulk tank.
- Chemical feed system.
- Equipment purchased to feed LATS through a permanent

Moving Forward
Current RAA ......... 0.040 mg/L

Where We Were... And Where We Are Now!