Ohio Public Water Systems and Phosphate Use ... revisited

Lake Erie Phosphorus Task Force Meeting
June 25, 2008

Outline
- “Cliff Notes” review of 2007 presentation
- PWS options for corrosion control – and what they typically select in Ohio
- Statistics on PWS phosphate use
- WWTP effluent vs. PWS phosphate levels
2007 “Cliff Notes”

- Phosphates added for corrosion control, Fe/Mn sequestration, filter aid, scale inhibition and chlorine stabilization
- Forms used in Ohio are phosphate, orthophosphate, polyphosphates, Zinc orthophosphate
- Lead and Copper Rule Timeframe:
  - 1991 USEPA Lead and Copper Rule
  - 1993 Ohio EPA adopted lead and copper rules
  - Mid-90s to current: PWS compliance with rule phased in, systems adding Corrosion Control or alternative

Corrections – Examples of PWSs using PO4

*Our central database contained a number of incorrect dates (data migration issues)... highlighting the difficulties of compiling an accurate basin-wide assessment of who adds phosphate and when.*

Bucyrus (prior to 1979), Upper Sandusky (Prior to 1982)
  - 2001-PO4 addition

Fremont (prior to 1978)
  - 2000-PO4 addition

Toledo (1997), Cleveland (1996)

Akron – prior to 1992 PO4 addition
  - 1998 OEPA letter requiring 0.6 mg/L minimum
Corrosion Control – Options

If high lead and copper results trigger CC treatment, then systems chose one of the following:

• pH and CaCO3 Control (used often in Ohio)
• Lead line replacement (costly and not widely done)
• Addition of corrosion inhibitor
  • Phosphate-based: zinc orthophosphate, orthophosphate, PO4, or polyphosphate, blend of Ortho-P and PO4
  • Silica-based: listed in rule but little or no current application in OH

Some PWS are changing the form of inhibitor in response to Pb/Cu Rule

Typical Dosing Levels

• Initial build-up period (target 1.0-3.0 mg/L - total PO4)

• Maintenance Levels
  • Target 0.5-1.0 mg/L
  • Actual Phosphate Levels in Finished Water NW/NE Districts is 0.59 mg/L (mostly within 0.05-1.2 mg/L)

• Data reviewed from PWS MORs submitted electronically. All other MORs stored in OEPA district files
Ohio EPA Districts

This study focused on the NW and NE districts

How many PWS Add Phosphate in our Northern districts?

NWDO and NEDO Summary
(3267 total SW, GW, PSW, PGW)

Treatment Objective = Corrosion Control, FeMn Removal, Filter Aid, Other

- “Phosphate Added” 106/3267 (3.2%)
- “Chemical Addition” 59/3267 (1.8%)

Assumed all "chemical addition" was phosphate – possibly an overestimate
Minnesota Phosphorus Study

- 2003 Public concern over eutrophication…pressure to ban P in automatic dishwasher detergents
- 2004 Comprehensive Report included analysis of Point and Non Point Sources with estimated Total P and Bioavailable P for each source.
- **Estimated Contribution to POTWs from Water Treatment Chemicals** ranges from 1.7% to 5.7% in each of the basins and was 3.1% statewide of the total POTW influent phosphorus.
- For comparison purposes: approximately 40% of Minnesota PWS use some form of phosphate (~5% of Ohio LE basin PWS use PO4, but ~ 50% of the population on public water)

What did we look at?

Requested to review our PWS phosphate data in greater detail and compare with WWTP effluent (total P)

**Key Question**…

*Is there a correlation between PWS initiation of Phosphate treatment and increased Total P levels in the WWTP effluent?*
**WWTP Discharge Data**

- 1990-2006 Ohio EPA SWIMS database
- WWTP – Total P and Flow from major and minor NPDES permitted dischargers in the LE Basin
- Basin-wide trends
- WWTP and local PWS comparison

**Basin-wide Trends**

- **Majors:** Total P limit = 1.0 mg/L in Lake Erie Basin
  - Discharge >1 MGD
  - Most have very consistent Total P levels in their effluent and trends in discharge not evident (no surprise here)

- **Minors:** No basin-wide P limit in Lake Erie Basin
  - Wide variation in Total P concentration from facility to facility and at the same station
  - Overall trend (AJ CHECK) slight decrease in Total P levels in last few years (probably related to taking care of “bad actors”)
**WWTP-PWS Comparison**

**Selection criteria**
- PWS data available
- PWS added PO4 to process during 1996-2006
  - Date of change and dosing levels known
- WWTP and PWS serve same area and assume that the PWS is primary source to the WWTP
- Attempted to identify both Major and Minor WWTPs and in multiple watersheds

**PWS-WWTP Comparisons**
- Toledo PWS: Added PO4 in 1997 (avg=0.3mg/L), Major WWTP
- Swanton PWS: Added PO4 in 2001 (avg=0.8 mg/L), Major WWTP
- Farmland Foods: Added PO4 mid-2006 (avg=?), Minor WWTP
- Bradner PWS: Added PO4 in August 2003 (avg=0.3-1.2), Minor WWTP
- Ottawa County Regional PWS: Added PO4 in Oct 2004 (avg=0.3-0.6)
  - Portage Cataba Island WWTP, Minor
  - Danbury Twp WWTP, Major
  - Oak Harbor WWTP, Minor
  - Port Clinton WWTP, Major
Mean Annual WWTP Final Outfall Phosphorous Concentration

MAJOR SYSTEMS  N = 76

- red circle: median
- blue triangle: average

Mean Annual WWTP Final Outfall Phosphorous Concentration

MINOR SYSTEMS  N = 302

- red circle: median
- blue triangle: average
Ottawa WWTP

# 2PD00028

Major

N = 1135

lin.slope = -0.02 mg/L/year

r² = 0.18

8 data points > 4.0 mg/L

Blue curve: loess regression

Red curve: linear regression

Green curve: mean yearly discharge (mgd)

Orange curve: mean yearly Phosphorous (mg/L)

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0.0 0.5 1.0 1.5 2.0 2.5 3.0

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Blue curve: loess regression

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Green curve: mean yearly discharge (mgd * 10⁻⁷)

Orange curve: mean yearly Phosphorous (mg/L)


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Red curve: linear regression

Green curve: mean yearly discharge (mgd * 10⁻⁷)

Orange curve: mean yearly Phosphorous (mg/L)

PO₄ adjusted

2002-2003

PO₄ added

Oct. 2004
WWTP Final Outfall P Time Series
Portage Catawba Island WWTP  # 2PJ00004  Minor  N = 847
lin.slope= -0.006 mg/L/year  r2= 0.01
5 data points between 10 and 54 mg/L
DW PO4 feed rates: 0.3-0.6 mg/L
Blue curve: loess regression
Red curve: linear regression
Green curve: mean yearly discharge (mgd * 10e-7)
Orange curve: mean yearly Phosphorous (mg/L)

WWTP Final Outfall P Time Series
Danbury Twp WWTP  # 2PG00053  Major  N = 254
lin.slope=-0.136mg/L/year  r2=0.42  Sen's slope=-0.006mg/L/year  Sen's.pval=0
one data point at 18 mg/L
DW PO4 feed rates: 0.3-0.6 mg/L
Blue curve: loess regression
Red curve: linear regression
Green curve: mean yearly discharge (mgd * 10e-7)
Orange curve: mean yearly Phosphorous (mg/L)
Thank you !!

- Michael Slattery - conducted statistical analysis and graphical presentations (S-Plus)

- DSW – for providing the SWIMS – NPDES data
Questions??

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**FWMC (mg/L)**

**WWTP Final Outfall Flow Weighted Mean P Concentration, by Size**

LEDB Discharge Basin; 1995-2006

- **Major system discharges > 1 mgd**
  - N = 78

- **Minor**
  - N = 305