MASSACHUSETTS WATER POLLUTION CONTROL ASSOCIATION

FALL 2019

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MASS WATERS

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Facility Profile— Hull WWTF

Location: Hull, MA

Startup Date: 1980

Design Flow: 3.07 MGD

Grade: 6

Type of Facility: Conventional Activated Sludge

Collection System: Four miles of 30- and 36-inch diameter interceptor sewer, approximately 40 miles of 6- to 24- inch collector sewers, some dating to the late 1800s, seven pumping stations, approximately 14,000 feet of force mains, 175 town-owned grinder pumps, and approximately 2,000 manholes.

Process Description: The Water Pollution Control Facility (WPCF) is located on the north side of the peninsula that juts out into the Massachusetts Bay south of Boston and serves the Town of Hull. The WPCF is surrounded by water on two sides and residential neighborhoods on the others. Due to its location, resiliency is important, as is odor control, because of the proximity of neighbors. The WPCF is currently operated by Woodard & Curran.

Flow enters the facility via a 36-inch interceptor and flows by gravity through the headworks, which includes an influent gate, mechanical bar screen and an aerated grit tank. Flow is then pumped up to the primary clarifiers, which are only in service during the winter months or peak flow events, or directly to the aeration tanks via five influent pumps.

The four aeration tanks are arranged into two parallel trains. Two of the tanks (1 train) are retrofitted with diffused air and two have the original mechanical aerators. Only one train is typically in service during dry weather using a step feed mode, with 100% of the return activated sludge (RAS) and approximately 10% of the influent fed to the first tank while the balance of the influent is fed to the second aeration tank in the process. During high flow periods, operation of the aeration tanks is switched to a modified contact stabilization mode with 100% of RAS sent to the first aeration tank and 100% of influent to the second aeration tank. After aeration, the mixed liquor flows to the secondary clarifiers for settling. RAS is pumped back to the first aeration tank.

(continued on page 4)

INSIDE THIS ISSUE:

Frank Cavaleri – Area Manager, Robert Scott – Area Manager, Eric Sutton – O&M Technician, Bill Boornazian – Assistant Plant Manager, Aram Varjabedian – Plant Manager, Joe Basler – Lead Operator, Andrew Zamanian – Intern, Not shown: Dave Wilson – O&M Technician, Ryan Holman – O&M Technician

LESS IS BETTER! - BENEFITS OF LESS CHEMICALS WHEN APPLIED TO BIOLOGICAL PHOSPHOROUS REMOVAL

Many facilities are concerned with the need to reduce the use of chemicals. Whether it is from increased environmental awareness, or having a desire to reduce the exposure to employees as well as the public, or as a cost savings to your budget, all of these efforts are directly linked to our work as wastewater operators. Today's responsible operators must have an understanding of the ultimate fate of each chemical being used in their process. By using "less is better" practices, operators and their supervisors will more effectively address the government regulations that have been established to prevent risks to personnel and the environment. With the use of chemicals, personnel need to plan for proper procedures and protection, have the proper PPE, and adequately protect the environment from the chemicals and their byproducts that are generated (which turns out to be a lot of extra effort).

The wastewater industry is now operating a process that enhances safety, adds value and performance across every aspect of our process, and helps to protect the environment, with the reduction and even the elimination of chemicals. As an industry we must work together in order to encourage innovation, and deliver greater value to our taxpayers and stakeholders. Safe, efficient, environmentally responsible operations, that deliver value for all is simply good business.

Positive Benefits from Reduced Chemicals:

- Safety is improved; from the reduction of contact with chemicals, heavy lifting and moving, sampling, staging and slipping
- Physical exertion is reduced; physical requirements involved with replenishing and refilling chemicals
- Labor cost reduction; time and effort involved with monitoring, accepting delivery, and adjusting chemical additions are reduced or eliminated
- Chemical and Electrical costs reduction; budget costs are reduced when chemical costs are decreased or eliminated, electrical costs are reduced when pumps are decreased or eliminated
- Reduced expenditure of equipment and parts; wear and tear of parts, replacement parts and costs associated are reduced or completely eliminated
- Maintenance reduction; maintenance of pumps and equipment required for chemical dosing are reduced or eliminated
- Process performance and efficiency improved; biological treatment is more stable and consistent, less chemical adjustment and monitoring, less solids are removed with Biological Phosphorous Removal
- Aluminum reduction in effluent; with the reduction or elimination of aluminum salts, aluminum is reduced in the effluent which will help to meet your NPDES aluminum permit limits

Less Chemicals in = Less Chemicals Out: Less is Better

At this time, I encourage all operators to engage in learning from the wastewater treatment facilities that have been operating their process using Biological Phosphorous Removal. This process has improvements in safety, reduced energy consumption, a reduction in the operating budget, and at the same time contributing to clean water quality. Clean water infrastructure has had minimal amounts of dollars invested in upgrades; if you can manage any more money from your budget to aid in repairs and upgrades to your facility then it is time well invested. At the Ayer Clean Water facility we have been maintaining full and partial Biological Phosphorous Removal for over 36 months, and look forward to sharing our training, ideas and process controls with others.

Ken Harwood

Town of Ayer

Clean Water Facility

Tell Me How Much You Like to Learn Instead of How Smart You Are

Eric J. Wahlberg, Ph.D., P.E. (California), former Colorado Class A Operator

WasteWater Technology Trainers (wwtechtrainers@gmail.com)

I now realize the two most dreaded topics for operations professionals are moles and statistics. "Moles" here does not refer to the burrowing mammals ruining your lawn, but the gram atomic- or molecular-weight of an element or compound, which contains Avogadro's number (a really, really big number, 6.022×10^{23}) of atoms or molecules, respectively. I'll just leave it at that.

Statistics, however, I can't leave alone, nor should you as an operations professional.

Regulators take into account the variability of wastewater and wastewater treatment when establishing effluent requirements. For example, a discharging facility may be required not to exceed monthly average, 7-day average, and instantaneous BOD concentrations of 30, 45, and 60 mg/L, respectively. Operations professionals, too, are well aware of the variability inherent in wastewater as they frequently blame the influent for performance problems at their treatment plants.

During process-control decision-making, an operations professional often looks at two pieces of data, yesterday's and today's. The data might be readings from an online instrument or results from lab or onsite testing. The operations professional determines whether the two numbers are the same or different. If they are the same, no action is required. If they are different, the operations professional has to decide whether a process-control change is warranted and, if so, what the change will be. Making the correct decisions about processes speaks directly to the competency and skill of an operations professional, and it starts with making the correct same-or-different determination.

Given the universal recognition of how much wastewater and wastewater treatment vary, it is mind-blowing that most process-control decisions are made without regard to the variability in plant-performance and process-control data. In fact, many operations professionals take the exact opposite approach: they use moving averages—designed to mask, or "smooth," data variability—in process-control calculations. (continued on page 8)

MWPCA Events

December Quarterly Meeting — Wednesday December 11, Mansfield MA

NEWEA Operators Day @ Annual Conference - Tuesday January 28, 2020

MA—CT—VT Ski Day at Stratton Mountain Vermont — Friday, January 31, 2020

MWPCA Annual Trade Show - Wednesday March 18, 2020—Devens Commons, Devens MA

MWPCA Annual Golf Tournament— Wednesday June 17, 2020 Heritage Country Club, Charlton MA

(**Hull** …. from page 1)

Secondary effluent overflows the weirs and flows to the effluent pump wet well. Plant effluent is then pumped to the chlorine contact chamber via four submersible pumps and disinfected with sodium hypochlorite. Treated effluent is discharged via a 2,700-foot gravity ocean outfall.

Odor Control: Several systems are in place to enhance biological treatment and odor control, including: 1) addition of Bioxide into the collection system seasonally, 2) In-Pipe biological additive used in the collection system, 3) wet well aeration at all remote pump stations, and 4) Drylet biological additive into the aeration tanks. The WPCF also uses a chemical odor scrubber.

Sludge Handling: Primary and waste activated sludge [WAS] are blended in the gravity thickener during the winter months. In spring, summer, and fall seasons, WAS is thickened via a rotary drum thickener when the primary clarifiers are offline.

Sludge Disposal: 4-8% liquid sludge hauled off site for further dewatering and is eventually incinerated at a regional facility.

Certified Operators & Staff: Woodard & Curran Operations staff includes 6 full time employees: Plant manager (Grade 7C), Assistant Plant Manager (Grade 6C), 3 Operators (Grade 5C and two Grade 3M), and a Mechanic. There are also four part-time support staff, including 2 Senior O&M Specialists (Grade 7C), an Office Manager, and Area Manager.

The Town of Hull's sewer department staff includes the Director of Wastewater Operations, Assistant Director of Wastewater Operations, a Facilities Coordinator, and a Bookkeeper.

For more information on the facility, please contact John Struzziery, PE Town of Hull Director of Wastewater Operations (jstruzziery@town.hull.ma.us) and Bill Boornazian, PE, Assistant Project Manager (wboornazian@woodardcurran.com).

One of the most scenic wastewater facilities in the State, Hull MA

Operators Exchange Candidate, Kevin Gardner, from Quonset, RI Visits Massachusetts Facilities

On September 9th, 10th, and 11th the MWPCA participated in the Operator Exchange Program by hosting the Rhode Island candidate, Kevin Gardner. Kevin visited Billerica, Acton, some small decentralized facilities, Upper Blackstone, and Uxbridge as well as attending the September Quarterly Meeting at Mt Wachusett. There was even enough time leftover for a quick visit to Treehouse Brewery! Thanks to all the host facilities for your help with this most worthwhile program.


MWPCA Board Member Ben Smith, RI Operator Exchange candidate Eric Gardner, and James Legg from Uxbridge discuss the upgrades going on while touring the Uxbridge facility.

Karla Sangrey UBCW, Mark Johnson UBCW, Mickey Nowak MWPCA, Edris Taher UBCW, Joe Parker UBCW, exchange operator Eric Gardner of Quonset RI, Denise Descheneau UBCW, and Winnie UBCW meet after a tour of the Upper Blackstone


Joe Parker , Shift Supervisor for Upper Blackstone Clean Water, discusses the operation of their sludge incinerator with RI Operator Exchange candidate Eric Gardner


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(**Tell Me How Much** …. from page 3) The objective of this article is to get operations professionals to acknowledge the importance of quantifying data variability when making process-control decisions rather than ignore it by various "smoothing" techniques. With this acknowledgment, the need for statistics becomes apparent. Because they help operations professionals interpret data and, in so doing, afford them the ability to make more informed process-control decisions, statistics are not to be feared but embraced. The use of statistical process control (SPC) charts is introduced as the simple but powerful tool it is.

Figure 1 shows the MLSS concentration over 10 days. Also shown is the 3-day moving average, clearly indicating a steadily increasing concentration. Similarly Figures 2 and 3 show the MLSS concentration steadily decreasing and relatively constant, respectively.

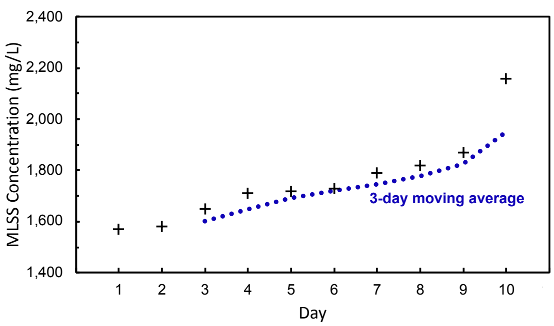

Figure 1. *Ten days of MLSS data with 3-day moving average.*

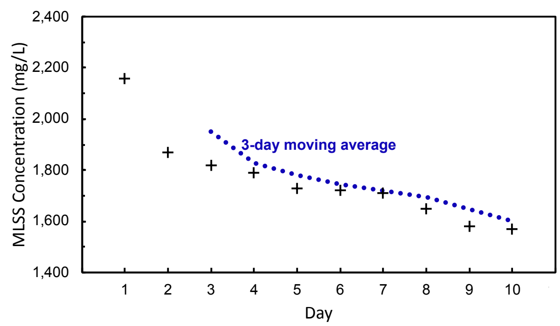

Figure 2. *Ten days of MLSS data with 3-day moving average.*

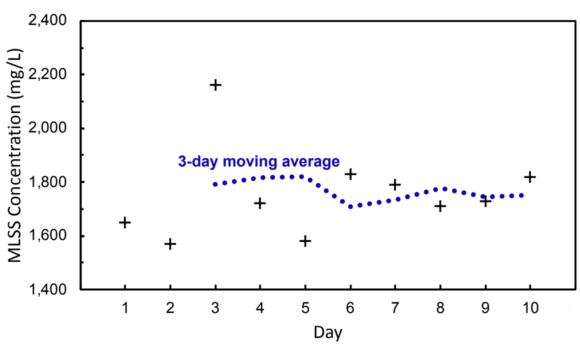

Figure 3. *Ten days of MLSS data with 3-day moving average.*

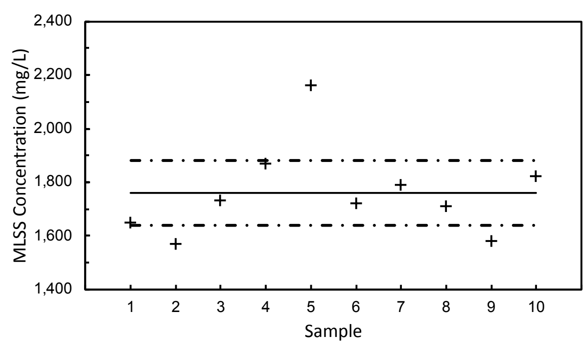

Figure 4. *MLSS results from 10 samples collected in separate bottles from the same location, one right after the other, in under two minutes. The solid line indicates the 10-sample average, 1,760 mg/L. The dot-dash lines indicate the 95% confidence interval about the average (1,638 – 1,882 mg/L).*

Figures 1, 2, and 3 are typical of the approach used by many operations professionals to identify data trends. But what trend are we looking for? If an increasing or decreasing trend is indicated, the process is changing, so not in control. In actuality, Figures 1, 2, and 3 all use the exact same data. The data were originally collected at a 9.5-mgd treatment plant in Minnesota to quantify the variability in measuring the MLSS concentration. Ten mixed liquor samples were collected in separate bottles from the same location, one right after the other, in less than two minutes. The samples were analyzed by the agency's certified lab. Figure 4 shows the results. The 10 concentrations range from 1,570 to 2,160 mg/L, with an average of 1,760 mg/L. The 95% confidence interval about the average is 1,638 to 1,882 mg/L. While many would expect relatively little variation in the MLSS concentration, Figure 4 demonstrates considerable variability in the mere act of sampling then analyzing for the MLSS concentration.

All operations professionals should know the MLSS concentration is a response variable. Because response variables cannot be used as control variables (a defining principle in control theory), the MLSS concentration should not be used to control the activated sludge process. Still, the MLSS concentration is used to calculate the all-important solids retention time (SRT), so knowing its variability is critical in activated sludge process control. (continued on page 9)

(**Tell Me How Much** …. from page 8) The reason the SRT is so important is because it controls sludge quality. It is not possible to have good effluent quality without good sludge quality. Sludge quality is defined by how the solids flocculate, settle, and compact. The 30-minute settled sludge volume (SSV_{30}) from a settleometer test measures sludge compaction. Like all measurements, especially in wastewater treatment (see Figure 4), the SSV_{30} varies. In order to adjust the SRT target to get the best sludge quality at your plant, operations professionals must know the statistical accuracy of the SSV_{30}. This requires the test be run more than once a day; doing it three times a week, for example, is woefully inadequate.

Statistical process control charts take into account the variability in a measured response variable, like the SSV_{30}. There are two SPC charts: one showing the central tendency (i.e., average) of the data (AVG Chart), and one showing the variability of the data quantified using the data range (R Chart). When properly implemented, SPC charts take the guesswork out of process-control decision-making as they give two outcomes: do nothing or do something. In order to control a process—for example, the activated sludge process—those responsible will want to produce a predictable result with minimum variation centered on a target value. This is accomplished by quantifying and analyzing process variability, the foundation on which SPC charts are built. Until the profession settles on more refined guidance, it is recommended to target an SSV_{30} such that the solids concentration in the sludge blanket after 30 minutes in a 2-L Mallory settleometer is greater than 8,000 mg/L. See Figure 5: For a given MLSS concentration, an SSV_{30} below the line is desired.

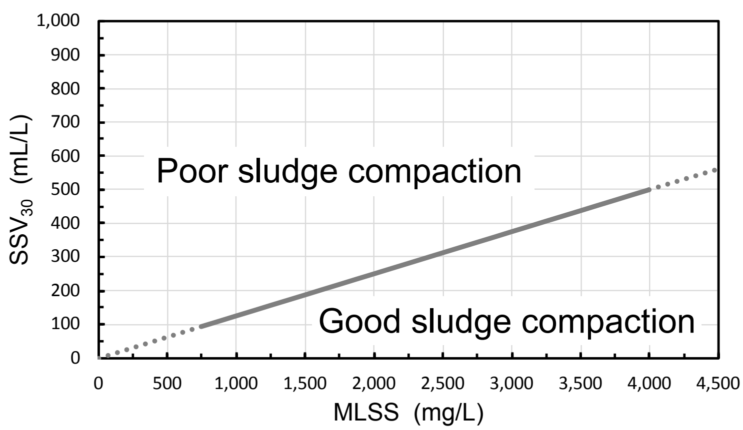

Figure 5. *Control SRT to maintain SSV_{30} below the line indicating good sludge compaction.*

To accept the challenge to control sludge quality—rather than it control you—the following procedure is recommended as a starting point:

1. Do two settleometer tests <u>each</u> <u>day</u>, <u>every</u> <u>day</u>.
2. Obtain a sample of the mixed liquor to be used in each test and analyze for MLSS.
3. With the paddle provided, <u>gently</u> stir the mixed liquor in the settleometer for two minutes. Make sure everybody doing the tests does it the same way.
4. Record the sludge volume after 30 minutes settling. This is the SSV_{30}.
5. Complete Steps 6 – 9 as soon as the second daily SSV_{30} reading is recorded.
6. Calculate the daily SSV_{30} average (add the two SSV_{30} readings and divide by two).
7. Calculate the daily SSV_{30} range (subtract the smaller SSV_{30} from the larger).
8. Plot the daily SSV_{30} average (Step No. 6) on the AVG Chart.
9. Plot the daily SSV_{30} range (Step No. 7) on the R Chart.
10. After one month, calculate the average of the daily SSV_{30} averages.

(continued on page 11)

NEIWPCC NEWS

2019 is a Renewal Year - Wastewater license renewal paperwork must be postmarked by **December 31, 2019**. Renewal forms were sent out in **September.** More information is available on NEIWPCC's operator renewal web site (https://neiwpcc.org/learning-center/massachusetts-wastewater-operator-training-certification/massachusetts-wastewater-operator-renewals-info/). Haven't met your 20 TCH (training contact hours) for this renewal period? NEIWPCC one- and two-day courses are being offered throughout Massachusetts this fall. For more information, please visit NEIWPCC's training calendar https://portal.neiwpcc.org/training-schedule.asp.

Operator Certification Exams - Computer-based testing locations for Massachusetts wastewater certification exams include: Auburn, Boston, Fall River, Lawrence and Springfield. Are you curious or intimidated about taking a Computer-Based Test (CBT)? Watch the YouTube video showing what the experience is like on the day of your exam appointment. The video link can be found at: http://www.abccert.org/testing_services/Computer-BasedTesting.asp

Wastewater Training Suggestions
Did you try to sign up for a course but it was full? Or has it been years since it was offered? NEIWPCC wants to hear from you! Suggestions for topics and locations are taken into consideration when planning courses. Send your ideas to **training@neiwpcc.org**. Or look for **Jen Lichtensteiger** at MWPCA meetings, hosting NEIWPCC classes, and at events across New England.

Visit the NEIWPCC Booth at the NEWEA Annual Meeting - Stop by and visit the NEIWPCC booth at the NEWEA Annual Meeting in Boston in January 2019. NEIWPCC training and certification staff will be present to answer your questions and take suggestions for training topics.

For More Details Massachusetts Wastewater Operator Training and Certification: http://neiwpcc.org/learning-center/massachusetts-wastewater-operator-training-certification/ NEIWPCC Training Calendar: https://portal.neiwpcc.org/training-calendar.asp

For more information or questions on NEIWPCC or the MWOT program, please contact us at training@neiwpcc.org or at (978) 323-7929.

(Tell Me How Much …. from page 9)

11. Indicate the “average of averages” (Step No. 10) on the AVG Chart as a solid horizontal line. This is the central line (CL) on the AVG Chart.
12. After one month, calculate the average of the daily SSV_{30} ranges.
13. Indicate the “average of ranges” (Step No. 12) on the R Chart as a solid horizontal line. This is the CL on the R Chart.
14. Calculate the control-limit interval for the AVG Chart by multiplying the “average of ranges” (Step No. 12) by 1.88 (this number is specific to a sample size of 2).
15. Calculate the Upper Control Limit (UCL) for the AVG Chart by adding the control-limit interval for the AVG Chart (Step No. 14) to the “average of averages” (Step No. 10).
16. Indicate the UCL on the AVG Chart (Step No. 15) as a dotted horizontal line.
17. Calculate the Lower Control Limit (LCL) for the AVG Chart by subtracting the control-limit interval for the AVG Chart (Step No. 14) from the “average of averages” (Step No. 10).
18. Indicate the LCL on the AVG Chart (Step No. 17) as a dotted horizontal line.
19. Calculate the UCL for the R Chart by multiplying the “average of ranges” (Step No. 12) by 3.27 (this number is specific to a sample size of 2).
20. Indicate the UCL on the R Chart (Step No. 19) as a dotted horizontal line.
21. The LCL on the R Chart is equal to 0, so the x-axis is the LCL on the R Chart.
22. Repeat Steps Nos. 1 – 9 plotting the daily SSV_{30} average (Step No. 6) on the AVG Chart now with CL (Step No. 11), UCL (Step No. 16), and LCL (Step No. 18) lines, and the daily SSV_{30} range (Step No. 7) on the R Chart now with CL (Step No. 13), UCL (Step No. 20), and LCL (Step No. 21) lines.
23. Sludge quality (compaction) is in control when the daily SSV_{30} average and range data points are randomly distributed about the CL between the LCL and UCL on the AVG and R Charts. This is the desired **do nothing** outcome.
24. Sludge quality (compaction) is not in control when a daily SSV_{30} average and/or range data point is below the LCL on the AVG Chart or above the UCL on the AVG and/or R Charts. When a data point indicates the SSV_{30} is out of control, the entire O&M staff should figure out why, and a process-control change should be implemented if warranted. This is the **do something** outcome.

Controlling sludge quality is the most important job for an activated sludge operations professional. Good effluent quality is not possible without good sludge quality. Meeting the effluent permit does not necessarily mean the plant is in control and being operated for the least cost to your ratepayers. Over time, controlling your plant with SPC charts will lead to the least-cost operation, a goal you can be extremely proud of achieving.

Welcome New Members!

Misty Williams-Fritze	Joseph D'Ambrosio
Pamela Welsh	Thomas Green
Frank Gatek	Michael DeRosa
Barbara Survilas	Peter Goudreau
William Paszko, Jr.	Kevin Kelly
Douglas Meadows	Floyd Jones
Mark Aucoin	Sengsambath Ep
Christopher McClure	Dominic Pashoto
Michael Binnall	Carolyn Fiore

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MA DEP NEWS by John Murphy (john.j.murphy@state.ma.us)

Below are the stats for the wastewater certification exams year to date. If you have any comments on the stats, training issues, or any other issue, please email me at john.j.murphy@state.ma.us.

2019 Year to Date (1/1/19 through 10/7/19) Wastewater Certification Exam Statistics				
Exam Grade	**Passed**	**Failed**	**Total**	**Pass Rate**
1I	32	41	73	43.8%
2I	80	99	179	44.7%
3I	6	30	36	16.7%
4I	2	20	22	9.1%
1M	11	16	27	40.7%
2M	31	62	93	33.3%
3M	17	15	32	53.1%
4M	39	94	133	29.3%
5C	21	47	68	30.9%
6C	21	98	119	17.6%