Spend a Dime, Save a Dollar

Do a Treatment Plant Operations Audit First

by: Michael J. Graves

Public works and utility directors sometimes face the non-compliant operation of their water or wastewater treatment facilities. This bad news often comes in a non-compliance order from the local, state, or federal regulatory agency with jurisdiction over the community's treatment plant. In many cases, these orders accompany specific tasks that must be completed within a specific schedule or excessive fines will be imposed.

These directors routinely look to their treatment plant operations staff to explain the reasons for non-compliance and to develop a plan to regain compliant operation within the allotted time. Many times this "in-house" investigation and planning will result in soliciting "outside" professional assistance from a consulting engineer.

A typical approach includes developing an engineering report to evaluate and recommend ways to improve the plant's performance through process modifications or newer treatment alternatives. When focusing on upgrades and new technology as the first step to correct a non-compliant operation, utilities are often on the fast track to costly capital improvements.

A different—and potentially less costly—approach involves plant optimization as the first step toward finding a solution to address a treatment plant's non-compliant operation. The concept is to harvest the low hanging fruit first. In many cases, compliance can be achieved without costly capital improvements.

In the early 1990s, the Environmental Protection Agency developed the Composite Correction Program to assist utilities that struggle to maintain treatment plant regulatory compliance. In addition, the American Water Works Association and its Research Foundation published the Self-Assessment Guide for Surface Water Treatment Plant Optimization. Both of these resources provide operators, managers, and consultants with a model for completing water and wastewater treatment facility operations audits.

Operations consultants are building upon these resources by providing clients with an unbiased third-party perspective and evaluation of the treatment facility's operation. A proven framework for a successful operations audit typically contains the following three major categories:

- Evaluate Existing Performance
- Indentify Opportunity for Improvement
- Corrective Action / Plant Optimization

Additionally, the operations audit should include a comprehensive evaluation of all factors that may contribute to a facility's non-compliant operation including design constraints, methods of operation, maintenance activities, and administrative support. With this holistic approach to treatment plant evaluation, the utility can identify performance limitations that can be corrected without major capital improvements.

When performing the operations audit, it is important for the operations consultant to bring together a team of stakeholders who play a major role in the treatment plant's operations, maintenance, and administrative oversight. This team will embark

upon a rigorous program to assess existing performance limitations and develop methods of improvement to meet performance goals.

EVALUATE EXISTING PERFORMANCE

The first step of an operations audit is to determine if the plant's current treatment levels meet performance goals. The performance goals are typically based on relativity to industry performance standards or are established utility goals for a plant's specific treatment system. For instance, a water treatment plant may impose a turbidity goal of < 2.0 ntu from the clarification/sedimentation process. Other goals may focus on filter operation, disinfection use, activated sludge mixed liquor suspended solids concentration, or secondary clarifier sludge blanket depth, depending on the type of treatment plant and the given processes within the facility.

Evaluation of the existing unit processes can be accomplished with a thorough review of historical data. Sometimes this data is not readily available, so your operations consultant should be prepared to compile at least three years of data to accurately assess historical conditions. After data compilation is complete, trend graphs can be developed to represent seasonal impacts on water demand and quality.

If problems are identified, steps should be taken to alleviate the reasons a performance goal was not met. Some of those reasons may be design, operations, or administrative.

CAPACITY OR EQUIPMENT RELATED NON-COMPLIANCE

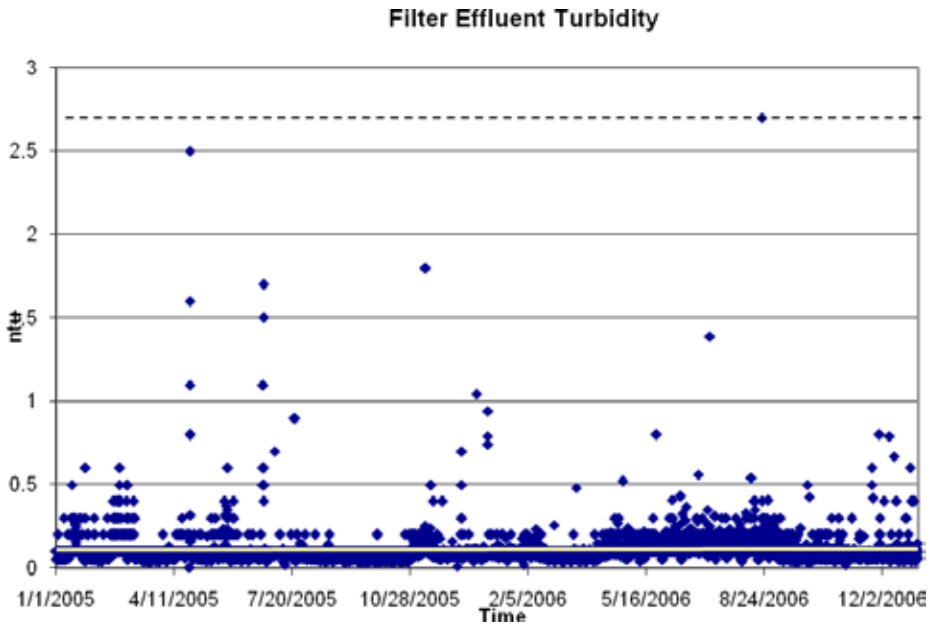
To accurately determine the reason a performance goal was not met, the operations consultant must determine if the existing unit processes are adequate. If the major unit processes are inadequately sized or lack critical equipment components, then capital funds expenditures may be required to address the limited performance. The first step should determine if adequate process unit sizing exists. As recommended by the Environmental Protection Agency and the American Water Works Association, this can easily be accomplished with the use of a performance-potential graph.

Major unit processes can be evaluated by their capability to consistently produce high-quality water. The potential, or adequacy, of each unit process to meet optimum performance goals is then determined. If a unit process is not performing to optimum levels, then the cause is determined as either design (capacity limited), or operations related.

Each of the major unit processes is evaluated to determine if its physical size can meet the required performance goals during periods of peak instantaneous flow rates. Once performance goals for each process are established, historical unit performance data is plotted to identify occurrences when the performance goals were not met.

Additionally, the performance-potential graph also indicates a process unit's treatment potential for hydraulic loading. This maximum loading is then compared to the three-year peak instantaneous flow rates that a given process may have experienced to determine a potential limitation in a unit's treatment capacity.

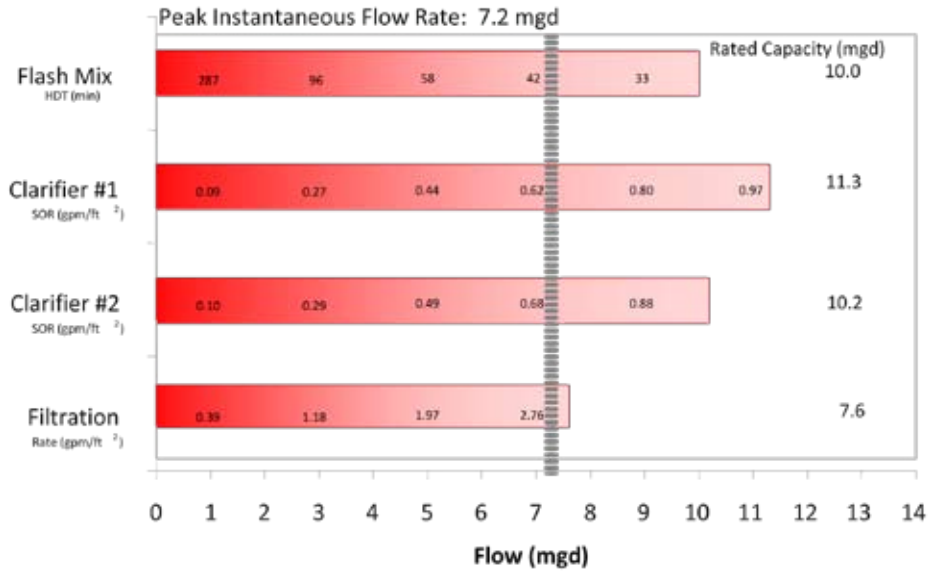
If the major unit processes are adequately sized and no major equipment repairs are necessary, then the most likely culprit for poor performance is operations related.



Trend of Filter Effluent Turbidity

OPERATIONS RELATED NON-COMPLIANCE

Typically, operations non-compliance is related to unit process control functions. The American Water Works Association's self-assessment guide indicates that the approaches and methods used to maintain process



control can significantly affect the performance of plants that have adequately maintained and designed facilities. The two areas of focus when determining the proper operation of a water or wastewater treatment facility include (1) proper process control sampling and data interpretation, and (2) proper application of operational methods when making process adjustments.

The plant operations staff must routinely gather and record relevant unit process data. This is critical to assess a unit process' daily, weekly, monthly, and seasonal performance. The collection and storage of this data must happen on a consistent basis to develop trends that typically forecast unit process failure. The operations staff must develop and rigorously follow a written Process Control Plan.

Once an individual unit process begins to exhibit limited performance trends, standard operating process control parameters should be referenced and implemented. Typical parameters requiring adjustments might include flow rate changes, coagulant dosage, aeration rates, mixing energy, recycle stream modification, backwash frequency/duration, disinfection breakpoint, re-carbonation rate, and solids removal.

The ultimate success in preventing non-compliant operation is through rapid implementation of the proper process control adjustment. However, beyond the operations staff's ability to recognize when an adjustment is necessary, they must also understand the technical concepts of why a change is necessary. As such, utility administrators must ensure that their water and wastewater operations staff is properly trained in the concepts and methods of treatment plant operations.

Administrative support for operations starts with proper funding, staff, and training resources. This commitment to provide the tools necessary to keep the operations personnel up to date with the latest advances in process control testing and monitoring is a must. After all, if the operators are responsible for compliant operation, they must have the resources in place to offer them a chance to succeed.

Finally, once the staff understands the technical concepts of water treatment, they must have the pride and persistence to see that the treated water meets all regulatory compliance standards. With an aging operations workforce and a declining number of personnel choosing operations as a career, sometimes it is difficult to locate these individuals. Through better pay, benefits, and prestige in the operations industry, individuals with the tenacity to deliver compliant operations will surface.

IDENTIFY OPPORTUNITY FOR IMPROVEMENT

The first step toward outlining a plan for improved treatment plant operation starts with prioritizing the list of performance-limiting factors. These factors are prioritized in order of their adverse effect on achieving desired plant performance. A simple rating system is typically developed to help with prioritization.

Once the list of non-compliance factors is developed, it is imperative that these items are shared with utility policy makers and funding resources. The fact that there are optimization items on the list is often good news to utility administrators and governing bodies. These optimization items indicate that there are actions to take prior to, or instead of, large-scale capital improvements.

These items often result in minor adjustments in operational methods that can significantly impact the plant's ability to return to compliant operation. Many times a change in chemical feed point, a different type of chemical, or a new process control test will result in system-wide benefits that improve plant performance and offset major capital improvements.

Priority	Description
1	Poor performance is routinely repeated and has a detrimental effect on the water quality.
2	Poor performance is periodically repeated and has a detrimental effect on the water quality. Poor performance is routinely repeated and has a minimal effect on the water quality.
3	Poor performance is periodically repeated and has a minimal effect on the water quality.

CORRECTIVE ACTION / PLANT OPTIMIZATION

Once the stakeholder team has prioritized the performance limiting factors, corrective action must be taken to bring the treatment plant's operation back into regulatory compliance. With input from the stakeholders, the operations consultant should develop a corrective action plan (CAP) or optimization plan for use by the utility.

The CAP should list the items to be addressed, the party responsible, and a timeline for implementation. Often, the CAP focuses on developing written operating procedures or guidelines that document the necessary operator activities that ensure compliant plant operation. The operations consultant can certainly assist with development of these procedures, but the procedures are usually more effective and rigorously followed when developed by the treatment plant staff. This staff "buy-in" often results in a sense of pride in the procedure and a tenacity to see it followed. These written procedures should be kept accessible to all operators in either hard-copy or e-copy format, or embedded within an existing Supervisory Control and Data Acquisition system for quick and easy access.

Additionally, optimization activities typically include development of process control data sheets to standardize the sample collection, testing, and interpretation of unit process data. Also, operators should be trained on the development and interpretation of trend charts or graphs. These tools become very valuable in assisting an operator with identifying the onset of poor unit process performance and establishing correlations between process upsets and other variable plant conditions (i.e. temperature, flow, season, etc.)

MAKE THE OPERATIONS AUDIT STEP ONE

The operations audit approach involves the concept of plant optimization as the first step toward solving the non-compliant operation of a water or wastewater treatment plant. Although capital improvements may still be necessary after the completion of an operations audit, utility administrators can use the audit as a tool to evaluate the treatment plant's current level of performance and confirm to what degree, if any, that costly capital improvements are needed. An operations audit is often recognized by the regulatory community as a first step toward regulatory compliance and many times preferred prior to completion of an engineering report. Finally, by conducting the operations audit, utility administrators will have a tool for continuous plant optimization, operator training, and compliant operation for many years to come.

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