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Process Optimization Can Solve Today's Water Treatment Challenges

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Safe drinking water is vital to public health, but many water treatment plants (WTPs) struggle to consistently deliver reliable, high-quality water that meets finished water goals. To combat aging infrastructure and failing processes, a tailored treatment approach and integrated project delivery method can offer substantial benefits — and relieve pressure — for WTP operators.

Exploring new ways to evaluate water treatment processes and applying appropriate technologies will address challenges head-on while improving treatment and operations. Operators will need to update aging facilities and infrastructure if they are to meet new demands and comply with increasingly stringent regulations.

The water industry must comply with the Environmental Protection Agency's (EPA) Safe Drinking Water Act regulations, which currently limit more than 90 contaminants and continue to evolve with unregulated contaminants and health advisories. In addition, secondary standards that focus on taste, odor, color and other aesthetic features must be addressed to maintain customer satisfaction. This unique operating environment, coupled with rising public awareness of water safety, has prompted the water industry to continue searching for better ways to treat these contaminants while increasing efforts to protect public health.

Whether the raw water source is groundwater, surface water, water reuse, or a combination that varies throughout the year, WTP operators today confront changing ecosystems within these sources that create a range of dynamic challenges. There is a vast range in physical and chemical treatment requirements, and applying a generic treatment process approach will not always produce satisfactory results. Even when treating similar raw water sources, using the same cookie-cutter approach for a different location will not necessarily produce consistent and reliable finished water goals.

Strategic Water Quality Evaluation

For water treatment optimization, the most optimal improvements come from applying a strategic, holistic approach that tackles a wide range of challenges. Examination of the existing physical and chemical processes can improve water treatment success, often costing far less than it would to design and build new improvements.

Many projects include new infrastructure, regardless of the root problem. But before jumping straight to construction, take time to evaluate underlying deficiencies in the existing physical and chemical processes that are currently being used.

Understanding the root of the problem can provide a clear path to developing strategic solutions needed to help WTP operators successfully tackle treatment challenges within existing infrastructure.

Optimization of Treatment Processes

When it comes to the evaluation and application of drinking water technologies, diligent research will provide customized answers for improved treatment and operation. For many utilities, the solution comes in the form of increased treatment capacity, improved operations, lower operating costs and better finished water quality by refining the existing processes, without adding expensive technologies or new infrastructure. Our project delivery approach includes:

- Hands-on testing.
- Identifying specific procedures to improve the physical processes.
- Refining chemical systems to deliver optimal doses at the right location.
- Collaborating with WTP staff and operators to provide training and tools for daily use.

Through this kind of focused evaluation of the physical, chemical and operational components of each treatment process, utilities can incorporate cost-effective techniques that lower operating costs and simplify operations. In evaluating options to optimize treatment processes, these will be the key areas of focus:

- **Emerging Contaminants.** Per- and polyfluoroalkyl substances (PFAS) continue to be an evolving concern. PFAS are a complex group of human-made compounds that are water- and oil-repellent and resistant to thermal and chemical degradation. Certain PFAS are nonbiodegradable, mobile, persistent and bioaccumulate. Referred to as forever chemicals, PFAS do not degrade in the bodies of humans, animals or in the environment. The EPA is committed to developing enforceable limits for PFAS compounds in drinking water and released revised guidelines that would require WTPs to monitor for six specific chemicals and reduce if levels go above allowable limits. In March 2023, EPA proposed to set a Maximum Contaminant Level (MCL) for PFOS and PFOA at 4 parts per trillion (nanograms per liter) and will address four additional PFAS (GenX, PFBS, PFNA, and PFHxS) as a mixture using a Hazard Index calculation. Treating PFAS is challenging, with limited treatment technologies available. Each technology has certain advantages and disadvantages. Various funding initiatives have been approved that should continue to spur communities to develop policies and procedures to protect public health and address upcoming regulatory requirements.
- **Lead and Copper Rule.** Since it was first enacted in 1991, the Lead and Copper Rule (LCR) has been revised by the EPA numerous times as public health concerns have grown. Under a comprehensive set of changes finalized in 2020, water service providers have new requirements to assess their assets and operations and then enact programs to address any aging lead and copper water distribution lines that pose a risk of leaching into drinking water supplies. The new LCR mandates specific testing protocols to be used, improved tap sampling procedures, expanded testing and closing of loopholes. The goal is to speed up the identification and removal of these contaminants in drinking water systems.
- **Dissolved Organic Carbon (DOC) Reduction.** Natural organic matter is problematic at nearly every stage in the water treatment process. DOC serves as a general water quality indicator of how well treatment processes are operating. By removing more DOC, WTP operators might improve coagulation and disinfection, mitigate taste and odor, reduce disinfection byproducts, and improve water quality in the distribution system.
- **Disinfection By-Products (DBP).** While chemical disinfection is a proven and commonly used technique, there is a balancing act between protecting customers from waterborne pathogens and minimizing the risks associated with the formation of DBP. Understanding the types of DBP and the specific disinfectants to blame — along with reactions due to temperature increases, pH values and precursor material — can determine optimal solutions for protecting public health against these groups of carcinogens.
- **Finished Water Stability.** Insight into the chemical stability of finished water is key to avoiding long-term problems in the distribution system. Chemically unstable water leads to corrosion; calcium carbonate buildup; loss of disinfectant residual; nitrification; leaching of lead, copper and other metals; biofilm development; and other problems that can lead to catastrophic consequences. Evaluation of the proper balance of pH and alkalinity helps avoid corrosion and/or scaling, allowing for optimal operations.

New Treatment Technologies

Success in the water industry stems from the ability to effectively integrate the best available technology (BAT) and sound engineering in a manner that maximizes the use of existing facilities. For some WTPs, the wrong technologies might be in place, resulting in poor treatment performance, even when those technologies are optimized. There are times when using a new technology, however, will provide the missing piece to meet finished water goals. While a range of new technologies exists, each WTP must evaluate the actual improvement needs required to avoid unnecessary cost increases. An understanding of process goals and current operational methods helps identify the proper innovative approaches. New technologies, when applied and integrated correctly, can reap positive results.

Collaborative Project Improvement Approach for Water Treatment Optimization

- Data collection and review
- Preliminary evaluation
- Process evaluation
- Filter evaluation
- New treatment strategies
- Design and cost
- Project management and control
- Final deliverables and review

FIGURE 1: Nathan Dunahee conducts testing on contaminated water to meet regulatory requirements.

Progress Presents Opportunities

Any change to optimize one area of treatment must be implemented without causing additional problems to overall operation. Too often enhancements are incorporated that are generic in nature, without consideration of specific water quality issues or the interactions with existing technologies. This can often reduce, rather than increase, the effectiveness of the overall treatment process.

To avoid challenges that arise from a proposed solution, new improvement projects must define operational and water quality goals, evaluate the current operating situation, and determine an ideal solution for the process.

Conclusion

When it comes to upgrading your water treatment facilities, the focus should be on holistic, creative solutions that emerge from strategic evaluations. Sitting down with the right team will help equip your plant with the optimal treatment processes and advanced technology needed to get moving in the right direction. Getting a jump-start on implementation eliminates risk and creates the opportunity for necessary — and timely — change, accomplishing desired goals while saving money.

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