



# Blue-White®

## Disinfection Technologies: How Do You Make the Right Choice

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**There are many steps** involved in properly treating wastewater so that it meets regulatory requirements and can be reused or discharged, and disinfection is a critical step in the process. Disinfection kills or disables pathogens which may be harmful to humans, the ecosystem, or both.

While sodium hypochlorite, chlorine, is the most well-known and widely used disinfectant, there are other technologies that are also being used successfully and may be worth considering. These include, peracetic acid (PAA), ozone, and UV disinfection. It is critical for engineers, project managers and operators to understand the pros and cons of each disinfection technology before incorporating them into a water treatment system.

### Effectiveness

The first and most important thing to consider when comparing disinfection technologies is how effective they are at disabling pathogens, such as cists, viruses, and bacteria. In a water treatment system, there are two measures of disinfection: immediate and residual.

Immediate disinfection refers to the initial ability of the chemical or UV rays to kill microorganisms. Under normal circumstances, chlorine, PAA, ozone, and UV may appear equal in effectiveness. However, turbidity can shield pathogens from disinfectants. For UV systems, turbidity is an even bigger issue because it can prevent UV rays from penetrating the water entirely, rendering it largely ineffective. This may be especially true with industrial wastewater or in systems where public and industrial wastewater are mixed.

Residual disinfection occurs downstream as the disinfectant travels through the distribution system, and only chlorine

offers residual disinfection. Ozone and PAA react too quickly, dissipating within minutes of being administered. UV cannot provide any disinfection beyond the lamp system.

This may be acceptable in many applications, particularly for wastewater that is discharged to sensitive bodies of water. This

is why it's important that decision makers have a clear understanding of the demands that will be put on the system, and the results they expect to achieve.

### Safety Factors

No disinfectant is without safety concerns.

**Ozone** is administered as a gas and is a powerful irritant that can damage lungs. While ozone has a distinct smell, the odor is not always strong enough to detect.

**Chlorine** is also a powerful irritant to lungs, skin, and eyes. As

such, operators must wear appropriate personal protective equipment (PPE). However, chlorine also has a powerful odor that is immediately noticeable, giving operators ample warning of a leak or spill.

**UV light** can be harmful to eyes and skin, although the lamps are typically enclosed during operation and rarely pose a threat.

**PAA** can cause damage to the skin, eyes, and lungs. Those handling the chemical should do so in a well-ventilated room and wear appropriate protective gear. It is also corrosive.

### Dosing Levels

Neither ozone nor UV can be overdosed. UV disinfection does not add chemicals. Meanwhile, ozone dissipates quickly, breaking down into oxygen within minutes. The additional oxygen adds a pleasant taste to water with no adverse effects.



**Figure 1.** Chemical metering pumps play a critical role in the success of water and wastewater treatment. But that doesn't mean they have to be difficult to operate. New technologies are simplifying the setup and operation of these feature-rich pumps.

PAA breaks down into acetic acid, water, and oxygen. This makes it safe to treat effluent that is discharged into source water, or other bodies with high levels of organic content. It oxidizes almost instantly, so there is rarely any residual chemical after discharge.

The same is not true for chlorine. Excess chlorine can dramatically change the taste and odor of water, making it unpleasant (or harmful) to drink. While some downstream chlorine is beneficial for its residual disinfection, operators must use precise dosing via advanced chemical metering (Figure 1), pH and chlorine analyzers, and more.

### Unintended Effects

In addition to the impact on taste and odor, chlorine has two other secondary effects that can impact usage. The first is corrosion. Unlike UV and ozone, chlorine can, in the long term, damage pipes and equipment. While this impact is minimal depending on the amount of chlorine in the water, older or more sensitive infrastructure may be better protected with an alternative.

The second is disinfection byproducts (DBPs). These substances can form when natural organic matter reacts with chlorine and can be harmful if consumed or inhaled. While DBPs can be mitigated with good upfront filtration and treatment, operators using chlorine may still need to test their water to ensure compliance with U.S. EPA-prescribed limits. A chlorine analyzer (Figure 2) that will provide ongoing information and log data on free chlorine, total chlorine, and pH levels can be installed to help in this process.

### Cost And Availability

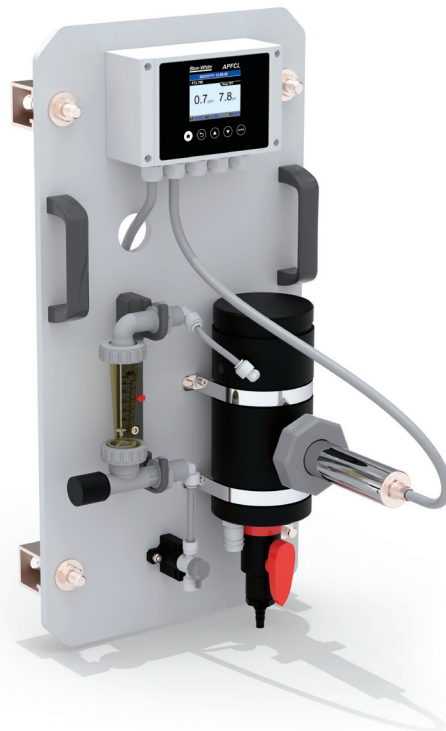
UV systems have a high upfront cost but are often easy and affordable to maintain — they do not require any chemicals and the only operating cost is electricity and the occasional lamp replacement.

Ozone, which is provided in and administered using compressed gas cannisters, has a moderate upfront cost but is very expensive to run as the gas is difficult to make. PAA is also expensive and the number of manufacturers and distributors is far fewer. However, as adoption of PAA as a disinfectant is increasing, these factors are likely to change. It is also regulation agnostic and has a far longer shelf life than chlorine.

Chlorine is the most affordable. Not only is it cheap and easy to obtain, but chlorine can be easily dosed using efficient and cost-effective metering pumps. Even when combined with ancillary equipment such as pH and chlorine analyzers, flow meters, and chlorine level sensors, chemical metering/ dosing pumps are more cost-effective than other disinfection technologies. Advanced features such as maintenance alerts and failure warnings can help ensure that any given pump continues to run effectively for a long time.

### Working Together

Disinfection does not have to be all or nothing. For example, it is possible to add small amounts of chlorine after initial UV, ozone, or PAA treatment in order to take advantage of residual disinfection. The final decision will depend on a variety of factors, including total cost, operator expertise, downstream operations, and infrastructure conditions, among others. It is important to work with engineers and vendors to design a system that meets the needs of the operation.



**Figure 2.** The APFCL Total Chlorine, pH, and Temperature Analyzer will continuously test water for chlorine levels and can alert operators when free chlorine drops below a pre-set threshold.