Maximizing UV System Performance

By: Eric Peterson, UV Sales and Service Manager, Pureflow, Inc.

It Takes More Than Scheduling An Annual Lamp Replacement To Maximize The Performance Of A UV System.

In order to optimize the performance of UV equipment, one has to understand that a UV unit is much more complex than simply changing out UV lamps once a year. The old adage, "you can pay me now or you can pay me later," couldn't be more true. This holds especially true if you are satisfied with purchasing the many generic replacement parts that are available on the open market.

Today's UV systems are far superior to yesterday's legacy systems. However, one has to keep in mind that today's systems are still built on the same platform as earlier generations. All UV systems incorporate a UV lamp(s), quartz sleeve(s), reactor chamber, elastomers and a power supply. But that does not mean your existing legacy equipment is ready for the trash heap, either. There are many well maintained UV systems still operating as well as they did when they were first installed. Many of these UV systems are 20 to 30 years old. They just require a little TLC to get them back to their original operating condition.

What is the secret to longevity? The answer is simple. A well maintained system is all that is required. A properly maintained UV system goes beyond the obvious annual lamp change out, cleaning of the interior of the quartz sleeve and sensor adjustment. This maintenance perspective can be applied to any existing UV system.

Where do you start? First, begin with the owner's manual. Most reputable UV manufacturers provide an owner's manual with each unit. Inside the manual there should be a well laid out preventative maintenance (PM) schedule. If not, consider the following guidelines.

Design Material… UV light is aggressive. It will oxidize or corrode just about everything it comes in contact with, including stainless steel. If a UV system is not manufactured with high quality material and it is not properly maintained, it will cause maintenance issues down the road.

UV Lamps… All UV units incorporate a single or multiple UV lamp(s) into their design. The UV lamp is the critical component that makes a UV system what it is. Each unit requires periodic lamp replacement. While many UV lamps will continue to operate well beyond their stated lamp life, a lamp's performance declines if it is left to operate too long. Typically, lamp replacement should be scheduled no later than 4,000 to 5,000 hours for medium pressure systems and 9,000 hours for low pressure systems. Do not wait for the lamp to burn out before replacement is required. A physical process called solarization blocks the UV light from being emitted into the water stream rendering it ineffective. As a lamp becomes solarized, it turns slightly brown in color and should be replaced. This is what eventually filters out the UV.

Mercury Disposal… All UV lamps contain mercury. As more companies become environmentally conscious, they tend to look for more responsible waste disposal programs for the UV lamps. When selecting your next water treatment service company, make sure they have a program in place to properly dispose of the lamps. Typically, you can expect to pay some fee per lamp to have the lamp picked up, the mercury properly extracted, recycled and disposed.

UL Listed Equipment… Most reputable UV manufacturers have their equipment UL listed in the U.S.

Typically, a UV manufacturer receives their UL listing on the entire unit, not on each individual component within the unit. Should non-genuine UV replacement parts be incorporated into the equipment, the unit's UL listing would become void. For this reason it is not recommended that non-genuine OEM replacement parts be incorporated into UV systems. Before utilizing generic replacement parts and losing the UL listing on the equipment, it may be advisable to check with your risk management team and insurance provider to determine the risks associated with this decision.

Quartz Sleeves… The sleeves are probably the most abused parts within a UV system, yet they are one of most critical components that deliver UV into the water stream. Quartz sleeves provide a protective barrier around the lamp so that it can operate at optimal temperature. In order for the quartz sleeve to maximize a unit's performance, both the interior and exterior of the quartz sleeve must be cleaned periodically, even UV units installed in UPW systems. All quartz sleeves are susceptible to fouling.

Quartz Sleeve Cleaning… The cleaning frequency of quartz sleeves will be site specific and directly related to water quality. UV systems that are installed in post RO/DI locations will require cleaning much less frequently than units installed on raw water or surface water systems. A general rule of thumb; a post RO / DI UV system should have the quartz sleeves cleaned once a year. One should plan on cleaning quartz sleeves quarterly on post activated carbon systems and more frequently for hard water applications exceeding 5 grains of hardness.

Quartz Sleeve Replacement… Quartz sleeves, just like UV lamps, wear out over time. Quartz will lose its ability to transmit UV light rays into the reactor chamber. To maximize the optimal performance of any UV unit, UV manufacturers recommend that the quartz sleeves be replaced with each lamp replacement. Most companies typically replace their quartz sleeves every 3-5 years for disinfection applications and they replace their quartz sleeves for TOC reduction, ozone destruction and UV-Dechlorination applications every 1 to 3 years.

Reactor Chamber... While virtually all companies that operate or maintain a UV system change out the UV lamps as scheduled and clean the quartz sleeves periodically, many companies overlook the importance of cleaning the interior of the UV rector chamber. The inside of a reactor chamber acts as a mirror to reflect UV light back into the water stream. When it becomes fouled or scaled, it loses its reflective qualities. Don't overlook the need to physically clean the interior of a UV reactor chamber. A unit's performance will suffer if this important step is ignored.

To speed the scheduled PM cleaning process of the reactor chamber and the exterior of quartz sleeves, consider using a Clean in Place (CIP) system if your system will allow it. A 1% solution of phosphoric acid can save valuable hours over a complete unit disassembly.

Stock Replacement Parts… Don't forget to stock a few replacement lamps, quartz sleeves and o-rings for those unexpected emergencies. Quartz sleeves are like glass. They are fragile and they tend to break when improperly handled or abused. If replacement quartz sleeves are not readily available, and one breaks, a complete water system could be shut down. Imagine the opportunity cost of lost revenue by not keeping one or more quartz sleeves on hand when companies are producing $100,000 to $1,000,000 worth of product an hour. Don't be frugal with a UV system when trying to determine what components to keep in inventory. Have a few quartz sleeves on hand so that you do not shut down an entire production because of a $72 to $100 sleeve.

Matched Power Supply… A matched power supply is critical to the overall performance of the UV equipment. UV manufacturers have invested significantly to developing power supplies that maximize each UV unit's output. They want the surface wall temperature of their lamp to operate at a particular temperature for a particular application. That means they have to drive the lamp at a certain voltage and current to achieve that desired temperature. When original ballasts burn out, some have found that off-the-shelf generic ballasts can be easily substituted in place of the original equipment. Don't make this assumption, as the equipment's performance will likely suffer. One should plan to replace their ballasts every 5-7 years.

Lamp Sockets… Lamp sockets are another critical component to the UV unit that is often overlooked. Lamp sockets deliver the necessary voltage to the UV lamp to produce the UV output. Over time, and like everything else, lamp sockets wear out. One should plan on replacing lamp sockets every 3 to 5 years.

O-rings & Gaskets…O-rings and gaskets are designed to maintain the hydraulic integrity of the equipment. Yet, these components are often overlooked in the annual PM schedule. Typically, elastomers are not replaced until the unit starts leaking. When you think about it, o-rings and gaskets usually are directly exposed to the UV light. In a short period of time elastomers become brittle, crack and leak. Change the o-rings once a year and the gaskets every two years to avoid leaking and the potential leaching of contaminants into your critical process systems.

Dirt & Dust… A UV unit incorporates a number of critical electrical connections into the unit design. In many cases, cooling fans are used to move air across heat sensitive components. After two to three years of continuous operation, the inside of a UV unit's electrical enclosure will become filled with dust, dirt and grime. Add to that, a small persistent water leak and you will have quite a mess on your hands. Over time, this dirt and dust works itself into the electrical connection reducing the integrity of that connection. Set up an annual PM schedule to vacuum out the inside of each electrical enclosure. For those units that incorporate a built-in dust fan, don't forget to clean or replace that filter as well. Your unit will be easier to maintain and will operate more efficiently.

Intensity Meter & Sensor… Not too long ago, UV intensity meters and probes provided a 0-100% relative intensity measurement. One must be very careful to achieve any real qualitative value from the meter and probes. The very nature and process of utilizing an intensity meter and sensor requires a rigid iterative process performed by a well trained technician to achieve relatively reliable estimates of intensity measurement. In addition, some actually thought that the UV output would be increased by continually adjusting the intensity meter to 100%. This was not a realistic thought. The original idea was to have a tool that measured a unit's UV output. In a perfectly operating system, one would clean their quartz sleeves, install new UV lamps, clean the UV intensity probe and reassembly the unit. With the lamps on and operating at their correct operating temperature, the intensity meter would be adjusted to 100%. After 72 hours of operation, the new lamp's intensity would drop off until the lamp's output stabilized. This required a technician to come back and adjust the intensity meter back to 100%. Over the course of 8,000 to 9,000 hours, the UV intensity would drop 40% from its new lamp intensity level. At a 60% intensity level, the unit would be telling you that either the quartz sleeves were dirty, one or several lamps have failed or the lamps need to be replaced because they have reached their end of lamp life.

This is no longer considered "best practice". If you still operate a UV system with one of these antiquated instruments, the time has come to bring your UV unit into the 21st century.

Digital intensity meters that read absolute intensity have been available for several years. They are far superior

to the old 0-100% analog meters they replace. Digital UV intensity meters are also hot water and steam sterilizable and some can even be provided with an optional NIST certificate. Say good riddance to that old analog intensity meter and sensor and take advantage of one of the best upgrades available for your older units. One should plan on replacing their UV intensity probe every 3-5 years.

Final Thoughts… A properly maintained UV system will dramatically extend the useful life and provide the best performance of your system. The UV system is one of the most cost effective components of any water treatment system. We encourage you to follow your owner's manuals for advice on PM schedules. If you have any questions concerning your UV system, contact Pureflow. We would be pleased to evaluate your UV equipment along with providing you expertise on your entire water treatment system.

Eric Peterson is a recognized expert in the field of UV. He holds over 20 years experience in the industry and has held multiple positions within Aquafine Corporation, Trojan Technologies, and Advance UV where he established global channels of distribution, strategic alliances, and business development in both the industrial and municipal arenas.

Eric has authored several papers on UV and has given multiple talks around the world. Eric can be reached at Pureflow, Inc. for additional comments or applications. Email: eric.peterson@pureflowinc.com

Article is re-printed with permission of Eric Peterson. No unauthorized reproduction or use of this article without the written consent of Mr. Peterson or Pureflow, Inc.

Copyright 2008©