Sterilight

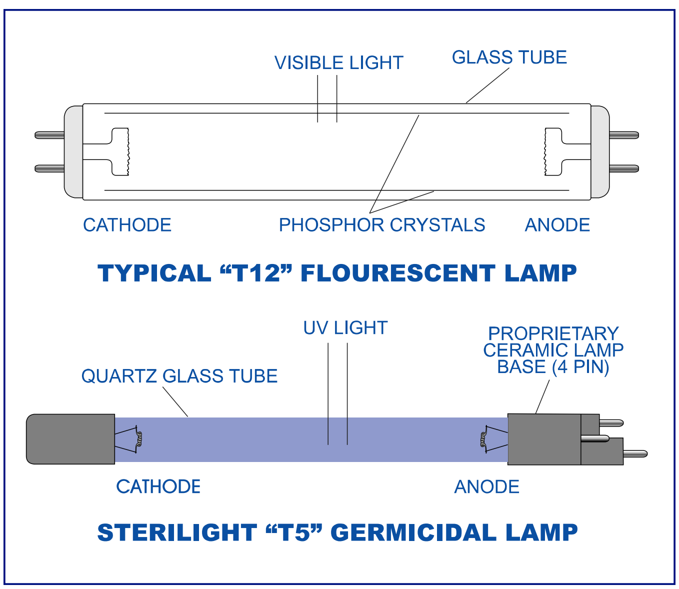
ULTRAVIOLET WATER STERILIZER

Sterilight's ICE Ballast Takes UV Market by Storm!

By Myron Lupal, BA, CWS-VI

Ultraviolet, or UV as it is commonly referred to, has now become the superior method of disinfection in the water treatment industry. Since its first use in the early 1900's, UV systems have been installed in virtually every country in the world in a myriad of applications ranging from a simple point-of-use system treating a kitchen faucet on a rural farm to systems providing primary disinfection to large cities.

As UV installations continue to grow at an ever-expanding rate, UV manufacturers are working to develop new and innovative systems and designs. All UV systems have basic "core" components that make up a UV system. These components include the UV lamp, reactor vessel, power source and peripheral components such as UV monitors, temperature probes, solenoid valves, etc. A UV manufacturer can design most of these components to work as a stand-alone design, however the key is for the manufacturer to incorporate the individual components into a total system! The challenge is to provide a system that will function in a country with a somewhat "unstable" power network equally as well as a very stable power network such as exists in North America.



Traditional Magnetic Designs

Traditionally, manufacturers have used simple electromagnetic devices or "ballasts" as they are commonly referred to. These devices incorporate electrical wires wound around a ferrite core. The numbers of windings determine the output current delivered to the lamp. The ballast also incorporates a starter to physically generate enough starting voltage to vaporize the mercury enclosed inside the low pressure UV lamps. This all sounds relatively simple, and in fact is, as long as both the input voltage and input frequency remain constant.

The problem is that this statement is far from being accurate. Many regions around the world have extremely unstable power grids with both fluctuating voltage and frequency. To deliver the optimum UV output, a typical, low pressure UV lamp operates at an output current of 425mA (other lamp types may operate at 185mA or 800mA). If the lamp operates at less than 425mA, then the system produces less UV output and consequently less UV dose. In simple terms, the UV system operates at a lesser capacity on lower voltages. Conversely, if the lamp is overdriven at an output above 425mA, critical ballast and lamp failure will occur.

Magnetic Pitfalls!

Magnetic ballasts suffer from a multitude of pitfalls. Although the cost of a magnetic ballast is relatively low, their use in the design of the UV system offers many obstacles. Ultraviolet lamps offer optimum output at a temperature of 40°C (104°F). If the temperature rises above this optimum, the resistance of the lamp changes, altering the voltage and current supplied by the ballast. The result is lower UV output and ultimately a lower UV dose. In low temperature situations, the lamp may experience difficulty in starting. In order for manufacturers to offer a variety of models with different flow rates, it is necessary to use UV lamps of varying lengths. As you vary the length of the lamp, you vary the voltage that the lamp requires to operate. In order to provide a system incorporating a magnetic ballast, the windings contained within that ballast must be matched exactly to provide the proper voltage and current to the lamp. This translates into the need for a single ballast for each lamp at a specific voltage and a specific frequency. As voltage and frequency vary tremendously (voltages do vary even in North America), one can simply imagine how many different ballasts would be required to provide the optimum output under each unique circumstance! When the incoming voltage is high, the lamp is overdriven and runs hot. The more it is overdriven, the hotter it gets, resulting in premature ballast and/or lamp failure.

What happens when a system using a G36T6L lamp designed to operate on an input voltage of 115V suddenly receives 105 volts during a "brown out" condition? The results of this would be lower lamp current resulting in a system that never reaches the prescribed UV dose. In an ideal situation, for a magnetic ballast to function as designed, one would need to vary the output flow based upon the input voltage and frequency!

Frequency, or electrical "cycles", can cause even more disastrous results with magnetic ballasts. Input frequency variations as little as ± 3 Hz. can cause ballast and/or lamp failures. Even though many countries claim to have "clean" power, it has been our experience that vast variations do exist and that the continued use of magnetic devices are simply not flexible enough to adequately perform consistently in the field! This is even more serious considering that a UV system is designed to destroy waterborne pathogenic organisms.

A New Era in Electronics!

In an effort to provide customers with the best possible components for their UV systems, the exploration of electronic "solid-state" ballasts began in the early 1990's.

In simple terms, an electronic ballast incorporates a series of transistors, filter capacitors and transformers. The ballast takes the AC input and converts it to DC thereby eliminating the effects of frequency variations. The capacitors store this energy and modulate the electrical output. The ballast then converts this DC back to AC and delivers this current back to the lamp. If properly designed, the results of this device are a ballast that operates at extremely cool temperatures and operates over a wide voltage and frequency range.

These electronic ballasts proved to be a vast improvement over traditional magnetic ballasts, however, these designs did not address the issue of regulating the output current. Even in these new electronic ballasts, the lower the voltage delivered to the lamp, the lower the output current and the lower the UV dose delivered to the water.

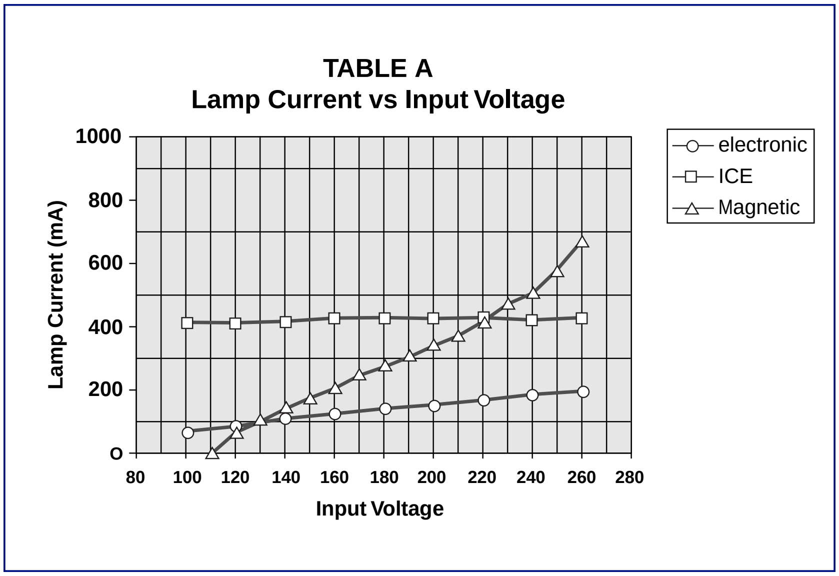
'ICE' comes of Age!

In the late 1990's, Sterilight embarked on a program to design an electronic ballast that would operate over a wide range of input voltages, be frequency independent, operate over a wide range of UV lamps, and operate the UV lamps at their optimum operating parameters to maximize UV output and lamp life! This was obviously a large wish list, but after many months of research, development and testing the resulting ICE ballast was "born"!

Why ICE?

As a result of the excellent thermal management characteristics of this superior electronic ballast, the "ICE" moniker seemed to be most appropriate. Most of the electronic ballasts in use today are simply modified versions of ballasts used in the lighting industry. The ICE ballast was specifically designed for use in UV systems. By using overrated components and good thermal management, the reduced heat build-up offers substantially longer component life and trouble free operation. The unique stress – free mechanical interface to the ballast's aluminum housing allows for maximum heat dissipation of the power semiconductors.

Our patent pending design incorporates open loop current control topology, allowing for maximum UV lamp output performance over a wide range of input voltage or frequency. This design eliminates the thermal runaway problem normally associated with closed loop systems.



The useful life of a UV lamp is largely determined by the crest factor performance of the ballast driving the lamp. The unique open loop current control circuitry of the ICE ballast compensates for crest factor degradation caused by aging of the filter capacitors. In a "standard" electronic ballast, the crest factor is degraded by the amount of AC ripple voltage on the DC voltage supplied to the inverter circuit. As the filter capacitors age, this ripple voltage of the DC supply will increase, therefore degrading the crest factor performance of the ballast.

In an effort to comply with European and North American certification protocols, the ICE ballast offers full filtering capabilities for both EMI (electromagnetic interference) and RFI (radio frequency interference). It is CSA certified for North American use under the "C US" designation as a stand-alone device and is fully CE compliant for use in Europe.

How do others compare?

As mentioned earlier, the evolution of ballast design has evolved from heavy, inefficient magnetic designs to compact, efficient electronic designs. Sterilight's proprietary ICE design stands at the leading edge of technology as it combines all the benefits of a regular electronic ballast, but incorporates the critical function of open loop current control and excellent thermal management!

Table A compares a standard electronic ballast with the ICE ballast. As you can see by this graph, the output current of the ICE ballast remains constant at 425mA throughout the entire input voltage range of 100 to 260 volts. An inferior competitors standard electronic ballast will function over the same range, however, its output current ranges from a low of 71mA to a high of 197mA. In the case of this ballast, even though it is an electronic ballast, the manufacturer was not even able to reach the required output current at a single specified voltage! This ballast would not supply the proper UV dosage which would be further compounded by cold water. If you examine the magnetic device, you can clearly see that this device should only be used at 220V with no variations in voltage or frequency!

Efficiency is a measure of how effectively a ballast converts the incoming power to the power demands of the UV lamp. A typical magnetic ballast may operate at, <50% efficiency. Electronic ballasts can operate over a wide range of efficiencies. Properly designed electronic ballasts should exceed 90% efficiency. This is especially important for UV disinfection since the UV system is designed to be operated on a continuous basis. Inefficient ballasts waste energy and cost more to operate. This wasted energy shows up as heat. A ballast, which runs hot, is wasting energy! The ICE ballast runs exceptionally cool, resulting in little energy waste.

In Summary?

Sterilight lies at the forefront of leading edge technology in regards to advancement in UV technology. Their innovation in the area of electronic ballast currently stands alone in the industry. There is simply no comparison when it comes to the ICE ballast. Archaic magnetic ballasts are a thing of the past. If a manufacturer is not providing you with a system that offers constant current (and they currently cannot), they are misleading you if they quote a specified dosage or flow rate. As discussed earlier, if a ballast does not operate at its rated output, then the unit cannot possibly produce the optimum amount of UV… it's that simple.

To summarize, Sterilight's ICE ballast offers the following unique features:

- Constant current output over the entire range of input line voltage
- Increased ballast life due to cooler operating temperatures
- Optimum UV output over a wide range of input voltages
- Not affected by line frequency variations (47-63Hz.)
- Crest factor control resulting in longer lamp life
- Instant start lamp for preheat lamp circuitry resulting in no lamp flickering
- Substantially increased energy efficiency
- Built-in EMI/RFI filtering (compensates for radiated emissions & conducted interference)
- New moulded lamp connector (positive lamp connection)
- One ballast for 1/2 to 12 gpm applications
- Built-in circuit transient protection
- Detachable power cords based on the IEC world standard
- Patent pending design

R-Can Environmental Inc, located in Guelph Ontario manufactures a broad range of ultraviolet disinfection systems under the Sterilight brand name in flow rates ranging from 1/2 to 1,000 gpm.

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