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WATER QUALITY PRODUCTS

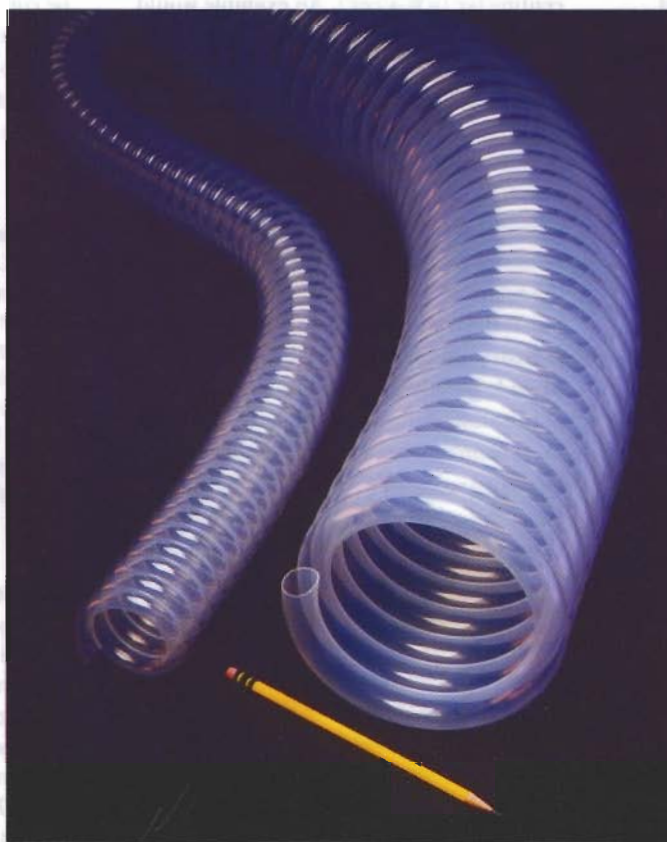
ULTRAVIOLET TECHNOLOGY

Coiled Tubes vs. Quartz Sleeves in UV Applications

The use of quartz sleeves in ultraviolet (UV) light's treatment of water has been the medium of choice for many years. Quartz sleeves always have been cleaned off and replaced at intervals recommended by product manufacturers.

Now there seems to be an upheaval in the ranks, which brings into light compact system designs, longer contact times, less shadowing, cost savings and easier, safer change outs. Coiled fluoropolymer tubes are not new—they have been used in the Asian market for more than eight years. They may not be as time tested as their quartz counterpart, but the coiled tubes offer a very promising change in UV water treatment.

The coils can give the system designer more contact time to the UV light source. With more turbulent water flow caused by the coil, there also is less shadowing of contaminants. This enables the designer to produce more compact water treatment systems such as above and below counter units. These coiled tubes are used successfully in the Asian market, and nearly 1 million of the tubes were sold for above-the-counter water treatment systems. Coiled tubes will become a mainstay in an industry looking



for new and more cost-effective ways for production while allowing easier maintenance for end users and, of course, compact designs for use in labs, recreational vehicles, under-the-counter units and portable systems.

Looking at UV light from a professional water treatment specialist's point of view reveals possibilities overlooked before in this application and other uses to be

mentioned later. UV light transmission is essential for destroying bacteria in water treatment, but whether a quartz sleeve or plastic tube is the best choice for protection of the bulb, effectively controlling bacteria is what needs to be determined. Different applications and influent water changes to some degree the end result needed by the user. Maintenance costs and ease of use in the field are other factors that determine the choice of bulb protection. Pretreatment of the influent water also is another factor in using such a system to prevent premature system failure. Many times point-of-use (POU) and point-of-entry (POE) water treatment designs neglect pretreatment and this allows for the scaling of the sleeves whether they are plastic or quartz. This scaling prevents the proper transmission of the UV light and, in turn, reduces the effectiveness of the system's bacterial reduction abilities. Turbidity is another factor that often is missed, and the shadowing of the particles can compromise effectiveness. The particles causing the turbidity also can scale the sleeves. In applications requiring UV light or reverse osmosis (RO), a pretreatment of the water is recommended to reduce maintenance costs and prevent premature failure of the system.

The pros of using a coiled tube are numerous, with the number-one advantage being compact design. Cost also is significant, not only for production reasons but also for replacement costs and ease of maintenance. The coil's ability to achieve longer contact times because of its design and longer travel of water flow by the UV lamp is what makes using the coil something that water system designers can appreciate. The coiled tube causes the water to become more turbulent, which decreases the chances of shadowing or hiding of bacteria, thus increasing effectiveness. Coiled tubing helps designers save room and enables compact designs for water treatment where space is essential. Systems for labs where tabletop units need to be employed and under-the-counter systems where space is limited can be addressed easier and more cost effectively.


One of the advantages is durability and safety when changing, handling or shipping coiled tubes as compared to quartz sleeves. Breakage or damage from touching coupled with sensitive handling of the quartz sleeve is no longer an issue. The coiled tubes are easy to work with, thus enhancing compact design. Elongated tubes for other applications also are manufactured for uses where compact design is not essential, but the cost of tube replacement is a factor.

Periodic changing of the sleeve is a moot point when comparing quartz or plastic protective coverings. Both must be changed or cleaned at intervals that are caused by UV light breakdown or scaling. A recent study revealed and proved the reduction of UV light transmission in quartz sleeves caused by solarization or the breakdown of quartz from the UV light radiation. The degradation of the quartz sleeve proves that a sleeve cannot be used

forever with just cleaning or wiping and replacement is necessary at various intervals depending upon operation. The UV lamp itself suffers from this solarization degradation and must be changed based on hours of use. The impurities in the glass and quartz cause the solarization—a darkening of the glass or quartz—which reduces the clarity, resulting in the UV light transmission loss. The coiled tubes do not suffer breakdown from this phenomenon.

UV dosage rates equal UV lamp intensity multiplied by contact time multiplied by transmission value. This dosage rate is measured in microwatt seconds per square centimeter ($\mu\text{W-s/cm}^2$). An example would be a UV lamp with an intensity of 4,000 $\mu\text{W-s/cm}^2$ multiplied by a contact of 10 seconds gives a theoretical dosage of 40,000 $\mu\text{W-s/cm}^2$. Manufacturers usually rate this dosage against distilled water, which usually has a transmission rate of 100 percent. A transmission rate of 90 percent is more practical in the real world, and this dosage rate of 40,000 $\mu\text{W-s/cm}^2$ translates into a theoretical 36,000 $\mu\text{W-s/cm}^2$. An industry standard for UV light dosage to provide germicidal control in a typical application generally is 30,000 $\mu\text{W-s/cm}^2$. Most common waterborne organisms can be destroyed with 15,000 $\mu\text{W-s/cm}^2$ or less. This additional built-in dosage rate, therefore, can be compensated by any UV loss in most systems, whether the reduced rate was affected by plastic tubing or quartz sleeves. Total organic carbon applications, however, would need to be examined to be sure the loss of transmittance would not affect the high-purity water needed for the application, thus, reducing the water quality. This loss could have consequences that may be devastating in certain manufacturing processes. Again, no matter which type

of sleeve is selected, there is inherent possibilities of UV light transmission loss that will occur.

Applications for the use of these coiled or elongated tubes are numerous. Although tested and sold in the Asian market, these coils have not been widely used in the U.S. market. Systems using UV light for under-the-counter water treatment are a viable marketplace for low flow rates, especially in an industry where POU/POE water treatment is in the limelight because of public health issues and concerns. Commercial and industrial applications also are being developed and tested. Other arenas that could be pursued would be contact tubing for ozone systems and de-chlorination units. The possible uses and applications for these coiled and elongated tubes are unlimited in the water treatment industry. 

References

- 1 K. Kawar, J. Jenkins, B. Srikanth, A. Shurtleff. "Ultraviolet Light, Deterioration of the Light Transmittance Value of Quartz Sleeves Due to Continuous Exposure to UV Radiation," *Ultrapure Water*, October 1998.
- 2 J. Beauchamp, CWS-V, CI. "Residential UV: Disinfection from a Dealer's Perspective," *Water Conditioning and Purification*, March 1998.

About the Author

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