Salt Chlorine Generators

ECGs (salt chlorine generators) have become a popular sanitizer by converting dissolved chloride ions into available chlorine

By the PHTA Recreational Water Quality Committee (RWQC)

THE PURPOSE OF THIS article is to provide a basic explanation of how electrolytic chlorine generators (ECGs) work. Electrolytic chlorine generators are sold for the treatment of swimming pools.

SUMMARY OF CHARACTERISTICS

- Often referred to as electrolytic chlorine generators, electronic chlorine generators, saltwater chlorinators or saltwater generators (SWG)
- Uses electricity and dissolved salt (typically sodium chloride) to produce chlorine for the pool
- As with traditional chlorine sanitizers, the chlorine produced by the ECG yields hypochlorous acid in the pool
- The chlorine that is produced sanitizes the pool water and destroys contaminants such as those found in sweat, urine and wind-blown debris
- Properly sized systems reduce or eliminate the need for routine addition of chlorinating products
- Produces chlorine only when the circulation system is operating
- Other chemicals, such as balancing chemicals, algaecides, flocculants and metal sequestrants, may be required to protect pool surfaces and equipment and maintain water quality

GENERAL DESCRIPTION

ECGs work by converting dissolved chloride ions into available chlorine. Housed within the ECG are two types of electrodes called cathodes *(positive charge)* and anodes *(negative charge)*. The electrodes are coated with a thin layer of a special metal called ruthenium, which is essential for the production of chlorine. As *direct (DC)* electric current passes through the cell, it generates chlorine gas which, when dissolved in water, provides a free available chlorine residual. This process does not result in the addition of stabilizer or balancing chemicals.

APPLICATION

ECGs are installed in-line and produce chlorine only when the circulation system is operating. For these systems, a pool-grade salt, such as sodium chloride, is added directly to the pool to establish a concentration of about 3,000 to 5,000 ppm. This salt concentration is much less than that of seawater (which contains between 31,000 to 38,000 ppm of salt). Since different ECGs require different salt concentrations, pool operators must follow the manufacturer's instructions.

To assure proper generator function, maintaining the appropriate salt concentration is important for other reasons. Too much salt can increase the potential for corrosion and also make the water taste and feel more like seawater (salt residue on the skin after leaving the pool). On the other hand, too little salt can result in decreased cell efficiency (lower chlorine production) and shorter electrode life.[1] Since most of the chlorine generated reverts back to chloride again during use, the salt is automatically recycled. As a result, salt will only have to be replaced after repeated backwashing, splash out or when partially draining and refilling.

In addition to in-line systems, brine systems are also available. Instead of pre-dissolving large quantities of salt in the pool, brine systems typically use two chambered holding tanks that are filled with salt solution. This eliminates the need for adding salt to the entire pool as the pool water does not come into direct contact with the electrolytic cell. The brine system injects chlorine gas directly into the circulating system.

Regardless of the type of system used, a pool with a properly sized and operating ECG shouldn't require supplemental chlorine for daily sanitizer maintenance. However, supplemental oxidizers or superchlorination may still be required on occasion (e.g., heavy bather load or for remedial treatments).[2] Importantly, proper water balance must continue to be maintained by the pool operator. Since the chlorine produced from ECGs is non-stabilized, the use of cyanuric acid may be required in accordance with PHTA standards.

PRECAUTIONS

Due to the high pH at the surface of the cathode plates within the ECG, scale formation is highly likely. It's important to note that scale formation will occur inside the ECG even if the pool water is properly balanced. Because of the relatively high level of carbonate ions in the pool, calcium carbonate scale is the type of scale that's most likely to form. However, other types of scale can also deposit inside the generator such as calcium phosphate, calcium sulfate and barium sulfate.

Options for removing scale include acid cleaning, rinsing the electrodes with water from a hose, reversing polarity and using antiscalants (Note: Some ECGs can reverse the current flow to the electrodes. In effect, the anode temporarily becomes the cathode and vice versa. This process is called 'reversing polarity,' the net effect of which is scale removal). While effective, acid cleaning and reversing polarity can shorten the effective life of the ECG, since they also remove a small amount of the ruthenium coating. Excessive acid cleaning will damage the cell. Rinsing the plates with a pressurized water hose may be sufficient to remove most of the scale without harming the ruthenium coating. Antiscalants provide ongoing protection against scale formation, which can help minimize the frequency of cleaning or reversing polarity.

The ECG produces available chlorine as dissolved chloride in the water passes across the ruthenium-coated electrodes inside the halogen generator. Scale reduces the contact of the water passing through the ECG with the electrodes, effectively reducing the production of available chlorine. Insufficient chlorine will quickly lead to a deterioration of water quality.

In addition, as electric current travels through the electrodes, heat is produced. Fortunately, pool water cools the electrode plates when passing through the generator and prevents damage from heat buildup. However, when scale coats the electrodes, it shields them from the pool water's cooling effect. The resulting heat buildup can damage or permanently ruin the ECG. Therefore, it is important to follow the manufacturer's recommendations for preventing and removing scale.

Salt needed for the operation of in-line or immersion units will result in elevated TDS (total dissolved solids) readings. Therefore, water replacement recommendations have to be adjusted accordingly. A non-saltwater pool should be partially drained and refilled when the TDS level has reached or exceeded 1,500 ppm above source water. However, this should not occur in a saltwater pool until the TDS level in the pool has increased by 1,500 ppm after adding salt. Keep in mind that high TDS values will also affect water balance calculations.[3]

It is recommended that for commercial pools, only models certified by independent testing labs be used. Sections 15 and 16 of ANSI/NSF International Standard 50[5] deal respectively with in-line and brine-type ECGs.[4] NSF International is an independent, non-profit organization that helps to set standards for and test and certify products related to public health. Since all ECGs are electrical devices, they should also be certified to UL 1081.[5]

ECGs produce hydrogen gas. Operation of the ECG without adequate flow of water can result in explosion. Many systems are designed with protection (i.e. flow switches) to prevent this from happening. ECGs shall be electrically interlocked with the circulation pump to remove power from the ECG when the circulation pump is shut down. Most ECGs have an internal flow detection device that will prevent the unit from producing chlorine during low flow conditions, but these should only be used as a secondary protection to electrically interlocking to the filtration pump.

REFERENCES

1. K. Wall, Modern Chlor-Alkali Technology, Vol. 3, Chichester: Ellis Horwood, Ltd., 1986, p. 411
2. Diane S. Rennell, Ed., Basic Pool & Spa Technology, second Edn., Alexandria, VA: National Spa & Pool Institute, 1992, p. 312
3. ANSI/APSP/ICC-11 2019 American National Standard for Water Quality in Public Pools and Spas, Pool & Hot Tub Alliance, 2019. See Section A7.4 Total Dissolved Solids
4. NSF/ANSI Standard 50 Equipment for Swimming Pools, Spas, Hot Tubs and Other Recreational Water Facilities, 2019. More information at http://www.nsf.org
5. ANSI/UL 1081 Standard for Swimming Pool Pumps, Filters, and Chlorinators (Ed. 7), 2016

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