APSP The Association of Pool & Spa Professionals®

REFLECT SUCCESS

Fact Sheet

# Electrolytic Chlorine Generators

**Revised – June 2011**

***Brought to you by the APSP Recreational Water Quality Committee***

## I. INTRODUCTION

The purpose of this fact sheet is to provide a basic explanation of how electrolytic chlorine generators (ECGs) work. Electrolytic chlorine generators are sold for the treatment of swimming pools.

## II. SUMMARY OF CHARACTERISTICS

- Uses electricity and dissolved salt (typically sodium chloride) to produce chlorine for the pool
- Often referred to as electrolytic chlorine generators, electronic chlorine generators or salt water chlorinators
- The chlorine that's produced sanitizes the pool water and destroys contaminants such as those found in sweat, urine and wind-blown debris
- As with traditional chlorine sanitizers, the chlorine produced by the ECG yields hypochlorous acid in the pool
- Properly sized systems reduce or eliminate the need for routine addition of chlorinating products
- Produces chlorine only when the circulation system is operating
- Does not add stabilizer or balancing chemicals
- Other chemicals such as algaecides, flocculants and metal sequestrants may be required to protect pool surfaces and equipment and maintain water quality

## III. GENERAL DESCRIPTION

ECGs work by converting dissolved chloride ions into available chlorine. Housed within the ECG are two types of electrodes called cathodes and anodes. The electrodes are

coated with a thin layer of a special metal called ruthenium, which is essential for the production of chlorine. As electric current passes through the cell, it generates chlorine gas which provides a free available chlorine residual to the water.
Most ECGs are installed in-line and produce chlorine only when the circulation system is operating. For these systems, a large amount of pool grade salt such as sodium chloride is added directly to the pool to establish a concentration of about 3,000 – 5,000 ppm. This salt concentration is much less than that of seawater (which contains between 31,000-38,000 ppm of salt).[1] In-line generators are installed directly in the pool's circulation return line and available chlorine is generated when dissolved salt passes through the device. Since different ECGs require different salt concentrations, pool operators must follow the manufacturer's instructions.

In addition to assuring 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).[1] On the other hand, too little salt can result in decreased cell efficiency (lower chlorine production) and shorter electrode life.[2] 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.

Although less common, some ECGs are designed for direct immersion into the pool. This feature allows the generator to produce chlorine even when the recirculation isn't operating. Therefore, the operator and swimmers should note that there may be high concentrations of chlorine near the generator, especially when the pool water is stagnant.

In addition to in-line and direct immersion 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.

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).[3]

## IV. APPLICATION

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 use of 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.

## V. PRECAUTIONS

The ECG produces available chlorine as water passes across the ruthenium-coated electrodes inside the halogen generator. Scale reduces the contact with water passing through the ECG, 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's 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-salt water pool should be partially drained and refilled when the Total Dissolved Solids (TDS) level has reached or exceeded 1,500 ppm above source water. However, this should not occur in a salt water 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[4].

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 deal respectively with in-line and brine-type electrolytic chlorine generators.[5] Since all ECGs are electrical devices, they should also be certified to UL 1081.

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.

## VI. REFERENCES

1. http://en.wikipedia.org/wiki/Seawater.
2. K. Wall, *Modern Chlor-Alkali Technology, Vol. 3,* Chichester: Ellis Horwood, Ltd., 1986, p. 411.
3. Diane S. Rennell, Ed., *Basic Pool & Spa Technology, second Edn.,* Alexandria, VA: National Spa & Pool Institute, 1992, p. 312.
4. ANSI/APSP-11. 2009 Standard for Water Quality in Public Pools and Spas. Section A7.4 Total Dissolved Solids.
5. NSF International is an independent, non-profit organization that helps to set standards for and test and certify products related to public health. NSF International-listed products can be searched on the Internet at http://www.nsf.org.