Two Shades of Green

Photo: Powell Water

Original EC units handled flows of 11 gallons per minute. This modern system handles flows of 600 gallons per minute.

Able to address many, if not all, of the issues raised by traditional treatment methods, electrocoagulation is an environmentally friendly and economical alternative.

By Henry Vere

Perhaps every onsite water treatment system setup has its drawbacks: excess water or energy use, changing government regulations (adding to the complexities of keeping within compliance), or the expenses generated by landfilling substances that prove toxic enough to be a problem. There are also new dilemmas on the horizon, such as the growing issue of pharmaceuticals and personal care products (PPCPs) and endocrine disrupting compounds (EDCs) appearing in wastewater and groundwater. Unfortunately, many municipal or OWT systems simply are not designed to deal with these substances. Adding insult to injury, systems large and small must pay strict adherence to the bottom line and stay within their budget. Additionally, electrocoagulation has the benefit of being environmentally friendly and economical, especially when it comes to water savings.

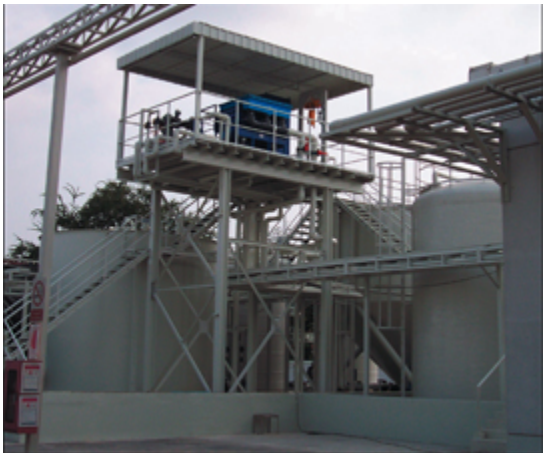

Photo: Powell Water

EC technology has continued to improve flow volume from the original systems, which date back to 1903.

Scott Powell, owner of Powell Water Systems Inc. in Denver, CO, worked years ago as a chemist engaged in making fuel alcohol. When President Ronald Reagan decided to take away the fuel alcohol, or gasohol, tax credits, the lab where Powell worked was shut down. Looking for new opportunities, Powell jumped at the chance to meet Jim Liggett, a lab associate's family member who also happened to hold an electrocoagulation (EC) patent. "I guess that's what got everything started for me," says Powell. He started Powell Water Systems Inc. in 1999 and obtained patents allowing large-flow EC units.

EC technology has been around since 1903, and yet many are not aware of the technology and its effectiveness as a water treatment option.

Several water treatment companies are betting that EC will soon rise from obscurity and take its rightful place as a mainstream treatment option. In addition to Powell Water, there are several other treatment technology providers gearing up for an EC boom, including Quantum Ionics Inc., Landa Water Cleaning Systems, PARS Environmental Inc., Oil Trap Environmental Products Inc., and Gerber Pumps International.

Kilowatts Treat Water Drops

Traditionally, there have been two categories of water treatment systems: *mechanical filtration*, which places a screen

of different technologies in the flow of water to remove contaminants, and *chemical flocculation*, which mixes engineered chemicals in the wastewater to separate the contaminants from the water.

EC, on the other hand, relies on a process of passing electric current through a liquid. EC treatment depends on the amount of amperage passing through the water. During the EC process electricity actually dissolves the metal blades placed within the water while at the same time removing waste compounds from the water.

The blades themselves are simply flat sheet metal of a certain length that slides into slots so that if someone purchases a piece of equipment from the company, he can literally maintain it at his location without returning to Powell Water Systems Inc. to buy additional materials: perhaps the ultimate in user-friendliness, according to Powell. Chemical treatment for sludge in a plating shop could typically cost $14 per 1,000 gallons of treatment. With EC it could be $1 per 1,000 gallon. For a central water treatment plant performing portable restroom water treatment using electrocoagulation at 50 gallons per minute, the operating cost savings are approximately $1 million per year over chemical treatment, according to Powell.

“The best place for such a system is where people need to save and reuse water. One large plasma screen TV manufacturer has literally reused all their production water.”

Benefits Aplenty—from Water to Energy Savings to the Environment

According to Powell, a small Santa Barbara, CA, electrical plating plant had been using 800 gallons of water per day. After installing one of Powell’s EC units the company went to using 60 gallons of water per month due to the reuse of basically all of its production water.

Other plants have reported an increase in their electrical bills by approximately $100 per month. “Back in the days of President Jimmy Carter when the electrical utility companies had to go around and tell all their customers how to save electricity, they’d take us around to their customers and demonstrate that it takes less electricity to clean up water with EC than it did to run the blowers for the aeration for biological treatment,” adds Powell.

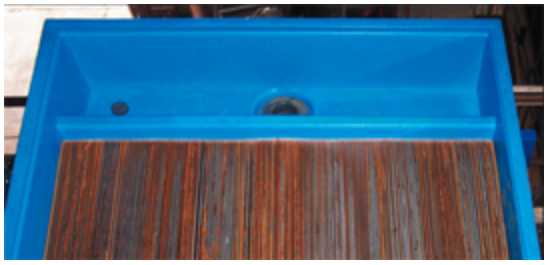

Photo: Powell Water

EC has 80% less solids than chemical coagulation.

“According to the EPA, compared with chemical coagulation, EC has 80% less solids or sludge and dewaters 76% faster. It’s very friendly to the environment, the reason being that chemical coagulation involving polymers holds water. An example is disposable diapers containing polymers to hold water in the gel. On the other hand, EC repels water; therefore it dewaters so much faster.

“Municipal, aerated sewage sludge which must be hauled can be cut easily by 50%. In addition to less sludge to haul, another advantage is the sludge will completely dry down. When it is placed on the field it will dry to dust. Chemical coagulated sludge, which in Europe is actually banned from some landfills, will remain soggy and wet. When it’s out smoothing the top of the landfill the earthmoving equipment can fall into the soggy hole; it’s still a bog out there.”

EC does have a limitation with the type of carbon chains it can separate from water. These chains must be larger than six carbons to be split effectively. For a manufacturer involved with short carbon chains, such as one involved with the production of soft drinks where the biological oxygen demand (BOD) is mainly simple sugars, EC will remove only 50% of the BOD present.

In the case of slop oil, a Powell Water Systems Inc. unit will separate the water from the oil by over 99%. The oil wasted at a refinery and often termed “slop oil” may actually be recovered with a Powell Water Systems Inc. system: The oil is separated from the water and the oil can be recovered.

“In today’s society where oil prices are high, this is a great opportunity to be able to recover oil and save the environment from basically slop oil storage,” says Powell. “Some cooling towers are silica-limited, such as those in the utility industry. Our systems are quite effective in removing silica or phosphates as some have problems with those. Combine that with oils and greases and we can supply a very broad spectrum of treatment.”

Though treatment of soft drink manufacturing wastewater may not be the best use for such technology because, as mentioned earlier, the chain of carbons is simply too short, there are some cases, even in that industry, where EC can prove useful. “In some countries the groundwater contains pesticides,” says Powell. “One beverage manufacturer came to us in order to remove pesticides from the water. EC will remove pesticides or halogenated hydrocarbons from out of water very effectively.”

For the above use there is a removal rate of 99%. It removes bacteria from water at an equally high rate. “Overall for anyone desiring to reuse their water this is an excellent, excellent way to accomplish that,” adds Powell.

Regulations Have Become the Driver Across the US

As with many other businesses in the wastewater treatment industry, what drives much of EC business is government regulations, which prevent people from dumping water directly on the ground. “Our feeling is that the government will continue to lower the allowable outputs with their regulations until they force a business or operation to recycle the water. But then that always has been a chief focus for us: cleaning up the water to the extent that it can be reused,” says Powell.

The EC equipment is set up somewhat like the way a car battery is set up, the positive pole on one side and the negative on the other. Plates and the liquid inside are protected or housed to avoid contact.

Electricity is put through water, and in the case of bacteria, the osmotic pressure either causes the bacterial cell to rupture or else the bacteria is more conductive and causes electricity to “short” through the bacteria. Powell is unsure exactly how his system works in killing bacteria. “But our units do a very good job of destroying bacteria,” says Powell. “Even for ‘super bugs,’ our process coagulates the cells or makes them clump together before they’re separated out in the clarifier.”

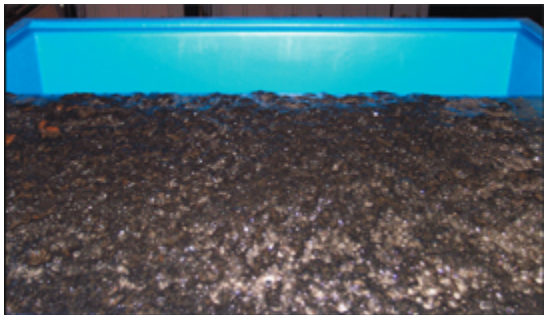

Photo: Powell Water

EC systems effectively remove bacteria from the water.

At a Centralized Wastewater Treatment Facility

Affiliated Wastewater Environmental Services, a centralized wastewater treatment facility in Denver, uses a Powell Water Systems Inc. EC unit primarily for metals removal. Waste material is hauled to Affiliated’s 6,000-square-foot building for electrocoagulation, just one type of treatment performed there.

Affiliated Wastewater Environmental Services handles only non-hazardous wastewater, with no residues, for example, from such things as metal-treating operations. With its own vacuum trucks, the company will travel to the customer’s site and pick up the waste and bring it back to its site for treatment. Industries Affiliated Wastewater Environmental Services treats include car washes, truck washes, mud and water operations, and other non-hazardous wastes.

Photo: Powell Water

Regulations have become much more stringent over the past few decades to limit the levels of metals in the water.

“EC primarily removes metals for us, which is critical as we have a wastewater discharge permit for water-quality standards,” says Barbara Tillman, compliance manager and owner of Affiliated Wastewater Environmental Services. “The 12 metals in our permit which we must catch include arsenic, antimony, zinc, and titanium, to name a few. We’ve used EC for four of the six years our company has been in business.”

The unit the company obtained has a relatively small footprint of 6 feet by 10 feet by 4 feet in size. Maintenance on the unit is minimal. Metal blades are changed approximately every four months. The blades must be cleaned daily as well. Washing is done automatically with hydrochloric acid. Acid is pumped in, bubbled, and then drained back out in an acid-holding tank and eventually gets reused.

“The acid is well-contained in a closed-loop system,” says Tillman. “There is really little opportunity to be exposed to the acid.”

The main benefit of Affiliated’s use of EC has been to keep the company in compliance, within the limits of its discharge permit—which in turn allows it to stay in business. “As soon as the EPA changed the rules we simply had to get more treatment into our setup to stay in business; it’s as simple as that,” adds Tillman. “EPA became much more stringent. It was all very complicated, including a 2,000-page regulation. In general there are semi-volatiles and metals and there are very low discharge limits on all of them—much lower now than they were.”

Electrocoagulation: Automated

Areas of tremendous growth and development for EC include the treatment of slop oil and oilfield production water. As mentioned earlier, a driver in that development has been pressure from the EPA for cleanup in these areas. The treatment does an excellent job of breaking oil and water emulsions in treating slop oil. In oilfield production water it is effectual when steam recovery takes place.

OilTrap Environmental Products Inc. in Olympia, WA, focuses on oil and grease, suspended solids, and heavy metals in wastewater treatment, also using EC. According to Dale Nelson, president of OilTrap, typically the marketplace goes from 5 to 100 gallons per minute. OilTrap has also installed systems that are running 200 gallons per minute.

OilTrap designs both custom and standard footprints. Much of its primary business involves industries such as heavy equipment washing, marinas, military wash operations, forest products processing, aircraft refurbishing, auto auctions, equipment washing, and metal finishing and deburring. Overall OilTrap serves everything from industrial wastewater to stormwater runoff applications.

“We have a very wide spotlight in our treatment processes so it’s not just oily water that we treat,” says Mike Davis, vice president of application engineering. “We provide stormwater treatment for discharge to surface water, sewer discharge for industrial wastewater, and also recycling for zero-discharge situations.”

Though EC has been around for over 100 years, companies such as 15-year-old OilTrap have taken this technology to higher levels of capabilities. They manufacture their entire systems in-house, shipping to job sites globally. A system arrives on the job site turnkey and usually can be installed and operational in one day.

In a *World Business Review* interview, Richard Moss, a professor of environmental science at University of North Carolina at Asheville, said the biggest benefit of EC is that generally for small- to medium-scale operations, you don’t need an operator. The system will really run by itself. The other big advantage is that you really are not adding chemicals. You are using an electric field to remove particles and chemicals.

“We are one of the only companies having developed a process or a treatment cell which does not require cleaning,” says Davis. “Through many levels of design we’ve achieved a way to repel the contaminants away from the plates so our cell does not require labor-intensive acid baths or descaling; our cells are replaceable as they are a sacrificial anode and it only takes three minutes to replace a cell. This is the only maintenance on the OilTrap system.”

The design does not require any type of chemical additions other than pH adjustment; therefore the OilTrap system does not require the added cost of polymer for containment separation. OilTrap has designed a process in its cell in which large volumes of gases are generated in the water. OilTrap does not inject gases into the water; they’re generated through electrolysis. Tiny bubbles attach to the coagulated particles, much like in a dissolved air floatation system, and cause the contaminants to become buoyant.

“We don’t have to add any air; it just develops and causes all the contaminants to float,” says Davis. “We simply skim them off the top and they’re deposited into a holding tank. There are no filters on our system, no separation chemicals required, and basically there’s no daily maintenance to our system. We’ve made some huge advances in our technology and it’s still evolving very quickly.”

The contaminants separated from the water through the OilTrap system generally will pass a Toxicity Characteristic Leachability Process test, a lab test proving that metals separated from the water through this system will not leach or redissolve in the water.

Davis considers this process an emerging technology, replacing mechanical filtration, chemical treatment, or bioremediation in many industrial applications. “It is so simple to use as well,” adds Davis. “The OilTrap system is basically a one-button operation. You simply leave it in automatic and you can walk away without any detrimental effects. We’ve essentially taken all the control switches off the system except the ‘on/off’ switch. This eliminates the adverse effects of ‘knob-twisters that exist in all locations.’”

Many equipment washing operations such as equipment rental facilities are moving away from mechanical filtration to this type of technology, according to Davis. The specification of a system is based on the required flow rate a particular site has to process with. For smaller systems with the treatment rate of 5 gallons per minute, the standard footprint is 6 by 8 feet. They’re also currently treating wastewater streams of almost 300 gallons per minute. Beyond that size their systems are modular, increasing in 100-gallon-per-minute increments.

“Technological advancements are changing the world we live in,” adds Davis. “Water treatment is no exception.”

Electrocoagulation Providers
Quantum Ionics Inc. (www.quantum-ionics.com)
Landa Water Cleaning Systems (www.landa.com)
PARS Environmental Inc. (www.parsenviro.com)
Oil Trap Environmental Products (www.oiltrap.com)
Gerber Pumps International (www.gerberpumps.com)
Powell Water Systems Inc. (www.powellwater.com)

Henry Vere writes extensively on engineering and scientific subjects.