

ElectroCell

SIDE STREAM PARTICLE PRECIPITATOR SYSTEM

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The intent of this White Paper is to formally introduce ElectroCell and to describe how it works either in a stand-alone mode or in conjunction with Demand Flow. We started introducing the ElectroCell solution to our Demand Flow customers a little over year ago and have successfully implemented it on several Demand Flow installations for various customers. ElectroCell helps improve the efficiency of the plant beyond what Demand Flow can do on its own although it positively impacts the efficiency on Demand Flow projects as well.

It can be used on its own or in conjunction with Demand Flow. To date all our projects with ElectroCell have been combined with Demand Flow and so we currently have no experience with the ElectroCell solution on a stand-alone basis and we are confident it would be very beneficial to plant efficiency on its own.

ElectroCell is used to improve the efficiency of Condenser Water systems on water cooled chiller plants. It works alongside the existing chemical treatment of the plant. The continuous intake of solids into the condenser water is unavoidable; a typical 600-ton cooling tower "scrubs" airborne contaminants (dust & pollen) from the atmosphere and deposits as much as 1800 pounds of particulate matter into the condenser cooling water system each year. Heavy particles settle to the tower basin, which will require manual removal. Lighter particles travel through the Condenser Water system. Over time these particles build up in volume and contribute to four primary treatment concerns: corrosion, scaling, fouling and microbiological activity. These treatment concerns are inter-related such that reducing one can have an impact on the severity of the other three. The ElectroCell System effectively removes of the full range of solids in the condenser water without the use of a filter media. The system combines physical technologies, variable controlled flow rates, and vessel design to accomplish an average of 92%-97% particle removal through precipitation down to a particle size of 1 micron. Solids (organic and inorganic) are normally held in solution by electrical charges. The addition of ions with opposite charges destabilizes the solids, allowing them to coagulate. The condenser water passes through a series of larger parallel-piped precipitation vessels and experiences a dramatic reduction in flow rate. Suspended solids with increased mass precipitate out of solution and settle to the bottom of the pods. Condenser water flows upward through static mixers that also further retard flow rate and enhance uniform coagulation and precipitation of solids. As the solids coagulate, they increase in size and sink to the bottom of the precipitation vessels. Before the condenser water is allowed to flow back into the condenser water system the water passes through one final vessel that houses a powerful electromagnet that removes any metal fragments in the water and prevents them from entering back into the condenser water system. Eventually these solids are purged from the system as part of the

normal blowdown process associated with the conductivity set-point supplied by the water treatment system.

The benefits of the ElectroCell solution are:

Reduction in water consumption: Demand for makeup water in cooling towers is decreased with an increase in the system's cycles of concentration. Essentially, higher cycles of concentration mean that water is being recirculated through the system longer before blowdown is required. Less blowdown reduces the amount of makeup water required in the system, resulting in water savings. There is also the potential for a reduction in the sewage bill. The ElectroCell system measure the amount of water flushed to the drain. If the make up water flow is measured, you can calculate the amount of water that evaporates at the cooling towers that does not go down the drain as sewage. In many municipalities, they will discount their sewage charges if you can demonstrate the difference between make up water flow and sewage flow.

Reduction in energy consumption: The elimination of solids in the condenser water reduces the likelihood of scale and fouling at the cooling towers and the condenser tubes in the chillers. Even the smallest layer of scale or fouling on any heat exchange surface can reduce the rate of heat exchange, forcing the system to work harder to achieve the desired cooling and in turn increases energy costs.

Enhance chemical use: Chemicals are used to bind suspended particles in the water stream and prevent scaling and corrosion. Dirty water requires more chemicals than clean water because a buildup of solid contaminants provides a buffer that reduces the effects of treatment chemicals. The ElectroCell system removes suspended particles, reducing the need for additional chemical treatments such as dispersants and biocides.

Lower cooling tower maintenance cost: Traditionally, cooling towers are cleaned by draining the tower and having the sediment removed mechanically or manually from the sump. Costs associated with the cleaning process include downtime, labor, lost water, and additional chemicals. The ElectroCell system routinely provides longer periods of continuous operation before being taken off-line for required maintenance.

Control of biological growth: Biological growth control and reduction can mitigate potential health problems, such as those caused by *Legionella*. ASHRAE Guideline 12-2000 has basic treatment recommendations for control and prevention, stating that the key to success is system cleanliness. *Legionella* thrives where there are nutrients to aid its growth and surfaces on which to live. The ElectroCell system can minimize habitat surfaces and nutrients by maintaining lower particle levels in the water stream.

One important benefit of using the ElectroCell System with Demand Flow is the amount of data that Demand Flow collects regarding plant performance. Energy on every chiller, pump and tower fan is trended collecting data every 15 minutes and plant tonnage plant performance is calculated. With a good baseline of data, it is very easy to determine the electrical savings associated with the ElectroCell system.

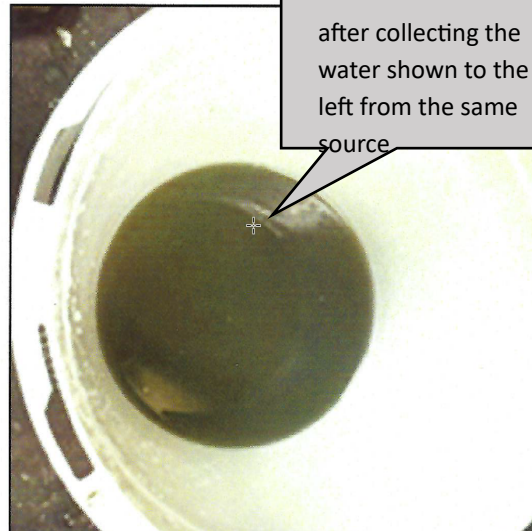
On our test site at a hospital with Demand Flow in Nashville, we were able to measure a 11.3% savings that we could associate with the ElectroCell system after normalizing the data for weather. The simple payback on the project was 2.6 years. This is right in line with the savings and simple payback predicted by ElectroCell. Additionally, prior to the start up of the ElectroCell system a sample of condenser water was taken and sent to a third-party lab for the analysis of the water. Essentially the analysis told us the content of the water including the dissolved solids as a percentage of the water sample. About two weeks after the ElectroCell solution was turned on, we collected another sample of the condenser water and sent it again to the third-party lab for analysis. After a few weeks we got a report from the lab that the 99.2% of all solids were removed. Finally, on each project before we start up the ElectroCell system we collect a large sample of condenser water in a 5-gallon bucket. In each case so far, the water looks clean enough to drink. After turning the ElectroCell solution on we waited about a day and then took more water out of the system the water was dark brown, and it looked muddy. The ElectroCell system took a great deal of the solids (even dissolved solids) out of the condenser system and that is what we were seeing in the water. This visual test, while not providing any empirical data, speaks volumes for the effectiveness of this system. (See below)

CASE STUDY:

99.702% Reduction of suspended particles down to one micron



Relatively clear water collected from the condenser water system prior to turning on the ElectroCell System.



Sediment collected from seemingly clear water one day after collecting the water shown to the left from the same source

If you have any questions about Demand Flow or the ElectroCell System please contact me, Mark Benevides at Mark.Benevides@Siemens.com or by cell phone at +1 (678) 447-3418.