



**CLEAN**  
**ENVIRONMENTAL**  
**SOLUTIONS**

**HELICAL CATHODE  
ELECTRO COAGULATION**



## Cyanide Destruction Treatment Plant

This is a fully automated system controlled by two PLC's that carry out the cyanide destruction process from 9,000 ppm down to 0.5 ppm.

For this application, chlorination alone is not able to destruct the ferricyanide complex. Cyanide is still bound to the iron and is detected during chemical analysis.

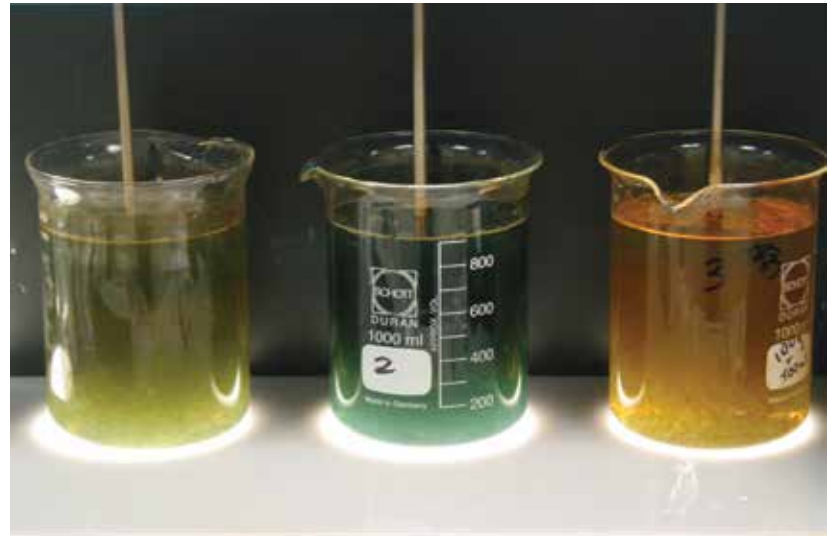
The ferricyanide complex is only effectively destructed by electrocoagulation.

# ELECTRO COAGULATION

An advanced, modern and economical wastewater treatment technology that has gained popularity in the last 10 years in North America, South America and Europe. Clean Environmental has patented and developed a new and innovative design called *Helical Cathode Electrocoagulation* which differs from conventional plate technology. The new design gives several advantages over plate technology such as:

- » Able to handle all types of wastewater without plugging.
- » Provides a larger surface area in a small compact design. This allows a simpler design and uses lower amperage requirements per cell.
- » Easier Maintenance due to a much simpler design.
- » Higher flow rates can be achieved in a small foot print design.
- » Light weight. Plates are heavy. Our cells are only a fraction of the weight.
- » Much lower operating cost. Our design uses very low voltages, providing big savings to the customer. Most treatments can be achieved between 1 and 7 volts.

Electro-coagulation has several advantages over conventional treatment methods. This is because as the process indicates Electro (means we apply electrical charge to the contaminated waters) Coagulation (we change the particle surface charge). As we change the particle surface charge we change the electric double layer minimizing the Zeta-potential to the point where coagulations of particles occur very fast, forming very stable and robust colloids that precipitate out solution with ease.



## Laboratory Capability

We develop the right application for our customers in a professional environment to find the setting that will best suit their needs.

# ADVANTAGES & BENEFITS

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## Filtration

Filtration technology requires a high particle size for it to work. It is limited to only certain types of contaminants. If free oils and greases are present it will cause high maintenance cost on filters.

## Biological Treatments

This type of technology treats oil and grease relatively well but does not treat suspended solids or heavy metals. It also requires careful pH adjustments to keep the bacteria alive. It can therefore be high maintenance.

## Chemical Treatment (Chemical Coagulation)

This technology can treat heavy metals but requires very strict control of pH. Most of the time chemical treatment methods increase the TSS (total suspended solids) and produce large volumes of sludge with high bound water content. This is because the electrical double layer formed by chemicals is not as strong and pronounced as when formed by electrocoagulation. Therefore chemical coagulation is usually slow to filter and difficult to dewater because the floc contains more water.

## Electrocoagulation

This technology uses the same mechanism as chemical coagulation but the characteristics of the floc are dramatically different than the floc formed by chemical coagulation. The floc produced by Electrocoagulation contains less bound water, and is easier to filter because is more shear resistant. In addition, Electrocoagulation is able to treat oil and greases with ease, reduce TSS and BOD.

# IDEAL APPLICATIONS

- » Pulp Industry
- » Mining
- » Dye/ink (Fluorescent Penetrant Dyes)
- » Land Field Leachates
- » De-florination
- » Nitrogen removal
- » Metal processing (heavy metals in general and specifically hexavalent chromium)
- » Food Stuff waste
- » Marinas
- » Oil and Grease
- » Reduction of Total Suspended Solids



## Field Testing

Trailer mobile unit used to gather data in a real environment. This unit has been used at mine sites to test for the removal of heavy metals, arsenic and other contaminants.

The information gathered by the mobile unit helps to acquire information to build a permanent system and to verify the treatment in a real working environment.



## Results of Treatment

Samples of water before and after HC-EC water treatment. Suspended solids and contaminants have been reduced.

# COMMON REACTIONS

## Seeding

Producing new active sites (centers) for larger particles to react. This helps to reduce TSS.

## Emulsion Breaking

Hydrogen and Oxygen formed by electrolysis attack the water receptor sites in oils and greases, destabilizing the molecules and causing them to precipitate out of solution. Electrocoagulation is a very effective way to separate oil and grease.

## Halogen-Complex

The active metal eroded by the electrocoagulation process is highly charged and therefore can bind to chlorides or halogens that are attached to hydrocarbon molecules. Once the heavy metal is bound it can cause separation (precipitation) of toxic compounds such as pesticides, herbicides, PCBs etc.

## Bleaching

This is a process where the products of electrolysis (Oxygen in particular) and electric current induced into the solution can oxidize dyes, cyanides and bacteria.

## Oxidation/Reduction

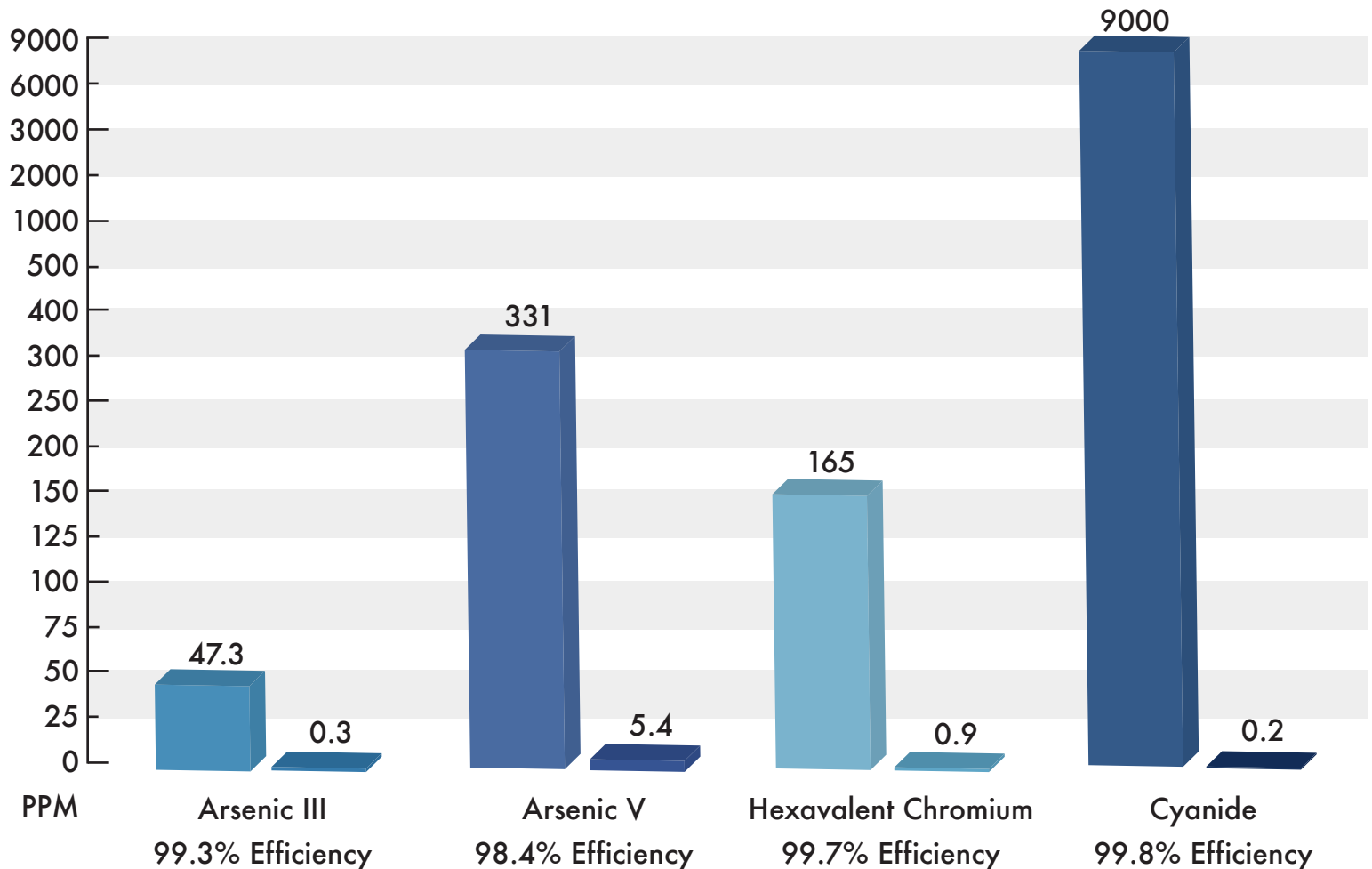
The current inside the electrolytic cell can also induce oxidation reduction reactions in the anode and cathode depending on the Electrode Potential of each species in solution. For example the reduction of hexavalent chromium to trivalent and then precipitating together with the metallic hydroxides produced is one example of these reactions. Electrocoagulation is the only treatment process that can treat hexavalent chromium directly due to this mechanism.



## Clear Results

After HC-EC, water sample contaminants are down to acceptable levels.

# PROCESS RESULTS



## Contaminant Removal

HC-EC is effective at removing Arsenic in both oxidation states (III and V). Almost 100 % removal efficiencies were achieved during pilot testing at the Red Lake Mine in Ontario.

**Total Chromium** was treated at a local plating shop using only 5 cells achieving almost 100% removal efficiency at flow rates of 22 L/min. Flow rates depends on the number of cells, power requirements and contaminant levels.

**Cyanide Treatment** Installation treating total cyanide at a local hardening plant where cyanide is bound with Iron (Ferricyanide Complex). The HC-EC technology is able to treat levels of 9,000 parts per million down to a 0.22 parts per million at 40 L/min



# **CLEAN ENVIRONMENTAL SOLUTIONS**

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