Water Technology

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An innovative, economical and efficient method of silica removal from waters

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Electrocoagulation: An Innovative, Economical, and Efficient Method of Silica Removal from Water

The removal of contaminants such as silica from water can be a challenging proposition. Some examples of industries that need to remove silica from the water before discharge or reuse are: cooling towers, boiler blow feed water or boiler blow down water, car washes, semi-conductor manufacturers, and steam injection oil recovery wastewater. Really, any industry that processes wastewater water for discharge or reuse often faces the challenge of removing silica from their process water.

Silica in water most often is naturally-occurring. Some of it is man-made like car wash water. Silica, in general, is reactive silica and colloidal silica. Whatever form this constituent is in, silica must be removed before treatment and reuse or disposal/discharge. The most familiar methods for removing silica from a waste stream are lime softening, ion exchange, and reverse osmosis. Electrocoagulation improves upon these alternatives.

Lime Softening

Lime softening is one of the most common methods for removing silica from water such as makeup to cooling towers, make up to boilers, or boiler blow down water. Lime softening utilizes the addition of lime (calcium hydroxide) to remove hardness (calcium carbonate and magnesium carbonate) ions by precipitation. Silica particles are absorbed in flakes of magnesium and calcium hydroxides. These flakes (floc) can then be sent to a clarifier or filter where the separated silica can be disposed. As the percentage of silica in the water changes, so must the percentages of chemicals that must be added. In a lot of cases, heavy metals will be present in the sludge (settled floc) and will require the extra expense of disposal into a hazardous waste facility. Lime softening typically requires a fairly sizable capital investment and can be costly due to the quantity of chemicals used and disposal costs of large amounts of residuals produced, especially if hazardous waste facilities are needed.

Ion Exchange

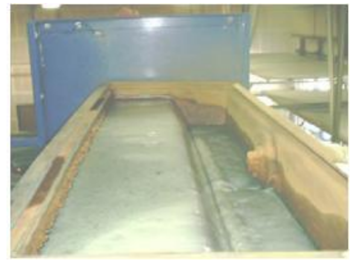
The definition of “ion exchange” from Wikipedia is “an exchange of ions between two electrolytes or between an electrolyte solution and a complex. In most cases, the term is used to denote the processes of purification, separation, and decontamination of aqueous and other ion-containing solutions with solid polymeric or mineralic ion exchangers.”

Ion exchange works very well for the removal of silica; however, the disadvantage of this process is that the resin exchangers need continual recharging and replacement, adding significant ongoing costs to the process. In addition, if there are heavy metals within the exchange resins with the silica, these concentrated ion metals usually do not pass the TCLP leachability test and must be disposed of in a hazardous classified landfill, adding further expense.

Reverse Osmosis

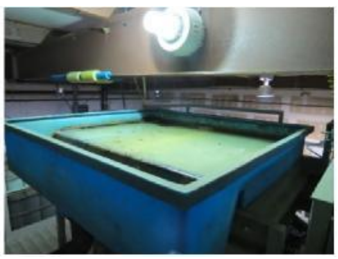
Reverse osmosis (RO) is a membrane-technology filtration method that removes many types of large molecules and ions from solutions by applying pressure to the solution when it is on one side of a selective membrane. The result is that the solute is retained on the pressurized side of the membrane, and the pure solvent is allowed to pass to the other side. To be "selective", this membrane should not allow large molecules or ions through the pores (holes) but should allow smaller components of the solution (such as the solvent) to pass freely.

Using reverse osmosis or any membrane technology to remove silica can be problematic. Silica is like glass and will cut holes in the membrane and will decrease the efficacy of a membrane because of the abrasiveness of the particles. Heavy metals foul membrane leading to their premature death. Membrane systems should have a pretreatment regimen to get rid of the constituents that foul membranes. If pretreatment is done prior to membrane treatment, then membranes will perform optimally without expensive replacement.



<u>Electrocoagulation</u> - The Simple, Economical and Efficient Approach to Silica Removal from Water

Electrocoagulation (EC) will successfully remove silica, heavy metals, and other contaminants from aqueous solutions. With the use of clean electricity, electrocoagulation efficiently removes a wide range of contaminants with a single system. The EC makes constituents in the water "separable". Heavy metals are converted from ion forms to oxide forms, allowing them to be disposed in a non-hazardous landfill. Because electrocoagulation utilizes methods that precipitate out large quantities of contaminants in one operation, the technology is the distinct economical and environmental choice for industrial, commercial and municipal waste treatment. The capital and operating costs are usually significantly less than chemical coagulation.



The industry leader and the world's largest supplier of industrial electrocoagulation (EC) systems has more than 150 installations worldwide. The EC chamber consists of flat metal blades placed parallel to each other. Untreated water is introduced into the bottom of the chamber and is dispersed evenly as it moves upward through the blades. Direct current is applied to the first and last blade. The liquid then becomes a conductor, allowing the current to pass freely throughout the chamber. This results in a flood of electrons into the water, neutralizing charged particles, causing them to precipitate out of solution. In addition, the metal blades react to the current by releasing charged metal ions that act similar to chemical coagulants.

The unit also contains an automated clean-in-place (CIP) system and an air purge system that fluidizes precipitates and reverses polarity in order to extend metal blade life and prevent contaminants from coating the blades. No chemicals are required for the treatment process. The acid solution used in the automated cleaning cycle is recycled and, when exhausted, is routed through the EC system for final disposal. EC has become recognized as a very effective means for economically treating a wide variety of challenging water treatment applications and are available in sizes ranging from 1 gpm to multiples of 2,500 gpm.

There are competing EC systems on the market. Cost alone is not the best or wisest reason to purchase a particular EC system. The capital cost (CAPEX) on some EC units are low; however, because of their power supplies and chamber designs, the operations cost (OPEX) can be very high.

There are distinct OPEX advantages to using the correct electrocoagulation system:

No process chemicals are required - The treatment process requires no chemicals. The system is periodically cleaned with an acid solution that is recycled.

There are minimal operator requirements – Even the largest systems can be operated with only 1 or 2 operators. Operator training is straightforward. The simple design ensures the system is very reliable and cannot be damaged by operator error or process upset.

There is very low operating cost – Besides manpower, the only operating costs are power and periodic metal blade replacement. Power consumption is typically 4 kwh/1,000 gallons, and metal blade consumption is about 0.20 lbs. /1,000 gallons treated.

There is very minimal waste disposal – Most contaminants are precipitated as oxides which render them non-hazardous and able to pass the TCLP test. Since no additional chemicals are added, the waste volume is minimal and can typically be discharged into dumpsters for haul-off or non-hazardous landfill.

High-temperature water can be processed – High-temperature water such as silica laden water from geothermal water or boiler blow down water can be treated and re-used. EC chambers can be specified to withstand very hot water which allows for a continual and complete treatment process without the added expense of cooling the water as is needed before using membrane or ion exchange technologies.

In summary, electrocoagulation may soon move from the optional treatment method to the essential treatment method as the US EPA begins to enforce the laws protecting the environment from toxic wastes, including heavy metals. Electrocoagulation cleans most wastewater streams with less operating cost and produces less sludge than chemical precipitation. The metal oxides that remain in the sludge will pass leachability tests (TCLP), allowing the sludge to be disposed in a non-hazardous landfill. The reuse opportunities for the water are increased because dissolved solids are not added to the waste water stream.

Mr. Sundine has more than 40 years of experience in the horticulture, wastewater, and environmental field. He specializes in natural wastewater remediation, bioremediation, erosion control, soil amendments, biological microalgae aeration, and animal waste remediation. In addition, he has extensive knowledge of the turf field, specifically golf courses and sports turf. He can be reached at 720-363-0548. Email: isolite@ix.netcom.com