



*Electrocoagulation and other  
wastewater treatment technologies*

## **KASELCO**

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## **KASELCO SYSTEMS DESCRIPTION**

KASELCO manufactures and installs electrocoagulation (EC) systems for treating various types of water, both wastewater and other waters. KASELCO produced its first system in 1996 and now has over 100 systems operated by customers across the United States, Canada, Mexico, South Africa, Saudi Arabia, Portugal and China. KASELCO developed a working reactor that is now covered by three US patents with other patents pending and applied for.

Candidate waste streams are tested in pilot-scale bench tests and then further tested at production scale. Sludge volume is measured to allow reliable solids separation design. Performance guarantees are issued with the systems.

There are a number of differences between the KASELCO offerings and the competition. KASELCO is capable of designing, building, and installing complete manual or automated systems, from water collection through solids separation. Reactors are available in 2.5, 10, 25, and 125-1500gpm models. This description covers only the first three sizes. Flows requiring capacities between sizes are met using either multiple reactors or circulating reactors operating independently to maximize treatment. Some unique features include:

**CHEMISTRY:** All projects are approached from an electrochemistry standpoint. Although not all reaction mechanisms are fully defined, they can be explained in real terms. A research program is continuing with Lamar University, Beaumont, Texas, and Texas A&M University to further define the reactions. The US Agency for International Development has funded an additional program to examine specific applications. Universities in Mexico are performing research in conjunction with Lamar.

**REACTORS:** The KASELCO Sur-Flo reactors (2.5 to 25gpm) are totally enclosed, self-cleaning units with simple sacrificial plates. No acid washing is ever required. The plates are made from common, recycled sheet steel with no welding or special cutting required. Plates are 1/4" and 3/8" thick for extended life. There are three reactor configurations, with the choice based on the conductivity of the waste. Their ranges overlap, making selection easy and reliable (seawater requires a type 011 reactor).

The reactor cases are 2" thick PVC for durability. Each free-standing reactor is mounted in a sturdy, steel stand over a pan equipped with caster wheels for portability. Reactors may be moved easily for rebuilding (plate replacement). Door seals use continuous quad-rings and swinging clamps hold the door covers with swing-away bolts. Reactors will tolerate firm solids up to 1/8" diameter.

The water sees a number of polarity changes in its 14 second path through the reactor, adding both electrical and mechanical turbulence. The flow rate is maintained at a velocity sufficient to keep the plates clean by using a positive displacement feed pump. Normal flow is bottom to top, but can be reversed to clear large obstructions.

Plates and flow are horizontal. There is no separation of phases (solids, liquids, and gasses) within the reactor, and no dry spots on the plates. ALL the water sees both electrical poles, so oxidation and reduction can both occur among ALL the species present.

Electricity is connected to the plates using 1/2" copper bar that is vinyl-coated for permanent insulation. Bolt or stud threads are not used for electrical contact. Each electrical input point to the reactor is completely sealed from leakage using reliable, simple compression fittings.

Any gasses generated within the reactor are expelled with the water at its design velocity, with no opportunity to form gas pockets.

Scale formation (from plate surfaces) is minimized by periodic electrical current reversal and liquid velocity, and scale is kept small by that same velocity and the path of the water. There is no need for separate scale removal. When a reactor is placed in service it is typically not opened until the plates are exhausted.

Reactors are connected to the power supply electrically using quick-connects and to fluid lines using simple unions. A reactor can be removed from service and replaced in less than two minutes.

The KASELCO reactor has reached treatment levels unsurpassed by previous EC systems and with greater reliability. Systems are "industrial grade" to require minimal attention and service. Plate replacement (complete reactor rebuild) in the largest reactor requires less than two hours.

**PLUMBING:** All liquid plumbing is Schedule 80 PVC. All liquid valves are true-union ball valves. Should a valve eventually fail it can be replaced in minutes without cutting and gluing pipe. Since waste service can result in plugged lines, each section of plumbing is accessible either through a union, a cleanout, or a removable valve.

Pneumatic lines use flexible hose rated at 300psi. Connections for regulators, etc. are hydraulic swivel fittings, so that any single component can be removed without disassembling or disturbing other parts.

**POWER SUPPLIES:** KASELCO uses durable, air-cooled SCR rectifiers that are equipped with automatic amperage and voltage control and with automatic, periodic reverse current. The reversing circuit prevents contacts from being made or broken under load. Constant voltage and amperage allow the units to accept a range of varying conductivity without problem or attention. The rectifiers are rated for 100% duty cycle to their maximum amperage at maximum voltage. They are of proven commercial design and not manufactured uniquely for this application.

Power to the reactors is limited to 48 volts DC to prevent hazards to operators. Rectifiers are available for any input line voltage and any phasing. Reverse timers are electronic. Tap switches are available to limit power consumption within the transformer when low voltage output is required.

**CONTROLS:** KASELCO can provide any degree of automation using industrial-grade PLC controllers. Full annunciation (operator interface) panels allow the operator to control any variable, operate any

function singly, operate the system automatically in any mode (discharge, batch, or circulate). Programs and ladder logic are provided as part of the operator's manual.

Controls include automatic shutdown circuits that monitor reactor and pump pressures to avoid reactor damage from plugged lines, pump failure, lack of water supply, or other causes.

Automatic cycles are available for KASELCO or other manufacturer's filter presses and for clarifier sludge removal. Systems can control the pH of the influent or effluent, measure and control conductivity, and perform many other functions.

**DOCUMENTATION:** Each system is furnished with full documentation. An operator's manual is written specifically for each system or installation. It includes operation, maintenance, and troubleshooting. A separate manual is provided with parts books, drawings of KASELCO items (including reactor and plates), ladder logic, PLC programs, and vendor parts and maintenance books for buyout items.

Process and instrumentation diagrams are produced prior to construction.

**WORKSMANSHIP:** KASELCO systems are manufactured to the highest degree of workmanship. All metal parts are either plated or painted or both. All fasteners are stainless steel (there are some high-strength exceptions). Unistrut and clamps used are either fiberglass or galvanized, then epoxy powder-coated. Tanks are typically polypropylene with UV-blockers (fiberglass tanks are available). Tank penetrations are avoided where possible, to prevent leakage. Parts are attractively painted with finishes made to withstand the environment without service. Coat tar epoxy is used on painted, wetted surfaces such as within clarifiers. Baked finishes are used on all but the largest parts, which receive 2-part epoxy.

## DETAILED DESCRIPTION

**KASELCO - ELECTROCOAGULATION.** Electrocoagulation is a process that uses electricity and sacrificial plates to combine with contaminants in a waste stream, producing insoluble oxides and hydroxides that are easily removed. It replaces complex chemical treatments. The need for acid, caustic, ferric chloride, sulfites or many other reagents is either reduced or totally eliminated. The process can also break oil emulsions and oxidize low levels of organics and surfactants.

Standard technologies for flotation or settling are used for separation of solids or phases after the reaction. With mixed wastes, both floating and settling techniques may be employed concurrently.

Several materials such as steel, aluminum, and titanium are available for the reactor plates. Each material is specific to an application, although each can also treat a broad range within that application. Reactor design and plate selection are based on laboratory testing and our extensive experience with electrocoagulation.

**Treatment levels** are typically below the capabilities of conventional chemical precipitation (see table, below). This makes electrocoagulation the method of choice for direct dischargers or others faced with ultra-low limits. The table does not demonstrate the lowest levels possible, but shows the levels achieved by efficient, operating systems tuned for long plate life. Lower levels are achievable if necessary, even less-than-detectable levels.

<u>CONTAMINANT</u>	<u>BEFORE</u> (ppm)	<u>AFTER</u> (ppm)
Aluminum	120.0	*0.00
Chromium, hexavalent	77.5	0.016
Chromium, hexavalent	742.0	*0.002
Chromium, total	105.0	0.022
Copper	79.0	0.05
Hardness, magnesium	10.0	0.0
Nickel	37.5	0.05
Nickel	441.0	*0.32
Phosphorous (phosphate)	24.0	0.70
Phosphorous (phosphate)	175.5	*0.40
Zinc	59.2	0.13
Zinc	175.5	*0.40
BOD	39900	*5080
COD	53300	*7320
Oil & Grease	9958	*45.6

\*Results from sequential reactors

**Water re-use** has greater potential since fewer reagents are added to the waste stream and some dissolved solids are removed by the process. The system will remove some chlorides and sulfates, depending on their associated cations. Sulfate removals of up to 84% have been achieved. Also, since fewer or no reagents are added to the wastewater for treatment the final anion concentration is lower regardless of the removal rate. This reduces the load on and increases the recovery rates of any subsequent treatment used for water recycling, such as membrane technologies or ion exchange.

**Treatment costs** can be drastically reduced. The KASELCO process typically reduces treatment costs to \$0.84 to \$5.00 per thousand gallons of wastewater, including less than \$1.00/Mgal for electricity. Concentrated solutions may entail a higher cost, but may not. A KASELCO expert will evaluate your wastes and recommend the optimum treatment of spent concentrates.

**Complete and retrofit systems** are available for your specific waste treatment problem. Built as packaged, skid mounted systems or separate floor-mounted components, the KASELCO unit will be designed to fit your plant.

**KASELCO CLARIFIERS** featuring easily serviced, vertical plates, are available for flows up to 10 gpm. Units can be skid-mounted for quick installation and for applications requiring secondary containment, or floor mounted. The plates are individually removable without tools even while the system is running. The vertical surfaces prevent the bridging common with many wastes. Each clarifier is designed with an upstream flow-through sludge thickener. This concept reduces the load on the clarifier and allows continuous sludge removal from the clarifier without affecting the fluid level. Pumps with no moving parts are used to transfer the sludge gently and economically.

**KASELCO FILTER PRESSES** are sized to your needs. Polypropylene plate sizes from 470 to 1,000mm are available with cake thicknesses of 32 or 38mm. Either manual or air-operated hydraulic closure can be provided. The design of the side rails will allow expansion of most sizes. A swing-up closing cylinder allows free access to the plate pack during dumping. Integral dump hoppers that also serve as drip pans can be furnished for the smaller, and dump hoppers designed to roll and be handled by forklift for larger presses.

The KASELCO systems are designed for serviceability, with the operator and maintenance technician in mind. All plumbing components have cleanouts or removable sections. Only true-union ball valves are used in waste service. PLC, touch-screen PLC, or relay logic controls are options. Chemical-resistant epoxy and coal tar epoxy are used to provide an attractive, durable finish.

Successful application of each system is assured by a complete laboratory analysis of your representative sample. Pilot-scale testing at your site can also be arranged, and each unit comes with a performance guarantee.