10 th Annual International Cleaning Technology Exposition

Conference March 3 – 5, 2003
McCormick Place
Chicago, IL

Witter Publishing Corporation
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Flemington, NJ 08822
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Pages 270 - 272 Clean Tech 2003 Proceedings

Water Reuse Eliminates Government Required Treatments for Wastewater Discharges

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Abstract

The only way to eliminate the intrusion of continual government wastewater inspectors is to eliminate the water discharge. Clean electricity properly applied will cause a multitude of water contaminates to become separable from water. Electrocoagulation causes emulsified oil, textile dyes, heavy metals, turbidity, pesticides, bacteria, suspended solids, arsenic, phosphates, nitrates, zinc, biochemical oxygen demand, chrome, nickel, lead, copper, PCB's, chemical oxygen demand, sewage, and more to become separable from water, making the water suitable for reuse.

Background

Government discharge standards have been established for water discharge to the environment. The discharge standards are established to meet political needs and seem to be lowered as technology advances detection limits. The government regulators may enforce the discharge limits by fines, public humiliation, or by shutting down the production facility. The required water testing, monitoring, reporting, and spot inspections by the regulators consume valuable time and resources.

Water reuse on site is the best way to save this most precious natural resource. The recycled water can be cleaned up and conditioned to meet the specific reuse need. Water recycling can eliminate water discharge. With out water discharge the expense of testing, monitoring, reporting and spot government inspections is greatly reduced or eliminated. The cost of water purchases and water disposal is reduced.

Cleaning the water sufficiently to be reused can be accomplished in several ways including reverse osmosis, ion exchange, evaporation, chemical coagulation, and or electrocoagulation (EC). Each of the treatment methods, or a combination of the methods, has advantages and disadvantages depending upon the type of water to be reclaimed and the intended use of the reclaimed water. Water recovery on site allows the selection of the treatment based on the specifics of the water content to be recovered and the specific quality of water needed in the reclaimed water process.

Reverse osmosis separates contaminants from the portion of the water that permeates the membrane and concentrates contaminates in the reject water that does not pass through the membrane. The permeate water quality can be controlled by the type of membranes used. The reject water may be 30% of the total water stream. In addition to wasting the reject water, the disposal cost for the reject water may cost more that the reverse osmosis operating cost. The reverse osmosis process is not very effective in mixed streams containing oil, grease, bacteria, and silica, which cause membrane fouling.

Ion exchange captures specific ions in the water. Ion exchange adds one type of ion to water as a second type of ion is removed. A common type of ion exchange adds two sodium ions to the water in the process of removing one calcium ion from the water. The cost of ion exchange resin regeneration is significant in terms of water loss. When regulated heavy metal ions like chrome are removed from the water, the regeneration liquid is high in acid and metal content creating a costly hazardous waste.

Evaporation or distillation produces clean water. The solids separated during the distillation process can be concentrated in the bottoms. Energy consumption and capital cost are the main drawbacks.

Coagulation caused by altering the charge on metal ions, organics, and colloidal particles creates a large particle that can be settled or filtered out. Chemical coagulation typically uses a dissolved salt. Part of the salt will attach to the material in the water to be coagulated. The other part of the ion typically remains in the solution. Chemical coagulation creates a hydroxide sludge that attracts water. The hydrophilic sludge holds water, which increases the volume of sludge generated and increases the dewatering time.

Electrocoagulation adds electrons to the solution by passing alternating current or direct current through the solution from the power grid. The electrons destabilize the material in the water creating oxide sludge when sufficient activation energy is present. The oxide sludge repels water and filters well. The oxide sludge dewaters well, eliminating the bogging problem associated with polymer treated sewage sludges in landfills, which will stick a tractor for years. Heavy metal ions converted to metal oxides will pass the leach tests making them non hazardous. Metal oxides can be smelted to recover the metals in a usable form.

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Steam cleaner wash water reclamation case study:

Valley Detroit Diesel Allison, Bakersfield, California, assembles Detroit Diesel Allison engines and performs semi tractor repair. The engines are covered with oil, dirt, grease, and normal road grime. The engines are steam cleaned prior to assembly or repair.

The steam cleaning is performed over a pad. The spent steam cleaner wash water is collect in a pit. The dirty steam cleaner wash water is designated as a hazardous waste due to the heavy metal content. During the rainy season, rain runoff water from the parking lot would also collect in the pit and mix with the dirty steam cleaner wash water.

The hazardous wastewater had to be measured, tested, and accounted for to the local government inspector. The hazardous wastewater was hauled off by vacuum trucks for disposal at a cost of $0.60 per gallon in the dry season and $2.30 per gallon in the rainy season. The government inspector would physically inspect the water volume and truck hauling records monthly at the facility.

Valley Detroit Diesel Allison decided to reclaim the steam cleaner wash water in 1988. A containment facility was built to store diesel fuel, motor oil, antifreeze, used motor oil for recycling, and water treatment. A 26,000-gallon holding tank stores the surges of parking lot rain run off water and used steam-cleaning water from the pit. The water is processed through a 2 gpm EC unit and clarifier. The oil, grease, dirt, and heavy metal solids separated from the clarifier are placed in the used oil storage tank for recycling. The clear water from the clarifier passes through a swimming pool. The reclaimed water is stored in a 1,000-gallon clean water storage tank for reuse in the steam cleaner. A float switch control system in the dirty water storage tank and clean water storage tank turn the unit on when there is dirty water to treat and room for clean water storage.

The clear water met all federal secondary drinking water standards with the exception of surfactants (soap) (Table 1). The recycled surfactants reduced the need to add soap at the steam cleaner. The sludge from the EC process contained 90 mg/kg oil and grease. The heavy metals were converted into oxides. The sludge passed the California states TTLC and STLC leach tests as required by CAC title 22 (Table 2). As a result the State Health Board approved the EC processed sludge as a non hazardous waste suitable for landfill disposal.

The government inspector stopped visiting the site after the first three months of water recycling. Because the water is recycled there is no water disposal records, no continual water testing, and no vacuum trucking fees. The EC unit requires about one hour of maintenance per forty hours of operation. The operating cost for electricity and blade replacement is less than one cent per gallon. The company purchased EC systems for each of their three locations.

Lab results:

Table 1. The recycled Steam cleaner wash water lab analysis follows: (004-263).

Constituent	Wastewater ppm	EC water ppm	% Removal
Antimony	<0.01	0.014	
Arsenic	0.30	<0.01	96.7% +
Barium	8.0	<0.10	98.7% +
Beryllium	<0.01	<0.01	
Cadmium	0.141	0.031	78.0%
Chromium	7.98	0.05	99.4%
Cobalt	0.13	<0.05	61.5% +
Copper	6.96	<0.05	99.3% +
Lead	7.4	1.74	76.5%
Mercury	0.003	<0.001	66.7% +
Molybdenum	0.18	0.035	80.7%
Nickel	0.4	<0.05	87.5%
Selenium	<0.005	<0.005	
Silver	<0.01	<0.01	
Thallium	<0.10	<0.10	
Vanadium	0.23	<0.01	95.7% +
Zinc	19.4	1.20	93.8%

Table 2. The dry sludge separated from the Steam cleaner wastewater listed above was tested for leach ability as follows (005-462):

	TTLC		STLC	
Element	**Raw mg / kg**	**Max State**	**Raw mg / l**	**Max State**
Antimony	2.4	500		
Arsenic	3.85	500		
Barium	307	10,000		
Beryllium	nd	75		
Cadmium	nd	100		
Chromium	59.2	2,500		
Cobalt	10.4	8,000		
Copper	498	2,500	3.8	25
Lead	790	1,000		
Mercury	0.15	20		
Molybdenum	21.3	3,500		
Nickel	25.5	2,000		
Selenium	nd	100		
Silver	2.7	500		
Thallium	14.2	700		
Vanadium	42.1	2,400		
Zinc	1,798	5,000	60	250
Oil & Grease	89,780			

Conclusion:

Electrocoagulation provides a cost effective, onsite way to recondition water for reuse. Water reconditioning for on site use eliminates governmental discharge concerns. Peace of mind results because proposed changes to government discharge regulation no longer apply. The water reconditioning equipment capital and operating cost is offset by water reuse, timesavings with government inspectors, discharge lab testing, and fines.