Water Treatment Made Simple

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ABSTRACT

The high demand on water resources and landfills resulting from increased industrialization and population growth are problems facing the global community. With the environmental regulations becoming increasingly more stringent, there is a growing need for more efficient and cost effective methods to abatement. An innovative approach to the treatment of industrial wastewater to meet the tightening discharge requirements and protect the environment is presented.

The new single-step AQUASIL® Technology is a fast process with enhanced efficiency in removing contaminants such as heavy metals, oil & grease, and TSS. As well, this treatment lowers the levels of chromium (VI), arsenic, selenium, phosphate, fluoride, TDS, COD and phenol. It brings about sustained compliance, is economical, and protective of the environment. Unlike conventional techniques, the new treatment eliminates the use of the various dangerous chemicals, is easy to implement and operate, requires less maintenance, delivers high quality effluent, achieves zero-discharge through the recycle/reuse, and generates nonhazardous waste.

Industrial effluent, mine discharge, municipal wastewater, and groundwater can be treated with the AQUASIL® process. Case studies from different industrial operations will be discussed.

INTRODUCTION

Industrial wastewater generally contains contaminants such as suspended solids, dissolved organic matters, and heavy metals at levels considered hazardous to the environment and could pose a risk to public health. Such contaminants must be removed or their levels be reduced to legally acceptable levels prior to discharging the water to the environment. The type of water treatment program put in place by an industry is influenced by factors such as the nature and volume of the waste stream, discharge regulations, available space, and the nature of generated waste. The nature and volume of the waste stream and discharge regulations will influence the choice of equipment and treatment chemicals. The overall cost of treatment involves operational cost such as energy, labor, treatment chemicals, sludge disposal, and maintenance. The classification of generated waste is very important as disposal of hazardous waste costs about three to four times that of nonhazardous waste.

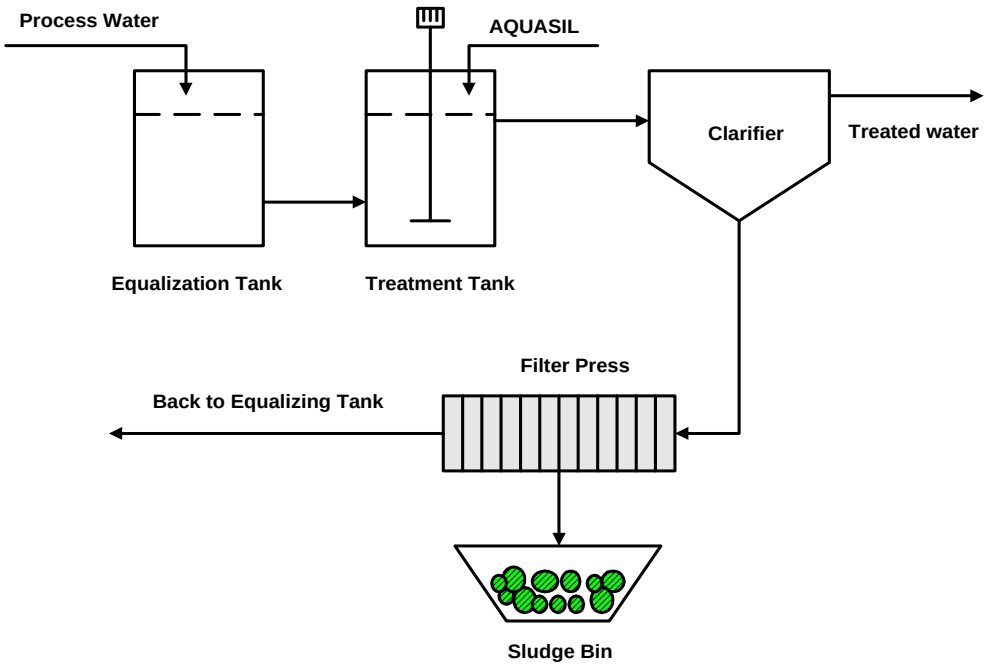
Conventional precipitation techniques are generally multi-step, time consuming, and require extensive equipment and handling. The treatment is carried out sequentially and requires multiple pH adjustments and the addition of hazardous chemical. Furthermore, both hydroxide and sulfide precipitation methods suffer great limitations and both generate hazardous waste that requires further treatment and stabilization.

As the collective industrial discharge continues to grow and the regulations governing such discharge become more stringent, industries are in need of new technologies and products that enhance treatment efficiency and are protective of the environment and public health. As an alternative process for treating industrial waste streams, the AQUASIL® treatment has become popular as it is very simple and easy to implement and operate.

AQUASIL® TECHNOLOGY

The AQUASIL® treatment employs proprietary advanced materials that are made to fit the chemistry of the particular waste stream. They are used in either the batch or continuous processes. In the AQUASIL® treatment, effluents can be treated at either low, neutral, or moderately high pH. Use of AQUASIL® products eliminates problems inherent in the application of liquid chemicals. The products also overcome problems associated with hardness and the presence of complexing or chelating agents, surfactants, and detergents. Figure 1 illustrates a conceptual setup of the AQUASIL® treatment.

FIGURE 1: Conceptual Setup For AQUASIL® Treatment



The AQUASIL® treatment is applicable to effluents from industries such as anodizing, galvanizing, automotive, machining, plating, circuit board, metal finishing, surface coating, tannery, parts cleaning, stamping, food processing, paint spray booth, pulp & paper, laundry, and chemical manufacturing, to name just a few. Some examples are given below.

CASE STUDIES

Case 1: Automotive

An automotive manufacturing operation has a wastewater treatment system operating at 2.3 m^3 per minute daily. Waste streams from the various operations are fairly concentrated in suspended solids, oil and heavy metals. In the conventional treatment, a combination of acid, emulsion breaker and DAF were used for oil removal. Lime slurry and polymer flocculent were then used to precipitate heavy metal hydroxides and treated effluent was released to the sewer. Sludge was treated with sludge thickener and dewatered in a filter press.

Treatment with an AQUASIL® product, conducted over a period of several months, at a dose of 350 milligram per liter (mg/L) produced much more favorable results than the conventional process, as shown in Table 1. All hazardous treatment chemicals and the DAF were eliminated, and the costs of energy, maintenance and labor substantially reduced. The high quality of the treated effluent allowed for water conservation through recycling.

TABLE 1: Automotive Operation. Performance Comparison Between Current and AQUASIL®Treatments

Case 1 Parameter	Limits, mg/L	Conventional mg/L	AQUASIL® mg/L
Oil & Grease	50.0	1900	24.5
Suspended solids	NA	35.4	6.5
Total phosphorus	NA	13.2	0.34
COD	NA	991	597
Phenol	0.20	0.19	0.09
Cadmium	0.37	0.005	ND
Chromium	1.47	0.083	ND
Copper	1.80	0.280	ND
Lead	0.37	0.040	ND
Nickel	2.12	0.150	ND
Silver	0.37	0.006	ND
Zinc	1.39	0.180	ND

Case 2: Metal Plating

A plating facility in Michigan has a highly acidic waste stream (pH < 1) containing high levels of chromium, zinc, and iron. The facility has a continuous treatment system operating at a flow rate of 210 liter per minute (lpm). The system utilizes Fe^{2+} from the acid pickling to reduce chromium (VI) to chromium (III). In the conventional treatment, lime –anionic polymer chemistry was used to precipitate and settle metal hydroxides. Sodium dithiocarbamate was used in order to maintain compliance with discharge requirements. Sludge is dewatered in a filter press and the waste is dried and hauled away as hazardous material.

With the AQUASIL® treatment, treated effluent showed residual metal concentrations about 10 times lower than municipal discharge limits, as shown in Table 2. This treatment eliminated the use of lime, flocculent and the noxious dithiocarbamate.

TABLE 2: Metal Plating Wastewater Before and After Treatment

Case 2 Parameters	Daily Max. ppm	Before ppm	After ppm
Cadmium	1.20	1.30	< 0.002
Chromium	7.00	127.00	< 0.05
Zinc	4.20	145.20	0.22
Iron	1,000.00	> 10,000	< 1.0
PH	6.0 - 9.5	< 1	8.70

Case 3: Circuitboard Manufacturing

An Illinois-based circuit board manufacturer has a wastewater treatment system operating at 492 lpm daily. The waste stream contains mainly copper and lead. The system operates by drawing wastewater from the various sumps (etching, plating, etc.) to an equalization tank. The waste stream is then fed into three mixing tanks in series. In the conventional treatment, acid-ferrous sulfate-amine coagulant mixture is added in the first tank. Caustic soda is added in the second tank to precipitate metal hydroxides. In the third tank a polymeric flocculent is added to enhance sedimentation in the clarifier. Treated water from clarifier flows to a neutralization tank, where pH is adjusted and then flows to a holding tank. The neutralized effluent is pumped through a sand filter, then to a holding tank, and finally released to the sewer. Sludge is mixed with a thickener and filtered in a filter press. The waste is hauled away as a hazardous material.

In the AQUASIL® treatment, a dose of 500 ppm of the AQUASIL® reduced the level of copper to 1.30 ppm and that of lead to < 0.05 ppm, as shown in Table 3. The treated water is clear and can be recycled. The treatment eliminated the need for all liquid chemicals, neutralization tank, sludge thickening, and generated nonhazardous waste.

TABLE 3: Circuitboard

Case 3 Parameters	Daily Max. ppm	Before ppm	After Ppm
Copper	3.00	25.20	1.30
Lead	1.00	7.30	< 0.05
Nickel	3.00	< 0.05	< 0.05
PH	6.0 – 9.5	7.80	8.50

Case 4: Aircraft Maintenance Facility

An aircraft maintenance & service facility in Florida operates a small wastewater treatment system based on carbon adsorption. The system consisted of two granular activated carbon (GAC) cartridges, one in use and one standby. As the waste contains high levels of grease, heavy metals, emulsified oil, and heavy petroleum oil, the system was prone to fouling and required continuous monitoring while in operation. It was deemed inefficient and was put out of commission. Through a new environmental program the facility was required to implement an innovative technology into its operation and that the new technology be assessed for environmental benefits, labor and cost savings and the ability to interface with routine operations.

A treatability study, using an AQUASIL® product, was conducted on a sample of the wastewater and results are shown in Table 4.

TABLE 4: Aircraft Maintenance Facility

Parameter	Limits mg/L	Before mg/L	After mg/L
Total Arsenic	0.002	0.500	<0.001
Total Barium	1.00	5.100	0.034
Total Cadmium	0.050	120.0	<0.001
Total Chromium	0.200	14.00	0.017
Total Copper	1.130	2.900	0.050
Total Iron	0.300	79.00	0.030
Total Lead	0.200	0.990	0.003
Total Mercury	0.002	0.001	<0.0005
Total Nickel	1.290	85.00	0.060
Total Selenium	0.002	2.000	<0.002
Total Silver	0.100	1.200	<0.025
Total Zinc	0.400	0.025	0.070
Suspended Solids	275	580	7.5
Total oil & Grease	25.00	23000	13.6
pH	6.0 – 9.5	7.85	8.4

The AQUASIL® process proved very effective in removing the main contaminants, i.e., oil & grease, suspended solids, and heavy metals, from the waste stream. As a result, the facility contracted AQUACHEM to design and install a fully automated batch treatment system to treat the oily waste stream.

WASTE DISPOSAL

All techniques used in the treatment of waste streams produce large volumes of sludge/waste that is generally hazardous due the high concentrations of contaminants therein. Safe disposal of such waste is troublesome and the problem is aggravated by the continued increase in the number of wastewater treatment systems. Currently, the waste is transported to treatment plants where it undergoes further treatment to render it suitable for long term disposal. Such a manipulation adds to the overall cost of treatment.

Waste generated by the AQUASIL® treatment is already stabilized and does not require any further treatment to render it suitable for disposal in a landfill.

Characteristic waste passes the TCLP test and meets regulatory requirements for disposal as nonhazardous material. Listed waste also passes the TCLP test and can be disposed of likewise, once an exclusion has been granted. Table 5 shows TCLP test results for the aircraft maintenance waste generated by the AQUASIL® treatment (case 4).

TABLE 5: Analytical Results of Contaminants in Aircraft maintenance Waste (case 4)

Parameter	Concentration in Filter Cake, mg/kg	RCRA limits, mg/L	TCLP, mg/L
Arsenic	2.22	5.0	ND
Cadmium	649	1.0	ND
Chromium	25.4	5.0	ND
Lead	2.31	5.0	ND
Selenium	1.18	1.0	ND
Silver	36.8	5	ND
Flash Point ^{o}C	---	60.5 – 93.3	> 93.3

CONCLUSION

The AQUASIL® treatment is simple to implement, employs safe products and provides an economical alternative to current techniques. It lowers labor, energy and maintenance costs, delivers effluent that meets or exceeds discharge requirements and generates nonhazardous waste.

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MORE INFORMATION

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