

Zerowaste Perchloroethylene Condenser & Evaporator Technologies



Dry Cleaner Company A

Location: Eastern Iowa

Industry: Dry Cleaning

Process: Dry Cleaning Using
Perchloroethylene

Waste Reduced: Perchloroethylene

New Environmental Technology for Small Business (NETSB) Project Summary

NETSB, a program developed by the Iowa Waste Reduction Center (IWRC) at the University of Northern Iowa, strives to increase the use of new environmental pollution prevention technology by small business, resulting in measurable environmental and economic benefits.

When choosing which technologies to test, the IWRC recognized three key areas of consideration: environmental criteria, economic measures and small business use feasibility. The equipment should have a positive impact on the environment, such as pollution prevention or energy savings. The technology should be evaluated considering capital costs, operational costs and return on investment. And finally, the equipment should be applicable in a small business environment.

In 2006-2007, the IWRC placed several types of potential pollution prevention technologies at small businesses throughout Iowa including: soy-based metal working fluids, RASERS heat reclamation equipment, Zerowaste wastewater treatment systems and Green Earth® dry-cleaning solvent alternative.

Small Business Placement Description

A commercial dry cleaning operation in Eastern Iowa is equipped with a dry-to-dry type dry cleaning machine that utilizes perchloroethylene (perc). The facility dry cleans up to 230 pounds of garments daily, which results in the generation of approximately 132 gallons of perc-contaminated wastewater (separator water) annually. Proper management and disposal of separator water is problematic due to its negative health and environmental implications and applicable waste management regulations. In order to eliminate and/or lessen these concerns, the dry cleaning industry was selected as a target for NETSB program pollution prevention technology placement and demonstration of Zerowaste wastewater treatment units.

Technology Description

Perc is a common dry cleaning solvent that is toxic to humans and is a precursor to ground level ozone (smog). An estimated 30.8 million pounds of perc was used in the dry cleaning industry in 2005.¹ Use of perc dry cleaning machines generates wastewater from the condensation of the perc dry cleaning solvent and moisture present in the clothing being cleaned. This wastewater is commonly referred to as separator water.

Separator water treatment units, such as Zerowaste wastewater condensers and evaporators (<http://www.zerowaste.net/>) can

significantly reduce the concentration of perc in separator water. Untreated separator water can contain perc in concentrations ranging from 55-199 mg/L according to laboratory data collected in this phase of the NETSB program.

Zerowaste wastewater treatment units consist of a combination of gross filters, activated carbon filters and evaporation/condensation equipment to remove and recover perc contained in separator water. The recovered perc can be placed back into the dry cleaning equipment for reuse. The treated separator water is then collected for subsequent on or off-site treatment or disposal. Solids collected in the gross filters and spent activated carbon filters will require periodic removal and disposal in compliance with applicable local, state and federal regulations.

Environmental Background

Regulations impacting perc use, handling and waste disposal include the National Emission Standard for Hazardous Air Pollutant (NESHAP) specific for dry cleaners. This NESHAP requires the use of equipment and best management practices to minimize perc loss. Other regulations include the Resource Conservation and Recovery Act (RCRA), which governs the storage and disposal of hazardous waste (i.e., perc-contaminated wastes) and the Clean Water Act (CWA), which regulates the types and contaminant levels of wastewater that may be discharged to sanitary sewers.

Although NESHAP and other laws prescribe best management practices for perc at dry cleaning facilities, releases to the environment may still occur through escape of vapors from dry cleaning equipment and storage containers, spills/leaks, and discharge of perc-contaminated separator water. Perc is persistent in the environment and toxic to plants and animals at relatively low concentrations. As an additional concern, the degradation of perc in the atmosphere contributes to ozone depletion and its harmful affects.

Improper storage, handling, and disposal of perc have resulted in significant contamination to soil and groundwater. The State of Florida estimates the average cleanup cost of perc-contaminated sites resulting from dry cleaning operations at \$475,000.²

Health & Safety Background

The Occupational Safety and Health Administration (OSHA) regulates human health exposure to harmful substances in the workplace. Humans can be exposed to perc through inhalation, ingestion and dermal contact. Short-term exposure can affect the nervous system causing dizziness, fatigue, nausea, headaches, sweating, loss of coordination and unconsciousness. Long-term exposure can cause liver and kidney damage, memory loss and confusion. Perc can accumulate in fatty tissue and is considered a possible carcinogen.³

Outcomes

POLLUTANT REDUCTION OUTCOMES

The Zerowaste unit was installed and operated during 2006 and 2007.

To determine the Zerowaste unit's effectiveness, as measured by perc concentration reduction, pre- and post-treatment samples were collected for laboratory analysis using the Toxicity Characteristic Leaching Procedure (TCLP). Table I summarizes the analytical results.

Company	Pre-treatment Perc (mg/liter)	Post-treatment Perc (mg/liter)	% Reduction
Dry Cleaner A	114	0.150	99.87
Dry Cleaner A	102	0.146	99.86
Dry Cleaner A	95	0.134	99.86

Table I: Pre-Treatment and Post-Treatment Perc Sample Results

As Table I data show, the Zerowaste unit reduced the wastewater concentration of perc up to 99.87% at this demonstration site.

ECONOMIC OUTCOMES

Separator water volume, waste and wastewater management and simple payback period should be considered when evaluating the cost/benefit of purchasing and operating this technology at a given dry cleaner.

Zerowaste units are relatively inexpensive, ranging from \$1000 to \$1500. Maintenance costs associated with monthly filter change-

out is estimated to be \$160 annually. Annual testing of the treated wastewater adds an additional \$100 in laboratory fees.

The cost of separator water hazardous waste disposal per gallon was calculated from the facility's disposal records. Disposal cost savings were determined from the estimated volume of untreated separator water generated and disposed of off-site as hazardous waste versus treated separator that may now be acceptable for discharge to a sanitary sewer system. This information and related calculations to determine the Zerowaste technology payback at this particular dry cleaning facility is summarized below:

Volume of Separator Water Generated (gal/yr)	132
Cost of Disposal as Hazardous Waste (\$/gal).....	\$6.95
Annual Disposal Costs as Hazardous Waste	\$917.40
Cost of Zerowaste Equipment	\$1,000
Annual Cost for Filter Replacement	\$160.00
Annual Costs for Laboratory Testing	\$100.00
Payback Period (\$1260/\$917.40/year)	1.4 years*

*A one-time expense to TCLP test used filters may be necessary. If the filters are hazardous, their disposal will incur some annual expense, slightly effecting the payback period.

TECHNOLOGY ACCEPTANCE AND USE OUTCOMES

The Zerowaste units are relatively inexpensive and show a short payback period.

The equipment is easy to install and operate. To obtain maximum results, regular monthly maintenance of the machines including changing the filters is vital.

Zerowaste significantly reduced the concentration of perc in separator water creating alternative disposal options and recovered perc for reuse in the dry cleaning equipment both of which may reduce costs associated with dry cleaning operations. Regular maintenance of the equipment is critical. Periodic testing of the treated wastewater for perc concentration is recommended to confirm the system is effective and separator water disposal practices are in compliance with applicable local, state and federal regulations.

ACRONYMS USED IN THE CASE STUDY

CWA.....Clean Water Act
IWRCIowa Waste Reduction Center
NESHAPNational Emission Standard for Hazardous Air Pollutant
NETSB..New Environmental Technology for Small Business
OSHAOccupational Safety and Health Administration
Perc.....Perchloroethylene
RCRA.....Resource Conservation Recovery Act
TCLPToxicity Characteristic Leaching Procedure

References

- ¹ <http://www.epa.gov/dfepubs/projects/garment/findings.htm>
- ² <http://www.dep.state.fl.us/waste/categories/drycleaning/default.htm>
- ³ <http://www.epa.gov/ttn/atw/hlthef/tet-ethy.html>