

# Zerowaste Perchloroethylene Condenser & Evaporator Technologies



## Dry Cleaner Company D

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 family-owned dry cleaning operation in an urban area in Iowa is equipped with a dry-to-dry type dry cleaning machine that utilizes perchloroethylene (perc). The facility dry cleans up to 190 pounds of garments daily, which results in the generation of approximately 218 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.<sup>1</sup> 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 approximately 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.<sup>2</sup>

## 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.<sup>3</sup>

## Outcomes

### POLLUTANT REDUCTION OUTCOMES

The dry-to-dry machine at this facility generates separator water with a high concentration of perc, which if decanted too quickly will result in a layer of free phase perc in the remaining separator water. Before placing the Zerowaste machine at the facility, the IWRC initially sampled the separator water and sent it for TCLP testing. Sampling was conducted on July 13, 2006. Perc concentration was measured at 55.1 mg/L, designating the separator water a hazardous waste.

The Zerowaste unit was installed on July 26, 2006 with the anticipation that using it may decrease perc concentration in separator water enough to render it non-hazardous.

After installing the Zerowaste unit, separator water was collected (September 13, 2006) and sent for TCLP testing. Post-treatment perc concentration was measured at 18.7 mg/L indicating the equipment wasn't operating optimally.

Routine inspection, maintenance and filter changes on the Zerowaste unit were conducted November 15, 2006. The condition of the filters revealed that separator water with concentrated perc had passed through the unit. The facility relied on the electronic controls to alert the operator to the presence of perc. The manufacturer stresses that the system is not designed to handle separator water

containing concentrated perc and that the signals are meant only as a backup to regular inspection and maintenance.

To remove concentrated perc from the separator water, the facility began settling the separator water in a closed container. The aqueous phase is then sent to the Zerowaste unit and the free phase perc is returned to the dry-to-dry machine. A small layer of aqueous/perc waste is added to the hazardous waste drum.

On Dec 15, 2006 another post-treatment sample was collected and analyzed for perc. The concentration was 6.58 mg/L. This concentration was still higher than desired. Facility and IWRC staff reviewed wastewater handling and sampling procedures. It was concluded that concentrated separator water was still being sent to the Zerowaste unit and, possibly, inadequate settling time and agitation during the collection of the wastewater may have introduced higher levels of perc. It was determined that both the influent and effluent of the Zerowaste unit should be sampled and analyzed for perc after the following operational controls were in place:

1. The Zerowaste unit filter change out is to be monthly.
2. The separator water is to be collected in a closed container and allowed to settle for 24 hours prior to treatment by the Zerowaste unit.
3. Great care not to agitate the container while the aqueous phase is removed is necessary.

4. Periodic testing of the treated wastewater is recommended to assess the unit's effectiveness.

The facility continued to use the equipment and another pre- and post-treatment sample was collected on June 6, 2007. The sample was analyzed using TCLP methodology and the perc concentration was determined to be 1.26 mg/L. While this was the lowest perc concentration recorded at this demonstration site, the treated separator water remained hazardous waste (i.e., TCLP concentration for perc greater than 0.7 mg/L). As a result, less expensive separator water disposal options were not realized.

## TECHNOLOGY ACCEPTANCE AND USE OUTCOMES

In this specific case, the Zerowaste reduced the concentration of perc in separator water but not to the extremely low levels experienced at the other three demonstration sites. This suggests regular maintenance of the equipment is critical. Periodic testing of the treated wastewater for perc concentration is also strongly recommended to confirm the system is operating effectively and treated separator water disposal practices are in compliance with applicable local, state and federal regulations.

**ACRONYMS USED IN THE CASE STUDY**

CWA.....Clean Water Act  
IWRC ....Iowa Waste Reduction Center  
NESHAP .....National Emission Standard for Hazardous Air Pollutant  
NETSB..New Environmental Technology for Small Business  
OSHA .....Occupational Safety and Health Administration  
Perc.....Perchloroethylene  
RCRA.....Resource Conservation Recovery Act  
TCLP .....Toxicity Characteristic Leaching Procedure

**References**

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