SOLVENT RECOVERY IN THE DRY CLEANING INDUSTRY SIC-7216

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INDUSTRY PROFILE

Drycleaning establishments include industrial drycleaners, commercial drycleaners and coin-operated facilities. Although a number of drycleaning firms recycle their clean solvents on the premises, many establishments still vent solvent-laden plant air and dryer exhaust directly into the atmosphere.

In the United States, 50% of drycleaners use perchloroethylene (perc) as the cleaning solvent, while the remaining establishments utilize Stoddard solvents (petroleum distillates) or fluorocarbons.

According to a survey completed in December 1984 by GCA Corporation, a consulting firm, 588 firms were listed as dry cleaners, SIC-7216, in the Commonwealth. The majority of these firms are listed as small quantity generators (SQG). Due to their SQG status, these firms are strongly affected by the transportation charges, since haulers generally charge more per gallon for shipments that are below a certain size. SQG's are not cost-effective customers according to transporters.

For the drycleaner about to set up shop, an assortment of highly efficient low polluting equipment (closed loop) is available. Many of the new machines have heat and water conservation loops, resulting in a 30-50% savings in energy cost and a reduction in water cost by 50-80%. These units will be discussed later in this paper.

WASTE GENERATION

The average drycleaner generates two to three 55 gallon drums of solid or semi-solid waste every month. The drycleaner with on-site distillation generates of still bottoms consisting of grease, oil, detergent, solvent, additives and dirt. Depending on the efficiency of stills, the bottoms range from a dry powder to a wet sludge that contains solvent and the filtered material.

ON-SITE SOLVENT RECOVERY- PERC PLANTS

In 1972, perc cost $2.40 per gallon and in 1985 the price has soared to $5.00 per gallon. Good housekeeping practices to limit fugitive emissions are an integral part of minimizing pollution as well as enhancing company profits. These practices include:

* ensurance of gasket integrity on dryer doors
* minimizing solvent retention in garment during unloading
* periodic replacement of seals on dryer deoderizing and aeration valves
* repairing holes in air and exhaust ducts
* closing solvent containers when not in use

Most perc plants use a reclaiming dryer which permits recovery of solvent during drying. However, during deodorizing, solvent-laden air is exhausted directly to the ambient air. Carbon absorption (CA) and refrigeration/condensation (R/C) will control these losses and facilitate recovery.

Carbon Absorption Technique: new equipment is designed with CA as an integral part of the machine. Existing machines can be retrofitted with an assortment of CA units. Exhausts from storage tanks, distillation units, muck coolers, dryer condensers and plant ventilation systems can be rerouted to feed into the CA unit. (FIG.1)

Solvent-laden air attaches to the carbon bed. Air cleaned of solvent is exhausted to the outside. During the desorption, the carbon bed is regenerated by flushing with steam to pick up solvent. The steam and solvent vapor then undergo condensation and separation. The clean solvent is reused in the dry cleaning process. CA can remove more than 96% of the solvent in the exhaust system otherwise ventilated to the outside.(FIG.2)

Economics: the 1981 capital cost of a carbon absorption unit for a small commercial plant (25 lbs. machine) is about $5000. These units are best suited for larger industrial cleaners who will realize a faster Return On Investment (ROI) than smaller commercial establishments.

Refrigeration/Condensation Technique: stripped air is returned to the dry cleaning machine, eliminating the need for external venting ducts. Incoming solvent-laden air is cooled by refrigeration to strip it of it's solvent. The temperature is cooled below the dew point of the vapor, causing the solvent to condense. The solvent-free air is returned to the dry cleaning machine. The recovered solvent is fed to a storage tank for future use and the water from the separation is sewered. (FIG.3-4)

The advantages of R/C over AC units for commercial establishments include:

* no requirement of a costly steam installation
* clothes come out cold, minimizing wrinkling and reducing the possibility of swales

Economics: although the capital costs are slightly higher for R/C than CA units, the annual operating costs are less and the installation is about one-quarter the cost of a CA unit.

Example: a drycleaner in western Massachusetts purchased a Bowe dry-to-dry machine (R/C unit) at a cost of approximately $30,000. Prior to the new installation the cleaner used 150-200 gallons of perc a month. Since May of 1984 he has used 22 gallons of perc. Based on the savings on solvents alone this unit has an ROI of 3.6 years.

Frimair (France) perfected a unit with built in refrigeration and a heat pump. The machine uses closed-looped technology, eliminating the necessity for outside venting or a carbon-activated reclaimer.

The rate of solvent recovery is accelerated over other systems because condensation is achieved through a built-in freon refrigerant unit with a compressor instead of a conventional water cooling unit.

The rapid speed of the solvent recovery operation permits a longer deodorization phase without prolonging the length of the cycle. Clothes leave the machine at room temperature, and, according to the equipment manufacturer, are not wrinkled.

One of the most common sources of solvent loss is in the filter sludge, also known as filter muck. Even after 24 hours of drainage, filter sludge contains as much as 75% perc, or about three pounds of solvent per pound of filter powder.

Cooking solvents out of regenerable filter materials in a muck cooker can reduce the amount of solvent lost in filter material by 89%. Most coin-operated and many commercial installations use cartridge filters for filtration. Cartridges can be used where soil loadings are low. Spent cartridges should be drained in their housing for 24 hours to minimize solvent loss.

Residues in the botton of distillation units are also rich in solvents. Proper distillation can reduce solvent content in the still bottoms to less than 60% by weight. Perc content in still bottoms can be reduced to 1% through use of oil cookers.

ON-SITE SOLVENT RECOVERY-PETROLEUM PLANTS

Similar technologies used in perc plants are applicable for drycleaning establishments that use petroleum or Stoddard solvent as a cleaning medium. Although the capital cost is high in relationship to the savings and the ROI is longer, these techniques can result in a 95% reduction of petroleum in the dryer exhaust.

Condensation systems are relatively new to the petroleum cleaners. Designed to replace the conventional dryers, these units use steam heated coils to drive off solvent contained in the fabrics. The major difference is that the condensation solvent recovery system uses less water-cooled coils to condense the solvent vapors.

The petroleum is separated from the water in a separator unit and recovered for reuse. The unit has a 90% efficiency in reduced solvent vapor otherwise exhausted by a conventional dryer.

Economics: capital costs a very high. The cost for a 105-lb. condensation solvent recovery unit is $15,000 (1981 U.S.). However, the shrewd businessman will look beyond the capital cost and realize the first year of operation will net the company $5,000 through reduced solvent loss (ROI-3 years). For the smaller operator, purchase of a 50-lb. unit is still an investment, however, the ROI is 8 years.

ON-SITE SOLVENT RECOVERY-FLUOROCARBON PLANTS

Drycleaning equipment designed to use fluorocarbon solvents was the best designed equipment, incorporating built-in controls and maximum solvent recovery. As the prices for other solvent increased, these engineering principles were applied in the manufacturing of drycleaning equipment using perc and Stoddard solvents.

NORTHEAST FABRICARE ASSOCIATION

The Northeast Fabricare Association (NEFA), an industy association, offers over 2,500 drycleaners a creative, coordinated waste hauling service to help them comply with environmental law at an affordable rate.

On July, 18, 1983, NEFA signed a contract with Safety-Kleen for project "Waste-B-Gone". This program offers hazardous waste pick up for small generator drycleaners in the Northeast. Prior to this program waste was collected and disposed of in secure landfills. Under this contract waste will be picked up and recycled. Drycleaners who generate small quantities of waste solvent and sludge are combined to increase purchasing power, thus reducing liquid waste disposal costs from approximately $180/bbl to $100/bbl and solid waste disposal costs from a high of $210/bbl to less than $100/bbl.

NEFA's program offers many advantages to the drycleaner who choses to participate in this program:

* cost savings for disposal
* educational programs regarding hazardous waste regulations
* low cost liability insurance
* hazardous waste manifest tracking system

For additional information regarding the "Waste-B-Gone" NEFA program, please contact:

Ms. Kathy Camponescki
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Northeast Fabricare Association
268 Main Street
Stoneham, MA 02180
617-438-1226

CONCLUSION

Technological innovations in the drycleaning industry has moved into high gear, bringing with it an abundance of highly efficient, low polluting equipment that promises to clean better, more safely and at a lower cost.

For the small operator who decides to modernize his business, good housekeeping practices and equipment to retrofit to existing equipment is commercially available at reasonable costs.

NEFA's program will assist the drycleaner both financially and administratively in the handling of whatever remaining hazardous waste has been generated.

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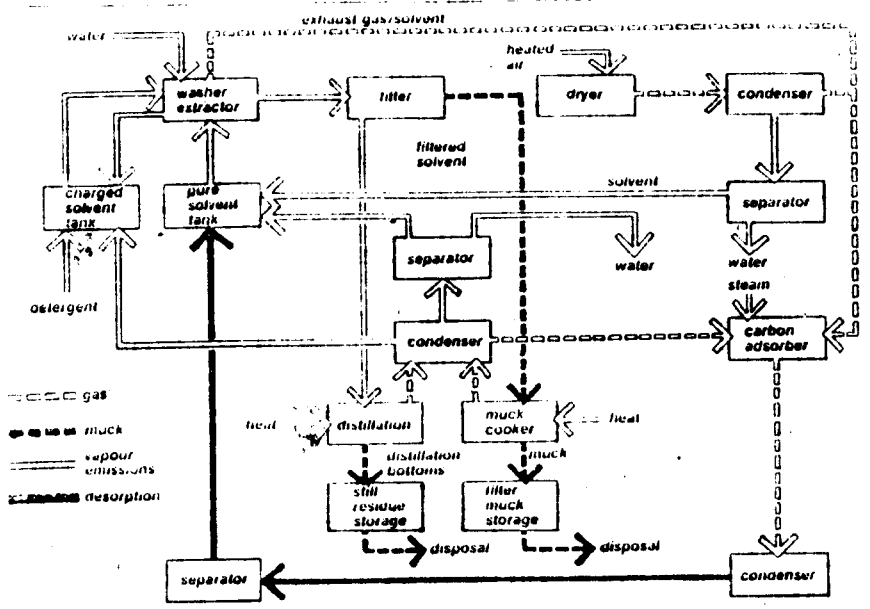
Perchloroethylene Dry Cleaning Plant Flow Diagram

Solvent-laden exhaust from the solvent storage tanks, distillation unit, muck cooker, dryer condenser and plant ventilation system can all be routed to feed into a carbon adsorber to remove solvent from the exhausted air.



The Carbon Adsorption Process

During the adsorption cycle, the solvent in the incoming air tempora attaches to the carbon bed. During the desorption phase, the carbon is regenerated by flushing with steam which in turn picks up solvent. steam and solvent vapour undergo condensation and separation. clean solvent is re-used in the dry cleaning process.

Source: Operating Tips for Better Dry Cleaning, PPG Industries

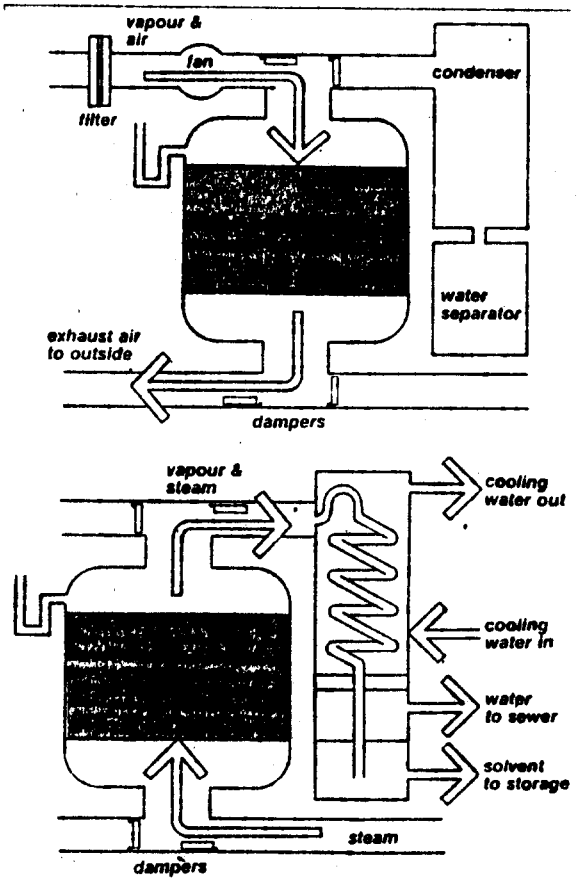


Figure 3

Solvent Recovery Unit and Dry Cleaning Machine

With the refrigerated condenser system, the air that has been stripped of solvent can be returned directly to the dry cleaning machine, eliminating the need for external venting ducts.

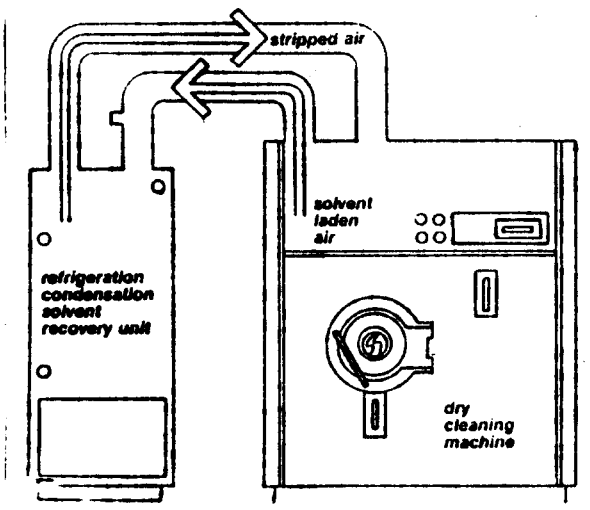


Figure 4

Refrigeration/Condensation System

Low temperature refrigeration is used to strip solvent from the air. A stripping is required for only a few minutes during aeration at the end o each drying cycle, the size of the refrigeration unit is kept to a minimun by using a cold storage system.