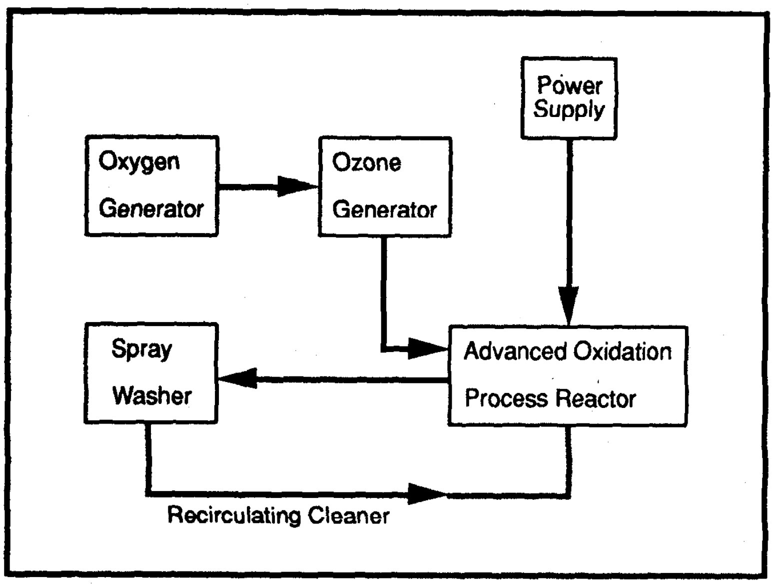
Minimizing Waste in Automotive Spray Washers Using Ozone and Electrolysis

Mike P. McGinness

A new process treats used cleaning solution from automotive spray washers with advanced oxidation, which converts the insoluble fats and oils into useful soluble surfactants. The cleaning solution is then reused to clean the next batch of dirty parts.



Advanced Oxidation Process Using Ozone and Electrolysis to Minimize Waste

Introduction

When cleaning solutions used in automotive parts spray washers are exhausted and ready for disposal, they contain contaminants from the dirty automotive parts and from other cleaning processes. Before disposing of the used cleaning solutions, the waste generator must determine if the waste is hazardous.

While currently available products can separate oils and greases from the cleaning solutions to extend the life of the cleaning bath, those products do not eliminate the eventual need for disposal. Chlorinated solvents are rapidly being replaced by aqueous cleaners to avoid a new ozone-depletion product-labeling law requiring manufacturers to label products that have been cleaned with ozone-depleting chemicals.

Past experience has already demonstrated that the advanced oxidation process will oxidize the organic compounds frequently dragged in on parts from other processes (Rice and Browning 1980). Also, waste water treatment using ozone is well known and documented in the literature (Langlais 1991).

Concept Description

An advanced oxidation process using ozone and electrolysis can oxidize the oils and greases in automotive cleaning solutions into polar water-soluble surfactants that can then be used in the same cleaning process. The oxidation process converts insoluble organic fatty acids, greases, and oils into various soluble surfactants and wetting agents. At the same time, existing surfactants and organic contaminates are oxidized into carbon dioxide.

The process, shown in the figure, consists of an external tank and plumbing that accommodates the circulation of an aqueous cleaning solution from the spray washer to the tank and back to the washer. A pressure-swing adsorption oxygen generator feeds dry, high-purity oxygen to a corona-discharge ozone generator. The oxygen and ozone are generated and used as needed. Alternating DC current is fed to permanent electrodes immersed in the tank. The only waste produced by the process would be a very small amount of precipitated inorganic solids, such as sand or gravel, which can easily be rendered non-hazardous or even recycled if they contain heavy metals such as lead.

Economics and Market Potential

By using the advanced oxidation process, a typical automotive remanufacturing facility could reduce its hazardous waste by 20,000 to 30,000 lb per year. Facilities in the more heavily regulated areas such as California, where used oil is a listed hazardous waste, should realize a 6- to 12-month payback.

This process reduces the amount of water and chemicals used to maintain the cleaning process and the cost of waste disposal because the water and cleaning compounds are reused. Energy savings result because the process eliminates 1) the energy currently used to produce and deliver fresh water and chemicals, and 2) the energy used to treat and destroy the waste from existing processes. This process also allows the cleaning bath to be maintained at the peak performance of a new bath, resulting in decreased cycle times and decreased energy consumption for cleaning the parts.

Key Experimental Results

The current prototype is being used on a typical automotive spray washer that is used to clean engine parts before their repair and remanufacturing. The washer holds 60 gal of recirculated cleaning solution that is heated and used at 93°C. A 5-HP pump feeds the cleaning solution through the nozzles at 60 lb of pressure. Because the cleaner is heated, a great deal of water is lost to evaporation. To replace that water, the rinse water is reused as makeup water.

In a recent test, a one-year-old, completely exhausted cleaning bath was restored to 80% of the performance of the original cleaning bath in less than 8 hours of processing. In a second test, 4 gal of motor oil were introduced into the same 60-gal cleaning bath. Careful evaluation determined that the motor oil had been converted into synthetic detergents and that the cleaning bath was now outperforming the new original cleaner by 100%.

Future Development Needs

Additional testing at temperatures from 21°C to 54°C is planned. We will evaluate the possibility of cleaning with a cold bath to reduce the energy consumed by the cleaning process. The cycle times and levels of cleanliness achieved will be compared with those at the elevated temperatures normally used in this type of process.

To supply various market needs, we will need a very flexible and automatic process control method to control this process in the field. The process controller needs to be able to optimize the power used to convert fats and oils into surfactants and to optimize cleaning cycle time by optimizing the concentration of surfactants in the recirculating cleaning.

The next major objective in determining potential markets for the concept is to place several experimental systems in the field and evaluate the various process control methods available to us before attempting any major marketing efforts.

References

Langlais, B. 1991. *Ozone in Water Treatment, Application and Engineering*. Lewis Publishers, International Ozone Society, Chelsea, Michigan.

Rice, R. G., and M. E. Browning. 1980. *Ozone for Industrial Water and Waste Water Treatment, a Literature Survey*. EPA-600/2-80-060, U.S. Environmental Protection Agency, Washington, D.C.

For further information, contact

Michael P. McGinness
VP Technology
EcoShield Environmental Systems, Inc.
ecomike@ecoshieldenv.com
Toll Free: 877-ECOSHIELD

Compiled by

Pacific Northwest Laboratory for the U.S. Department of Energy, Innovative Concepts Program 392240. This flier was printed on recycled paper.