THE ENVIRONMENTAL TECHNOLOGY VERIFICATION PROGRAM

U.S. Environmental Protection Agency

Concurrent Technologies Corporation

ETV VERIFICATION STATEMENT

TECHNOLOGY TYPE:	**MICROFILTRATION**		
APPLICATION:	**AQUEOUS CLEANING APPLICATIONS**		
TECHNOLOGY NAME:	**Membralox® Silverback™ Model 900**		
COMPANY:	**USFilter Corporation**		
POC:	**David Hill**		
ADDRESS:	**28 Cook Street** **Billerica, MA 01821**	**PHONE:** **FAX:**	**(978) 262-2313** **(978) 667-1731**
EMAIL:	**hilld@usfilter.com**		

The United States Environmental Protection Agency (EPA) has created the Environmental Technology Verification Program (ETV) to facilitate the deployment of innovative or improved environmental technologies through performance verification and dissemination of information. The goal of the ETV Program is to further environmental protection by substantially accelerating the acceptance and use of improved, cost-effective technologies. ETV seeks to achieve this goal by providing high-quality, peer-reviewed data on technology performance to those involved in the design, distribution, financing, permitting, purchase, and use of environmental technologies.

ETV works in partnership with recognized standards and testing organizations, stakeholder groups consisting of buyers, vendor organizations, and states, with the full participation of individual technology developers. The program evaluates the performance of innovative technologies by developing test plans that are responsive to the needs of stakeholders, conducting field or laboratory tests (as appropriate), collecting and analyzing data, and preparing peer-reviewed reports. All evaluations are conducted in accordance with rigorous quality assurance protocols to ensure that data of known and adequate quality are generated and that the results are defensible.

The P2 Metal Finishing Technologies Program (ETV-MF), one of 12 technology focus areas under the ETV Program, is operated by Concurrent Technologies Corporation, in cooperation with EPA's National Risk Management Research Laboratory. The ETV-MF Program has evaluated the performance of a microfiltration technology for the recycling of alkaline cleaners. This verification statement provides a summary of the test results for the USFilter Membralox® Silverback™ Model 900 alkaline cleaner recycling system.

VERIFICATION TEST DESCRIPTION

The USFilter Membralox® Silverback™ Model 900 (Silverback™ unit) was tested, under actual production conditions, on an alkaline cleaner, at Gates Rubber Company in Versailles, MO. Alkaline cleaning is performed on metal parts at different times during the manufacturing process to remove oils, coolants and other metalworking fluids prior to electroplating. The verification test evaluated the ability of the Silverback™ unit to remove oils and recover the alkaline cleaning chemistry.

Testing was conducted during two distinct 5-day test periods (Run 1 and Run 2):

- During the first test period (Run 1), the Silverback™ unit was operated at a typical oil and suspended solids loading rate for Gates Rubber Company operations.
- During the second test period (Run 2), the Silverback™ unit was operated at a significantly higher than normal oil and suspended solids loading rate.

Historical operating and maintenance labor requirements, chemical usage, and waste generation data were collected to perform the cost analysis.

TECHNOLOGY DESCRIPTION

The Membralox® Silverback™ Model 900 is a microfiltration technology that is used to recycle alkaline cleaner. In operation, alkaline cleaner contaminated with oil, enters a two-compartment stainless steel tank through a prefilter that removes large particulate material from the feed stream. Free oil accumulates in the initial compartment and can be removed on a periodic basis through a drain port located on the upper part of the tank. The liquid then moves to a second tank compartment through a sub-surface passage; thereby leaving the floating oils in the first compartment. The liquid in the second compartment (referred to as the recirculation tank) is pumped through a microfiltration ceramic filter (0.2 µ). The filter reject returns to the recirculation tank and the recovered alkaline cleaner flows back to the cleaning process. At Gates Rubber Company, the Silverback™ unit recovers 1.0 gpm of alkaline cleaner.

VERIFICATION OF PERFORMANCE

24 hour composite samples were collected from the feed to the Silverback™ unit and the recovered cleaner from the Silverback™ unit daily during each test. In addition, a 5% solution of the concentrated cleaner was made and analyzed for comparison purposes.

Average analytical results for key parameters are shown in Table 1. Total solids is a measure of all dissolved and suspended solids in the samples. Alkaline components and dipropylene glycol ether are the key inorganic and organic ingredients of the alkaline cleaner. Total suspended solids and oil are the contaminants being removed during the recovery process. The recovered alkaline cleaner is similar in composition to the unused cleaning solution with regard to its key organic ingredient (dipropylene glycol ether), but significantly higher regarding total solids and alkalinity.

Test Run	Total Solids mg/l (EPA 160.3)	Total Alkalinity mg/l as CaCO3 (SM 2320B)	Dipropylene Glycol Ether mg/l (GC/FID)	Total Suspended Solids mg/l (EPA 160.2)	Oil mg/l (EPA 8015 modified) (SW-846)
RUN 1 AVG IN	9340	2580	6160	164	147
RUN 1 AVG OUT	8700	2520	6240	52	24
RUN 2 AVG IN	10100	2340	5380	450	660
RUN 2 AVG OUT	9720	2200	5100	14	18
5% CLEANER	4000	1150	5900	5	24

IN = feed to the recovery unit OUT = recovered alkaline cleaner
5% CLEANER = unused alkaline cleaning solution at normal operating strength (5%)
SM = Standard Methods for the Examination of Water and Wastewater, 18th ed.
EPA = Methods for Chemical Analysis of Water and Wastes, 1983
GC/FID = Matrix specific gas chromatography/flame ionization detection method

TABLE 1. SUMMARY OF KEY ANALYTICAL DATA

Alkaline Cleaner Recovery. The recovery percentages for total alkalinity and dipropylene glycol ether were consistently high, indicating that the Silverback™ unit is very efficient in recovering these key ingredients of the cleaning solution. Recoveries greater than 100% are due to uncertainties inherent in the analytical precision.

		Average	Min	Max	Standard Deviation
Alkaline Component Recovery %	Run 1	97.8	92.6	100.0	3.3
	Run 2	93.9	86.4	100.0	6.5
Dipropylene Glycol Ether Recovery %	Run 1	101.4	96.9	106.8	3.9
	Run 2	95.0	81.6	100.0	8.0

Table 2. Cleaner Recovery Efficiency

Contaminant Removal Efficiency. Contaminant removal efficiencies, calculated for the primary contaminants of the alkaline cleaning bath: oil and total suspended solids (TSS), are shown in Table 3. For the two test runs, average TSS removal efficiency ranged from 69.3% to 94.5% and average oil removal efficiency ranged from 82.3% to 97.0%. The Silverback™ unit was more efficient in removing TSS and oil at the higher oil and suspended solids loading rate simulated in Run 2.

		Average	Min	Max	Standard Deviation
TSS % Removal	Run 1	69.3	56.2	82.4	11.3
	Run 2	94.5	79.4	99.8	8.5
Oil % Removal	Run 1	82.3	71.7	91.5	8.8
	Run 2	97.0	95.2	98.3	1.2

Table 3. Contaminant Removal Efficiency

Energy Use. Energy requirements for operating the Silverback™ unit at Gates Rubber Company include electricity for the system pump and steam (from a natural gas fired boiler) for reheating the recovered alkaline cleaner for re-use in the cleaning process. Electricity use was determined to be 134.3 kWh/day, based on continuous use of the system. The energy requirement for reheating the recovered alkaline cleaner is 271,000 BTUs/day. The amount of natural gas required to generate this quantity of energy is approximately 2.71 therms/day.

Waste Generation. A waste generation analysis was performed using current operational data and historical records from the Gates Rubber Company. Implementation of the Membralox® Silverback™ Model 900 has reduced the disposal frequency of the alkaline cleaning solution from 15 times per year to two times per year. The overall volume of concentrated waste generated from alkaline cleaning has been reduced by 67.5% and the weight of total solids in the waste products has been reduced by 58.9%.

Operating and Maintenance Labor. Operating and maintenance (O&M) labor requirements for the Membralox® Silverback™ Model 900 were monitored during testing. The O&M labor requirement for the equipment was observed to be 3.75 hrs/wk. O&M tasks performed during the verification test include daily inspections of the unit and weekly cleaning of the tank and membrane.

Cost Analysis. A cost analysis of the Membralox® Silverback™ Model 900 was performed using current operating costs and historical records from the Gates Rubber Company. The installed capital cost (1999) of the unit was $43,000 (includes $36,000 for the unit, $5,000 for storage tanks, and $2,000 for installation costs). The annual cost savings associated with the unit is $32,064. The projected payback period is 1.3 years.

SUMMARY

The test results show that the Membralox® Silverback™ Model 900 provides an environmental benefit by extending the bath life of the alkaline cleaner, thereby reducing the amount of liquid and solid wastes produced by the cleaning operation without removing the cleaning constituents of the bath. The economic benefit associated with this technology is low operating and maintenance labor and a payback period of approximately 1.3 years. As with any technology selection, the end user must select appropriate cleaning equipment and chemistry for a process that can meet their associated environmental restrictions, productivity, and cleaning requirement.

Original signed by:
E. Timothy Oppelt

E. Timothy Oppelt
Director
National Risk Management Research Laboratory
Office of Research and Development
U.S. Environmental Protection Agency

Original signed by:
Donn Brown

Donn W. Brown
Manager
P2 Metal Finishing Technologies Program
Concurrent Technologies Corporation

NOTICE: EPA verifications are based on evaluations of technology performance under specific, predetermined criteria and appropriate quality assurance procedures. EPA and *CTC* make no expressed or implied warranties as to the performance of the technology and do not certify that a technology will always operate as verified. The end user is solely responsible for complying with any and all applicable federal, state, and local requirements. Mention of commercial product names does not imply endorsement.