

## **Abstract**

### **Pollution Prevention - Parts Washing of the 1990's**

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Air pollution has caused EPA to focus on solvent-free alternatives for parts washing. California recently passed Rule 1171 banning solvent parts washing from January 1999. Many water-based systems are available. Independent studies by the Institute for Research and Technical Assistance (IRTA) in California demonstrated that ZYMO a bioremediating system was \$400-600 per year less expensive to operate than mineral spirits or other water-based systems. ZYMO-“The Parts Washer” uses bioremediation, which can extend the bath-life of the cleaning fluid for up to two years in comparison to every 4-6 weeks for mineral spirits or other water-based systems. Extended bath-life minimizes the amount of waste. Small hazardous waste generators may therefore become exempt by moving to such a system.

## **Pollution Prevention - Parts Washing of the 1990's**

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### **Introduction**

Parts washing is a general term used to describe degreasing of parts where oil, grease and dirt are removed. The degree of cleaning required is site and application dependent. This paper will focus on automotive and industrial maintenance applications for replacing petroleum solvents such as mineral spirits with water-based, non-hazardous cleaners.

In the last twenty years, mineral spirits has become the most common petroleum solvent used to clean the parts resulting in a multi-million dollar industry for recycle and reuse of the mineral spirits. Traditionally, the advantage of mineral spirits over water-based cleaners have been:

- Excellent cleaner
- Applicable to a diversity of applications
- Fast
- Inexpensive

Unfortunately, mineral spirits also has several disadvantages:

- Hazardous
- Flammable
- Creates volatile organic emissions (VOC's)
- Contains ozone depleting compounds (ODC's)
- Requires disposal

With the growing problems of air pollution and non-attainment of Federal Standards in our cities the Air Quality Management regulators have taken a closer look at the major causes of air pollution. In 1993, studies by the South Coast Air Quality Management District (SCAQMD) in California (CA), showed emissions from solvent cleaning operations to account for 27% of the total organic emissions in 1993. SCAQMD stated that 60% of these emissions were attributable to cold cleaning operations (16.2% of total emissions) with petroleum distillates accounting for half of the emissions. In 1994 Federal Laws were promulgated by the Environmental Protection Agency (EPA) called National Emission Standards for Hazardous Air Pollutants (NESHAP) for halogenated solvent cleaners. This caused further focus on solvent cleaners by SCAQMD. Finally, in November of 1996, SCAQMD promulgated a law called Rule 1171 banning solvent parts washing in the lower Los Angeles basin by the 1st of January, 1999. This event sent shock waves through the parts washing industry as vendors of parts washing services were faced with replacing some 40,000 free standing parts washers in the LA basin.

The alternatives had been well evaluated by the Independent Research and Technical Association (IRTA) in a study funded by Environmental Protection Agency (EPA). The study evaluated mineral spirits and several types of washing equipment using water-based technology including:

- Manual free standing parts washers
- Bioremediating parts washer (ZYMO)
- Spray cabinet washers

The overall economic conclusions of this study are summarized in Table 2.

**Table 2: Average Usage Comparison by IRTA - Annualized Costs**

Study Cost Criteria	Mineral Spirits	Aqueous - Sink/Cabinet		Aqueous + clarifier - Sink/Cabinet		ZYMO - Bioremediating	
		Off-site - HazWaste	Off-site - Non-Haz	Off-site - HazWaste	Off-site - Non-Haz	Off-site - HazWaste	Off-site Non-Haz
Equipment	N/A	163/1060	163/1060	163/1060	163/1060	204	204
Chemical	N/A	297/189	297/189	297/189	297/189	120	120
Labor	1885	2074/415	2074/415	2074/415	2074/415	2262	2262
Electric	240	720/1522	720/1522	720/1522	720/1522	100 <sup>1</sup>	100 <sup>1</sup>
Disposal	N/A	300/600	105/210	N/A	N/A	136	N/A
Service	1213	N/A	N/A	N/A	N/A	N/A	N/A
Regulatory Fees	N/A	N/A	N/A	60	N/A	N/A	N/A
<b>Total Costs</b>	<b>\$3,338</b>	<b>\$3554/3786</b>	<b>\$3359/3396</b>	<b>\$3314/3246</b>	<b>\$3254/3186</b>	<b>\$2822</b>	<b>\$2686</b>

**Notes:**

1. Corrected from \$720/yr with written permission of IRTA.
2. N/A = Not applicable.
3. Capital costs for equipment were amortized over 10 years.

In summary, it can be concluded from the IRTA cost comparison that ZYMO the bioremediating system cost was about 20% less or \$400-600 per year less to operate than other parts washers.

The IRTA report made further cost comparisons between water-based cleaners and mineral spirits under low and high usage conditions. In both cases, IRTA’s report showed water-based systems to be more competitive. However, IRTA failed to compare bioremediating parts washers in this final analysis. Table 3 below uses the same assumptions as IRTA to compare all types of parts washers.

**Table 2: High & Low Usage Comparison by IRTA - Annualized Costs**

Study Cost Criteria	Low Usage			High Usage		
	Mineral Spirits	Aqueous	ZYMO	Mineral Spirits	Aqueous	ZYMO
Equipment	N/A	163	204	N/A	1,060	204

Chemical	N/A	198	80	N/A	378	240
Labor	628	691	746	7,540	1,659	4,524
Electric	120	360	50	960	3,104	200
Disposal	N/A	200	N/A	N/A	1,200	N/A
Service	1,213	N/A	N/A	1,213	N/A	N/A
Regulatory Fees	N/A	N/A	N/A	N/A	N/A	N/A
<b>Total Costs</b>	<b>\$1,961</b>	<b>\$1612</b>	<b>\$1080</b>	<b>\$9,713</b>	<b>\$7,401</b>	<b>\$5,168</b>
<b>Savings versus Solvent</b>		<b>\$349/yr.</b>	<b>\$881/yr.</b>		<b>\$2312/yr</b>	<b>\$4,545/yr.</b>
<b>ZYMO -Savings vs. Water</b>			<b>\$532/yr.</b>			<b>\$2,233/yr.</b>

**Assumptions:**

**Low usage (Sink and Drum):**

- Usage: 10 minutes/d - Labor 33%
- Bath-life 6 months + (66%)
- Electric usage (50%)
- Reduced chemical costs (198/297 = 67%)
- Disposal (Non-hazardous )

**High Usage (Spray Cabinet)**

- Usage: 2 hours/d
- Labor (200%)
- Electric usage (200%)
- Reduced chemical costs (378/189 = 200%)
- Disposal (Non-hazardous )

All other assumptions based on previous data in Table 2.

While the IRTA report forms an excellent base for comparison of mineral spirits to water-based cleaners there were other shortcomings in the economic cost comparison, which would have made neutral pH cleaners and bioremediating parts washers even more attractive:

**Solvent related cost not included:**

- Lost labor due to handwashing
- Dermatitis related work issues
- Costs of soaps, barrier creams and use of gloves.

Mechanics generally wash their hands after using solvent to minimize defatting and subsequent dermatitis problems. Surveys by Advanced Bioremediation Systems estimate handwashing to be about 20-40 minutes per day per mechanic, which at \$20 per hour labor cost is approximately \$2,000 in additional labor per year. The issue of skin disease, particularly, occupational skin disease is further highlighted by a report from the Health and Safety Executive (HSE) in the UK which quotes that “about four million working days are lost in the United Kingdom each year because of skin disease”. On a pro-rata basis this would equate to about 20 million working days lost in the USA or about \$3.2 billion in lost time assuming that the cost of labor is \$20/hour.

**Aqueous related costs not included or compared:**

- Service/mechanical maintenance of spray cabinets (estimated at \$1000/yr)
- Electricity consumption of ZYMO (Estimated at \$720/yr - actual \$100/yr)
- Lost labor due to handwashing when using alkaline cleaners
- No comparison of the benefit of extended bath-life over other aqueous cleaners

The IRTA study did demonstrate that a host of other technologies were available to the end-user for replacing solvent parts washers and washing systems. Unfortunately, for those companies involved in the service aspects of the business the change over to water-based cleaners will result in the need for significant capital investment.

ZYMO a bioremediating parts washer was the only technology more cost-effective than solvent parts washers in high, medium and low usage applications. This paper now focuses on bioremediating parts washers as the alternative parts washing technology of the 1990's.

### **Bioremediating Parts Washers**

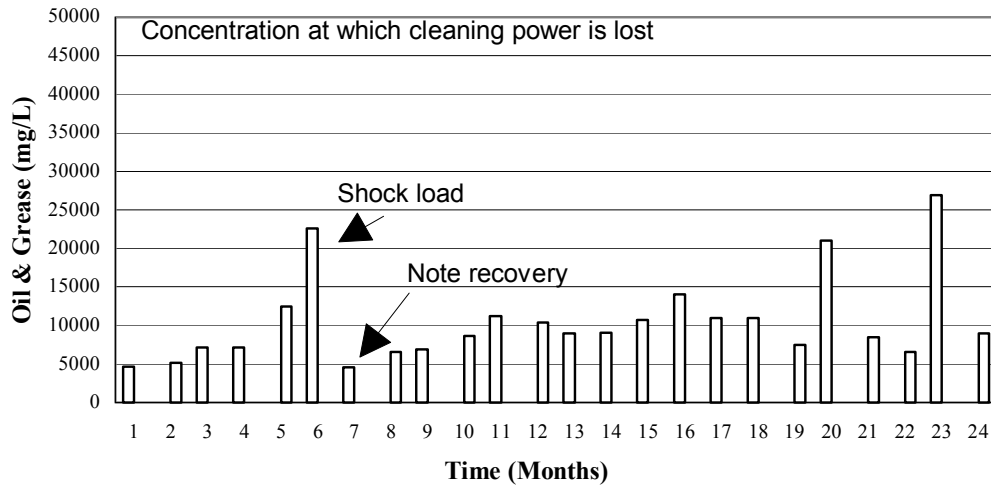
The patent pending process concept of the ZYMO bioremediating parts washer was developed by Advanced Bioremediation Systems of Norcross Georgia in 1995. Since, this time, the concept has gained National and International recognition by many corporations including General motors, Firestone, Honda, Wynn's, CarQuest, 3M, Monsanto, Akzo Nobel, National Parks, Coast Guard, City of Santa Monica, Aerospatiale in France, Hyundai in Korea and other companies in the UK, Germany and Japan.

While there are now several companies claiming "me-too" bioremediating parts washers many simply do not work effectively. Buyers should request vendors for a minimum amount of information during their evaluation of bioremediating parts washers including:

- Oil and grease data during operation - at least 18 months of data;
- Toxicity Characteristic Leachate Procedure (TCLP) tests on filters and fluid;
- Independent test data;
- Cost comparisons to mineral spirits;
- References;
- Advice on use and disposal.

ZYMO-"The Parts Washer" has been demonstrated to extend the life of the cleaning fluid for up to two years. Data from a four bay automotive shop is shown in Figure 1 below.

**Figure 1: Operating Data from 4 Bay Automotive Shop**



One interesting facet of this parts washer is the ability of the system to recover from shock loads of oil and grease during heavy usage. This has led to the industry expression that the system is “self-regulating”. The cleaning fluid used in ZYMO called Surfzyme only requires top-up to replace drag-out and evaporation. After two years the bulk fluid needs to be changed in most cases due to build-up of color bodies.

Another aspect of water-based parts washing is disposal of filters and fluid in accordance with local environmental regulations. The ZYMO parts washer uses polyester filters which contain microbes to inoculate the system. These are generally changed out every two-four weeks depending on usage. Disposal is site dependent on whether hazardous materials have been introduced into the unit during the washing process.

### **References:**

1. SCAQMD - “Draft Staff Report for proposed Amendment to Rule 1122 - Solvent Degreasers”, March 5, 1997.
2. Institute for Research and Technical Assistance (IRTA), “ Parts Cleaning in Auto repair Facilities - The Conversion to water”, April, 1997.
3. Health and Safety Executive - Guidance Notes MS 24 - “Health Surveillance of Occupational Skin Disease”, Medical Series 24, January 1991.

