

# Comparison of Alternative Pollution Prevention Technologies for Boat Maintenance and Repair Facilities in Macomb County

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Macomb County Health Department

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## INTRODUCTION

The purpose of this project was to identify best management practices that would minimize or eliminate sources of pollutants from boat maintenance and repair facilities. The Macomb County Health Department (MCHD) received a Pollution Prevention Grant from the Michigan Department of Environmental Quality in July 2001. The goal of this grant project is to achieve waste reductions in solvents, toxic paints, and petroleum waste generated by Boat Maintenance Repair Facilities (BMRFs) and boatyards in the Macomb County portion of the Lake St. Clair watershed through the use of source reduction, reuse, and recycling. Environmental Consulting & Technology, Inc. (ECT) was the technical consultant for the project.

### **PROJECT GOAL**

The project goal is to achieve waste reductions in solvents, toxic paints, and petroleum waste products generated by BMRFs and boatyards in the Macomb County portion of the Lake St. Clair watershed through the use of source reduction, reuse, and recycling.

### **PROJECT OBJECTIVES**

- Survey nationwide projects for P2 technologies and practices that can be implemented in Macomb County BMRFs and boatyards.
- Perform an engineering evaluation of the expected waste reductions, cost effectiveness and technical merits of these technologies.
- Identify, develop site-specific designs for, and implement appropriate technologies as pilot projects at BMRFs and boatyards.
- Consult with BMRF and boatyard owners/operators to demonstrate the correct implementation and maintenance of these technologies and the associated environmental and economic merits of implementing the technologies.

The Macomb County Health Department (MCHD) contacted BMRFs throughout the County to explain the program and to solicit their input. To facilitate this input, the MCHD established a Technical Advisory Committee. Membership included representatives from the MCHD Marina Program staff, BMRF owners or operators, pollution prevention (P2) vendors and consultants.

## 1.0 STATEMENT OF ENVIRONMENTAL CONCERNS/ISSUES

Near shore sediment studies in the Macomb County portion of Lake St. Clair have shown elevated concentrations of copper in the sediment that can result in a toxic impairment of the overall habitat for fish and wildlife. The Clinton River Remedial Action Plan (RAP) recommended removal of these sediments, and their contaminant sources, as a necessary step in remediation of the watershed.

Macomb County is home to approximately thirty-three boatyards and Boat Maintenance and Repair Facilities (BMRFs) located along the Lake St. Clair shoreline and the rivers leading to the lake. BMRFs are known sources of heavy metals such as copper found in anti-fouling hull paint. Other potential pollutants from these facilities include organic chemicals found in oils, paints, pesticides, cleaners, solvents, and other boat related products. These metals and organic chemicals accumulate in sediments resulting in environmental degradation of streams and lakes. Concurrent with efforts to remediate the historic pollutants, there is an inherent need to eliminate any on-going sources. This Pollution Prevention Project for Boat Maintenance and Repair Facilities is a non-regulatory means of eliminating these sources.

This study identified current practices, potential sources of contamination associated with those practices and alternative technologies that could provide pollution prevention benefits. The results of the study and recommendations for selection of alternative technologies are presented in the following sections.

### 1.1 PRELIMINARY INVESTIGATION

BMRFs offer a variety of services for recreational boaters, sport fishermen and commercial fishing operations. BMRFs can be a significant source of “point” and “non-point source” contamination because of their close proximity to surface waters. Contamination washed from these sites in rainwater runoff is commonly referred to as “non-point source” pollution. “Point source” pollution refers to contaminants that are discharged directly into a lake or stream from a pipe or drain.

The type of work and the type of chemicals being used at these facilities, coupled with the proximity to surface water, means even a small BMRF can have a relatively large impact on the marine environment. Therefore, pollution prevention at BMRFs can significantly improve surface water quality.

Preliminary investigation of practices at BMRF facilities in Macomb County indicated that there were three primary areas where alternative pollution prevention technologies could be implemented. The three areas are:

- Boat Paint Removal
- Parts Cleaning
- Oil Recycling/Oil Filters

A national survey was conducted via the Internet to identify pollution prevention programs relevant to this project. A complete listing of programs around the country that were identified as part of this research task is included in the Reference Section of this document. Potential pollution prevention technologies identified in these programs were investigated and a recommended technology was selected in each of the three areas listed above that would result in either waste reduction or an increase in recycling or reuse.



## 2.0 PAINT REMOVAL

### 2.1 RESEARCH

#### 2.1.1 CURRENT PRACTICES

Available information coupled with site visits conducted by MCHD and Environmental Consulting & Technology, Inc. (ECT), showed that the following techniques are currently being practiced in Macomb County for removal of bottom paint:

- Sand blasting,
- Razor stripping,
- Vacuum sanding,
- Non-vacuum sanding, and
- Chemical stripping.

Water blasting is no longer being used for paint removal, but is used for the removal of accumulated algae and sediment on the bottom of boats. The runoff from this process typically flows onto the ground or into a lake or stream.

Some limitations associated with current technologies include:

- Sandblasting is generally not used for removal of bottom paint at Macomb County BMRFs because of stricter environmental protection and occupational health regulations and because it is also very abrasive and has a greater potential for damaging the gel coat of the fiberglass boats.
- Sanding of any sort creates airborne dust that can impact adjoining boats in a marina unless the boat being stripped is enclosed with tarps or is inside a building. The dust from sanding can also affect water quality.
- Razor stripping can cause unnecessary damage to the gel coat.
- Chemical stripping creates chemical waste, releases excessive volatile organics (VOCs) into the air, and creates excess waste from the towels and application materials.
- All of these techniques tend to be long and tedious with the stripping of one boat taking a few days.

An additional concern is the significant amount of waste that these techniques generate. For example, a typical “scuff and paint” process used to renew the surface and which does not remove all the bottom paint, generates thirty 6-inch sanding disks, 50 pieces of finish grade sandpaper, two gallons of waste acetone, and one box of used rags for a 40’ boat. This is in addition to the dust created by the process. Given the limitations of these techniques and their environmental impacts, other technologies were evaluated for the removal and renewal of bottom paint.

### 2.1.2 ALTERNATIVE TECHNOLOGIES

A review of the available literature identified other approaches for removal of bottom paint. Three of the alternative approaches that were evaluated for their pollution prevention benefits are described in the following paragraphs.

- **PLASTIC BLASTER:** The plastic blaster uses compressed air driven plastic pellets to clean areas. The process collects and separates the pellets and paint chips and reuses the pellets. The plastic blaster requires a self-contained blasting environment to facilitate collection of the pellets and paint chips. A companion system is used to collect the pellets and separate them from the paint.
- **CO<sub>2</sub> BLASTER (DRY ICE):** The CO<sub>2</sub> blaster uses compressed air driven “dry ice” for stripping bottom paint off the boat. As the CO<sub>2</sub> media (dry ice) hits the surface of the boat and begins to warm up, it goes through a phase change from a solid to a gas that dissipates into the air. The paint chips are deposited on a ground tarp for collection and disposal.
- **ICE BLASTER:** The Ice Blaster uses compressed air (<150psi) and tap water to operate. Water consumption is approximately 20-25 gal/hr. The machine generates its ice from the supplied water and a fine mist of ice and compressed air is projected against the hull of the boat. Paint removal is accomplished through surface flexing rather than abrasion. As the ice melts, the water mixes with the paint chips being removed and collects on a ground tarp. The paint scraps and water on the tarp can be vacuumed and swept up and disposed of properly following the operation.

Advantages and disadvantages associated with each of the three paint removal methods were evaluated to determine which techniques could be implemented in a BMRF. The following characteristics of each process were identified.

- **PLASTIC BLASTER**

#### Advantages

- Minimizes the generation of additional waste products beyond the paint chips removed from the boat.
- Simplified disposal process.
- Reduces disposal costs.
- Reusable media (plastic pellets).
- Does not involve the use of chemicals.

## **Disadvantages**

- This process requires a specially engineered working area.
  - Additional resource investment is required for a specialized collection system to effectively separate the pellets from the paint chips.
  - Operation of the system requires the use of personal protection equipment for the operator, including a supplied air system.
  - The system is loud and hearing protection must be worn.
- **CO<sub>2</sub> BLASTER (DRY ICE)**

## **Advantages**

- The CO<sub>2</sub> process avoids increasing the amount of waste associated with the paint because the dry ice used to remove the paint dissipates into the air.
- Disposal costs are reduced and the waste is easily collected for disposal.
- The CO<sub>2</sub> blaster will not affect the gel coat on the boat unless blistering has occurred. If blistering has occurred, the air void would be removed during the blasting process and that section of the boat would need to be repaired. This is considered to be advantageous because air voids should be detected and corrected before they develop into a larger problem.

## **Disadvantages**

- Carbon dioxide poses a concern as a greenhouse gas. While no liquid or solid waste beyond the paint chips is generated, this process does result in carbon dioxide emissions being released into the atmosphere.
  - The system is extremely loud (85-130 db) and hearing protection must be worn at all times when the system is operating.
  - The CO<sub>2</sub> blaster is not as powerful as sandblasting and is not quite as good at removing stains.
  - The system must be used in a well-ventilated area. Supplied air equipment may be necessary for the operator.
  - The system requires ordering and storing dry ice and equipment refilling during the blasting operation.
- **ICE BLASTER**

## **Advantages**

- Reduces water consumption from a maximum of 600 gal/hr, generally associated with a water blaster, to 20-25 gal/hr.

- The process allows for the evaporation of most of the water leaving a powdery paint substance that can easily be swept up for proper disposal.
- The machine does not have to be loaded during operation like the CO<sub>2</sub> blaster since it generates its own ice from supplied water.
- There are no specific venting requirements and no need for supplied air equipment for the operator.
- As with the CO<sub>2</sub> blaster, the ice blaster will not affect the gel coat unless blistering has occurred and then the air void will be penetrated during the blasting process and that section of the boat will need to be repaired prior to painting.
- Paint chips and water can be vacuumed up for disposal.
- Reduces airborne dust.

### **Disadvantages**

- Paint removal is accomplished through surface flexing rather than abrasion, which can limit the ability of the ice blaster system to remove some types of paints.
- Generates water waste that mixes with the paint chips, adding to disposal costs or necessitates inclusion of a treatment/separation process.
- The system is loud (95 db) and hearing protection must be worn.

### **2.1.3 CONCLUSIONS AND RECOMMENDATIONS**

In selecting a technology for further evaluation, several factors were assessed in addition to potential environmental impacts. In each case, the technology was also evaluated for ease of use and the costs associated with purchase of the equipment as well as operating costs. This evaluation process resulted in the elimination of two of the technologies and the selection of the third alternative for demonstration purposes.

#### **Eliminated Technologies**

**PLASTIC BLASTER:** Based on the cost of the equipment, the need for significant dedicated space to operate the process, and the need for supplied air, it was concluded that this system is not feasible for most BMRFs.

**CO<sub>2</sub> BLASTER:** This technology was not selected because of the contribution to the problem of greenhouse gases, the inadequacy of the process in removing stains, and the potential problems associated with storing and handling dry ice during blasting operations.

## Selected Technology

ICE BLASTER: Due to the reduced environmental impacts resulting from the utilization of the ICE BLASTER technology, this option was chosen for further evaluation at a BMRF. Discussion about the demonstration and the results can be found in the IMPLEMENTATION AND RESULTS section of this document. While the environmental advantages of this technology outweigh the other processes evaluated in this study, it should be noted that the cost of the ice blaster equipment may make it prohibitive for most BMRFs.

The following table compares the three pollution prevention blasting technologies evaluated in this study to the two technologies used previously in Macomb County.

**Table 2.1: Blasting Technology Comparisons**

	Technologies Used in the Past		Researched Technologies		
	Water	Sand	CO <sub>2</sub>	Ice	Plastic
Purchase Media	No	Yes	Yes	No	Yes
Utility Costs	Electric/Water	Electric	Electric	Electric/Water	Electric
Air Pressure	7,000-60,000 psi	60-100 psi	80-125 psi	150 psi	10-50 psi
Consumption	300-3,000 gal/hr	Reuse	1-10lb/min	20-25 gal/hr	Reuse
Compressor	Yes	Yes	Yes	Yes	Yes 20-50hp
Residual for Disposal	Up to 600 gal/hr water	Sand and Paint	Paint	2-10 gal/hr water and paint	100 cars = 55 gal drum of plastic and paint
Enclosed Blasting Area	No	Varies	No	No	Yes
Noise	Moderate	High	85-130db - High	High	High

## 2.2 DEMONSTRATION AND RESULTS

An ice blasting demonstration was conducted on April 25, 2003 at Blaz Marina in Harrison Township, Macomb County. Those present at the demonstration were representatives from the MCHD, ECT, Universal Ice Blast, Inc. and their engineering firm, a representative from the MDEQ, the Blaz Marina BMRF owner/operator, and representatives from various BMRFs. The boat that was used in the demonstration was a 34-foot fiberglass TollyCraft. The ice blasting demonstration was conducted outside and was completed in one day including setup, blasting, and clean up.

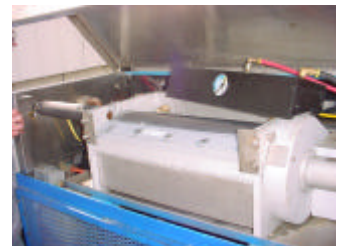
**Set-up** began around 9:00AM and included tarping off the area surrounding the boat so that over spray would not discolor the surrounding boats and the removed paint would be contained in the tarped area.

**Blasting** began around 10:00AM and ended around 3:00PM (this time included a one hour lunch break). The technician that conducted the ice blasting wore a tyvek suit and a face shield to protect his clothes and face. He also wore gloves and boots during the blasting operation.

The vendor noted that the ice blaster can be adjusted to create thicker ice by rotating the drum slower or changing the temperature. Typically the ice created is the size of a grain of rice. Larger ice particles will facilitate better paint removal in areas where the paint is harder to remove. By increasing the pressure of the blaster up to about 150psi, the ice blaster becomes more effective, but at a certain point it levels off and the blasting ability does not increase with increasing pressure.

**Clean up** of the blasting demonstration began around 3:00PM and ended around 5:00PM. Much of the water from the ice blast evaporated on impact or evaporated on the tarps as the blasting was occurring which left a powder looking paint substance that was swept up.

The powdery substance was disposed of in a 55-gallon drum with the liquid waste that was created. Because the waste is not a hazardous waste under the Resource Conservation and Recovery Act (RCRA) as noted in Table 2.2, it could have been disposed as part of the general dumpster waste as long as it did not have "free liquids." Approximately 18-20 gallons of a water/paint mix (some of which was in frozen chunks) was collected on the tarps and was vacuumed up with a shop-vac during and after the demonstration.



## 2.2.1 OBSERVATIONS

During the demonstration, an ice blasting survey was given to the observers of the demonstration. This survey included the following questions:

- What are your current methods of paint stripping?
- Does the ice blasting process create less airborne matter/dust compared to your current method?
- Do the paint chips that are removed from the boat collect on the tarps?
- How effective was the ice blaster compared to your present method?

The demonstration surveys filled out by BMRF owners/operators indicated that the existing paint removal practices used in the Macomb County area included chipping, scraping, sanding, and sand blasting. Compared to existing practices, ice blasting would create LESS airborne matter and dust and is just as effective. All agreed that the tarping also did a fine job of collecting the excess water and paint chips that were removed from the boat. When compared to sandblasting, less waste was created, but observers mentioned that sandblasting might be a faster operation, as the sand is more abrasive than the ice. Also, the paint above the water line of the boat was more difficult to remove and therefore took more time and effort. Overall, the BMRF owners/operators believed that the ice blast system seemed to do the job at an equivalent level to chipping, scraping, sanding, and sand blasting. It also proved to be quicker than all the other methods evaluated with the exception of sandblasting.

## 2.2.2 ANALYSIS OF THE WASTE PRODUCT

The waste from the blasting demonstration was sent to a lab for testing of the eight RCRA metals and copper so that it could be properly disposed of. The results of the testing are listed in the following table.

**Table 2.2 Laboratory Analysis Results for Total Metals**

<b>Metal</b>	<b>Level in parts per million (ppm)</b>
Arsenic	=0.005
Barium	=1.0
Cadmium	0.015
Chrome, TOT.	=0.050
Copper	8.0
Lead	0.034
Mercury	=0.0002
Selenium	=0.005
Silver	0.003

=: Less than or equal: Indicates that the metal was not detected or was below the detectable limit.

The metal analysis determined that there was copper in the paint that would likely impair nearby sediments if allowed to be directly discharged. Since copper has no regulatory limit under RCRA, the material was determined to be non-hazardous. The waste fluid was hauled off by

Macomb County's contracted waste hauler and was transferred to Dupont in New Jersey where it will be managed as a low heat energy wastewater. Any metals that exist in the wastewater will be stripped and the water will be discharged to the local wastewater treatment plant.

In discussions with the Michigan Department of Environmental Quality (MDEQ), it was determined that the ice blasting waste could be solidified and disposed of in a dumpster as long as that waste did not exceed 220lbs/month. Above 220lbs/month, the waste would be regulated under the Natural Resources and Environmental Protection Act. If the fluid is kept in liquid form, it would be handled as a non-hazardous liquid waste. The disposal facility would require an annual waste approval including analytical results.

## 2.3 COST COMPARISONS

**Table 2.3: Costs Associated With Each Of The Alternative Technologies**

	<b>Equipment Costs</b>	<b>Operating Costs</b>	<b>Disposal Costs</b>
<b>Vacuum Sanding</b>	\$1,000	Small amount- electricity	Depending on waste volume generated*
<b>Sand Blasting</b>	\$10,000	\$30 total - media cost, gasoline	Depending on waste volume generated*
<b>CO<sub>2</sub> Blasting</b>	\$33,000	\$59.12/hr – dry ice, electricity	Depending on waste volume generated*
<b>Ice Blasting</b>	\$70,000	\$3/hr – water and electricity	\$240 per year for analytical and between \$.10 and \$1.00 per gallon for disposal in liquid form. No cost if solidified and disposed of.

Notes: The sand blasting and CO<sub>2</sub> blasting equipment prices include a compressor.

The Ice blasting equipment can be plugged into an electrical socket to run, or a generator if no electricity is available. This price does not include a generator.

A complete self-contained ice blasting truck can cost upwards of \$140,000 with blaster, tarps, and generator.

\*Anticipated disposal method is with other solid waste generated at facility.

## 2.4 SUMMARY

### 2.4.1 COMPARABLE PERFORMANCE AND QUALITY

The demonstration showed that the quality of the paint removal operation with the ice blast system was as effective as chipping, scraping, sanding, and sand blasting and quicker than all of the methods mentioned except sand blasting. Discussions with BMRF operators and owners and the demonstration survey results indicated that the ice-blaster compared fairly well to other techniques of removing bottom paint from boats.

### 2.4.2 REDUCED WASTE

The ice blasting technique creates less particulate matter and waste as compared to the sand blasting technique that is currently used by some BMRFs. The need for additional sanding is



eliminated because the ice blasting method leaves a surface that allows for a strong bond between the paint and the hull.

Chemical stripping, although used seldom is also a method still in place. Ice blasting eliminates the need for chemicals in the stripping process and all of the rags and towels that are used and disposed of with chemical residue. Since this process does not use any chemicals for stripping, it also eliminates the possibility of a chemical spill that may enter the waterway. In comparison with scraping and sanding, the ice-blasting technique generates no waste sand paper and also often eliminates the steps of washing the boat with acetone before and after the scraping and sanding. According to Universal Ice Blast, acetone wash is not necessary after blasting, but Blaz marina did acetone wash prior to applying paint. The ice blasting process is much quicker and does reduce waste in many ways. The following table identifies the waste streams that would be reduced or eliminated if the ice blasting process is used.

**Table 2.4: Waste Streams that would be Reduced or Eliminated by Ice Blasting**

	Waste Streams			
	Particulates	Towels, Clothes, Sand Paper	Chemicals/Acetone Wash	Bulk Waste
Sanding	Yes	Yes	Usually	No
Scraping	Yes	Yes	Usually	No
Chemical Stripping	No	Yes	Yes	No
Sand Blasting	Yes	No	Usually	Yes

## 2.5 RECOMMENDATIONS

Overall, the ice blasting process seems to result in the least amount of negative environmental impacts when performed properly. Steps must be taken to ensure that any residual water and paint chips are properly contained until disposal. While buying equipment may be cost prohibitive, renting an ice blasting system may be a more cost effective approach. Hiring a contractor specializing in paint removal using the ice blasting technique may be the most effective approach. It also provides added benefits.

- The volume of work would justify the cost of the equipment.
- The ice-blasting equipment would replace sandblasting equipment that is currently used by contractors.
- Experience and efficiencies can be inherent in the process when “specialized” contractors complete the work.

## 3.0 PARTS CLEANING

This part of the study reviewed the use of solvents in parts cleaning operations. Environmental impacts from the solvents used include the release of volatile organics to the atmosphere and a source of potential contamination to soil, groundwater and surface water. For that reason, this study focused on evaluation of a non-solvent based process for washing parts.

### 3.1 RESEARCH

#### 3.1.1 CURRENT PRACTICES

Almost all maintenance operations at BMRFs involve parts cleaning. Historically, solvents have been used for parts washing. Solvents are very volatile, have a low flash point, and the liquid waste is a regulated hazardous waste. The solvents in use can be either petroleum based (benzene, toluene, xylene), or mineral spirits (naphtha based). The environmental problems inherent with either of these systems are addressed through pollution prevention in the same manner. Parts washers currently in place at many BMRFs in Macomb County recirculate a liquid solvent that must be disposed of after about 300



hours. Most of this material is returned to a supplier, cleaned, and then recycled back to the users. There is a relatively new solvent-based system on the market that cleans and refines the solvent at the parts washer and recycles the “cleaned” solvent back to the parts washer. The system heats the solvent and recovers the vapors in a condenser system, returning the liquid to the parts cleaner and storing the residue in the solvent recovery unit. Periodic removal of the residue from the solvent cleaning operation is required. This residue must be disposed of as a hazardous waste. New solvent is also added to the system to bring it back up to the correct operational level.

The parts washers currently in use can have an impact on the air environment in the immediate working area. Additionally, they can have a longer-term impact on the environment from release of volatile organics to the atmosphere and the need for periodic disposal of solvents and by-products. California has banned the use of solvent-based parts cleaners and compelled the industry to change to aqueous based products or other non-volatile cleaners.

#### 3.1.2 ALTERNATIVE TECHNOLOGY

The aqueous-based parts washer system investigated under this project is a technology by ChemFree Corporation called the “SmartWasher.” The SmartWasher uses a “bioremediating” process that accelerates the breakdown of organic compounds through the use of enzymes, bacteria, or fungi.

The SmartWasher uses a microbe impregnated mat (OzzyMat), and an aqueous-based degreasing fluid (OzzyJuice) to clean dirty parts. When the OzzyJuice passes through the OzzyMat, it activates the dormant microbes in the OzzyMat. The microbes and the OzzyJuice solution are contained in the heated base of the SmartWasher where they thrive and multiply once they're activated. The microbes in the OzzyMat are living components in the SmartWasher system and are a specialized blend of cultures selected and created to degrade a wide range of organic wastes. The eight strains of microbes that are present in the OzzyMat are classified as American Type Culture Collection (ATCC) Class I. Organisms in this classification have no recognized hazard potential under ordinary conditions of handling and are therefore subject to unrestricted distribution.



The hydrocarbon-eating microbes present in the SmartWasher are mixed with catalysts and nutrients and then introduced into the petroleum-contaminated water as the cleaning stream passes through the OzzyMat. The microbes then bond to the petroleum molecules and start to discharge enzymes which break down the hydrocarbon structures into a more water soluble and digestible material that is absorbed through the cell wall where it is digested further. The catalysts mixed with the microbes aid in the organism's rate of digestion and reproduction. The bioremediation materials continue to reproduce exponentially throughout the contaminated water until all of the hydrocarbons are consumed. Once all of the hydrocarbons are consumed, the end result is a "clean" fluid with water and carbon dioxide remaining from the digested hydrocarbons.



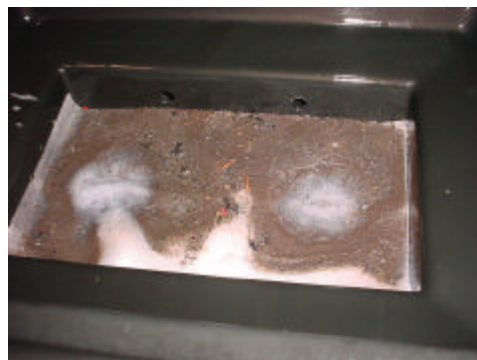
### Advantages

- Unlike traditional parts cleaners, the Smart Washer does not use petroleum-based solvents/chemicals to remove greasy residue.
- The fluid in the SmartWasher does not need to be changed which virtually eliminates hazardous waste and also eliminates the need to contract with hazardous waste removal agencies, alleviating "cradle to grave" liability.
- The OzzyJuice is VOC-free, pH-neutral, and has been considered safe for the employees who are in constant contact with it.

### Disadvantages

- The SmartWasher needs to be kept at a constant temperature of 105°F.
- The OzzyMat needs to be changed approximately once a month.

- About 5 gallons of OzzyJuice needs to be added approximately every month and a half, depending on the use of the SmartWasher.
- Different types of OzzyJuice work differently on various greases and oils.



The following table provides a comparison between the traditional solvent-based parts washer, the solvent recirculating system and the non-solvent based process.

**Table 3.1: Parts Cleaning Technology Comparisons**

	Technologies	
	Safety Kleen Recirculating Washer	SmartWasher
Recycle	97% - liquid turned 3% - burned for energy	100% - reused in parts washer
Waste hauled off	From once a week to once a year	Never – unless emptying parts washer
Fluid Necessary	15 gallons solvent	20-25 gallons OzzyJuice

### 3.2 DEMONSTRATION AND RESULTS

#### 3.2.1 SET-UP

Two SmartWashers from the ChemFree Corporation were installed on November 18, 2002 at Sommers Marine in Harrison Township, Macomb County. Set-up was considered minimal by the BMRF. All that was needed to set up the system was to remove the SmartWashers from the box, put them in place, add the OzzyJuice and OzzyMat to the units, plug them into an outlet, and attach the lights. Then, the units were allowed to heat to the required 105° for the duration of its operation. One of the SmartWashers that ChemFree provided was a manual control washer and the other was an electronic control parts washer. After allowing time for the SmartWasher to heat up and activate the microbes, the unit was ready for operation.

#### 3.2.2 OBSERVATIONS

Overall, the BMRF owner that used this technology in a side-by-side comparison for 6-months stated that the SmartWasher takes about the same amount of time to clean parts as their old solvent based washer. He also stated that the SmartWasher is very good at cleaning pistons and engines. It was less effective than the current system at removing cutting oil from parts.



The BMRF owner also reported that in many cases parts could be painted immediately after being cleaned with the SmartWasher without the intermediate step often needed following the use of the traditional solvent based washer.

He also mentioned that the OzzyJuice is very easy on hands and is cleaner to operate since there is no liquid waste. Waste generation was limited to the OzzyMat that needs to be disposed of once a month in the regular trash. The old parts washer they were using required that the liquid be replaced twice a month and disposed of in accordance with state and federal regulations.

Contrary to the perspective of the BMRF owner, one employee at this facility had constant problems with a rash occurring after using the SmartWasher. It also made his hands dry and crack and caused stinging in his cuts. A ChemFree representative noted that medical examinations of a few other people who experienced similar reactions found that the rash and burning sensations experienced are not from the aqueous OzzyJuice but are caused by the oil and grease removed by the OzzyJuice. ChemFree has stated that there are more than 300,000 individuals currently using the SmartWasher system and they have received only two reports of transient rashes on the arms of users not using gloves. It is always recommended that all employees using any part washing system should wear gloves.

### 3.3 COST ANALYSIS

Sommers Marine can use their current solvent-based parts washer for 300 hours before having it pumped out. They also have their tanks changed twice a year. The following costs are averaged.

**Table 3.2: Costs Comparison Between the Solvent-based System and the SmartWasher**

	<b>Equipment Costs</b>	<b>Fluid Cost</b>	<b>Pads</b>	<b>Pad Cost</b>	<b>Disposal</b>
<b>Solvent Based Parts Washer</b>	<b>\$1,000-\$2,000</b>	<b>\$27-\$32/5-gal</b>	<b>1/mo.</b>	<b>Varies</b>	<b>\$75-\$110/55-gal</b>
<b>SmartWasher</b>	<b>\$1,780</b>	<b>\$85/ 5-gal</b>	<b>1/mo.</b>	<b>\$9.95</b>	<b>None</b>

The cost of the SmartWasher equipment is very comparable to the solvent-based parts cleaner system. The area where an increased price will occur is with the fluid and pad cost. Some solvent-based washers also include pads, so in that case, the pad would not be an additional price.

The fluid cost for the SmartWasher is approximately \$55 more for a 5-gallon container. This increased cost will be recovered for the SmartWasher fluid if the BMRF typically disposes of four to six 55-gallon drums of solvents in a year. If the current solvent-based system does not utilize disposable pads, then the cost recovery would be achieved after the disposal of five to eight 55-gallon drums of solvent in a year. This cost recovery could vary further in relationship to fluctuating disposal costs.

### 3.4 SUMMARY

Overall, the side-by-side demonstration of the SmartWasher and the traditional solvent-based parts washers at Sommers Marine in Harrison Township resulted in a very positive outcome for this alternative technology. The SmartWasher will virtually eliminate hazardous waste disposal requirements and disposal costs from the parts washing equation. Furthermore, it will also eliminate the concern for a chemical spill or leakage since it uses non-hazardous biotechnology

instead of hazardous solvents. The only part of this system that requires periodic disposal is the OzzyMat, and this mat is not considered a hazardous waste.

From discussions with the workers and owner at Sommers Marine, it was summarized that the SmartWasher works well on pistons and engines but had a harder time removing cutting oil from parts. ChemFree Corporation when posed with this question responded with a list of different OzzyJuices that could be substituted as alternatives. These different types of OzzyJuice work differently on various greases and oils. The OzzyJuice varieties include: degreasing solution, heavy grease degreasing solution, truck grade degreasing solution, select metals degreasing solution, and even aircraft & weapons degreasing solution. Each type of solution has a rating of either fair, good, or excellent, depending on how well it cleans different substances such as: motor oil, bearing grease, impacted grease, cutting oils, etc.

The truck-grade degreasing solution that was used in the SmartWasher at Sommers Marine is not formulated to maximize the removal of cutting oils. On the comparison chart provided by the vendor, this formula of solution is rated as “good” for removing cutting oils. By changing to the solution specially formulated for degreasing, the rating is listed as “excellent”. Care must be taken when changing solutions because the solutions target different pollutants.

When purchasing a SmartWasher, it is important to discuss the specific parts washing needs with a ChemFree representative to determine which OzzyJuice is best for the application. Mixing different OzzyJuice solutions together will not increase the cleaning ability, but in fact, may completely neutralize one of the microorganisms.

### **3.5 RECOMMENDATIONS**

The ChemFree SmartWasher and other bio-remediating parts washers are a great way to decrease the production of hazardous waste. While the OzzyJuice and OzzyMats are more expensive than solvent and pads for other types of parts washers, the savings in disposal costs and manifesting can offset the increased cost of these materials. The environmental benefits seem to far outweigh the costs.



## 4.0 OIL FILTER CRUSHER

The third, and final practice evaluated by this study is the handling and disposal of used oil filters that still contain oil. This residual oil poses a hazard to soil, groundwater and surface water if it is allowed to drain from the filter without adequate containment and collection. The technology evaluated under this portion of the study crushes used oil filters, collects the residual oil so that it can be recycled and, thereby, reduces the volume of waste to be disposed of.

### 4.1 RESEARCH

#### 4.1.1 CURRENT PRACTICES

Oil filters from boats should be changed at least twice a year, once in the spring and once in the fall. Oil filters removed from boats at BMRFs are usually drained for a day or two and then placed in drums for disposal. In some cases, undrained or drained filters are mixed in with the general trash in the facility dumpster.

The oil that is drained from the filters into various containment vessels is recycled, but some oil is still left in the uncrushed filter when it is placed in a drum for disposal. Waste oil from these filters typically has high metal content and could therefore be classified as a hazardous waste. However, oil that is recycled is generally exempt from hazardous waste regulations.

Very few BMRFs in Macomb County have oil filter crushers. One specific BMRF has had their crusher for many years and in order to collect used filters from the marina boaters, the BMRF puts out a dock box for the boaters to place used oil filters and a milk jug for people to deposit the used oil. A contractor then transports the crushed oil filters and oil for disposal.



#### 4.1.2 RESEARCHED TECHNOLOGY.

Implementing an oil filter crusher reduces waste by increasing the amount of oil that can be captured and recycled and by reducing the number of drums of filters generated for disposal, in turn reducing hauling and manifesting costs. The crushed filters can also be recycled at a facility in Jackson, Michigan rather than being disposed of at a landfill operation.

#### Advantages

- Drains up to 95 percent of free flowing liquids contained in the filter.
- Reduces waste volume by approximately 80 percent.

## Disadvantages

- A minimal increase in labor time is needed to operate the crusher

## 4.2 DEMONSTRATION AND RESULTS

### 4.2.1 SET-UP

An OBERG International oil filter crusher model P-110WM was installed at Beacon Marine BMRF in March, 2003 for a 4-months trial period. Beacon Marine used a hi-lo to move the 360 lb. crusher into place and they installed a frame system to hold the filter crusher.



### 4.2.2 OBSERVATIONS

In the first two weeks Beacon Marine had already crushed 30-40 oil filters, which uncrushed, would have almost filled up a 55-gallon drum. There is approximately a 4:1 ratio on crushed filters to uncrushed filters and therefore the crushed filters only filled up about one quarter of a 55-gallon drum. Beacon Marine mentioned that they would be able to haul off one 55-gallon drum a year instead of three with the oil filter crusher. The P-110WM crusher was also able to crush up to six regular filters at a time and was also able to crush diesel filters.



The oil that is recovered when crushing takes place tends to be about 1-2 ounces when the filter has been draining for three or four days. This may not seem like much, but it tends to add up when many filters have been crushed. Also, some BMRFs may not take the time to drain filters for 3-4 days and therefore the amount of oil recovered is much greater. The crusher allows more oil to be recycled

instead of disposal and also allows the metal from the filter to be recycled. Huco Inc., a facility in Jackson Michigan accepts crushed filters from Macomb County BMRFs for metal recycling. They charge approximately \$80 for a 55-gallon drum of crushed filters. This price will cover the trucking, manifesting, recycling, and disposal. Huco Inc. recovers any leftover oil in the crushed filters and also recovers the metal which is turned into a low grade steel which can be used for materials such as hangers and rebar. This is an excellent alternative for crushed filters instead of just disposal.

## 4.3 COST ANALYSIS

Approximately 150 crushed filters can fit into a 55 gallon drum compared to 35 uncrushed filters. It costs from \$75-\$150/drum to have hauled off depending on the company regardless of how many filters are in the drum. The following table compares the drum disposal and delivery costs of Beacon Marine, the location of the oil filter crusher implementation.



**Table 4.1: Cost Comparisons – Crushed Versus Uncrushed Oil Filters**

	<b>Equipment Costs</b>	<b>Drum Disposal Costs</b>	<b>Drum Delivery Costs</b>	<b>Drums per Year</b>	<b>Return on Investment</b>
<b>Uncrushed Filters</b>	–	\$100/drum	\$70/drum	3	-
<b>Crushed Filters</b>	\$1965	\$100/drum	\$70/drum	1	5.7 yrs

Using the figures from the table above, if Beacon Marine had paid full price for the oil filter crusher, they would recover their costs in approximately 5.7 years. After the 5.7 years, the money saved from disposal costs is profit, minus minimal maintenance costs for the equipment. The Return on Investment would vary depending on the amount of oil filters that the BMRF receives in a given season. An oil filter crusher may be more feasible for a larger BMRF. For example, a much larger operation in the same general geographic area recovered the purchase and set-up costs of their crusher in one season because of the number of oil filters they receive and the amount of money they saved on disposal costs.

#### **4.4 SUMMARY**

An Oil Filter Crusher implemented at BMRFs will assist with pollution prevention in a few different ways. It will increase the amount of oil recovered and the amount of oil that can be recycled from oil filters when they are removed from boats. It will reduce the volume of waste to be disposed of and it will also provide the opportunity for the metal from the filters to be recovered and recycled.

#### **4.5 RECOMMENDATIONS**

Overall, oil filter crushers are an excellent idea for BMRFs. The environmental benefits far outweigh the costs of the crusher, and those costs can be recovered within a few years, depending on the amount of filters disposed of each year and the disposal costs. All BMRFs will eventually recover the costs for the crusher and will then reap the benefits in profit.

## 5.0 BEST MANAGEMENT PRACTICES (BMPs)

All Michigan businesses are required to abide by environmental regulations in their everyday business practices. BMRFs (which may also include marinas) have an even more important role since their daily operations bring them in contact with Michigan's waterways. A significant level of attention and commitment to preserving water quality is essential.

One of the best methods of pollution prevention is education of the boat repair personnel and the watercraft owners/operators so that they will think about the environmental consequences to their current practices. These practices are divided into two basic groups; chemical management and operational practices. The business practices of the BMRF industry were reviewed and those practices deemed to be most environmentally friendly were summarized in this chapter.

Pollution prevention and best management practices often save businesses money while at the same time improving the environment. Many options including alternative solvents and chemicals to promote pollution prevention at boat maintenance and repair facilities and marinas.

### 5.1 SOLVENTS/CHEMICALS – “GREEN MATERIALS”

Many marine maintenance products on the market today may have unintended environmentally harmful “side effects”. While the use of these products on one boat may appear to be insignificant, when multiplied by the thousands who recreate on Macomb County waterways, the overall environmental impact can be tremendous.

Both BMRFs and their customers can do their part by purchasing and using less toxic and more environmentally friendly products. In addition to being environmentally friendly, many alternative cleaning products clean for a fraction of the cost. Some good advice to follow would be to avoid purchasing and using marine maintenance products with the following warnings:

- Flammable
- Poisonous
- Corrosive
- Toxic



Carefully read product labels, and avoid using products that do not list the ingredients. Also, avoiding the following will help to prevent contaminating our lakes and rivers.

- Avoid anti-fouling paints containing copper, mercury, arsenic or TBT.
- Avoid cleaners that emulsify or contain phosphates, ammonia, chlorine, caustic soda, surfactants or potassium hydroxide.
- Avoid in-water hull cleaning.
- Avoid detergents and degreasers to clean the bilge.

Products containing toxic ingredients such as degreasers will dry the natural oil that fish need for their gills to take in oxygen. A good rule of thumb to follow is if the product is hazardous to human health, it is likely hazardous to the environment. It is also a good practice to do the following:

- Purchase only as much environmentally friendly cleaning products as needed.
- Share any leftover products with other boaters.
- Never rinse or drain any cleaning products overboard.



## 5.2 OTHER BMPs

### **Boat Cleaning**

- Pressure cleaning to rinse-off a boat that has been removed from the water should be restricted to an area with an impermeable surface and with a dike or pitch which allows the wastewater to be collected and directed into a tank or other containment device.
- Do not discharge wastewater from pressure washing into surface waters.
- Steam cleaning should be done on an impervious surface that will be able to collect and contain the cleaning effluent. Do not allow discharges to surface waters.
- When washing above the water line, use detergents and cleaning compounds that are biodegradable and keep amounts to a minimum.

### **Painting**

- Keep track of your inventory so that a minimum quantity of solvents and paints are stored on-site.
- Always store paints, solvents, and rags in covered containers to prevent evaporation.
- Use high transfer efficiency coating techniques (i.e. brushing and rolling) to reduce over spray and solvent emissions.
- When spraying paint, do so over an impermeable surface with a drop cloth or plastic sheeting and make sure over spray does not end up on open ground or surface waters.
- Use less toxic paint (water based instead of solvent based).

### **Paint Removal**

- Use alternative paint removal methods.
- Removing bottom paint through a sanding or scraping method produces a sanding dust that can contain potentially hazardous metals. Sanding should be done over an impervious surface with some type of drop cloth or plastic sheeting to catch the paint remnants.
- Use a retainment device so that the dust and paint can be vacuumed or swept up and properly disposed of.
- Dust should not be allowed to become wind-borne or leave the de-painting area.
- Use methods that reduce dust and waste.

### **Paints, waste diesel, kerosene and mineral spirits**

- Always store these products in leak-free containers on impermeable surfaces and under the protection of cover to prevent stormwater contamination.
- Label each container clearly with its contents.
- A licensed waste transporter should perform disposal of waste from these materials.

- Share leftover paint and varnish.

### **Wastewater/Liquid Wastes**

- Wastewater should not be discharged into any sewer that is designated as a “stormwater” sewer, or allowed to flow directly into surface waters.
- Do not discharge any liquid wastes into storm sewer, sanitary sewer, open ground, or surface waters unless it is a permitted discharge.
- Handle liquid waste products with care.

### **Storage of Engines and Parts**

- Store parts and engines on impervious surfaces in a manner in which any leaking fluids will not come in contact with stormwater.
- Care should be taken to prevent oil and grease from leaking onto the open ground.

### **New and waste oil** (engine oil, transmission fluid, hydraulic oil, gear oil)

- Store under cover on an impervious surface and in a clearly marked leak-free container.
- Avoid stormwater contact with container.
- Containers that are found to be leaking should be emptied as soon as detected.

### **Oil or fuel filters**

- Oil and fuel filters should be drained and then crushed before disposal.
- Recycle oil.
- When possible, drained filters should be recycled.
- Only filters that have been drained or crushed to remove all excess oil can be disposed of as solid waste.
- Use a dipstick oil change pump to remove oil from engines

### **Waste gasoline**

- Store in a covered area and on an impermeable surface.
- Store in a leak-free container that is clearly labeled “waste gasoline”.
- Whenever possible, filter the waste gasoline and use as fuel.
- Do not allow waste gasoline to evaporate.
- Do not pour waste gasoline on ground, in storm sewers, or surface waters.
- Remove waste from the site by a licensed waste transporter.

### **Petroleum products**

- Do not discharge into storm drain, sanitary sewer or onto the open ground or surface waters.
- Clean up spills promptly.
- Maintain a supply of petroleum absorbent material and “spill-dry” in readily accessible locations.

### **Oil, fuel, and grease spills on land**

- Oil or fuel from a spill should be collected and placed into the waste container.
- Absorb oil or fuel residues with “spill-dry” or similar product and dispose of by a permitted waste transporter.

- If spill contains gasoline, aerate absorbent material thoroughly before disposing to remove vapors.
- Follow spill-reporting requirements.
- Staff should have proper training to deal with spills.

### **Solvents/Chemicals**

- Use solvents with low volatility and coatings with low Volatile Organic Compounds.
- Store in covered containers to prevent evaporation.
- These materials should be treated as a hazardous waste and disposed of by a licensed waste hauler.

### **Antifreeze**

- Store in a clearly marked container under cover and on an impervious surface.
- Reuse and recycle antifreeze whenever possible.
- Use biodegradable antifreeze.
- Do not dispose of down storm drain.

### **Used Lead-Acid batteries**

- Store under cover on an impervious surface.
- Protect from freezing and have picked up by an approved transporter for recycle.

### **Glue and adhesives**

- Residual amounts of glues and adhesives remaining in empty caulking tubes may be disposed of as solid waste.
- All other glue and adhesive related wastes must undergo a determination for hazardous waste characteristics.
- Nonhazardous glues and adhesives in liquid form cannot be disposed of as solid waste, and should be used for their originally intended purpose.

### **Oil and fuel spills on water**

- Keep a floating containment boom large enough to enclose the spill area (minimum length of 40').
- Keep absorbent materials on hand to absorb spills on surface water.
- Follow spill-reporting requirements.
- Staff should have proper training to deal with spills.

### **Fueling**

- When fueling occurs, make sure to properly supervise the operations.
- Make sure all automatic shutoff devices are operating correctly.
- Avoid spills, but when spills occur, clean up promptly.

### **Petroleum control**

- Use oil absorbent pads when doing maintenance work.
- Use an approved container to capture fuel-vent overflows.
- Place bioremediating materials in bilge to control oil accumulations.

- Use Bio-socks or Smart Sponge to collect petroleum/oil in bilge.
- Use Bio-booms to collect oil that leaks from motors as they are started.

### **Regulation**

- Obtain a stormwater permit and develop a stormwater pollution prevention plan.

A Boat Maintenance and Repair Facility Checklist is available in Appendix A for use in assessing BMRF operations. It will assist the BMRF owner/operator in determining which areas can be improved upon.

## 6.0 PROJECT SUMMARY

Because of the close proximity of Boat Maintenance and Repair Facilities (BMRFs) to surface waters, these facilities can potentially have a large effect on water and sediment quality in their area. Even small BMRFs may have a relatively large impact on the surface water environment surrounding the facility. BMRFs and boatyards are known sources of organic chemicals and heavy metals. Implementing the technologies and BMPs discussed in this pollution prevention guidance can reduce substances such as copper, which has historically been part of anti-fouling hull paint, and organic chemicals found in oils, paints, cleaners, solvents, and other boat related products.

This project investigated technologies that could be implemented in the areas of paint removal, parts cleaning, and oil filter handling to reduce waste generated during these operations. Increased reuse of cleaning solution is practiced in the technology suggested for parts cleaning. Reduction of dust and waste is practiced in the technology suggested for paint removal, and use of the oil filter crusher technology results in additional oil recycling, as well as oil filter recycling.



The three technologies that were implemented or demonstrated at BMRFs were:

- Ice Blaster for boat paint removal
- SmartWasher for parts cleaning
- Oil Filter Crusher for oil filter handling

The Ice Blaster uses a high-pressure ice stream to remove paint from boat hulls. The system is environmentally friendly and is as effective as other methods currently in use. The waste materials generated:

- Are significantly less than by other methods currently in use
- Are generally non-hazardous and can be easily handled for disposal



The SmartWasher uses an aqueous based bioremediating cleaning solution to replace the solvent-based solution currently in use in many parts washers. The system:

- Eliminates the emission of volatile organic chemicals (VOCs)
- Eliminates the generation of used cleaning solvent that needs to be disposed of as a hazardous material
- Reuses, rather than wasting, all the cleaning solution in the system



The use of an oil filter crusher at BMRFs:

- Increases the amount of oil available for recycle
- Allows for recycling of the used oil filters
- Decreases the volume of solid waste from the used oil filters

Implementation of the BMPs in section five of this document will also assist in pollution prevention through:

- The use of less toxic and more environmentally friendly maintenance products
- The use of materials to eliminate generation of liquid wastes during fueling and maintenance activities
- The use of environmentally sound practices for operation and maintenance of watercraft

One of the best methods of pollution prevention is education of the boat repair personnel and the watercraft owners/operators so that they will think about environmental consequences to their current practices. Implementation of the technologies and BMPs recommended in this document will result in this increased awareness and education.

Pollution prevention at BMRFs will significantly improve water quality throughout Macomb County. The technologies and BMPs recommended as a result of this project will not eliminate the contaminated sediments in Macomb County. They will however definitely help eliminate additional contamination from occurring in the future through waste reduction, reuse, and recycle.



## 7.0 REFERENCES

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- [www.jclayton.com](http://www.jclayton.com) - Clayton dustless sanders.

**APPENDIX A**

**BOAT MAINTENANCE AND REPAIR  
FACILITY CHECKLIST**