INVESTIGATION OF WASTE RAG GENERATION AT NAVAL STATION MAYPORT

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FOREWORD

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This publication has been produced as part of the Laboratory's strategic long-term research plan. It is published and made available by EPA's Office of Research and Development to assist the user community and to link researchers with their clients.

E. Timothy Oppelt, Director
National Risk Management Research Laboratory

ABSTRACT

This report presents the results of an investigation examining pollution prevention alternatives for reducing the volume of waste rags generated at Naval Station Mayport, located near Jacksonville Beach, Florida. Hazardous and non-hazardous waste rags are generated as a result of maintenance and repair operations that take place at various shore-based Commands and onboard ships which frequent the Naval Station.

Five specific pollution prevention alternatives that should be considered for implementation by the Naval Station to reduce or prevent the generation of waste rags:

1. Better operating practices;
2. Installation of equipment cleaning stations to remove contaminants normally removed with rags;
3. Replacement of SERV MART rags with disposable wipers;
4. Use of recyclable rags for oil and grease removal; and
5. Confirmation that used rags are fully contaminated prior to disposal.

Implementation of these alternatives is anticipated to significantly reduce the volume of waste rags generated by the Naval Station. Alternatives 1 and 5 require no additional capital investment, but generate a reduction in waste. Alternatives 3 and 4 were estimated to generate a net cost savings to the Station, if implemented, in addition to reducing waste. Use of disposable wipers is somewhat more attractive from a cost perspective than recycling of non-hazardous waste rags, however. Alternative 2 is only recommended for high volume rag use areas. Each alternative is a proven technology that has already been implemented by at least one Command at the Naval Station.

This report was submitted in fulfillment of Contract Number 68-D2-00062 by Southern Research Corporation and Pacific Environmental Services, Inc. under the sponsorship of the U.S. Environmental Protection Agency. This report covers a period from 7/27/94 to 9/30/94; work was completed as of 9/30/94.

TABLE OF CONTENTS

LIST OF TABLES

1.0 EXECUTIVE SUMMARY

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The report recommends five specific pollution prevention alternatives that should be considered for implementation by the Naval Station to reduce or prevent the generation of waste rags:

1. Better operating practices;
2. Installation of equipment cleaning stations to remove contaminants normally removed with rags;
3. Replacement of SERV MART rags with disposable wipers;
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The five alternatives identified are recommended for implementation because of their potential to reduce pollution as well as the cost savings that they generate. Table 1.1 presents the pollution prevention alternatives identified and the type of rag that is best suited for implementation.

TABLE 1.1: SUMMARY OF POLLUTION PREVENTION ALTERNATIVES FOR WASTE RAG GENERATION

Alternative Identified	Recommended Rag Type	Notes
Implement Better Operating Practices	Both Hazardous and Non-Hazardous	
Use Disposable Wipers	Hazardous	Could also be used for Non-Hazardous
Use Recyclable Rags	Non-Hazardous only	
Dispose of Only Fully Contaminated Rags	Non-Hazardous only	Not recommended for hazardous rags
Install Equipment Cleaning Stations	Non-Hazardous only	Limit to high volume rag use areas

2.0 INTRODUCTION

Since 1988, the Waste Reduction Evaluations at Federal Sites (WREAFS) Program has identified and promoted pollution prevention opportunities at Federal facilities, including the Department of Defense (DoD) facilities in each of the three services and the U.S. Coast Guard Service. Twenty-six on-site pollution prevention opportunity assessments (PPOA) have been conducted by the Risk Reduction Engineering Laboratory (RREL) and DoD through WREAFS, generating over 130 pollution prevention technical options. This project is the latest of a series of pollution prevention studies conducted under WREAFS.

The purposes of this project were to: (1) develop a PPOA for non-aqueous liquid wastes generated by the Public Works Center - Transportation (PWC-T) at Naval Station Mayport and (2) investigate base-wide rag usage at the Naval Station to determine how and where waste rags are generated. The non-aqueous liquid wastes studied were used motor oil, hydraulic fluid, transmission fluid, antifreeze, and waste solvent from the washing of parts at the PWC-T. This report presents the results of the investigation of base-wide rag generation. The results of the PPOA for non-aqueous liquid wastes generated by the PWC-T are included in a companion report entitled "Pollution Prevention Alternatives for Public Works Center (Transportation) Waste Fluids at Naval Station Mayport."

As noted above, this report presents the results of the investigation of base-wide rag generation. Including the executive summary (Chapter 1) and the introduction (Chapter 2), the report contains six chapters. Chapter 3 describes the different types of waste rags and how they are generated, handled, and disposed. Chapter 4 presents pollution prevention alternatives that could be utilized to reduce the generation of both hazardous and non-hazardous waste rags at the Naval Station. The chapter also discusses the benefits and problems created by implementation of each alternative. Chapter 5 discusses the costs and

benefits of the alternatives presented for waste rags. Finally, Chapter 6 summarizes the pollution prevention alternatives considered and recommends selected alternatives for implementation.

3.0 WASTE RAG GENERATION, HANDLING, AND DISPOSAL

The mission of Naval Station Mayport is to provide support services for U.S. Navy ships and helicopters that operate from the Mayport, Florida Naval facility. A significant portion of the Naval Station's mission is to provide maintenance services for the airborne and sea-going vessels stationed at or visiting Mayport as well as hundreds of pieces of equipment that support the aircraft and ships. Support equipment includes automobile and truck fleets, road and light construction equipment, aircraft ground support equipment, and marine support equipment.

As a result of the maintenance activities that are required for the equipment described above, a large volume of hazardous and non-hazardous waste rags are generated. This chapter discusses the types of rags used by the various work centers and Commands at Mayport and provides a summary of the volume of waste rags generated in 1993. The chapter concludes with a discussion of how waste rags are handled and disposed.

3.1 Types of Rags Used

There are three types of rags that are currently in use at the Naval Station. The most prevalent type of rags used are those that are purchased through SERV MART, the supply organization for the Base. Rags are purchased in either 25 pound or 50 pound bales (National Stock #7920-00-205-1711). A 25 pound bale costs $22.08 and contains about 150 rags. An inspection of several bales found the rags consist primarily of discarded synthetic clothing (e.g., polyester pants, cotton/polyester shirts, etc.) cut into pieces, of varying dimension and thickness. The general consensus from on-site Commands was negative concerning the absorptivity of oil and grease by these wiping rags.

The second type of wipe rags used at the Naval Station are commercially manufactured paper and special synthetic fiber disposable wipers. These are specifically manufactured to absorb oil and grease. Disposable wipers are available in several sizes and are manufactured to satisfy general and special purpose requirements. For example, lint-free rags are purchased specifically for maintenance activities associated with hydraulic systems, which are very sensitive to contamination.

The third type of rags used at the Naval Station are recyclable rags. These are cotton rags designed specifically for oil and grease wiping and cleanup. They are commercially washed in industrial strength detergents to remove oil and grease, then reused repeatedly. Currently, two commercial vendors are under contract to provide several Commands (e.g., Ship Intermediate Maintenance Activity (SIMA) and PWC-T) at the Naval Station with recycled rags. Recyclable rags are collected from each activity by the contractor, cleaned, and returned for reuse. Only worn out reusable rags are disposed in landfills. Vendors estimate that a rag can be recycled up to 200 times before it must be replaced. The rags are provided through a commercial launderer at $0.18 per rag. The vendor charges $0.23 for replacing a rag that is lost from the inventory. Recyclable rags missing from the inventory are suspected to have been incorrectly used with a hazardous material and were discarded as hazardous waste.

Table 3.1 reflects the estimated number of pounds of both hazardous and non-hazardous waste rags generated by each Command or activity during calendar year 1993. The data were taken from two sources. First, data on the generation of hazardous waste rags was taken from the 1993 Mayport Hazardous Waste Report[1]. Secondly, non-hazardous rag data was taken from the refuse incinerator records for 1993[2].

The records classify rag amounts in pounds, bags, and drums. To enable reporting in pounds, two conversion factors were assumed . A "bag" of rags was assumed to weigh 10 pounds, while a "drum" of rags was assumed to have a weight of 70 pounds. These assumptions were based on discussions with shop personnel throughout the Naval Station.

TABLE 3.1: 1993 SUMMARY OF HAZARDOUS AND NON-HAZARDOUS RAG USAGE AT NAVAL STATION MAYPORT

Command[a]	1993 Hazardous Rag Waste[b] (pounds per year)	1993 Non-Hazardous Rag Waste[c] (pounds per year)	Total (pounds per year)
AIMD	2,542	3,152	5,694
CBU 420	0	70	70
FTC	219	80	299
Harbor Operations	471	920	1,391
HSL-40[d]	2,116	4,360	6,476
HSL-48[e]	4,576	5,793	10,369
SIMA	1,107	4,076	5,183
USS Aubrey Fitch	519	675	1,194
USS Boone	0	1,670	1,670
USS Dale	207	0	207
USS Doyle	0	40	40
USS Gettysburg	221	100	321
USS Hue City	120	190	310
USS John Hancock	2,212	1,670	3,882
USS McInerney	196	470	666
USS Monterey	0	565	565
USS Montgomery	0	655	655
USS Phillipine Sea	129	200	329
USS Saratoga	11,749	4,743	16,492
USS Spruance	0	990	990
USS Stark	0	370	370
USS Underwood	174	203	377

TABLE 3.1: 1993 SUMMARY OF HAZARDOUS AND NON-HAZARDOUS RAG USAGE AT NAVAL STATION MAYPORT

Command[a]	1993 Hazardous Rag Waste[b] (pounds per year)	1993 Non-Hazardous Rag Waste[c] (pounds per year)	Total (pounds per year)
USS Vicksburg	0	120	120
USS Yosemite	1,366	5,420	6,786
Visiting Ships	3,794	2,708	6,502
Unknown Sources	11,032	4,450	15,482
Totals	42,750	43,690	86,440

[a] AIMD = Aircraft Intermediate Maintenance Depot; CBU 420 = Construction Building 420; FTC = Fleet Training Center; HSL = Helicopter AntiSub Light Squadrons; SIMA = Ship Intermediate Maintenance Activity

[b] 1993 Mayport Hazardous Waste Report

[c] 1993 Mayport refuse incinerator records

[d] Includes HSL-42 waste rag usage

[e] Includes HSL-44 and HSL-46 waste rag usage

Table 3.1 also summarizes the total volume of waste rags generated by each Command during 1993.

Inspection of Table 3.1 revealed several key Commands that contributed to waste rag generation in 1993. Eighty-five percent of the total waste rags generated at Mayport came from three sources: 1) Ships visiting or based at the Naval Station (48 percent); 2) Helicopter Squadron (HSL) activities (19 percent); and 3) "Unknown Sources" (18 percent).

The USS Saratoga dominated the volume of waste rags generated by ships with a total of 16,492 pounds. This represents 40 percent of the volume attributable to ships. The helicopter squadrons generated a total of 16,845 pounds. Note that although the helicopter squadrons generated 19 percent of waste rags on the Base, the majority of them were non-hazardous rags. The waste rags generated from "Unknown Sources" were dominated by hazardous rags. In addition, there are seven ships home-ported at Mayport that have no hazardous rags listed under the ship's name. These ships may represent a large portion of the "Unknown Sources" as a result of personnel using a general hazardous waste activity nomenclature instead of a specific ship name to record the hazardous waste.

The assessment team also queried Base personnel to obtain rough estimates of 1994 waste rag generation based on current work levels at each particular work center. Based on their estimates, SIMA may already have achieved an 85 percent reduction in waste rag disposal due to recycling. SIMA has recently begun using approximately 1,500 commercially provided recyclable rags per week to clean non-hazardous waste from equipment. Their estimate of waste rag generation for 1994 is about 800 pounds versus the 5,183 pounds generated in 1993. SIMA's use of this contracted service may account for such a major reduction. Similarly, the CBU-420 has demonstrated an 87 percent reduction in waste rag generation through recycling. The estimated 1994 waste rag generation is 540 pounds versus the 70 pounds that required disposal in 1993. The 470 pound difference is a result of CBU-420 washing and recycling their 1993 non-hazardous rags at the automobile hobby shop.

3.2 Waste Rag Generation

Rags are typically used for the most simple of cleanup operations. A common use is to remove oil, grease, and hazardous cleaning solvents from equipment during maintenance operations. Rags are also used to wipe and clean up after painting operations. Occasionally rags are used to clean up small spills that occur around activities within a work center (e.g., engine repair). The waste rags are classified as being either "hazardous" or "non-hazardous". Hazardous waste rags are those that have come in contact with a hazardous substance as defined in Mayport's Hazardous Waste Management Plan:

> "Hazardous Substance (HS) - A material included in the specific list of chemicals designated by the EPA in 40 CFR 302 which, because of its quantity, concentration, or physical, chemical, or infectious characteristics, may pose a substantial threat to human health to the environment when discharged to the environment. Reportable quantities are listed in 40 CFR 302.[3]"

Some examples of hazardous materials include, but are not limited to, PD-680, acids, paint strippers, paints, and emulsifiers. Non-hazardous wastes are anything that is not a hazardous waste; typical examples are lubrication oils, greases, and synthetic oils.

Each Command at Naval Station Mayport has one or more work centers that generate waste rags. The activities that generate the waste rag and the types of contaminants vary by Command. The following is a brief discussion of the types of operations that generate waste rags and the contaminants deposited on the rags, listed by Command. In every case, waste rags are generated as specific parts, or the work areas themselves, are wiped or cleaned:

3.2.1 Aircraft Intermediate Maintenance Depot (AIMD)

AIMD provides preventative and intermediate maintenance for the aircraft that operate at the Naval Station. Intermediate maintenance is defined as maintenance activities that are more complicated than preventative maintenance operations (e.g., simple fluid replacements) but not as involved as a complete overhaul of equipment. Some examples include bearing replacement, electric motor winding replacement, and electronic circuit board repair. The work centers located within AIMD are: 1) Air Frames Repair; 2) Support Equipment Repair;

and 3) Aircraft Engine Repair. Activities that generate waste rags within each work center are discussed below:

Air Frames Repair. This work center performs repair and non-destructive testing of aircraft parts. The testing is done to inspect aircraft structural members for defects due to corrosion. The aircraft parts are sent to AIMD for testing and repair from the helicopter squadrons. Contaminants deposited on the rags include machine shop oils, greases, PD-680 (a mineral spirits-based cleanup solvent), emulsifiers, acids, penetrants, oils, and paint strippers.

Support Equipment Repair. This work center maintains and repairs in excess of 700 pieces of ground support equipment used by the helicopter squadrons. The equipment includes, but is not limited to, items such as hydraulic fluid purifiers, air compressors, generators, and blowers. The squadrons turn in the equipment to this work center to receive maintenance. Contaminants deposited on the rags include hydraulic fluid, diesel fuel, grease, synthetic oils, and PD-680.

Aircraft Engine Repair. This work center repairs the gas turbine engines used by the helicopter squadrons. Contaminants deposited on the rags include lubrication oil, synthetic oil, high temperature grease, sealants, and paint stripper.

3.2.2 Construction Battalion 420 (CBU-420)

CBU-420's current mission is to support a field hospital. Rags are generated by the equipment repair and maintenance work center, which services battalion support equipment. This equipment includes, but in not limited to, concrete mixers, vehicles, small portable generators, and pumps. Contaminants deposited on the rags generated by this work center include lubrication oil, hydraulic fluid, and grease.

3.2.3 Fleet Training Center (FTC)

The FTC provides training to assist military personnel in learning the maintenance procedures that are used by the different Commands and work centers at the Naval Station. Rags are generated in the FTC labs as a result of hands-on lab training for personnel. Contaminants deposited on the rags generated by FTC include lubrication oil, diesel fuel, hydraulic fluid, and greases.

3.2.4 Harbor Operations

Harbor operations provide light preventative maintenance support to the tug boats, barges, and marine service craft that are used at the Naval Station. Major repairs are not performed by Harbor Operations personnel. Contaminants deposited on the rags generated by Harbor Operations include lubrication oils, hydraulic fluid, grease, paint, and paint solvents.

3.2.5 Helicopter AntiSub Light Squadrons (HSL-40, 42, 44, 46, and 48)

Five helicopter squadrons operate at Naval Station Mayport. Each squadron provides routine and preventative maintenance services for each helicopter in their squadron. The activities range from mechanical and engine work to electronic equipment repair. Contaminants deposited on the waste rags generated include lubrication oil, hydraulic fluid, grease, and solvents.

3.2.6 Ship Intermediate Maintenance Activity (SIMA)

SIMA provides intermediate maintenance and repair services for ship equipment such as electronics equipment, electric motors, boilers, and ship weapons. SIMA provides these services for all ships stationed or visiting the Naval Station. Contaminants deposited on the rags include oil, grease, anti-seize fluid, machine cutting oil, solvents, paint, and paint thinner.

3.2.7 Ships

Ships make up the single largest source of waste rags generated at the Naval Station. Although the assessment team was unable to investigate rag generation onboard ships (other

than to calculate total pounds used), the operations performed on ships are very similar to those performed in the different shore-based Commands listed above. Therefore, the types of rags used, waste rag generation methods, and handling and disposal steps are assumed to be very similar to those discussed above.

Two additional areas discussed below generate waste rags, but were not included in Table 3.1. They are not listed in the Table because each currently recycles rags either through a commercial launderer or by washing on site.

3.2.8 Public Works Center - Transportation (PWC-T)

The PWC-T provides maintenance service for the equipment used to support both shore-based operations and the ships that frequent the Naval Station. The PWC-T provides maintenance for almost 700 pieces of equipment including light and heavy duty trucks, automobiles, buses, bulldozers, road graders, cranes, fork lifts, power generators, overhead hoists, and other heavy equipment. Activities that generate waste liquids involve the periodic replacement of motor oil, hydraulic fluid, transmission fluid, and antifreeze, and the cleaning of parts removed from the vehicle for repair. Each of the fluids used at PWC-T is a potential contaminant that may deposited on waste rags. PWC-T utilizes a commercial launderer to supply clean rags for use on their equipment.

3.2.9 Morale, Welfare, and Recreation (MWR) Automobile Hobby Shop

The automobile hobby shop provides a location for Base personnel to repair and maintain personal automobiles and recreational equipment. Operations within the hobby shop are identical to those in PWC-T, except that the types of vehicles are limited to automobiles and similar light-duty vehicles. Contaminants deposited on the rags generated by the hobby shop include lubrication oil, hydraulic fluid, transmission fluid, antifreeze, PD-680, and grease. The hobby shop has a washer and dryer on location that are currently used to clean and recycle non-hazardous rags.

3.3 Waste Rag Handling and Disposal

As noted earlier, waste rags generated by the various ships and other Commands located at Naval Station Mayport are either classified as hazardous or non-hazardous in nature. Each category of waste rag is handled and disposed by separate methods. The following is a discussion of waste rag handling and disposal, by category.

3.3.1 Hazardous Waste Rags

Rags contaminated with cleaning solvents, paint thinners, and paint are treated as hazardous waste. These waste rags are clearly labeled hazardous for disposal purposes. The rags are placed in double plastic bags and temporarily stored (30 days maximum) in 55 gallon steel drums. The drum tops are secured with clamping rings and are clearly marked as hazardous waste. Drum storage is maintained in each activity's hazardous waste material storage area. After removing the waste rags, an empty barrel is returned to the site to receive additional waste rags. In addition to the waste rags, data from the 1993 Mayport Hazardous Waste Report indicated that paint rollers and paint brushes were included in the bags containing waste paint rags approximately 16 percent of the time.

Hazardous waste rags generated from the helicopter squadrons are handled and reported differently than at other Commands. HSL-40 is responsible for the temporary hazardous waste storage facility, which contains hazardous waste rags generated from HSL-40 and HSL-42. HSL-40 and HSL-42 are located in the same building. HSL-48 provides this same service for HSL-44 and HSL-46, since these three squadrons are also located in the same building. As a result of this waste rag collection arrangement, all waste rags from the helicopter squadrons are reported as originating from either HSL-40 or HSL-48.

3.3.2 Non-Hazardous Waste Rags

Non-hazardous rags contaminated with petroleum-based motor oils, hydraulic fluids, and greases are handled as non-hazardous waste. The waste rags are clearly labeled non-

hazardous and are disposed in a landfill. Rags containing oil and grease are excluded from the definition of hazardous waste under 40 CFR §261.4.

Previously, non-hazardous rags were collected and destroyed at the Naval Station's refuse incinerator located on the Base. On May 31, 1994, the refuse incinerator was shutdown permanently. The current policy is to collect non-hazardous rags at each work center at the end of each shift. As with the hazardous waste rags, the non-hazardous rags are placed in double plastic bags and temporarily stored (30 days maximum) in 55 gallon steel drums. The drum tops are secured with clamping rings and are clearly marked non-hazardous. Although these waste rags are non-hazardous, drum storage is maintained in each activity's hazardous waste material storage area because of convenience. After removing the waste rags, an empty barrel is returned to the site to receive additional waste rags.

The Public Works Department is responsible for collection from the hazardous waste storage areas and disposal of both the hazardous paint and solvent rags and non-hazardous rags. Disposal costs for both hazardous and non-hazardous waste rags were estimated by Mayport personnel to be $1.85 per pound[4]. The assessment team found that all Commands visited were in full compliance with the Naval Station's policy for handling of non-hazardous rags and hazardous waste rags.

3.4 References for Chapter 3

1. "1993 Mayport Hazardous Waste Report". Provided by Naval Station Mayport, Mayport, Florida.

2. Naval Station Mayport refuse incinerator records for 1993 provided by the Naval Station Mayport Environmental Engineering Department.

3. Naval Station Mayport Hazardous Waste Management Plan. Department of the Navy. SOPA (ADMIN) Mayport Instruction 5090.1B. Naval Station Mayport, Mayport, Florida. April 1994

4. Telecon between Paul Grable of Pacific Environmental Services, Inc. and Mr. Jim Santarone at Naval Station Mayport. Estimated rag disposal costs. September 1994.

4.0 POLLUTION PREVENTION ALTERNATIVES

This chapter presents pollution prevention alternatives that could be utilized to reduce the generation of both hazardous and non-hazardous waste rags at Naval Station Mayport. The chapter discusses the benefits and problems created by implementation of each alternative.

During the visit to the Naval Station, the assessment team observed evidence of a concerted effort by staff to reduce wastes at the facility. Several ongoing practices support a pollution prevention ethic and reduced generation of waste rags. For example, AIMD and SIMA use wash stations to clean equipment thoroughly prior to being disassembled. This process removes large volumes of grease, oil, and dirt that would normally be wiped with rags during the repair process.

Additional opportunities were identified by the assessment team to make further progress in waste reduction. These alternatives can be classified into three general categories: 1) better operating practices that reduce the amount of contamination generated; 2) methods to reduce the volume of waste that requires rag wiping; and 3) methods to reduce the volume of rags to be disposed. Each alternative is discussed in detail below.

4.1 Implement Better Operating Practices

The first step towards reducing the amount of waste rags generated at Mayport is to reduce the amount of contamination generated that will require cleanup with rags. Reduction in the generation of these contaminates can be most effectively accomplished through better operating procedures. Many operations at Mayport can benefit from implementation of better operating practices. Several of these practices are listed below:

- Personnel Practices

    - Utilize good housekeeping methods such as maintaining a clean and orderly work area to minimize waste rag generation
    - Provide employee training related to steps to prevent waste rag generation
    - Provide employee incentives to promote waste rag pollution prevention through training and recognition programs

- Procedural Measures

    - Improve maintenance procedures to avoid waste generation that must be cleaned with rags
    - Re-evaluate maintenance periodicity to extend the time between maintenance requirements
    - Review equipment repair history to replace units requiring high maintenance
    - Use proper handling and application equipment to minimize cleanup

Although these practices are already in place in many work centers, implementation of these practices at all work centers should be considered to reduce pollution and waste rag generation at the Naval Station. Some specific examples include replacing worn seals on pumps, replacing old or high maintenance equipment, and using drip pans under mobile equipment. For more information related to improved operating practices, refer to the EPA publication Guides to Pollution Prevention: The Marine Maintenance and Repair Industry (October 1991)[1]. In addition, the Guide includes blank waste minimization assessment worksheets, which can be used to assess minimization alternatives for all pollution sources. It also includes the results of assessments performed on three different marine maintenance and repair yards.

4.2 Reduce Waste That Requires Wiping

The second pollution prevention category involves reducing the volume of waste that requires wiping with rags, but not the amount of contaminants generated at the source. The alternative identified is the installation of wash stations for equipment awaiting repair. As

stated earlier, this procedure is currently being used at both AIMD and SIMA. By installing wash stations at other Commands, the equipment to be repaired could be steam cleaned or washed prior to initiation of the repair operation. Washing the equipment removes the contaminants so that rags are not needed for this function. The contaminants removed, however, would still be released in wastewater streams generated by the wash stations. Requiring pre-cleaning before the equipment enters a shop for repair is estimated to result in a 50 percent or greater reduction in the use of rags.

This procedure must obviously be limited to equipment that can withstand vigorous cleaning, such as engines and heavy equipment. Implementation of this procedure on items such as electronic circuit boards is unrealistic. In addition, wash stations would, as noted above, generate wastewater streams containing grease and oil that the Base sewage treatment plant would be required to process.

4.3 Reduce Waste Rag Disposal Volumes

The final pollution prevention category is reduction in the volume of rags that are disposed. Three pollution prevention alternatives were identified that would result in a reduction in waste rag generation: 1) replace SERV MART rags with disposable wipers; 2) use recyclable rags for oil and grease removal; and 3) confirm that used rags are fully contaminated prior to disposal. Each of the alternatives is discussed in detail below.

4.3.1 Use Disposable Wipers

The relatively non-absorbent bale rags purchased at SERV MART for both hazardous and non-hazardous waste cleanup could be replaced with commercially available disposable wipers. SERV MART rags come in random sizes, are difficult to tear or cut, and are typically very poor absorbents of liquids. All personnel interviewed by the assessment team felt that the SERV MART rags were inferior. Base personnel also stated they would prefer a more absorbent and manageable rag substitute.

Disposable wipers, such as paper towels, are specifically manufactured to absorb liquids, greases, oils, and common solvent. Disposable wipers are marketed in different sizes for different purposes, from economy to heavy-duty. Heavy-duty wipers have pulp and textile fibers for strength and absorbency, reportedly tough enough for metal chips, rust, and machined surfaces. Using uniform, absorbent disposable wipers with an area of approximately one square foot would increase the ratio of contaminate per unit volume of rag waste, reducing waste rag generation. As with the SERV MART rags currently used for hazardous waste, the used disposable wipers must be disposed as hazardous waste.

4.3.2 Use Recyclable Rags

The use of recyclable rags for non-hazardous wastes could lead to a significant reduction in waste rags generated and disposed from the removal of oils and greases. Recyclable rags are made of cotton fibers for absorbency and man-made fibers for strength. Washing with industrial detergents can remove petroleum products from recyclable rags, re-establishing the high absorbency. Recyclable rags can be reused until mechanical abrasion during repeated use, and chemical effects from strong detergents, breaks down rag fibers. Rag remnants are then landfilled. Each time a rag is recycled, landfill requirements are reduced.

Rags could be recycled using either a commercial service or individual work centers that clean and recycle their own rags. A commercial service is currently being used by SIMA, while the automobile hobby shop cleans and recycles their own rags. A commercial service is the simplest operation since they provide the clean rag for use and pickup used rags to be cleaned. This completely removes the burden of purchasing and cleaning the rag. Although the commercial operation also removes the burden of wastewater disposal from the Command, the rag washing operation does generate a liquid waste stream that requires processing.

Individual washing and recycling of rags is most attractive at small work centers that generate few waste rags. Collection, cleaning, and redistribution of these rags is simple because of the low volume and minimum amount of effort required. The major disadvantage

is that wastewater generated by the cleaning operation must be processed through the Base sewage treatment plant.

4.3.3 Dispose of Only Fully Contaminated Rags

The assessment team inspected dirty rags that were in containers at several Commands. They found that a majority of rags had a significant amount of serviceability remaining. In many cases, the rags were only lightly soiled and could be used again. The lightly soiled rags could be the result of the very poor absorbency of the SERV MART rags, the ready accessibility of clean rags, or rigid adherence to current rag disposal policies by Base personnel.

Periodic inspection to segregate still serviceable rags from heavily contaminated rags could reduce rag volume. This would require minor additional effort by personnel in each work area to inventory the rags once a week before they are sent to disposal. Lightly contaminated rags could be separated and reused until dirty. In addition, limiting the availability of rags would help ensure that rags are fully used before disposal. Because of potential health hazards, this procedure is not practical for hazardous waste rags.

4.4 References for Chapter 4

1. Guides to Pollution Prevention: The Marine Maintenance and Repair Industry. United States Environmental Protection Agency. EPA/625/7-91/015. Office of Research and Development. Washington, DC. October 1991.

2. Grainger. Industrial and Commercial Equipment and Supplies 1994 General Catalog No. 385. W.W. Grainger, Inc. Lincolnshire, Illinois. 1994.

5.0 COSTS AND BENEFITS OF POLLUTION PREVENTION ALTERNATIVES

This chapter provides a review of costs and benefits for selected pollution prevention alternatives identified in Chapter 4. Costs and savings quoted in this chapter are valid for screening purposes only. The base case values for both hazardous and non-hazardous rag usage are presented first. Base case values reflect the assumptions associated with current operations. Next, each alternate case is presented. Alternate case values reflect the assumptions associated with the related pollution prevention alternative. Note that the costs used for each analysis are commercial costs and do not include any discounts that the Navy may be able to negotiate with a particular vendor.

5.1 Base Case Values and Assumptions

Table 5.1 presents the base cases used for comparison with the pollution prevention alternatives identified in Chapter 4.0. The cost associated with current practices for the purchase and disposal of hazardous waste rags is presented first. Annual usage of rags is based on the 1993 rag disposal inventory figures. SERV MART rag cost and rag disposal costs were obtained from Base personnel. The analysis assumes that the same number of rags will be used in future years.

The non-hazardous waste rag base case is also presented in Table 5.1. Annual usage of rags is based on the volume of rags sent to the refuse incinerator in 1993. As with the hazardous waste rag base case, SERV MART rag cost and rag disposal costs were obtained from Base personnel. The analysis assumes that the same number of rags will be used in future years.

5.2 Alternate Case Values and Assumptions

Other than the better operating practices that were identified in Chapter 4, four pollution prevention alternatives were identified that would result in a reduction in waste

TABLE 5.1: BASE CASE VALUES FOR BOTH HAZARDOUS AND NON-HAZARDOUS WASTE RAG USAGE

HAZARDOUS WASTE RAGS

Annual Quantity (lbs)	Rags per lb	Total Rags Used	Cost per rag[b]	Annual Purchase Cost	Disposal Cost per lb[c]	Annual Disposal Cost	Total Annual Costs
42,750	6	256,500	$0.1472	$37,757	$1.85	$79,088	$116,844

[a] National Stock #7920-00-205-1711. From 1993 Hazardous Waste Report.
[b] SERV MART price
[c] Mayport Environmental Engineering

Assumptions: Hazardous Waste Rags

1) Purchase 42,750 pounds of rags[a] annually for hazardous waste cleanup
2) Assume 6 rags per pound

NON-HAZARDOUS WASTE RAGS

Annual Quantity (lbs)	Rags per lb	Total Rags Used	Cost per rag[b]	Annual Purchase Cost	Disposal Cost per lb[c]	Annual Disposal Cost	Total Annual Costs
43,690	6	262,140	$0.1472	$38,587	$1.85	$80,827	$119,414

[a] National Stock #7920-00-205-1711. From 1993 refuse incinerator records.
[b] SERV MART price
[c] Mayport Environmental Engineering

Assumptions: Non-Hazardous Waste Rags

1) Purchase 43,690 pounds of rags[a] annually for non-hazardous waste cleanup
2) Assume 6 rags per pound

rag generation: 1) install equipment wash stations to remove contaminants normally removed with rags; 2) use disposable wipers for both hazardous and non-hazardous waste removal; 3) use recyclable rags for oil and grease removal; and 4) confirm that used rags are fully contaminated prior to disposal. The alternatives, which are discussed in detail below, are compared to the appropriate base case presented above. Note that where rag substitutes are evaluated, the alternate case assumes that the same number of rags are used as in either base case.

5.2.1 Install Equipment Cleaning Stations

The installation of a pressurized hot water cleaning station represents the first pollution prevention alternative analyzed. Equipment containing non-hazardous wastes that is cleaned at the station will have less contaminants that would need to be cleaned with rags. Since SIMA and AIMD already use wash stations and the assessment team did not investigate ship-based rag generation, the only Commands that might benefit from installation of a wash station are the helicopter squadrons.

Table 5.2 presents the results of the alternate case analysis for helicopter squadrons. The analysis assumes that the Base continues to purchase SERV MART rags for non-hazardous wastes for all Commands except the helicopter squadrons. In addition to the wash stations currently operating at AIMD and SIMA, one wash station is installed and used by the five squadrons to clean aircraft parts prior to repair. The new wash station is assumed to reduce the 10,153 pounds of non-hazardous rags used by the squadrons by 50 percent. Capital and operating costs for the new wash station were obtained from an outside vendor. Unit rag purchase and disposal costs are identical to those in the non-hazardous base case.

Based on the analysis, installation of a wash station for the helicopter squadrons is slightly more attractive than existing operations. A savings of $5,585 was generated by the reduction in rag usage. Based on the assumptions and analysis presented in Table 5.2,

TABLE 5.2: INSTALL WASH STATION FOR HELICOPTER SQUADRON PARTS CLEANING

Wash Station						
Capital Costs[a]	Operating Costs[a]	Capital Recovery Costs[b]	Total Annual Costs	Base-wide Annual Non-Hazardous Rag Usage (lbs)[c]	Base-wide Annual Rag Usage Cost[d]	Annual Alternative Case Cost
$21,000	$2,300	$3,419	$5,719	38,614	$105,540	$111,259

[a] Telecon with Consolidated Equipment Company, Raleigh, NC. Capital costs (installed): concrete work platform = $8,000; oil/water separator = $6,000; sewer connection = $3,000; and 3 hp electric hot water pressure washer = $4,000. Annual operating costs: pressure washer maintenance = $500; and detergents = $1,800

[b] Assumes useful life of 10 years and an interest rate of 10 percent, which yields a capital cost recovery factor of 0.1628 ($21,000 x 0.1628 = $3,419)

[c] Assumes rag usage for non-hazardous wastes at helicopter squadrons only is reduced by 50 percent (from 10,153 lbs to 5,076 lbs), dropping the total base-wide non-hazardous rag usage to 38,614 pounds (from 43,690 lbs)

[d] (38,614 / 43,690) x $119,414 (from Table 5.1) = $105,540

Assumptions

1) Purchase 43,690 pounds of rags annually for base-wide non-hazardous waste cleanup (from Table 3.1)
2) Sewer connection is close to proposed cleaning station
3) One pressure cleaning station needed
4) Existing waste water treatment plant is capable of processing additional effluent
5) No hazardous materials will be involved at the pressure wash stations

the wash station would need to reduce non-hazardous waste rage usage by 21 percent for the wash station to "breakeven." Although this alternative is an improvement over current operations, the other alternatives identified in Chapter 4, and evaluated below, generate much higher savings and are thus much more attractive.

5.2.2 Use Disposable Wipers

This alternative involves replacing the SERV MART rags currently purchased by the Base for both hazardous and non-hazardous waste cleanup with disposable wipers. Table 5.3 presents the results and assumptions for each alternate case. For both hazardous and non-hazardous wastes, the analysis found that a significant economic incentive exists to replace the SERV MART rags with disposable wipers. Replacement of the SERV MART rags with disposable wipers could result in a savings of at least $82,000 per year for hazardous waste rags and an additional $84,000 per year for non-hazardous waste rags. The amount (lbs) of waste rags generated is estimated to be reduced significantly, from a total (hazardous plus non-hazardous) of approximately 86,400 lbs per year to less than 16,000 lbs per year.

The savings and reduction in the amount of waste rags generated are driven by the much larger number of disposable wipers per pound that can be purchased versus the 6 rags per pound currently received with the SERV MART rags. The analysis assumes that one disposable wiper is equivalent in absorptivity to one SERV MART rag. Based on the very poor absorptivity of the SERV MART rags noted by the assessment team, this assumption appears to be valid. Even if three disposable wipers were assumed to be equivalent to the absorbency of one SERV MART rag, the analysis would still show disposable wipers to be preferred over the SERV MART rags.

5.2.3 Use Recyclable Rags

This alternative involves replacing the SERV MART rags used for non-hazardous waste cleanup with recyclable rags. The alternative assumes that a commercial operation is contracted to provide and launder the dirty rags. Table 5.4 presents the results and

TABLE 5.3: USE OF DISPOSABLE WIPERS FOR HAZARDOUS AND NON-HAZARDOUS WASTES

HAZARDOUS WASTE RAGS

Supplier[a]	Total Wipers Purchased	Wipers per lb[a]	Total Weight (lbs)	Cost per wiper[a]	Annual Purchase Cost	Disposal Cost per lb[b]	Annual Disposal Cost	Total Annual Costs
Economizer	256,500	53	4,840	$0.0458	$11,747	$1.85	$8,953	$20,701
Scott Wypall Plus	256,500	39	6,577	$0.0601	$15,416	$1.85	$12,167	$27,583
ScottCloth Heavy Duty	256,500	33	7,753	$0.0768	$19,699	$1.85	$14,380	$34,079

[a] Grainger. Industrial and Commercial Equipment and Supplies 1994 General Catalog No. 385
[b] Mayport Environmental Engineering estimate

Assumptions: Hazardous Waste Rags

1) One disposable wiper has the same absorbency as one SERV MART rag
2) Purchase 256,500 disposable wipers annually for hazardous waste cleanup

NON-HAZARDOUS WASTE RAGS

Supplier[a]	Total Wipers Purchased	Wipers per lb[a]	Total Weight (lbs)	Cost per wiper[a]	Annual Purchase Cost	Disposal Cost per lb[b]	Annual Disposal Cost	Total Annual Costs
Economizer	262,140	53	4,946	$0.0458	$12,006	$1.85	$9,150	$21,156
Scott Wypall Plus	262,140	39	6,722	$0.0601	$15,755	$1.85	$12,435	$28,189
ScottCloth Heavy Duty	262,140	33	7,944	$0.0768	$20,132	$1.85	$14,696	$34,828

[a] Grainger. Industrial and Commercial Equipment and Supplies 1994 General Catalog No. 385
[b] Mayport Environmental Engineering estimate

Assumptions: Non-Hazardous Waste Rags

1) One disposable wiper has the same absorbency as one SERV MART rag
2) Purchase 262,140 disposable wipers annually for non-hazardous waste cleanup

TABLE 5.4 USE OF RECYCLABLE RAGS FOR NON-HAZARDOUS WASTES

Number of Rags Used Per Year[a]	Number of Replacement Rags Purchased Per Year[b]	Annual Costs			Total Annual Costs
		Recycle Costs[c]	Replacement Rag Costs[d]	Disposal Costs[e]	
262,140	2,621	$47,185.20	$602.83	$808.14	$48,596

[a] Use 262,140 rags annually for non-hazardous waste cleanup (from Table 5.1)

[b] Based on a rag reduction ratio of 100. Telecon with Consolidated Equipment Company, Raleigh, NC

[c] Recycle unit cost of $0.18 per rag (from SIMA unit rag recycling costs) times the total number of rags needed

[d] Replacement rag unit cost of $0.23 per rag (from SIMA unit rag recycling costs) times the number of replacement rags purchased per year

[e] Disposal cost of $1.85 per lb (from Mayport Environmental Engineering estimate) and assumption that recyclable rags weigh the same as SERV MART rags (i.e., 6 rags per lb)

assumptions associated with the alternate case. The rag purchase and laundering costs used reflect the costs that SIMA currently pays for its recycling operation. The analysis also assumes that the same volume of rags will be used in future years.

Based on the results of the analysis, rag recycling is less than half the cost the Naval Station currently spends to purchase and dispose of the SERV MART rags. In addition, if all Commands were to participate in a recycling program, the launder and purchase costs of the recyclable rags could probably be negotiated lower because of the magnitude of rags used at Mayport. Note that although recycling does create a liquid waste stream, it eliminates the cost of disposal and the need to landfill these non-hazardous rags.

An additional part of the recyclable rag analysis looked at reducing recyclable costs. The concept was to provide a civilian contractor a distribution center on Base to recycle the more than 5,000 rags per week generated by the Base in 1993. The contractor would be responsible for receiving, washing, and distributing recyclable rags. It became evident early in the analysis that a quantity of approximately 5,000 recyclable rags per week can not be competitive with the price the contractor for SIMA charges.

5.3 Summary of Base Case and Alternatives

Table 5.5 presents a summary of the base case and alternatives in terms of 1) the amount (lbs) of waste rags generated, 2) the capital costs, if any, associated with implementing the alternatives, and 3) the annual costs associated with the base case and each alternative. As seen in Table 5.5, the Station is estimated to spend approximately $236,000 per year on waste rags. Under the three alternatives examined, expenditures are estimated to range from approximately $42,000 to $228,000 per year. Potential savings, therefore, are estimated to be as low as $8,000 per year to as high as $192,000 per year. Reduction in the amount (lbs) of waste rags generated range from approximately 6 percent (wash station, non-hazardous waste) to 89 percent (disposable wipes, hazardous and non-hazardous waste).

TABLE 5.5 SUMMARY OF BASE CASE AND ALTERNATIVES ON WASTE RAG GENERATION, CAPITAL COSTS, AND ANNUAL COSTS

Type of Rag	Scenario	Amount of Waste Rags Generated (lbs/yr)	Capital Costs	Total Annual Costs
Hazardous	Base Case	42,750	NA	$116,844
	Wash Station	NA	NA	NA
	Disposable Wipers	4,840 to 7,753	NA	$20,701 to $34,079
	Recyclable Rags	NA	NA	NA
Non-Hazardous	Base Case	43,690	NA	$119,414
	Wash Station	38,614	$21,000	$111,259
	Disposable Wipers	4,946 to 7,944	NA	$21,156 to $34,828
	Recyclable Rags	79	NA	$48,596
Total (Hazardous plus non-hazardous)	Base Case	86,440	NA	$236,258
	Wash Station	81,364	$21,000	$228,103
	Disposable Wipers	9,786 to 15,697	NA	$41,857 to $68,907
	Recyclable Rags	42,829	NA	$165,440

NA = not applicable

5.4 References for Chapter 5

1. Telecon between Paul Grable of Pacific Environmental Services, Inc. and Mr. Herndon at Consolidated Equipment Company in Raleigh, North Carolina. Estimated equipment and operating costs for non-hazardous rag cleaning operation. August 1994.

2. Grainger. Industrial and Commercial Equipment and Supplies 1994 General Catalog No. 385. W.W. Grainger, Inc. Lincolnshire, Illinois. 1994.

6.0 RECOMMENDED POLLUTION PREVENTION ALTERNATIVES

This chapter summarizes the recommended pollution prevention alternatives for the reduction of waste rags at Naval Station Mayport. Chapter 6 also includes recommendations for implementing the preferred pollution prevention alternative.

6.1 Implement Better Operating Practices

Reducing the amount of contamination that is generated and eventually cleaned or wiped with rags is the first step towards pollution prevention. Reduction in the generation of this waste should be accomplished through implementing the better operating practices detailed in Chapter 4. Implementation of these practices can be accomplished by increasing training and refining procedural steps. These changes can be implemented with minor increases in costs but can have significant pollution prevention impacts.

6.2 Reduce Generation of Rag Contaminants

Installation of an equipment wash station for the helicopter squadrons to reduce the volume of waste that must be wiped with rags has an economic advantage over current operations, but other alternatives are much more attractive. In addition, wash stations are already located at AIMD and SIMA, the two areas that could most utilize the benefits of this alternative. If further investigation of the helicopter squadrons indicates that a larger percentage of rags could be eliminated through installation of a wash station, this alternative in combination with recyclable rags or disposable wipers, might be more attractive. In any case, the installation of wash stations should be limited to areas where a high volume of waste rags are generated and equipment can be easily cleaned with steam or water.

6.3 Reduce Waste That Requires Wiping

Reducing the volume of waste rags generated can be best accomplished by replacing the SERV MART rags currently used by many Commands throughout the Base with either disposable wipers or recyclable rags. PES recommends that Mayport purchase disposable wipers for cleanup of hazardous wastes throughout the Naval Station. This will result in a significant savings in rag purchase and disposal costs. For non-hazardous wastes, PES recommends that the Base negotiate a contract with a commercial launderer to provide recyclable rags for all Commands on the Base. Although recycling of the non-hazardous rags is somewhat higher than the costs to use and dispose of disposable wipers, the Navy should be able to negotiate better laundering prices if other Commands agree to consider recycling. Even without more attractive laundering prices, recycling of rags is only slightly more expensive than purchasing disposable wipers but could prevent the introduction of over 43,000 pounds of waste rags each year to area landfills.

Periodic inspection to segregate serviceable rags from heavily contaminated rags is recommended as an excellent way to reduce rag volume and rag disposal expense. This would require minor additional effort by personnel in each work area to inventory the rags once a week before they are sent to disposal. Lightly contaminated rags could be separated and reused until dirty. Because of potential health hazards, this alternative is only recommended for non-hazardous waste rags.

6.4 Summary

Table 6.1 presents each of the pollution prevention alternatives identified in this report as well as those that are recommended for implementation. The recommendations for implementation were based on the potential of the alternative to reduce pollution as well as the economic advantages and cost savings generated. In addition, each alternative is a proven technology that has already been implemented by at least one Command at the Naval Station. If these recommendations are fully implemented throughout Naval Station, generation of waste rags should be significantly reduced.

TABLE 6.1: SUMMARY OF POLLUTION PREVENTION ALTERNATIVES FOR WASTE RAG GENERATION

Alternative Identified	Recommended Rag Type	Notes
Implement Better Operating Practices	Both Hazardous and Non-Hazardous	
Use Disposable Wipers	Hazardous	Could also be used for Non-Hazardous
Use Recyclable Rags	Non-Hazardous only	
Dispose of Only Fully Contaminated Rags	Non-Hazardous only	Not recommended for hazardous rags
Install Equipment Cleaning Stations	Non-Hazardous only	Limit to high volume rag use areas