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ABBREVIATED REPORT

A DECISION TREE FOR IMPROVING WASHRACK OIL/WATER SEPARATOR OPERATIONS

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EXECUTIVE SUMMARY

a. The U.S. Army Major Commands (MACOMs) and installations have programmed over 1000 environmental projects to upgrade washracks. The majority of those projects include installing new commercial off-the-shelf (COTS) oil/water separators. According to information in Public Works Technical Bulletin 200-1-05, Oil/Water Separator Selection, Installation, and Maintenance: Lessons Learned (app A, ref 1), recently published by the Army Center for Public Works, there is legitimate concern that new separators are not being chosen properly. In an effort to minimize the waste of Army environmental funding, the Army Environmental Center sponsored this project to quickly provide guidance which will help ensure future installations of oil/water separators are done effectively and only where needed.

b. Recently installed coalescing separators were evaluated at three locations to determine if the selection of each of those separators was appropriate. The evaluation consisted of a subjective assessment of maintainability, and a snapshot assessment of treatment performance. One of the separators was very easy to maintain, another was somewhat easy to maintain, but the third was very difficult to maintain and was not selected wisely. The assessment of treatment performance was inconclusive; at all locations, separator influent was already clean enough to discharge to most sanitary sewer systems. It is possible that none of the separators evaluated were necessary.

c. The observations made during the three separator evaluations supported previous observations reported by U.S. Army Construction Engineering Research Laboratory (CERL) personnel regarding washrack oil/water separators. Conclusions from these observations were used to prepare a guide which outlines the process of upgrading Army washracks. This guide, prepared in the form of a Decision Tree, also simplifies some of the guidance contained in U.S. Army Corps of Engineers (CE) Technical Letter, Selection and Design of Oil/Water Separators (ref 2). The Decision Tree is intended for use by installation and facility personnel as a general guidance tool when solving/preventing washrack compliance problems.

SECTION 1. INTRODUCTION

1.1 BACKGROUND

a. Many Army installations are programming projects to upgrade or replace existing tactical vehicle washracks and/or the oil/water separators normally associated with them. Most of these are environmental projects intended to bring outdated oil/water separators into compliance with pretreatment water quality requirements. The U.S. Army Environmental Center (AEC) has determined that over 1000 of these projects are programmed for a total estimated cost of 195 million dollars. The pretreatment requirements of the Clean Water Act, as enforced by local treatment works, are the primary driver for the washrack improvement projects. As the Army privitizes its federally owned treatment works (FOTW), it should be expected that many more washracks will be in noncompliance and a flood of new project requests may occur.

b. Several years ago, it became obvious that guidance was needed to help installations deal with upgrading their washrack separators. Since then, the Army has launched a series of studies to address the various options for upgrading pretreatment at washracks. These efforts include the following:

(1) Preparation of the Engineering Technical Letter (ETL), Selection and Design of Oil/Water Separators, a design guide prepared by the Office of the Chief of Engineers (completed 1994).

(2) Evaluation of washrack recycle systems, sponsored by AEC and the Army Center for Public Works (completed September 1998) (ref 3).

(3) Oil/water separator technology research conducted by CERL to develop design guidance for coalescing separators (scheduled completion September 1999) (ref 4).

(4) Characterization of washrack separator influents at Army Reserve facilities, sponsored by Headquarters (HQ), Army Reserve Command, CERL, and AEC (scheduled completion March 1998) (ref 5).

c. There was still a need to develop a formal decision process to aid the facility manager or environmental manager when addressing washrack problems. The decision making process involved when upgrading washrack oil/water separators had not been delineated prior to this effort.

1.2 OBJECTIVE

The objective of this study was to prepare a guidance document, in the form of a Decision Tree, which would assist facility and environmental managers in dealing with environmental compliance problems at Army washracks. This Decision Tree is intended to complement existing and soon-to-be-produced guidance documents dealing with pretreatment at washracks.

1.3 APPROACH

a. To prepare the Decision Tree, several sources of information were used. These include the following:

(1) An investigation of three recent installations of coalescing oil/water separators.

(2) Lessons learned contained in the Corps ETL and other documents.

(3) Numerous documented and undocumented site visits to existing separators.

b. The investigation of recent separator installations was conducted during this effort. The investigation consisted of evaluating the treatment performance and maintainability of three COTS separators, as installed. The basic technology utilized by the three systems is gravity separation enhanced by coalescing media. For reporting purposes, the manufacturers are designated as Manufacturers A, B, and C.

SECTION 2.   EVALUATION OF RECENT SEPARATOR INSTALLATIONS

2.1   MANUFACTURER A

2.1.1   Washrack and Separator Description

a. The oil/water separator was installed at a U.S. Army National Guard (ARNG) organizational maintenance facility. The facility personnel were responsible for supporting an Infantry Brigade (Enhanced Heavy Separate). The washrack facility (fig. 2.1-1) is designed to provide pretreatment of wastewater generated by washing tactical vehicles and equipment. The washrack facility consists of a sedimentation basin, an underground gravity oil/water separator, a pump pit, a centrifugal pump, and an above-ground, coalescing enhanced oil/water separator. The wash facility is under roof with the sides of the facility partially enclosed. The washing activity occurs on a concrete slab with a slight grade, which directs the wash water to the sediment basin. From the sediment basin, the wash water enters by gravity flow to a gravity-type oil/water separator. After treatment by the gravity oil/water separator, the wastewater is pumped to the COTS coalescing oil/water separator. The treated water is pumped to a sanitary sewer line that goes to the municipal publicly owned treatment works (POTW). The facility was constructed between August 1996 and February 1997 at a cost of 68 thousand dollars.

Figure 2.1-1.   Location A, facility overview.

b. Manufacturer A's separator (fig. 2.1-2) is a COTS, above-ground, coalescing enhanced oil/water separator. A commercial application of the system, as described by the manufacturer's literature, is to treat wastewater to remove free oil and dirt from the steam cleaning of machinery and equipment. The major system components include the following: stainless steel tank, coalescing plates, flow baffles, ozone generator, ozone treatment chamber, chamber skimmer, removable lid, lifting straps for the coalescing plates, oil surface skimmer, liquid level switch, sheen filter pack, containment bars, pit return outlet, and bulkhead fittings.

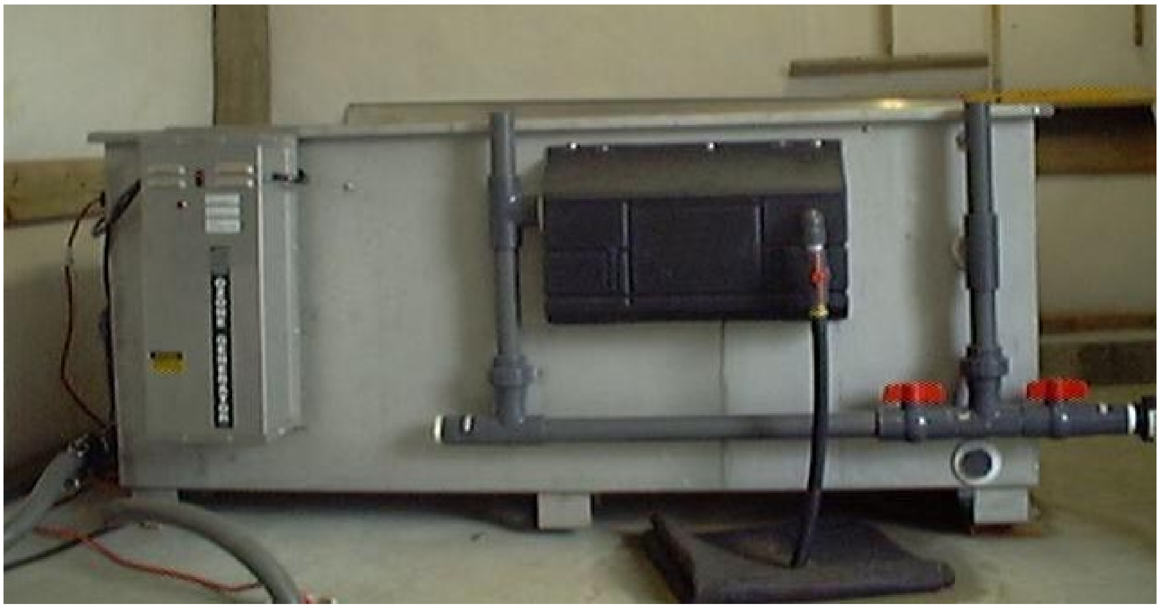


Figure 2.1-2. Manufacturer A, characteristic photograph.

2.1.2 Maintainability

a. Of the three separators evaluated, the equipment purchased from Manufacturer A was the easiest to maintain. The unit was above ground and could be serviced by personnel standing on grade. The top was easily removable without the use of tools. All piping, baffles, and other features which direct the course of the wastewater were easily accessible.

b. The coalescer consisted of inclined, sawtooth shaped, polyethylene plates. The plates were strapped together in bundles, which could be removed by one person without the use of tools. Removing the straps allowed the plates to be separated for individual cleaning.

2.1.3 Treatment Performance

2.1.3.1 Test procedure. The treatment performance was determined by measuring the total petroleum hydrocarbon (TPH) levels in the oil/water separator's influent and effluent. Systematic grab samples were taken by the U.S. Army Aberdeen Test Center (ATC)/CERL sampling team from the waste stream immediately prior to treatment by the commercial oil/water separator and as discharged from the oil/water separator. TPH levels in the influent and effluent of other treatment structures were also measured. All samples were analyzed by the ATC Chemistry Laboratory for TPH using EPA Method 1664 (ref 7).

2.1.3.2 Test findings.

a. Manufacturer A. During the wastewater treatment portion of the demonstration, an M35A2 truck (chassis and engine compartment) and a generator were washed. The truck was washed using a cold-water pressure wash, delivering soap and water at an approximated 3- to 5-gpm rate. The procedure to wash the generator included a lathering of the equipment with soap prior to washing. The soap utilized had been obtained from a commercial car wash. The soap manufacturer was unknown. Figure 2.1-3 shows a wash event at Location A.

b. Table 2.1-1 summarizes the influent and effluent TPH characteristics and provides a TPH removal percentage for each treatment device at Location A.

Figure 2.1-3. Wash event.

TABLE 2.1-1. TPH CHARACTERISTICS

Treatment Process	Average Influent, mg/L	Average Effluent, mg/L	Percent Removal, %	Peak Influent, mg/L	Peak Effluent, mg/L
Sediment basin	272.9	78.3	71.3	1378.8	161.2
Gravity oil/water separator	78.3	3.8	95.1	161.2	4.8
COTS oil/water separator	3.8	1.5	60.8	4.8	1.6

Note: Removal percentage = ((average influent – average effluent)/average influent) x 100.

2.2 MANUFACTURER B

2.2.1 Washrack and Separator Description

a. Manufacturer B's oil/water separator was installed at an ARNG organizational maintenance facility. The facility personnel were responsible for supporting an Engineering Battalion and a Transportation Company. The washrack facility (fig. 2.1-1) is designed to provide pretreatment of wastewater generated by washing tactical vehicles and equipment before discharge into the POTW. The washrack facility consists of a sedimentation basin, a pump pit, a centrifugal pump, and an above-ground, COTS, coalescing enhanced oil/water separator. The facility became operational in February 1992.

Figure 2.2-1. Location B, facility overview.

b. Manufacturer B's system (fig. 2.2-2) is an above-ground, coalescing enhanced oil/water separator. The separator is intended to remove oils and petroleum hydrocarbons from wastewater. The oil/water separator features a sloped sludge chamber directly under the oil-coalescing media, which is intended to collect settled solids and isolate them from the flow. The oil/water separator provides an internal oil reservoir to provide temporary storage of separated oil. The unit demonstrated was constructed of fiberglass. The major system components include the tank, slant rib coalescing media, dense coalescing pack (fig. 2.2-3), sludge chamber, an adjustable weir, a removable lid, an oil skimmer, and an oil reservoir.

Figure 2.2-2. Manufacturer B, characteristic photograph.

Figure 2.2-3. Manufacturer B, dense coalescing pack.

2.2.2 Maintainability

a. This separator is also above ground, which allows easy access to the coalescers, piping, baffles, etc. The cover was easily removed without the use of tools. The coalescer was in a configuration referred to by Manufacturer B as a “slant rib coalescer” (fig. 2.2-4 and 2.2-5). The plastic surfaces were molded into a one-piece honeycomb. The separator contained two coalescing plate packages. Each pack was easily removed by one person without tools. However, because the slanted surfaces were bound together, the pack could not be dismantled. The surfaces on the interior of the pack could not be reached for cleaning.

b. The plates were brittle and had been damaged during previous maintenance activities. Figure 2.2-6 shows a damaged coalescing plate.

Figure 2.2-4. Location B, coalescing plate packages removed for cleaning.

Figure 2.2-5. Location B, oil/water separator, top view, one coalescing plate package removed.

Figure 2.2-6.   Location B, damaged coalescing plate.

2.2.3   Treatment Performance

2.2.3.1 Test procedure. The treatment performance was determined by measuring the TPH levels in the oil/water separator's influent and effluent. Systematic grab samples were taken by the ATC/CERL sampling team from the waste stream immediately prior to treatment by the commercial oil/water separator and as discharged from the oil/water separator. TPH levels in the influent and effluent of other treatment structures were also measured. All samples were analyzed by the ATC Chemistry Laboratory for TPH using EPA Method 1664.

2.2.3.2   Test findings.

a. During the wastewater treatment portion of the demonstration, an M813A1 truck's chassis and engine compartment were washed. The truck was washed using a combination cold/hot-water pressure/steam wash, delivering soap and water at an approximated 3-gpm rate. The soap utilized was Pressure Cleaner Liquid High, National Stock Number (NSN) 6850-00-753-5000. The soap's label indicated that it was manufactured in January 1994 in accordance with MIL-C-22542B (ref 6).   Figure 2.2-7 shows a wash event at Location B.

Figure 2.2-7. Wash event.

b. Table 2.2-1 summarizes the influent and effluent TPH characteristics and provides a TPH removal percentage for each treatment device at Location B.

TABLE 2.2-1. TPH CHARACTERISTICS

Treatment Process	Average Influent, mg/L	Average Effluent, mg/L	Percent Removal, %	Peak Influent, mg/L	Peak Effluent, mg/L
Sediment basin	540.5	59.7	89.0	594.6	71.4
COTS oil/water separator	59.7	34.2	42.7	71.4	60.6

Note: Removal percentage = ((average influent - average effluent)/average influent) x 100.

2.3 MANUFACTURER C

2.3.1 Washrack and Separator Description.

a. The oil/water separator was installed at an Air Force Base (AFB). The facility personnel were responsible for maintaining aerospace ground equipment. The washrack facility (fig. 2.3-1) is designed to provide pretreatment of wastewater generated by the cleaning of aerospace ground equipment. The washrack facility consists of two sedimentation basins and an underground, COTS, coalescing enhanced oil/water separator. The washing operation is conducted within the maintenance shop building. The first sediment basin is located within the building and also functions as a catch basin for the wash water. The wash water flows from the first basin to the second basin by gravity flow. The second basin is of concrete construction and is located underground. The wash water then flows by gravity through the underground, coalescing enhanced oil/water separator to a sanitary sewer that goes to a POTW. The separator was installed in October 1995 at a cost of 47 thousand dollars.

Figure 2.3-1. Location C, facility overview.

b. The major COTS coalescing oil/water separator system components are as follows: sediment chamber, parallel corrugated plate coalescer, oil/ water separator chamber, 18-inch diameter manway with bolt-on extension, 4-inch diameter oil pump- out pipe with riser, vents, coalescer packs, and flow baffles.

2.3.2 Maintainability

The separator at Location C was an underground, horizontal cylinder type oil/water separator. Access to the separator was difficult due to small manways. Access was further restricted by the use of numerous bolts, which secured the access plate to the manway. The severely limited access significantly inhibited maintenance and virtually prohibited inspection. Current guidance recommends against installing separators below grade with access manholes because of difficulties associated with visual inspection, cleaning, maintenance, and safety (ref 2).

2.3.3 Treatment Performance

2.3.3.1 Test procedure. The treatment performance was determined by measuring the TPH levels in the oil/water separator's influent and effluent. Systematic grab samples were taken by the ATC/CERL sampling team from the waste stream immediately prior to treatment by the commercial oil/water separator and as discharged from the oil/water separator. TPH levels in the influent and effluent of other treatment structures were also measured. All samples were analyzed by the ATC Chemistry Laboratory for TPH using EPA Method 1664 (ref 7).

2.3.3.2 Test findings.

a. During the wastewater treatment portion of the demonstration, an A/M 32A-86 generator set was washed. The generator was washed using a hot-water pressure/steam wash, delivering soap and water at an approximated 3-gpm rate. The soap utilized was labeled Super Blast Off. Figure 2.3-2 shows a washed generator set.

b. Table 2.3-1 summarizes the influent and effluent TPH characteristics and provides a TPH removal percentage for each treatment device at Location C.

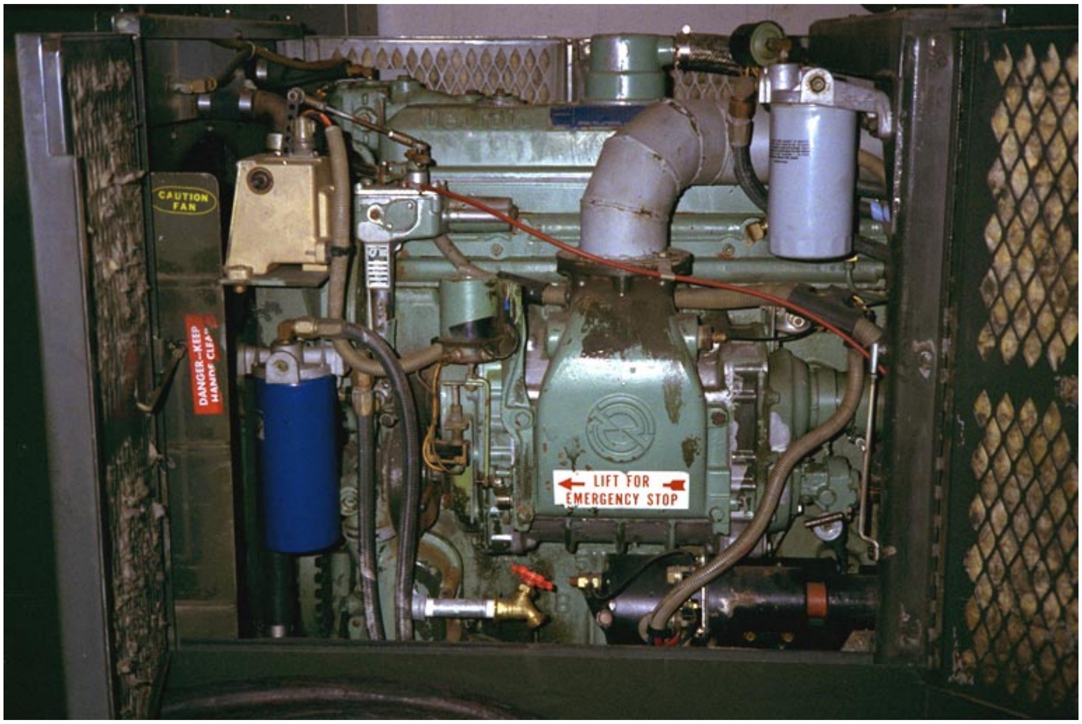


Figure 2.3-2. Washed A/M 32A-86 generator set.

TABLE 2.3-1. TPH CHARACTERISTICS

Treatment Process	Average Influent, mg/L	Average Effluent, mg/L	Percent Removal, %	Peak Influent, mg/L	Peak Effluent, mg/L
Sediment Basin	114.2	32.0	72.0	172.1	80.6
COTS oil/water separator	32.0	11.7	63.4	80.6	12.9

Note: Removal percentage = ((average influent - average effluent)/average influent) x 100.

2.4 TREATMENT PERFORMANCE SUMMARY

a. Manufacturer A. The average TPH level of 1.5 ppm in the effluent from the COTS oil/water separator is well below 100 ppm, indicating successful treatment. The average TPH level of 3.8 ppm in the effluent from the gravity oil/water separator is also well below 100 ppm, indicating successful treatment. (For evaluation purposes, successful treatment was defined to be an effluent with less than 100 ppm of TPH.) The average TPH level of 78.3 ppm in the sediment basin effluent is also below the 100-ppm limit; however, peak levels reached 1378.8 ppm. Additional treatment beyond the sediment basin was warranted to ensure peak pollutant loads were treated to the accepted level. Treatment beyond the gravity oil/water separator appears unnecessary to meet a 100-ppm TPH limit. It should be noted that pretreatment requirements vary by the local jurisdiction and that the user must determine local requirements.

b. Manufacturer B. The average TPH level of 34.2 ppm in the effluent from the COTS oil/water separator is well below 100 ppm, indicating successful treatment. The average TPH level of 59.7 ppm in the effluent from the sediment basin is also below 100 ppm, indicating successful treatment. Additional treatment beyond the sediment basin appears warranted to ensure peak pollutant loads are treated to an acceptable level. Treatment beyond the gravity oil/water separator appears unnecessary to meet a 100-ppm TPH limit.

c. Manufacturer C. The average TPH level of 11.7 ppm in the effluent from the COTS oil/water separator is well below 100 ppm, indicating successful treatment. The average TPH level of 32.0 ppm in the effluent from the sediment basin is also below 100 ppm, indicating successful treatment. Additional treatment beyond the sediment basin appears warranted to ensure peak pollutant loads are treated to an acceptable level. Treatment beyond the gravity oil/water separator appears unnecessary to meet a 100-ppm TPH limit.

SECTION 3. WASHRACK OIL/WATER SEPARATOR DECISION TREE

3.1 DECISION TREE DISCUSSION

Purpose. The Decision Tree is intended to be used as a simple guide for assessing the status of individual oil/water separators that serve washracks. A series of questions are provided to help the person making each assessment define what corrective action, if any, may be necessary to keep the separator operating efficiently and in regulatory compliance. All questions are site specific. The evaluator must have knowledge of how the separator is designed, maintained, and used. The evaluator must also have a basic understanding of how oil/water separators work. The decision tree is sequenced such that responses to questions are often dependent on corrective actions being completed from previous questions.

Q1 Is the washrack needed to sustain mission?

Can washing from two or more washracks be consolidated to minimize the administrative and maintenance costs of managing this washrack? If this is the case, it is recommended that only the minimal number of washracks remain open. Certainly, closing a washrack and transferring the washing function for one washrack to another will require cooperation from the current users of those washracks. If the washrack is not necessary for maintaining tactical vehicles/equipment, consider the use of private facilities.

Q2 Is it impossible to combine the wash activity with another washrack?

Similar to the narrative in Q1, operation and maintenance for oil/water separators may be alleviated if wash activities are combined. Instead of washing vehicles at several locations, you may consider combining wash activities and closing unused washracks.

Q3 Is adequate routine maintenance being performed?

Routine maintenance is essential for the efficient operation of oil/water separators. Excess accumulation of settled solids interferes with treatment by decreasing detention time of the wastewater flowing through the separator. Excess accumulation of floating oil can result in the discharge of concentrated oil during peak usage or storm surges.

A clean-out schedule should be established based on the anticipated accumulation of oil and solids. Ideally, this schedule would be determined by the usage of the washrack. However, usage is often unpredictable, and a set schedule must be used instead. The original schedule should be flexible, and eventually set based on experience at each washrack. It is CERL's observation that users should not be relied upon for either doing their own clean-out or reporting when clean-out is needed.

Often, the design of oil/water separators prohibits efficient maintenance. Consider replacing difficult-to-maintain oil/water separators. Any separator with small access holes or manways is not conducive to easy maintenance or inspection. The entire horizontal cross section should be accessible.

Q4 Are the weirs positioned correctly?

Weirs and baffles are often utilized to enhance separation, and prevent floating oil from exiting through the effluent pipe. The elevation of the floating oil overflow weir must be above the static water elevation of the clean effluent.

Q5 Is the OWS leakproof?

It is common for older oil/water separators, particularly those constructed of formed concrete, to have serious cracks and spalling. Leaking oil/water separators create a potential clean-up site. The structure of the separator should be inspected whenever it is emptied during maintenance cleaning. An obvious indications of leakage is if the water level in the separator drops below the outlet elevation at a loss rate greater than expected by evaporation.

Q6 If a storm water bypass exists within the separator, has it been eliminated?

Storm water bypasses within oil/water separators, or any treatment device, are considered to be in violation of the storm water regulations promulgated from the Clean Water Act. These bypasses must be plugged or otherwise eliminated.

Q7 Does treatment capacity of the separator adequately handle storm surges?

Often the largest flow to a separator is during an intense rain storm. If this flow exceeds the treatment capacity of the separator, floating oil and solids may be flushed from the separator into the effluent. Worst-case flow conditions can be determined from the maximum rainfall intensity for that region, and the total area which actually drains to the washrack separator. Design treatment capacity can obtained from manufacturer’s literature or design records. For gravity separators, at least a 2-hour detention is recommended.

Storm water inflow can be minimized by placing a cover over the washrack. Berming is often used to divert runoff from surrounding areas away from the washrack drain.

Q8 Is suspended solids removal acceptable?

The concentration of suspended solids in the separator effluent is often regulated by POTWs, sometimes by FOTWs, and always in individual NPDES permits. Minimally, 2 hours of detention time should be provided to allow for the removal of settleable solids from the washwater to prevent obstructions in the receiving sewer piping. Sampling and analysis may be needed to verify compliance.

Typically, a grit basin or trap is installed upstream of the separator to minimize the accumulation in the separator. Again, a 2-hour detention is recommended to provide adequate solids removal ahead of the separator.

Q9 Does the system discharge to a sanitary sewer line?

If cost effective, all systems should be connected to a sanitary sewer line to provide additional treatment and to reduce the number of sites where permit excursions could occur. Those systems that do discharge to a sanitary sewer line must meet pretreatment requirements in accordance with local treatment standards. Systems that discharge to the environment directly require a NPDES permit, which will contain strict oil and solids treatment provisions.

Q10 Is oil and grease removal acceptable?

The removal of oil and grease is the obvious goal of the oil/water separator. Most of the preceding questions have a direct impact on the effectiveness of the separator but not upon washing procedures, and corrective actions recommended from those questions should usually be completed before making a performance evaluation.

The concentration of oil and grease in the separator effluent is often regulated by POTWs, sometimes by FOTWs, and always for discharge to the environment. Sampling and analysis may be required to determine if oil removal meets requirements. If the separator fails to provide the treatment required, then the separator should replaced. Refer to Technical Letter No. 110-3-466, Selection and Design of Oil/Water Separators at Army Facilities, prepared by the U.S. Army Corps of Engineers.

Q11 Has the use of detergents or emulsifiers been minimized?

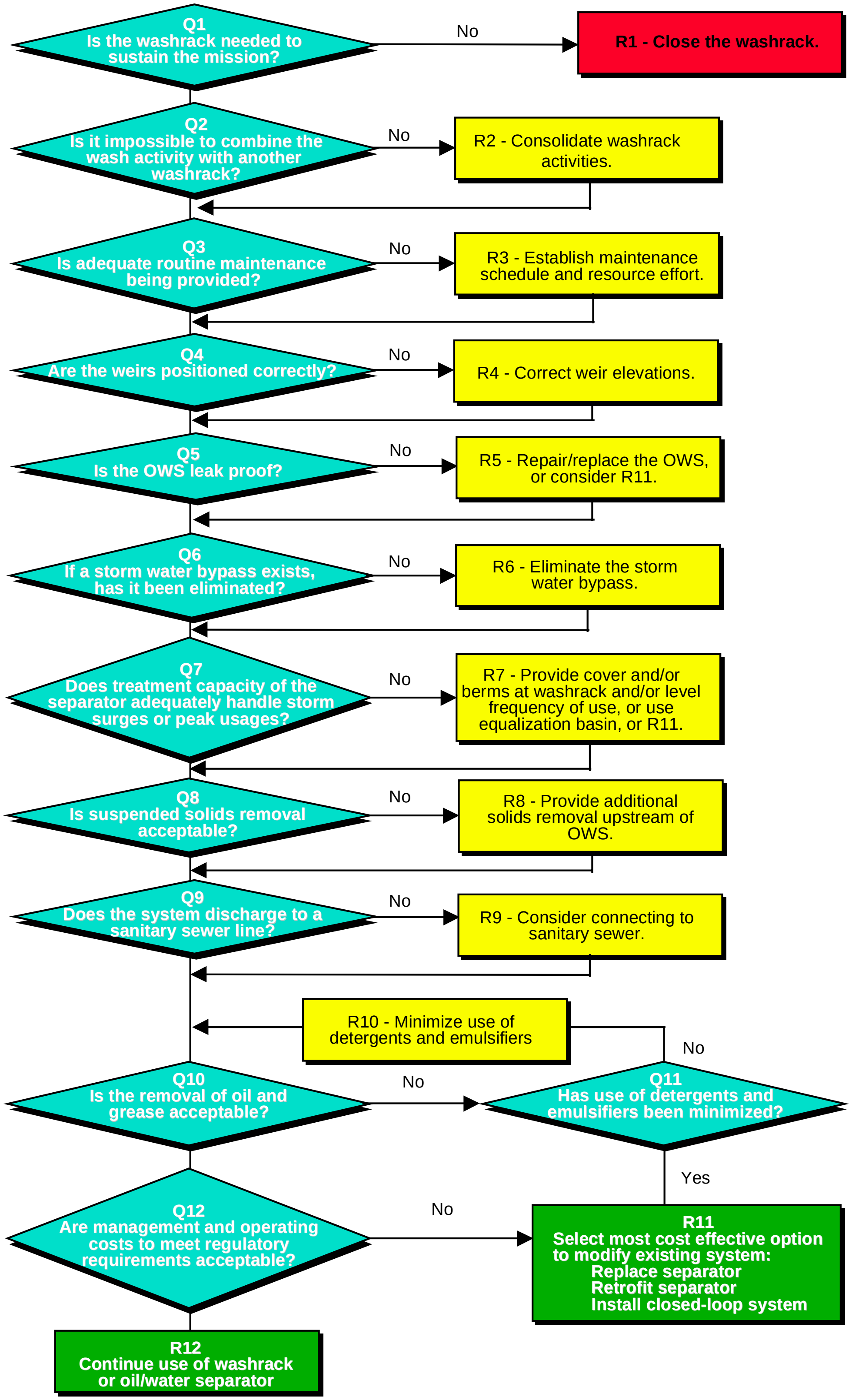
Detergents and other emulsifying cleaners reduce the effectiveness of all conventional oil/water separators. Emulsified oil passes through conventional oil/water separators. Prohibit the use of cleaners at the washrack.

Q12 Are management and operating costs to meet regulatory requirements acceptable?

The costs to manage an oil/water separator may include the following: permit fees, permit applications and renewals, sampling, maintenance, replacement coalescing media, and waste disposal costs. The NPDES permit-related costs may be eliminated by the installation of a closed-loop, nondischarging treatment system (R11). Many National Guard and some regular Army locations are going to this type treatment to avoid regulatory restrictions.

However, the decision to go to this type of treatment must be made very carefully. There are some disadvantages to closed-loop systems. Maintenance frequency and complexity for a recycle treatment system will be significantly higher than for a conventional oil/water separator. Biological growth (and possibly pathogens) must be controlled by disinfection. Disposal costs will not be eliminated. Concentration of metals by ion exchange media likely will result in a hazardous waste disposal stream.

3.2 DECISION TREE



SECTION 4. CONCLUSIONS

a. The use of pumps to feed oil/water separators may cause washracks to exceed the design flow capacity of those separators. Even though wash water flow may be less than the design flow rating, the flow from intermittent pumping is significantly greater than the wash water flow.

b. Recommendations made in the U.S. Army Corps of Engineers (CE) Engineering Technical Letter (ETL) 1110-3-466, Selection and Design of Oil/Water Separators at Army Facilities (ref 3) were not fully incorporated into the design of the demonstration facilities. This was particularly evident where the underground cylindrical separator had been installed.

c. Influents to the coalescing separators evaluated during this effort were already clean enough to discharge to most treatment works at all three sites visited even though cleaning agents were used at all three locations. It is possible that simple gravity separation will be adequate for the removal of grease, oil, and settleable solids at most Army washracks. High-performance coalescing separators may not be necessary.

This conclusion is based on limited data. Considering the large number of funding requests for washrack separator upgrades, it would be valuable to the Army to conduct a study to determine the performance of existing gravity separators.

d. The Decision Tree for Washracks Oil/Water Separators (section 3) was developed to aid the installation user in maximizing investments in washrack facility upgrades.

SECTION 5. RECOMMENDATIONS

a. Washrack designers should ensure that flow to the oil/water separator, either by gravity or pumping, does not exceed the design flow. Separators should be sized to treat flow from the pump that is used, rather than flow from the washrack hoses.

b. When selecting or designing a washrack facility, consult the CE ETL 1110-3-466. If a COTS oil/water separator is to be purchased, an open-top design will make visual inspections and maintenance of the oil/water separator and its subsystem components easier through increased accessibility in comparison to enclosed cylindrical-style or other limited access oil/water separators. Separator access covers/lids should be easily removable by one person without tools.

c. Installation and facility personnel who are programming upgrades to oil/water separators should ensure that the existing separators are nonfunctional, either for maintainability or treatment performance. A study of the performance of existing separators should be conducted by the Army to either support or justify the refusal of funding for the backlog of washrack funding requests.

d. All installation and facility personnel who are programming upgrades to existing washrack separators should go through the Decision Tree process outlined in this report prior to submitting environmental funding request documents.

SECTION 6. APPENDIXES

APPENDIX A. LESSONS LEARNED CHECKLIST

Items to consider when upgrading an oil/water separator[1]:

a. Determine the characteristics of the influent to the upgraded separator. Use those characteristics (i.e. flow and pollutant concentrations) along with pretreatment water quality goals (maximum allowable pollutant loading to receiving treatment works) to establish performance requirements. The influent characteristics should represent the normal worst case scenario. Procedures outlined in Section 2 of this report may be used to establish influent characteristics.

b. When selecting or designing a washrack facility, consult the CE ETL 1110-3-466 (see Web site described in paragraph g).

c. If upgrading to a COTS oil/water separator, purchase an open-top design. An open top with easily removable cover will make visual inspections and maintenance of the oil/water separator easier through increased accessibility.

d. If an above-ground oil/water separator is chosen, verify that the pumped influent flow is at or below the intended design flow rate.

e. When purchasing an oil/water separator, include a performance guarantee in the contract. Do not rely on the manufacturers' claims of wastewater oil effluent concentrations. Manufacturers' claims of free oil removal are not verifiable. In the contract, specify treatment performance requirements based on site-specific discharge limits. The verification of the limit should be by sampling and analysis as required to verify permit or pretreatment requirements.

f. Eliminate or minimize stormwater intrusion to reduce wastewater treatment volume and storm surges, thus minimizing separator capital cost.

g. Additional information relating to U.S. Army and DOD oil/water separator research efforts may be accessed at the following world-wide web address: http:/www.plaii.com/oilwater. Requests for additional assistance should be directed to the U.S. Army Environmental Center's Technology Transfer hotline: 1-800-USA-3845 or by electronic mail to: t2hotline@aec.apgea.army.mil.

[1] The following checklist is in part summarized information contained in the Public Works Technical Bulletin 200-1-05 "Oil/Water Separator Selection, Installation, and Maintenance: Lessons Learned". See Web site described in paragraph g.

Table B-1 presents the results of the TPH analysis of samples taken at Location A.

TABLE B-1. TPH DATA

Date Sampled: 20 May 1997

Sample Point	Sample No.	TPH, mg/L
Sediment basin influent	1	7.8
Sediment basin influent	3	120.8
Sediment basin influent	5	108.8
Sediment basin influent	7	1378.8
Sediment basin influent	9	10.5
Sediment basin influent	11	10.9
Gravity oil/water separator influent	14	41.9
Gravity oil/water separator influent	16	13.2
Gravity oil/water separator influent	18	41.5
Gravity oil/water separator influent	20	161.2
Gravity oil/water separator influent	22	148.7
Gravity oil/water separator influent	24	63.5
COTS oil/water separator influent	26	4.8
COTS oil/water separator influent	28	4.3
COTS oil/water separator influent	30	2.4
COTS oil/water separator effluent	38	1.5
COTS oil/water separator effluent	40	1.6
COTS oil/water separator effluent	42	1.4

Notes: Sediment basin effluent = gravity oil/water separator influent.
COTS oil/water separator influent = gravity oil/water separator effluent.

Table B-2 presents the results of the TPH analysis of samples taken at Location B.

TABLE B-2. TPH DATA

Dates Sampled: 6 and 7 May 1997

Sample Point	Sample No.	TPH, mg/L
Sediment basin influent	1	594.6
Sediment basin influent	3	492.9
Sediment basin influent	5	533.9
COTS oil/water separator influent	7	69.3
COTS oil/water separator influent	9	29.3
COTS oil/water separator influent	11	53.8
COTS oil/water separator effluent	13	6.7
COTS oil/water separator effluent	15	14.7
COTS oil/water separator effluent	17	26.0
COTS oil/water separator influent	19	67.8
COTS oil/water separator influent	21	71.4
COTS oil/water separator influent	23	66.5
COTS oil/water separator effluent	25	51.2
COTS oil/water separator effluent	27	60.6
COTS oil/water separator effluent	29	45.8

Note: COTS oil/water separator influent = sediment basin effluent.

Table B-3 presents the results of TPH analysis of samples taken at Location C.

TABLE B-3. TPH AND OIL AND GREASE DATA

Date Sampled: 24 June 1997

Sample Point	Sample No.	TPH, ppm
Sediment basin influent	[a] 2	172.1
Sediment basin influent	3	22.0
Sediment basin influent	6	99.7
Sediment basin influent	[b] 7	163.1
COTS oil/water separator influent[c]	17	80.6
COTS oil/water separator influent[c]	19	33.6

See footnotes at end of table.

TABLE B-3 (CONT'D)

Sample Point	Sample No.	TPH, ppm
COTS oil/water separator influent[c]	21	32.4
COTS oil/water separator influent[c]	23	25.9
COTS oil/water separator influent[c]	25	17.9
COTS oil/water separator influent[c]	27	24.7
COTS oil/water separator influent[c]	29	16.8
COTS oil/water separator influent	[d]31	24.3
COTS oil/water separator effluent	33	10.3
COTS oil/water separator effluent	35	9.1
COTS oil/water separator effluent	37	12.6
COTS oil/water separator effluent	39	10.9
COTS oil/water separator effluent	41	12.9
COTS oil/water separator effluent	43	12.0
COTS oil/water separator effluent	45	11.6
COTS oil/water separator effluent	47	14.0

[a]Sample No. 2 = 175 mL of sample.
[b]Sample No. 7 = 540 mL of sample.
[c]COTS oil/water separator influent = sediment basin effluent.
[d]Sample No. 31 = 710 mL of sample.

Note: All samples were 1000 mL or more except where otherwise noted.

APPENDIX C.   REFERENCES

1 U.S. Army Center For Public Works, Public Works Technical Bulletin 200-1-05, Oil/Water Separator Selection, Installation, and Maintenance: Lessons Learned, 5 November 1997.

2. U.S. Army Corps of Engineers, Engineering Technical Letter (ETL) 1110-3-466, Selection and Design of Oil/Water Separators at Army Facilities, 26 August 1994.

3. Albert, Brian L. and Gerdes, Gary L., User Guide for Implementation of RGF Washrack Recycle Treatment Systems, Facilities Engineering Applications Program Guide 97/120, U.S. Army Center for Public Works, September 1997.

4. U.S. Army Construction Engineering Research Laboratories, Oil/Water Separator Research to Develop Design Guidance for Coalescing Separators, report scheduled for release September 1999.

5. U.S. Army Construction Engineering Research Laboratories, Characterization of Washrack Separator Influents at Army Reserve Facilities, report scheduled for release March 1998.

6. MIL-C-22542B, Cleaning Compound, High Pressure Cleaner, Liquid, 26 August 1987.

7. United States Environmental Protection Agency, EPA Method 1664: N-Hexane Extractable Material (HEM) and Silica Gel Treated N-Hexane Extractable Material (SGT-HEM) by Extraction and Gravimetry Coil and Grease and Total Petroleum Hydrocarbons, EPA-821-B-94-004, January 1995.

APPENDIX D. ABBREVIATIONS

AEC	**=**	**U.S. Army Environmental Center**
AFB	=	Air Force Base
ARNG	=	U.S. Army National Guard
ATC	=	U.S. Army Aberdeen Test Center
CE	=	U.S. Army Corps of Engineers
CERL	=	U.S. Army Construction Engineering Research Laboratories
COTS	**=**	**commercial off-the-shelf**
ETL	=	Engineering Technical Letter
FOTW	=	federally owned treatment works
gpm	=	gallons per minute
HQ	=	Headquarters
MACOMs	=	U.S. Army Major Commands
POTW	=	publicly owned treatment works
ppm	=	parts per million
TECOM	**=**	**U.S. Army Test and Evaluation Command**
TPH	=	total petroleum hydrocarbons

APPENDIX E. DISTRIBUTION LIST

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