

WASTE MANAGEMENT

HAZARDOUS WASTE MINIMIZATION: PART IX

Waste Minimization in the Automotive Repair Industry

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Waste minimization in the automotive repair industry is characterized by the large numbers of small quantity generators (SQG) producing solvent, alkaline and detergent hazardous wastes. On-site management of multiple processes which vary depending on the size of shop make the administration of hazardous waste policies particularly complex. This paper presents the quantities and types of hazardous materials typically produced. Guidelines are presented to allow generators to organize a waste minimization program.

The automotive repair industry is comprised of small quantity generators (SQG). These comprise the largest and heaviest producers of hazardous waste material of all SQGs. The two-year survey of small quantity generators of hazardous waste issued by EPA's Office of Solid Waste (OSW) was released on March 12, 1985. It shows vehicle maintenance leading in numbers of generators (82,530 of 175,000) and highest in quantity of total waste produced (351,500 tons/year out of a total 760,000 tons/year) for SQGs.¹ SQGs produce less than one-half of one percent of the hazardous waste produced nationally. However, the sheer number of SQGs pose human health and environmental risks. EPA defines an SQG as generating at least 220 pounds but less than 2,200 pounds of hazardous waste per month.

The research performed to develop the industry characteristics used in this article is based upon the on-site audit of three specific sites. Interviews and discussions with additional shop owners and trade representatives were also performed to confirm the validity of the conclusions developed. Contractors who provide waste treatment and/or minimization equipment and equipment services cited in this article were interviewed to assess the proper use and application of these devices.

The automotive repair industry is composed of three primary segments. Shown in Figure 1 are those segments which produce the significant solvent and aqueous hazardous liquid wastes and sludges requiring disposal as hazardous waste. The areas which produce the majority of wastes are automotive repair shops and new car dealerships.

Repair Operations and Quantities of Hazardous Wastes Generated

Typical operations generating hazardous wastes can be generalized as those processes for engine parts and equipment cleaning, those processes for oil and grease removal, and wastes generated by solution replacements during engine maintenance. Table I

provides a description of typical materials used and waste types.

Table II provides the waste generation rates at three sites audited to develop typical material quantities. The majority of wastes produced are in the form of:

- Waste parts cleaning solutions and other miscellaneous detergent wastes
 - solvent cleaning solutions
 - aqueous detergent or caustic cleaning solutions
 - carburetor cleaners
 - aqueous floor cleaning detergents
- Oil and grease removal wastes from engine cleaning
 - hot tank sludges
 - engine spray cleaning waste solids
- Spent automotive fluids and batteries
 - waste anti-freeze solution
 - waste engine oil
 - spent automotive transmission fluids
 - spent automotive batteries

Worn or replaced automotive parts such as brake shoes or pads containing asbestos, and mufflers or shock absorbers containing hazardous components are not studied here since the hazardous components are fixated in the waste parts.

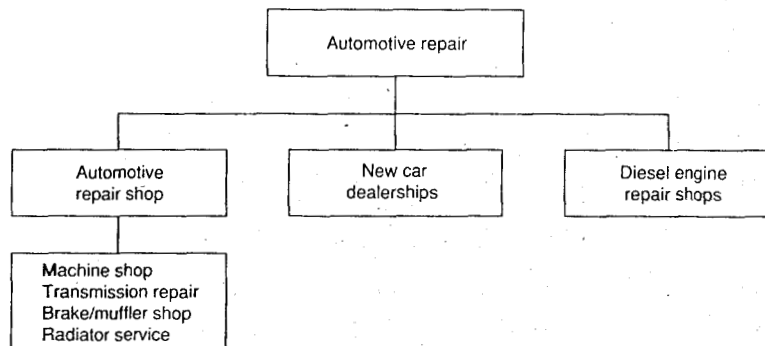


Figure 1. Segments of the automotive repair industry generating significant hazardous wastes.

Table I. Typical auto repair operations with materials used and waste products produced.

Process operation	Typical materials used	Typical material ingredients on label	General types of wastes generated
Oil and grease removal	Degreasers-(gunk), carburetor cleaners, engine cleaners, varsol, solvents, acids/alkalis	Petroleum distillates, aromatic hydrocarbons, mineral spirits	Ignitable wastes, spent solvents, combustible solids, waste acid/alkaline solutions
Engine, parts and equipment cleaning	Degreasers-(gunk), carburetor cleaners, engine cleaners, solvents, acids/alkalis, cleaning fluids	Petroleum distillates, aromatic hydrocarbons, mineral spirits, benzene, toluene, petroleumnaphtha	Ignitable wastes, spent solvents, combustible solids, waste acid/alkaline solutions
Solution replacement	Antifreeze solution, petroleum oil	Ethylene glycol, petroleum distillates	Hazardous liquid combustible liquid

Equipment Operation

The solvent parts washer recirculates solvent continuously from the solvent drum to the solvent wash tray where the parts are cleaned. Solvent is normally replaced with fresh solvent on a monthly basis. The hot tank uses an electrically heated aqueous detergent solution which cleans parts immersed in the solution. The tank may be equipped with air or mechanical agitation. Hot tanks usually operate at 180°F. The jet spray washer uses an electrically heated aqueous wash solution also. Parts are suspended in the washer and rotating water jets spray the parts to perform the cleaning. Both hot tanks and jet sprays are usually serviced monthly by removing 10 gallons of liquid and sludge and recharging the solution with detergent.

Typically, a transmission repair business will have a single jet spray washer and possibly one solvent sink. A typical auto machine shop would have one solvent sink and neither a jet spray or hot tank. A typical auto dealership might have several solvent sinks, a hot tank, and no jet spray washer. In most cases the equipment would be owned and serviced by the business with no outside maintenance service contractor.

Hot tanks are prevalent in the industry for removing oil, grease and dirt from large engine parts. Jet spray washers are not as prevalent, but considered essential in many transmission repair operations. Solvent sinks are universally used in most engine repair operations.

Description of Facilities Audited

Three companies were audited to assemble the industry characteristics. These are shown in Table III. The participants were chosen to characterize

Automotive Parts Cleaning Operations

Currently, most automotive repair businesses use equipment to minimize solvent or cleaning solution use and losses. These devices can also be viewed as control or containment vessels of hazardous waste materials. The operation and maintenance of these devices usually provides the key to control of the majority of uncontrolled liquid hazardous wastes generated on site.

Types of Equipment

Parts washers can be categorized as solvent parts washers, hot tanks, jet spray washers, ultrasonic cleaners, steam cleaners and bake-off ovens. The devices used primarily in automotive repair operations are solvent parts washers, hot tanks and jet spray washers. Ultrasonic cleaners have not been used as compared to the solvent parts washers generally found in most businesses. Solvent parts washers require the operator to manually wash parts in

a solvent stream. Bake-off ovens leave a dry solid residue which must be cleaned off by further mechanical cleaning. Bake-off ovens are used in many large volume engine rebuilding operations.

Solvent parts washers, hot tanks, and pressure cleaning chambers are self-contained baths with recirculating and/or agitated compartments. The solution is used and replaced on a 1- to 3-month schedule depending on the degree of use. The petroleum distillate solvent used in the solvent parts washer is a 310-400°F boiling point fraction material. Caustic soda is used for hot tanks cleaning ferrous based metals. Detergent based cleaners are used for hot tanks which clean aluminum based metals. Similar materials are used in the pressure cleaning chamber. A typical carburetor cleaner may contain 45 percent methyl chloride, 5 percent 1,1,1, trichloroethane and 15 percent cresylic acid. Carburetor cleaners may or may not be used with a small agitator type cleaning chamber.

Table II. Automotive repair hazardous wastes generated by audited firms.

Waste	DOT shipping name	Hazard class	Number	Firm A		Firm B		Firm C	
				gal/mo	lb/mo	gal/mo	lb/mo	gal/mo	lb/mo
Spent solvent	Waste petroleum distillate	Combustible liquid	UN 1268	7	54	80	616	2200	16940
Aqueous detergent or caustic wastes	Waste corr. liquid N.O.S.	Corrosive liquid	UN 1760	90	756	20	168	2000	17400
Carburetor cleaner	Waste compound cleaning liquid	Corrosive liquid	NA 1760	8	78	10	98	13	127
Antifreeze solution	Waste liquid	ORM-E	UN 9189	32	282	100	880	—	—
Engine oil	Waste petroleum oil	Combustible liquid	NA 1270	55	385	300	2100	—	—
Oily dirt with high metals	Waste corr. solid N.O.S. ^b	Corrosive solid	UN 1759	—	0	N.A. ^a	N.A.	<20	<500
Spent sawdust	Waste corr. solid N.O.S.	Hazardous solid	UN 1759	—	110	—	550	—	—
Lead-acid batteries	Lead dross cont. >3% free acid	ORM-C	NA 1/94	3 bat.	105	10 bat.	350	—	—
Detergent soln. from floor wash	Waste corr. liquid N.O.S.	Corrosive liquid	UN 1760	—	0	N.A.	N.A.	—	—

^a N.A.—not available.

^b N.O.S.—not otherwise specified.

Table III. Participants in waste audit study.

Name of company	Facility size	Type of business
Firm A	20 cars per week	Complete automotive repair specializing in transmission and engine maintenance
Firm B	500 cars per month	Auto dealership offering new car maintenance and service
Firm C	700 auto repair firms serviced	Auto parts cleaning. Major supplier of leased auto parts cleaning tanks and chemicals.

the industry. Firm A is representative of many small to medium auto repair shops. With 15 years of auto engine repair and maintenance experience, it represents an established auto repair shop. Parts cleaning operations on engine, transmission and differential repairs run the spectrum of engine drive train repairs. It services approximately 20 cars per week. The second firm, Firm B, is a large automotive dealership in northern California. Firm B services in its repair shop 500 cars and trucks per month, and sells 300 cars or trucks per month. Firm C provides a larger sampling of the wastes produced in the northern California area. Firm C leases solvent sinks and parts washing equipment to over 700 auto repair firms. These range from large dealerships to small repair shops, servicing an area from Redding to Reno to Salinas. The company sells the solvents and detergents used in its equipment. It recovers, processes, and disposes of the hazardous waste materials produced. Table IV shows the types and percentages of services provided at Firms A and B. Table V shows parts cleaning equipment used by Firms A and B as well as the equipment leased and serviced by Firm C.

Discussion

Hazardous Waste Control Levels

Six levels of solvent and aqueous hazardous waste controls can be identified and applied to each of the above selected firms types:

Level 1. No control—once-through waste generation and disposal to municipal sewer or dump.

Level 2. Waste collection for proper disposal.

Level 3. On-site reuse equipment to minimize solution use or loss.

Level 4. Service company to provide off-site waste recovery or recycling.

Level 5. On-site waste reclaim equipment.

Level 6. Source Reduction and Improved Housekeeping.

economic incentives. Many of these small businesses generate less than 10 gallons per month. These quantities can cost more for disposal than the original purchase price. Waste motor oils regularly picked up under different manifest variance permits are used as the vehicle for illegal disposal. Aqueous wastes often contain hazardous levels of grease, oil, and heavy metals. Many

Table IV. Services performed by individual audited firms.

Service provided	Firm A		Firm B	
	%	Vehicles per mo.	%	Vehicles per mo.
Periodic auto maintenance			25	125
Transmission maintenance	60	52	5	25
Engine repair	10	9	10-12	50
Brake servicing	20	18	2-3	10
Front end alignment			4-5	20
Light duty, noise, warranty work			30-35	150
Tune-up			10	50
Other	10	9	5	25
Total	100	88	100	500

Each repair shop is encouraged to start its waste minimization efforts by identifying those areas easily improved by source reduction and improved housekeeping methods. These changes can require the least efforts and expense and the most easily derived benefits. Additional efforts would proceed by applying successively Levels 2 through 5.

Waste Audit Study Results

The results presented are the information, alternatives, and specific vendors to minimize on-site waste generation that 1) limit illegal waste disposal, and 2) recycle and/or reduce volumes to be shipped off site. These results can facilitate self-compliance with hazardous waste disposal regulations.

In general, segregation of solvent and aqueous waste by small to medium repair shops must be promoted. This would include additional regulatory or

small shops illegally dispose of this to the municipal sewer, violating local regulations. This study showed that efficient use of a solvent service to supply and dispose of solvent wastes is an economical alternative.

Specific Areas of Non-Compliance and Compliance

Aqueous wastes are generated when a hot tank or jet spray is used to clean engine parts. Pick-up of the waste liquids and sludges can be provided by waste service companies with the proper shipping manifests. But in some cases, the waste hauler is dumping to the municipal sewer illegally. These problems are currently being identified and remedied by local and state enforcement agencies.

Large auto dealerships are often more aware of hazardous waste regulations. These firms comply with collection and manifesting requirements,

Table V. Parts cleaning equipment used and/or serviced by audited firms.

Equipment	Firm A Used and serviced	Firm B Used and serviced	Firm C Leased and serviced
Hot tank	—	2	300
Jet spray	1	—	38
Solvent sink	—	10	340

have rigid maintenance standards, as well as the financial resources needed for compliance. These shops are aware of alternatives. In many cases a group of five or more dealerships obtain more favorable pricing from maintenance service companies. Small and medium sized automotive repair operations should be encouraged to form cooperatives through trade associations to obtain comparable pricing. Source reduction methods can be practiced to reduce the quantity or degree of hazardous waste produced.²

Source Reduction and Housekeeping

Significant quantities of waste generation can be avoided by the proper operation of existing equipment and good housekeeping efforts such as preventing spills and the proper location of service equipment to simplify operations. Solvent sinks, hot tanks and jet spray washers have proven effective in reducing waste. Use of drip trays and collection of solid residues from cleaning further controls waste discharges.

On-Site Solvent Recovery and Aqueous Waste Volume Reduction

Solvent reclamation equipment is becoming available for small scale on-site use. For repair operations with existing shop owned solvent sinks the payback economics are favorable when spent solvent quantities exceed 50 gallons per month. A 2- to 3-year payback is possible in this case. For smaller operations with only one or two solvent sinks reduced solvent costs and spent solvent disposal costs do not adequately offset capital costs. For auto repair shops and dealerships using a solvent service the economics for small solvent recovery devices are not as favorable. Additional costs are incurred to purchase solvent sinks as well as reclamation equipment. Cost analyses are based upon comparisons with typical outside solvent services. Additional operating costs include utilities, materials, labor for sink maintenance and solvent handling, distillation labor, plus costs to dispose of distillation residuals.

The economics are very favorable when the recovery equipment is installed at the solvent service level of operation. Solvent used at the rate of 2200 gallons per month were found to pay back the cost of a recovery system in 6 to 9 years with annual cost savings of \$2,700 to \$4,800 per year. For 3700 gallons per month consumption, the savings are \$8,000 to \$9,000 per year for a 3- to 4-year payback on investment.²

Technology for small scale on-site aqueous waste volume reduction has

recently been adapted from larger scale uses. Evaporative volume reduction for coolants, rinse waters, water-based inks, and alkaline cleaners at 14 gallons per hour have been downscaled and re-priced for the 5 gallon per hour or less needed in the auto repair industries. These units can pay back in 1 to 2 years in non-union shops. Chemical treatment can produce a fixated sludge and sewerable water. However, the economics are unfavorable on-site at the small scale. For disposal off-site at larger scales of 5000 gallons per month, a payback period of 2 to 12 months is possible with yearly cost savings of \$28,000 to \$40,000 over Class 1 landfill disposal site costs. These economics only apply when and if Class 1 disposal site costs are imposed and incurred.³

Application of Hazardous Waste Control Levels

The six levels of control listed above can identify current waste practices.

Solvent Wastes. Level 1, no control, is currently practiced by many small to medium operations. These can be upgraded to Level 2, collection; Level 3, on-site reuse (solvent sinks); and Level 4, solvent service for waste recovery by proper information and selective enforcement of existing disposal regulations. Most medium or large repair operations currently use solvent sinks and/or solvent services. An off-site solvent service will recycle the solvent by distillation and direct reuse, or use as waste fuel. The effort to be made here is to assure proper on-site solvent segregation by the repair shop. Level 5, on-site waste reclamation equipment, is only economical for an off-site solvent recycling firm at the present time. Level 6, source reduction and housekeeping, can include low cost, simple housekeeping improvements as well as major operational changes such as upgraded washing equipment or chemical substitutions.

Aqueous Wastes. The use of hot tanks and jet spray detergent washers for engine and transmission parts is prevalent in the industry. This identifies a Level 3 application of reuse equipment. Most shops, small and large, have concluded that substantial labor savings are realized when these washers are used. Disposal of 10 to 80 gallons per device on a monthly basis is typical of most operations. The problem at this point is illegal discharge to the sewer. The technology for proper volume reduction is rudimentary at this time. It is not applied either at the source of generation or by the waste hauler. In other words, upgrading to

Level 4 may not reduce illegal sewerage.

Disposal to the municipal sewer at the repair shop is currently done either due to lack of information about the hazardous nature of this waste, or to avoid the expense of shipment and disposal at a Class 1 landfill. Currently, local jurisdictions are enforcing court orders to prohibit sewerage of hazardous wastes at auto repair shops by waste haulers. An alternative is the installation of volume reduction equipment. Volume reduction of approximately 10 to 1 can provide a solid residue. This can be stabilized for disposal at a Class 1 landfill. A combination of Level 4, service company providing off-site waste concentration, and Level 5, on-site volume reduction could provide this alternative. Both evaporative and chemical treatment methods are currently available. A combination of public information of current regulations, enforcement of existing regulations, and application of technology must occur to control these wastes.

Reference 2 provides a partial listing of equipment suppliers and contractors for services discussed in this article. These may be used as a resource to identify the proper equipment or service to solve specific waste minimization problems. A partial listing of collection and disposal services available for specific waste types is also provided. Use of calculation methods presented in Reference 2 will allow shop owners to develop payback periods for specific site applications.

Recommendations

Solvent Wastes

Waste segregation at small to medium auto repair shops can be accomplished. For collection and disposal the waste oil recycler must obtain the proper manifest variances for solvents. Alternately, a hazardous waste hauler can pick up these waste solvents. Lease of solvent cleaning equipment with material supply and waste disposal provisions is another alternative. Use of on-site solvent recovery equipment is favorable for processing greater than 50 gallons per month when solvent sinks are presently shop owned. Use of solvent recovery equipment by solvent sink service and maintenance operations is economically attractive and should be promoted.²

Aqueous Waste

For aqueous wastes, on site use of hot tanks and jet sprays for waste minimi-

zation is already a part of normal operations. The equipment reuses the cleaning solution until its activity is spent. Extension of the life of the solution would occur by:

- Prewash to minimize the introduction of oil and grease into the final wash solution. This can be accomplished by a pre-rinse with spent cleaning solution of parts to be cleaned,
- Periodic or continuous removal of dissolved solids and heavy metal components by sludge removal or solids fixation. The use of filtration equipment or a periodic tank maintenance service to remove sludge material,
- The addition of fresh detergents can reactivate the spent cleaning solution.

Chemical waste treatment equipment has marginal economics compared to equipment maintenance services. Chemical treatment methods can be favorable for an equipment leasing service company. A 2- to 12-month payback on the initial capital investment is possible. On-site evaporative waste treatment equipment will provide an approximate 12- to 15-month payback on investment.³

Spent radiator solution is generated at 30 to 100 gallons per month by medi-

um to large repair shops. This should be properly disposed of as a hazardous waste. Many smaller shops are not aware of this requirement, and are illegally sewerage this waste. Some licensed waste haulers may ship this waste for processing as a waste fuel.

Oil Wastes and Oily Solid Wastes

Waste engine oils in general are accumulated properly by large and small repair shops. Independent contractors properly manifest and refine these wastes for reuse.

Oily soils high in heavy metals content are a significant hazardous waste generated by hot tank cleaning. Often this material is not properly disposed of by large and small operations alike. Typically it is taken off-site to local municipal dumps. Proper practice would be to identify the hazardous nature of this waste and provide shipment to a Class 1 landfill. This material accumulates in the waste sump of the pressure spray cleaning bays on site.

Conclusion

Waste minimization in the automotive repair industry is a practicable response to the problems of hazardous waste. The operational practices, equipment alternatives, and capital

costs can be developed to provide a basis for sound business decisions to address these problems.

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Wesley M. Toy, P.E. is a consulting engineer specializing in the evaluation and design of treatment and handling facilities for hazardous materials, located at 18805 Cox Ave., Suite 120, Saratoga, CA 95070. This paper was submitted for peer review September 13, 1988; the revised manuscript was received October 5, 1988.

Planning and Conducting Sampling Surveys of Hazardous Wastes at Industrial Facilities

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Many organizations and their consultants are involved in sampling programs to characterize waste streams and materials at industrial facilities. Due to financial limitations, calendar deadlines, or other practical restrictions, a short-term, survey-type sampling plan ("sampling survey") may need to be implemented. Survey results can be used to determine if the wastes are hazardous or if they are being managed in accordance with applicable regulations. This paper brings together practical experience and diverse information to identify the major concerns in conducting sampling surveys and to suggest methods of approaching these concerns. The paper addresses sampling in time and space, "correct" sampling to minimize bias, selecting equipment to minimize contamination, sample handling, and quality assurance/quality control. Even a quick sampling survey can be a high quality effort with a careful approach to the critical issues.

Correct environmental sampling involves the partitioning of some batch of material to a subpart of the original material that is both manageable and representative of the original batch. The most important part of collecting an environmental sample is the careful planning and detailed approach necessary to collect for analysis a sample that can represent the original source material. A variety of sampling tools and methods may be used for obtaining samples of solids/sludges, liquids/slurries, and groundwater.

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