Chapter 4

HOUSEHOLD AUTOMOTIVE WASTE OIL: GENERATION AND DISPOSAL

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Oil enters the environment in several forms, ranging from raw crude to highly refined oil, and in many ways, including legal dumping, illegal dumping, continuous discharges, accidental spills, and leakage.

There is little information on how private motor vehicle owners who change their own oil actually dispose of their waste oil. This report, through data received from a household survey, will estimate the amounts of automotive waste oil generated by households in Berkeley, and summarize the disposal methods used by these residents. From the amounts of household automotive waste oil generated, this report will make an assessment as to the problem of waste oil disposal in the Berkeley area.

Waste Oil

Waste oil, as defined in this report, is oil which has performed its useful purpose and no longer has the chemical and/or physical properties required of it. It also becomes waste oil once it is discarded from the machine that it was intended to serve. Waste oil is generated by both industrial and private sources.

Automotive waste oil includes all crankcase oils, lubricants, transmission fluid, hydraulic oil, and small quantities of solvents that are used in motor vehicles. These become waste oil after they are changed or purposely drained. In this report, oil consumed by the vehicle itself and the discarding of oil in junked vehicles is not regarded as waste oil.

Currently, approximately 1.6 billion gallons of waste oil are generated in the U.S. annually (EPA, 1974). Oil consumption has remained fairly constant since the mid-1970s (Stenstrom and Silverman, 1982). About half of that is disposed of in an unknown manner or in a way that may lead to the pollution of surface and ground waters. Any oil dumped into the environment poses the threat of environmental damage. Since waste crankcase oil has a high metal content, it can pose an additional threat to the environment (EPA, 1974).

Automotive oil sales and waste oil generation in the U.S. are about 1.2 billion gallons of oil sold per year, and about 750 million gallons of waste oil generated per year (Stenstrom and Silverman, 1982). About 60% of all automotive crankcase oil sold becomes waste (EPA, 1973). About half of the waste oil generated is sent to reprocessors and re-refiners, and the other half is disposed of in ways that let waste oil enter the environment untreated (Maizus, 1975). Much of the oil that is recycled is returned to the consumer as refined lubricating oil or fuel oil (Maizus, 1971).

Waste oil is currently disposed of in a number of ways; some are definitely more environmentally sound than others. There are few data available on the long-term ecological effects of waste oil. The effects of waste oil upon the living environment must currently be determined by using data derived from the ecological effects of crude oil and used oil (Anderson, 1977).

Environmental Effects

Oil enters aquatic systems through storm drains and oil spills. Much of the oil entering aquatic systems through storm drain runoff enters in pulses directly related to precipitation. Although the concentration of oil in an aquatic system as a result of storm drain runoff is much less than the concentration as a result of an oil spill, storm drain runoff should not be ignored, because oil enters aquatic systems in the bay through storm drains at a relatively constant rate, whereas oil spills occur on a sporadic basis and large spills do not occur very often (Linden, 1979). The major contributor to waste oil in storm drain runoff is most likely used automotive oil (Wakeham, 1977). Oil spills in San Francisco Bay are much more serious a problem than waste oil entering the bay through storm drain runoff. The effects of oil spills are usually immediate and acute. Oil spills result in nearly instantaneous loss of life for benthic organisms, birds, fish, and some vegetation in spill affected areas. Oil in storm drain runoff is likely to have a slower or chronic effect on local organisms (Stenstrom and Silverman, 1982).

Oil is most damaging when discharged into shallow estuarine nursery areas. The shallowness of the water in these areas means that less oil is needed to produce concentrations that may produce a toxic effect upon organisms in the system (NAS, 1975).

The toxic effects may be acute, or sublethal. Acute toxicity results in the death of organisms immediately or shortly after contact with the oil. Acute toxicity is usually associated with oil spills. Sublethal toxicity may result in a shortening of the life span, lowering of reproductive productivity, or slow deaths of the affected organisms (Linden, 1979). After oil spills, many benthic organisms die from acute toxicity and suffocation (NAS, 1975).

Waterbirds, muskrats, and many other forms of wildlife require water that is free of surface oil for their health and reproduction. Egg laying has been inhibited when ducks have ingested even small quantities of oil (EPA, 1974). Where surface oil is concentrated to a degree such that it adheres to the plumage of waterbirds, large losses of waterbirds have occurred (EPA, 1974). Once the plumage of birds is soaked with oil, the bird loses its natural insulation to the cold, and also its buoyancy, because air in the plumage is replaced by water. The eventual result is the death of the bird due to exposure. Hundreds of thousands of birds have died from oil pollution in North American waters. Even when the birds are cleaned of the oil, they often die because toxic oil is ingested when they preen their feathers (EPA, 1973).

Oil that settles to the bottom of aquatic habitats can cover large areas and destroy plants, animals, and fish that live on or near the bottom of contaminated sediments. These organisms often become contaminated and enter the food chain where birds, humans, and other animals may later eat the contaminated organisms.

The mortalities of birds, animals, and fish as a result of oil pollution is direct, and in major oil spills is measured in the thousands. Species that spend most of their lives in salt or fresh water near oil pollution sources are most prone to death from oil pollution. But any organism that feeds directly or indirectly in areas that may be oil polluted is also vulnerable. Concentrations of oil as low as 310ul/l can cause problems for freshwater fauna (EPA, 1974). Areas of San Francisco Bay near storm drain outlets may have low concentrations of oil present which may have a negative effect on the biological productivity of organisms whose habitat is there.

Effects on Water Supply

It is important that public water supplies remain free of oil and grease contamination. Even amounts of oil as small as lmg/l in the drinking water may cause taste and odor problems. Also, small amounts of oil can cause scumlines in pools, water treatment walls, glasses, and other containers (Bock and Eckert, 1976).

Waste oil can also interfere with the ability of water treatment plants to treat waste water. Oily materials which enter activated sludge systems are almost immediately absorbed onto the biological floc. Large amounts of oily materials interfere with activated sludge systems by lowering the density of the floc to the level where some or all of the sludge settling properties of the system may be destroyed (Hydroscience, 1977).

Methodology

A household survey was used to gather data on automotive waste oil generation in Berkeley (see Appendix to Section IV.A.). The survey was conducted by telephone in January and February, 1984, and 69 households participated. The survey included questions that dealt specifically with automotive waste oil. The estimations for automotive waste oil disposal were derived from information obtained through the household survey.

The household members participating in the survey were asked if anyone in the household changes their own motor oil. If the response to the question was yes, then they were asked to estimate the amount of automotive waste oil they disposed of in the past year. If they couldn't estimate the amount of waste oil they disposed of, they were asked how many times a year their motor oil was changed.

The average amount of waste oil released when automotive oil is changed is about 4 1/2 gallons per oil change. To arrive at an estimate of annual waste oil generation, that figure was multiplied by the number of times the waste oil was changed in the past year.

Survey Results

Of the 69 Berkeley households completing the telephone survey, 43% had members that changed their own motor oil, and as a result, had waste oil to dispose of. Based on survey responses, it is estimated that approximately 113 gallons of waste oil are generated annually by the 69 households. Berkeley residents disposed of their automotive waste oil in several different ways, which could be grouped into five categories: disposal by taking to service stations and recycling centers, 59%; by household storage, 16%; by throwing it in the garbage, 12%; by dumping in storm drains, 8%; and by dumping on their property, 5% (Table 1).

Disposal Method	Estimated Gallons	Percentage
Service Stations & Recycling Centers	66.4	59%
Put on Ground	5.3	5%
Garbage Can	13.5	12%
Storm Drain	9.4	8%
Storage	18.4	16%
TOTALS	113.0	100%

Table 1. Estimated Yearly Generation and Disposal of Waste Oil from the 69 Berkeley households surveyed.

Only waste oil that is taken to service stations or recycling centers for disposal can be considered to be disposed of properly. Waste oil that is dumped into storm drains in Berkeley eventually flows into San Francisco Bay. Runoff enters San Francisco Bay along the shorelines. Shoreline areas are not rapidly flushed in comparison to the rest of the bay. As a result, accumulation of oil may build up in these areas, damaging shellfish beds, waterfowl, and vegetative life productivity (Stenstrom and Silverman, 1982).

Waste oil that is mixed with solid garbage in trash cans is taken to landfills, where it may percolate into the soil and contaminate ground water reservoirs (EPA, 1974). Waste oil that residents just dump in their yard may enter the ground water supply, but most of that oil stays near the surface of the soil and evaporates, emitting hydrocarbons to the atmosphere. That can create a hazard for pets and small children (EPA, 1974).

The amount of waste oil generated annually by all the households in Berkeley was estimated by using the survey results to find the average amount of waste oil generated per year for each of the 69 households surveyed. Then the average amount of waste oil generated by each of the surveyed households per year was multiplied by the total number of households in Berkeley. The total number of households in Berkeley at the last census was 44,704 (ABAG, 1982). The survey results projected over the entire population of Berkeley indicate that households generated 73,211 gallons of waste oil in 1983 (Table 2).

Disposal Method	Estimated Gallons Disposed	Ultimate Disposal Site
Service Stations & Recycling Centers	43,003	Returned to Consumer
Put on Ground	3,442	Groundwater
Garbage Can	8,747	Landfills, Groundwater
Storm Drain	6,074	San Francisco Bay
Storage	11,945	The Home
TOTAL	73,211	

Table 2. Estimated Annual Waste Oil Generation and Disposal; Survey Results Projected Over Berkeley's Entire Household Population.

Conclusions

The survey indicated that over 6,000 gallons of household automotive waste oil enters San Francisco Bay annually as a result of household disposal practices in Berkeley. This is about 17 gallons daily. An oil refinery that has a capacity of about 350,000 bbl/day is allowed legally to put over 130 gallons/day of waste oil into San Francisco Bay (Strenstrom and Silverman, 1982). 17 gallons/day is a small amount when compared with the amounts of oil that industrial sources are allowed to dump into San Francisco Bay.

Survey responses indicate that the people who stored waste oil did so because they knew it was potentially hazardous to the environment, and they didn't know the proper ways of disposing it. Once informed about recycling centers and service stations, these people stated that they intended to use those services in the future for disposing their waste oil. By informing people about the best ways to dispose of waste oil, the amount of household automotive waste oil that is taken to recycling centers and gas stations may increase to over 70% of the total household automotive waste oil generated in Berkeley.

The problem of automotive waste oil disposal from households in Berkeley was less than anticipated. It appears that the best way to deal with this problem in Berkeley would be to inform the public as to what should be done with their waste oil. Lists of service stations that accept waste oil and recycling centers should be made readily available to consumers at the point of their oil purchase, or large signs could be posted at service stations telling patrons what to do with their oil. Public education on the problem of waste oil disposal would be inexpensive, help in keeping the bay clean, and might even prompt citizens to put pressure on the larger oil producers and consumers who do not properly dispose of their motor oil.

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Chapter 5

THE ROLE OF RECYCLING IN COMMUNITY COLLECTION OF HAZARDOUS WASTE

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As concern grows over hazardous waste produced by households and small businesses, and the costs of commercial disposal remain high, many communities are turning to the collection of these wastes as an economical means of disposal. Though the amount of waste thus collected has sometimes been considerable, there has been little effort made to recycle any of it. This paper will discuss the potential for recycling collected wastes, using the City of Berkeley, California, as a model.

Collection of Household Wastes

Since 1981, many communities across the United States have experimented with residential hazardous waste collection (Table 1). Generally this has involved a one-time project consisting of a central collection site to which individuals bring their wastes. These programs have operated for periods of one day to three weeks, and a few have been repeated. One pesticide collection program is open year round, and in one program wastes were collected door-to-door.

Paints, pesticides, solvents and oils comprise the bulk of the wastes, though the relative proportions have varied. These proportions are often difficult to ascertain due to different methods of reporting data. For instance, some programs record paints, solvents and oils in separate categories, while other programs collect them together as "flammable wastes," or group them in other ways. Other difficulties arise in evaluating the quantities of waste reported. Some programs record the actual weights or volumes of wastes collected (primary quantities). Others report the volumes or nominal weights of the containers in which the wastes are turned in (secondary quantities). In most cases, however, the quantities reported are the volumes or numbers of drums in which the wastes are packed for transhipment (tertiary quantities). Any attempt to compare quantities of wastes collected must take into account the nature of the quantities reported.

Table 2 lists the weights of waste collected by 21 residential hazardous waste programs. These weights are primary weights calculated from the reported data (Table 1). It is often possible to determine from the context of the report which type of quantity has been recorded. In other cases, I have assumed that the volumes reported for oil are primary volumes, and that the volumes reported for other wastes are tertiary volumes.

Directing Organization	Date and Description of Project	Target Population	Number of Disposers	Materials Accepted	Materials Collected	Sources of Information
Marion County Health Department, Lebanon, KY	Jan 5-9, 1981 5 day collection from household, agricultural, & retail generators	Marion County, population-17,910	Not known	Pesticides	17 drums containing 1500 lb. of dry pesticides & 500 gal. of liquid pesticides	Brock, 1984, pers. comm.
Project Metro, Seattle, WA	Feb 7-28, 1982 3 week collection at Fire Dept; Phone-in for pickup at home	A neighborhood of 4000 households	15 drop-off; 1 pickup; an estimated 40 recycling oil	Pesticides & solvents; oil at 6 local service stations	2 drums of pesticides (90 lb. dry & 6 gal. liquid), ½ drum of solvents (3 quarts), an estimated 40 gal. of oil	Galvin & Ridgley, 1982b.
King County Health Department, Seattle, WA	Ongoing since 1982 Drop-off by appt. at 5 Health Dept. District Offices in the County	King County, population-1,270,000	Not known	Pesticides	About 10 drums per year	Swafford, 1984, pers. comm.
Department of Public Health, Lexington, MA	Oct 30, 1982 1 day collection by SCA Chemical Services at DPW yard	Lexington, population-29,479, 9673 households	94 individuals	Household hazardous wastes; no motor oil	7 drums of paint, 4 drums of pesticides, 3 drums of misc. wastes	Clark, 1984, pers. comm. Drawas, 1984, pers. comm. Smith, 1984, pers. comm.
Golden Empire Health Systems, Sacramento, CA	Oct-Dec, 1982 Collection on 10 saturdays at a Transfer Station	Sacramento County, 267,000 households	216 individuals (an estimated 250 households)	All household hazardous wastes, up to 10 lb.	2400 lb. of oil, 7100 lb. of other wastes; by volume, 46% pesticides & cleaners, 39% paints & thinners, 11% oil, 4 % acids	Purin, 1983. Purin, 1984, pers. comm.
Board of Health, Andover, MA	May 7, 1983 1 day collection by SCA Chemical Services	Andover, population-26,370, 8688 households	45 individuals	Not known	85 gal. of pesticides, 1 drum of oil, 3 drums of misc. wastes	Drawas, 1984, pers. comm.
Board of Health, Bedford, MA	May 14, 1983 1 day collection by SCA Chemical Services	Bedford, population-13,067, 3741 households	72 individuals	Not known	270 gal. of oil, 60 gal. of pesticides, 1 drum of solvents, 4 drums of misc. wastes	Drawas, 1984, pers. comm.
City Fire Department, Gresham, OR	May-Jun, 1983 Door-to-door pickup by Fire Department on 4 weekends	Gresham, population-33,005	Not known	Mainly pesticides, some solvents	5-6 drums of restricted pesticides and some solvents were collected & disposed of; another 30% in usable pesticides is being recycled	Stricker, 1984, pers. comm.
SCA Chemical Services (MA) Inc, Braintree, MA	May 21, 1983 1 day collection by SCA Chemical Services	Braintree, population-36,377, 11,484 households	100 individuals	Not known	270 gal. of oil, 3 drums of pesticides, 9 drums of misc. wastes	Drawas, 1984, pers. comm.
Chamber of Commerce, Fall River, MA	Jun 11, 1983 1 day collection by SCA Chemical Services	Fall River & 4 nearby towns, population-143,132, 68,892 households	20 individuals	Not known	3 drums of paint, 1 drum of pesticides, 2 drums of misc. wastes	Drawas, 1984, pers. comm.
Town of Plymouth, Plymouth, MA	Sep 24, 1983 1 day collection by SCA Chemical Services	Plymouth, population-35,913, 12,450 households	70 individuals	Not known	2 drums of flammable wastes, 1 drum of pesticides, 1 drum of corrosive wastes, 10 gal. of oil, 10 gal. of chlorine	Drawas, 1984, pers. comm.

Cape Cod Planning and Development Commission, Barnstable, MA	Oct 8-9, 1983 2 day collection by SCA Chemical Services	15 towns on Cape Cod, population-147,925	650 individuals	Not known	5735 gal. of flammable wastes, 1821 gal. of pesticides, 440 gal. of corrosive wastes, 220 gal. of oil, 240 gal. of misc. wastes	Drawas, 1984, pers. comm.
Public Health Department, Sudbury, MA	Oct 15, 1983 1 day collection by SCA Chemical Services at town yard	Sudbury, population-14,027, 4141 households	75 individuals	All household hazardous wastes	270 gal. of flammable wastes, 220 gal. of paint, 75 gal. of pesticides, 55 gal. of corrosive wastes, 30 gal. of misc. wastes	Drawas, 1984, pers. comm. Sullivan, 1984, pers. comm.
Department of Public Health, Lexington, MA	Oct 22, 1983 1 day collection by SCA Chemical Services at DPW yard	Lexington, population-29,479, 9673 households	213 individuals (Smith) 157 individuals (Drawas)	All household hazardous wastes	640 gal. of flammable wastes, 290 gal. of pesticides, 140 gal. of oil, 110 gal. of corrosive wastes	Drawas, 1984, pers. comm. Smith, 1984, pers. comm.
Town of Reading, Reading, MA	Oct 22, 1983 1 day collection by SCA Chemical Services	Reading, population-22,678, 7308 households	Not known	All household hazardous waste	1100 gal. of paint, 305 gal. of pesticides, 130 gal. of flammables, 50 gal. of corrosives, 30 gal. of oil, 10 gal. of chlorine, 5 gal. of asbestos, 35 gal. of misc. wastes	Drawas, 1984, pers. comm.
City of Palo Alto, Palo Alto, CA	Oct 28 & Nov 5, 1983 Collection on 2 saturdays at Recycling Center	Palo Alto, population-56,040	About 150 families	All household hazardous wastes	2474 lb. in 28 drums, including 996 lb. of paint, 533 lb. of pesticides, 420 lb. of solvents, 130 lb. of oxidants, 64 lb. of oil, 58 lb. of cleaners, 16 lb. of acids	Burnes, 1984, pers. comm. City of Palo Alto, 1983a. City of Palo Alto, 1983b.
Town of Concord Concord, MA	Oct 29, 1983 1 day collection by SCA Chemical Services	Concord, population-16,293, 5204 households	Not known	Not known	715 gal. of flammable wastes, 100 gal. of pesticides, 55 gal. of corrosive wastes, 25 gal. of chlorine	Drawas, 1984, pers. comm.
Town of Bedford, Bedford, MA	Nov 5, 1983 1 day collection by SCA Chemical Services	Bedford, population-13,067, 3741 households	30 individuals	Not known	330 gal. of flammable wastes, 55 gal. of oil, 55 gal. of corrosive wastes, 24 gal. of pesticides	Drawas, 1984, pers. comm.
Town of Dartmouth, Dartmouth, MA	Nov 5, 1983 1 day collection by SCA Chemical Services	Dartmouth, population-23,966, 7875 households	80 individuals	Not known	275 gal. of paint, 230 gal. of flammable wastes, 220 gal. of corrosive wastes, 180 gal. of pesticides	Drawas, 1984, pers. comm.
Town of Westford, Westford, MA	Nov 5, 1983 1 day collection by SCA Chemical Services	Westford, population-13,434, 3954 households	Not known	Not known	1356 gal. of flammable wastes, 180 gal. of pesticides, 90 gal. of oil, 55 gal. of corrosive wastes, 24 gal. of asbestos	Drawas, 1984, pers. comm.
County Environmental Health Services, San Bernardino, CA	Mar 24, 1984 1 day collection at city yard	San Bernardino, population-30,000	27 individuals	All household hazardous wastes	10 drums containing 175 gal. of liquid waste and 76 lb. of dry waste	Kindschy, 1984, pers. comm.

Table 1: 21 residential hazardous waste collection programs

Volumes given, other than for oil, are generally lab-packed volumes. Drum means a 55 gallon drum.

Community	Date	Target Households	Disposing Households[a]	Percent Participation	Paints: Pounds	Paints: Pounds per Disposing Household	Pesticides: Pounds	Pesticides: Pounds per Disposing Household	Solvents: Pounds	Solvents: Pounds per Disposing Household	Oil: Pounds	Oil: Pounds per Disposing Household	Total Of All Wastes: Pounds	Total Of All Wastes: Pounds per Disposing Household	Total Of All Wastes: Drums[b]	Total Of All Wastes: Drums[b] per Disposing Household	Drums[b] x 1000 per Target Household
Marion County, KY	Jan '81	5117[d]	-	-	nc	nc	5500[c]	-	nc	nc	nc	nc	5500[c]	-	17	-	3.3
Seattle, WA	Feb '82	4000	56	1.4	nc	nc	138[c]	2.5	6[c]	0.1	320[c]	5.7	464[c]	8.3	3	0.05	0.8
King County, WA	Ongoing	363000	-	-	nc	nc	1500[e,f]	-	nc	nc	nc	nc	1500[e,f]	-	10[f]	-	*
Lexington, MA	Oct '82	9673	94	1.0	1050[e]	11.2	600[e]	6.4	-	-	nc	nc	2100[e]	22.3	14	0.15	1.4
Sacramento, CA	Oct-Dec '82	267000	250	0.1	2100[g]	8.4	3300[g]	13.2	1050[g]	4.2	2400	9.6	9500	38.0	54[g]	0.22	0.2
Andover, MA	May '83	8688	45	0.5	-	-	232[e]	5.2	-	-	440[c]	9.8	1122[c,e]	24.9	5.5	0.12	0.6
Bedford, MA[h]	May '83	3741	72	1.9	-	-	164[e]	2.3	150[e]	2.1	2160[c]	30.0	3074[c,e]	42.7	11	0.15	2.9
Braintree, MA	May '83	11484	100	0.9	-	-	450[e]	4-5	-	-	2160[c]	21.6	3960[c,e]	39.6	17	0.17	1.5
Gresham, OR	May-Jun '83	9430[d]	-	-	nc	nc	975[e]	-	-	-	nc	nc	1050[e]	-	7	-	0.7
Fall River, MA	Jun '83	68892	20	*	450[e]	22.5	150[e]	7.5	-	-	-	-	900[e]	45.0	6	0.30	0.1
Plymouth, MA	Sep '83	12450	70	0.6	-	-	150[e]	2.1	-	-	80[c]	1.1	707[c,e]	10.1	4.4	0.06	0.4
Barnstable, MA	Oct '83	42264[d]	650	1.5	-	-	4964[e]	7.6	-	-	1760[c]	2.7	24200[c,e]	37.2	153.9	0.24	3.6
Sudbury, MA	Oct '83	4141	75	1.8	600[e]	8.0	205[e]	2.7	-	-	-	-	1773[e]	23.6	11.8	0.16	2.9
Lexington, MA[i]	Oct '83	9673	157	1.6	-	-	791[e]	5.0	-	-	1120[c]	7.1	3970[c,e]	25.3	21.5	0.14	2.2
Reading, MA	Oct '83	7308	-	-	3000[e]	-	832[e]	-	-	-	240[c]	-	4126[c,e]	-	30.3	-	4.1
Concord, MA	Oct '83	5204	-	-	-	-	273[e]	-	-	-	-	-	2441[e]	-	16.3	-	3.1
Palo Alto, CA	Oct-Nov '83	16011[d]	150	0.9	996	6.6	533	3.6	420	2.8	64	0.4	2474	16.5	28	0.19	1.7
Bedford, MA[h]	Nov '83	3471	30	0.8	-	-	65[e]	2.2	-	-	440[c]	14.7	1555[c,e]	51.8	8.4	0.28	2.3
Dartmouth, MA	Nov '83	7875	80	1.0	750[e]	9.4	491[e]	6.1	-	-	-	-	2531[e]	31.6	16.9	0.21	2.1
Westford, MA	Nov '83	3954	-	-	-	-	491[e]	-	-	-	720[c]	-	5125[c,e]	-	31	-	7.8
San Bernardino, CA	Mar '84	8571[d]	27	0.3	-	-	-	-	-	-	-	-	1476[c]	54.7	10	0.37	1.2
Total Reported		872217	1876	na	8946	na	21804	na	1626	na	11904	na	75848	na	477	na	na
Mean Value per Program Reporting		41534	125	1.0	1278	11.0	1090	5.1	407	2.3	1082	10.3	3612	31.4	22.7	0.19	2.0

Table 2: Rates of participation and quantities collected in 21 residential hazardous waste programs (Based on data in Table 1)

Symbols:
- nc Not collected
- na Not applicable
- \- Not known
- * Less than 0.1

Notes:

a Figured at one household per individual disposer, unless otherwise given in Table 1.

b 55 gallon drums, or an equivalent volume, lab-packed for transshipment.

c Computed at 8 lb. to the gallon, 440 lb. to the drum (used mainly for oil).

d Computed at 3.5 individuals per household.

e Computed at 150 lb. per 55 gallon drum (used for most wastes other than oil).

f Per year.

g For Sacramento, weights for Paints, Pesticides, and Solvents, and volume for All Wastes were derived by assuming that oil was packed at 440 lb./drum, other wastes at 150 lb./drum, and the ratio of pesticides/cleaners was 9/1, and paints/thinners was 2/1 (the latter ratios correspond to the ratios in Palo Alto, where the data is complete).

h The two Bedford collections have been treated separately, although they occurred in the same year.

i According to Smith (1984, pers. comm.), 213 disposers participated in the 1983 Lexington collection; according to Drawas (1984, pers. comm.), there were 157 disposers. The lower figure has been used in these calculations.

In each community that reported the quantity of paint collected, paint comprised roughly one quarter to three quarters of the total waste collected. In Palo Alto, in response to a mistake in advertising, about a ton of nonhazardous, latex-based paint was brought in, in addition to a half-ton of hazardous waste paint (Burnes, 1984, pers. comm.).

Some programs concentrated on collecting pesticides. In Marion County, Kentucky, over half a ton per day of pesticides was collected, which has been attributed to "the mostly rural (30 to 35%), heavily agricultural character of these counties, and to the fact that farmers and retail stores were allowed to use the service" (Galvin and Ridgley, 1982a, p. 103). Pesticides predominated in the Gresham, Oregon, collection program, where wastes were transported in 55-gallon drums lashed to the backs of fire engines, creating an incentive to limit the type and quantity of waste collected (Stricker, 1984, pers. comm.).

A small, unspecified amount of waste was also collected by the Gresham Fire Department; the limited quantity might best be explained by a disinclination to carry flammable materials on vehicles that could be called to a fire (Stricker, 1984, pers. comm.). Only a few communities reported quantities of solvents collected. Most programs apparently included them under "flammable wastes."

One fourth of the waste collected in the Sacramento program was oil. In Seattle, individuals who wished to dispose of motor oil were directed to one of six service stations that had agreed to accept oil during the three week collection period. The amount disposed of in this way was estimated to be 40 gallons, which accounts for 70% by weight of the waste reported. In Palo Alto, waste oil was only about three percent of the total; this may be due to the location of the collection site at a recycling center that handled waste oil.

It may indeed be possible to recycle some portion of each of these types of waste. Few communities have made any effort to do so, however, despite the sometimes large amounts of waste collected.

The largest communities had the lowest overall rates of disposal, measured either by the ratio of disposing households to target households (percent participation, Table 2), or by the number of packed drums per target household. In other communities, participation rates ranged generally from one half to two percent, with an overall mean of one percent.

It has commonly been assumed by sponsors of hazardous waste programs that a single collection would suffice to gather the bulk of the waste in a community, as people would bring in the wastes accumulated over the years, and that follow-up collections would yield little. In two communities, a collection program was run twice. In Bedford's second collection, held six months after the first, the participation rate went down by about half, but the weight of waste per disposing household went up. In Lexington, the second collection was one year after the first, and both the participation rate and waste per household rose. These results indicate that there may be a need for a regular, annual program of residential hazardous waste collection. With a regular program in operation, people might store their hazardous wastes for the next collection, rather than dispose of them by less desirable means.

Hazardous Waste in Berkeley's Households

The mean rate of participation in the 21 collection programs reported here is one percent, and the average amount disposed of is over 30 pounds (Table 2). There are 44,704 households in Berkeley; at these average rates, they would annually dispose of 73 drums of hazardous waste (Table 3). Alternatively, calculating the number of drums disposed of in Berkeley from the mean number of drums per 1000 households yields a figure of 89 drums. The discrepancy between these figures is mainly due to the fact that the data on many of the collection programs is incomplete. In this discussion the more conservative figure of 73 drums will be used.

Waste	Rate[a] (pounds per participating household)	Quantity (pounds)	(drums)	(recyclable[b] drums)
Paints	11.0	4917	32.8	8.2
Pesticides	5.1	2280	15.2	4.6
Solvents	2.3	1028	6.9	0
Oil	10.3	4604	10.5	10.5
Other	2.7	1207	8.0	0
Total	31.4	14036	73.4	23.3

Table 3: Projected types and quantities of wastes collected by a residential hazardous waste program in the City of Berkeley - based on 1.0% participation (mean rate of participation from Table 2) of the 44,704 households in Berkeley, or 447 participating households.

Notes: a Mean rates from Table 2

b For derivation, see text

There are indications that paint may be the largest component of household hazardous waste in the East Bay. The Transfer Station in Richmond operated by Bay Area Environmental, Inc., accepts small quantities of hazardous waste. An estimated 50% of this waste consists of paints and thinners (Wahbeh, 1984, pers. comm.). Oakland Scavenger, a solid waste collection service under contract to several East Bay cities, regularly receives calls inquiring about the disposal of waste paint (Sheahan, 1984, pers. comm.). Based on the projections in Table 3, Berkeley should expect to net about 2 1/2 tons of waste paint in a yearly collection.

Michelle Pappe's survey for this report of pesticides in Berkeley households found that only a negligible amount of pesticide waste is generated each year. This may be due to Berkeley's large student population and the large number of dormitory and apartment residents, or perhaps to a general reluctance to use pesticides. It might also be a result of the timing of the survey, which was conducted during the winter when pesticides are not in use.

The projections in Table 3 indicate that solvents would make up 9.5% of the packed volume of waste in a Berkeley collection. Nothing is known of the generation of waste solvents in Berkeley households.

In his survey for this report, Djon Gentry found that the rate of recycling of oil by private individuals in Berkeley was four times the reported national average. Despite this high recycling rate, extrapolations from the survey indicate that 18,000 gallons are disposed of annually, mainly down the sewer, in the trash, and on the ground. In addition, 12,000 gallons are stored awaiting future disposal. These figures display a need for additional pathways for the recycling of oil, in which a hazardous waste collection program could take part.

What About Hazardous Wastes from Small Businesses?

Hard data on the wastes generated by small businesses are scarce. A recent study concludes that only one percent of the hazardous waste in the United States is generated by small generators (defined as those companies producing less than 1000 kilograms of hazardous waste per month). This waste is mainly from manufacturing companies, which make up 13% of all small generators but account for 47% of the waste (TRW, 1979). One would therefore expect to find little waste from smaller generators and nonmanufacturing companies.

However, a 1982 survey of small generators (defined as companies producing less than 400 pounds of hazardous waste per month) in Tacoma, Washington, found that significant amounts of hazardous waste were produced and improperly disposed of by nonmanufacturing companies. These wastes threatened part of the city's water supply (Post, 1984, pers. comm.). Other surveys have also reported a high level of improper disposal of hazardous waste by small generators (U.S. Government Accounting Office, 1983, p. 12).

Current hazardous waste studies should yield fuller information. A survey of local small businesses is being conducted by the Association of Bay Area Governments (ABAG), and will be completed this summer (Russell, 1983, pers. comm.). The Environmental Protection Agency (EPA) is interviewing 50,000 small generators nationwide; results will be published by 1986 (U.S. General Accounting Office, 1983, pp. 13, 21). However, the most solid information will come from attempts to collect hazardous wastes from small businesses. The State of Florida is initiating the first major effort in this regard, as part of a three year hazardous waste program called "Amnesty Days"

(Drawas, 1984, pers. comm.; Carter, 1984, pers. comm.).

Small Business Wastes in Berkeley

In Berkeley, a series of surveys conducted for this report on four classes of small, non-manufacturing businesses (dry cleaning, printing, photofinishing and automotive repair) revealed a high degree of both on-site and off-site reprocessing, and a low level of waste production. Eighty-six percent of the dry cleaners interviewed use perchlorethylene as a cleaning fluid. Perchlorethylene is routinely filtered for reuse on-site, and filters and residues are sent to a recycler in San Jose, where they are further processed and distilled before final disposal (see paper by Janet Naito). Small printshops generate little hazardous waste other than the residues on cleaning rags, which are sent out for cleaning and reuse (see paper by John Dawson). Both printshops and photofinishing labs reprocess silver-containing photochemicals. Most other wastes from photolabs are disposed of down the sink, where they are rendered harmless by dilution and normal sewage treatment (see paper by Janet Crawford). Automotive repair shops recycle engine oil and transmission fluid, but dispose of antifreeze down the sewer (see paper by Barbara Elwell).

Taken together, these findings suggest that there is more recycling and less production of hazardous wastes in Berkeley than in many other parts of the country. One local hazardous waste recycler claims that this is true of the Bay Area in general, and suggests that it is the high cost of these materials, the expense of their proper disposal, and concern over health risks associated with their use that has led to conservative practices and reprocessing wherever possible. The heavy concentration of hazardous waste recyclers in the area has further insured the exploitation of any profitably recyclable wastes (Schneider, 1984, pers. comm.).

Despite this optimistic outlook, the local surveys indicate that there are still some quantities of business-generated hazardous wastes that are not being recycled or disposed of properly. Unfortunately, the available data are an inadequate base on which to predict the types and amounts of business-generated waste that could be collected and recycled by a community hazardous waste program.

Recycling Hazardous Waste

What types of hazardous waste can a collection program recycle? Both the Palo Alto and Sacramento projects received quantities of paint that seemed recyclable; however, in neither case was there any plan for sorting and handling usable paint, and all the paint was disposed of. In the future, these programs hope to recycle usable paint (Burnes, 1984, pers. comm.; Purin, 1984, pers. comm.). In Berkeley there are many potential users of recycled paint: the City Youth and Recreation Programs, the Public Schools, the University Art Department, or perhaps one of the East Bay muralists.

Pesticides are the most toxic wastes commonly collected. Yet in Gresham, Oregon, approximately one quarter of the wastes collected were nonrestricted pesticides. They are being recycled to small commercial growers through the Agricultural Extension Service of Oregon State University (Stricker, 1984, pers. comm.; Adams, 1984, pers. comm.). In King County, Washington, some of the pesticides collected by the Health Department have also been recycled (Swafford, 1984, pers. comm.).

The potential for cleaning (by filtration or distillation) and reuse of solvents depends upon the type and quantity of solvent and the degree of contamination. The one commercial waste reprocessor contacted was not encouraging about the possibility of recycling the quantities of solvent waste commonly collected (Schneider, 1984, pers. comm.). The Gresham, Oregon, Fire Department has used small quantities of waste lacquer thinner in practice fires (Stricker, 1984, pers. comm.).

Waste oil is the easiest to recycle of the common hazardous wastes, and is currently worth about 25¢ per gallon. Cleaners, though not collected in as large amounts, could be sorted and recycled in the same manner as paints. The possibility of recycling acids and other chemicals (as with solvents) is dependent upon the quantity collected, and the degree of contamination.

The Value of Recycling

The mean values from Table 2 can be used to make projections of the types and quantities of hazardous waste that will be collected in future programs. The projections for Berkeley indicate that a total of seventy-three drums will be needed to pack and dispose of the household hazardous waste that an annual collection would receive (Table 3). The recycling of motor oil would eliminate the need to dispose of ten of those drums. If one quarter of the paint received was usable and recycled, this would reduce the number of drums required by eight more. In Gresham, Oregon, one quarter of the pesticides collected are being recycled; if this were achieved in Berkeley, it would save the disposal of four more drums.

Thus recycling could reduce the volume of waste requiring disposal by twenty-two drums, or 30%. Estimates of the costs of packing and disposal per drum range from $95.00 in San Diego (Walker, 1984, pers. comm.) to $120.00 in Contra Costa County (Schaal, 1984, pers. comm.). At the average of $107.50 per drum, the recycling of twenty-two drums of waste would mean a savings of more than $2300 in disposal costs (Table 4). In addition, the waste oil could be sold for about $140.

Along with the economic advantages of recycling, there are benefits to the environment: recycling reduces both the demand on resources and the drain on the capacity of scarce hazardous waste disposal sites. The possibility of wastes being used rather than dumped would also entice more people to use the program. Finally, the positive action of recycling would enhance the public image of the program, and set a needed example for the community.

Some Legal Concerns in California

California's hazardous waste regulations are set forth in Chapter 6.5 of the California Health and Safety Code and in Chapter 30 of the California Administrative Code. These regulations originally

Waste	Drums To Be Disposed Of	Recyclable Drums
Paints	33	8
Pesticides	15	4
Solvents	7	0
Oils	10	10
Other	8	0
Total	73	22

4A.

Disposal costs without recycling (69 drums x $107.50/drum)	$7847.50
Less: Disposal costs of recyclable drums (22 drums x $107.50/drum)	- 2365.00
Disposal costs with recycling	$5482.50
Less: Proceeds from sale of oil (4604 lb. x 0.125 gal./lb. x $0.25/gal.)	- 143.87
Disposal costs with recycling and sale of oil	$5338.63
Net savings	$2508.87

4B.

Table 4: Projected disposal costs for a residential hazardous waste program in the City of Berkeley

A. Projected number of drums per annual collection (based on Table 3)

B. Projected disposal costs per annual collection

applied to all producers of hazardous wastes, with no exemptions for small generators or households. Producers who are not licensed for on-site disposal are required to ship all hazardous waste to a licensed Hazardous Waste Facility via a licensed Hazardous Waste Hauler (California Administrative Code, Section 66505c), and to complete a Hazardous Waste Manifest for all wastes shipped (California Administrative Code, Section 66470b). The all-encompassing nature of these laws has created some difficulties for the collection and recycling of hazardous waste.

Communities that wish to use a collection site that is not a licensed Hazardous Waste Facility may need to obtain a variance or temporary permit to operate a Transfer Station. A permit was granted in Palo Alto (Burnes, 1984, pers. comm.), but was not required in San Bernardino (Kindschy, 1984, pers. comm.). The Sacramento project used an existing Transfer Station (Purin, 1984, pers. comm.), as will the proposed projects in San Diego (Walker, 1984, pers. comm.) and in Contra Costa County (Schaal, 1984, pers. comm.), even though the Transfer Stations in these communities are not centrally located. The State Department of Health Services (DOHS) should clarify the need for permits, and the procedures by which communities may obtain them.

Until recently, some uncertainty existed over whether it was legal for individuals to transport their own wastes to a collection site. Assembly Bill 1015 (1983), which became law last September, amended Section 25163 of the California Health and Safety Code to exempt the transport of less than five gallons or fifty pounds of hazardous waste from licensing and manifesting requirements. These low limits may still cause some problems, however, for programs involving infrequent collection, or for attempts to collect wastes from small businesses. A higher level of exemption may be useful for some of the less dangerous hazardous wastes, such as paints and cleaners.

Section 25123.3 of the California Health and Safety Code, which prohibits on-site storage of hazardous wastes for more than ninety days, may also pose difficulties for annual collection programs. It is not clear whether this law was intended to apply to households, but it may present obstacles to a program of infrequent collection of wastes from small businesses.

Another area of confusion for community collections is the manifest requirement. Is the individual disposer or the collecting agency to be considered the generator of the waste? With whom does the 'cradle to grave' responsibility lie? In Sacramento a manifest was made up for each disposer; but in Palo Alto, one common manifest was prepared with the City listed as generator. The DOHS should issue guidelines for the proper manifesting procedures to be followed at community collection sites.

In the Palo Alto project the question was raised as to whether the sorting and recycling of wastes such as paints or pesticides should be considered treatment of wastes, and thus require a permit to operate a treatment facility (Burnes, 1984, pers. comm.). If the DOHS determines that this is so, it should initiate procedures by which communities may obtain the necessary permits, in accordance with its mandate to "promote recycling and recovery of resources from hazardous wastes" (California Health and Safety Code, Section 25170j).

Summary

Community collection programs are becoming an increasingly common option for the disposal of household hazardous wastes. An examination of waste surveys and past collections indicates that there is a real potential for the recycling of some of these wastes. Rough quantitive estimates of the household wastes that would be collected in a community can be made, but more information on this is needed; future programs should carefully record participation rates and amounts of wastes collected.

There is not enough quantitive information on the generation of hazardous wastes by small businesses to assess the potential for collection and recycling, though there may well exist untapped opportunities for the reuse of certain types of waste. Future surveys may cast some light on this, but a final evaluation will probably have to wait until collection programs open to small businesses are put into effect.

California's stringent regulations for the control of hazardous waste may pose certain obstacles to the development of community collection and recycling programs. Although some of the worst problems have been remedied, further clarification of the law is needed, particularly regarding the sorting and recycling of wastes. Administrative procedures for obtaining collection site permits should be streamlined, and some amendment of the regulations concerning the storage and transportation of small quantities of hazardous waste may be necessary.

Projections show that recycling should significantly reduce the disposal costs of community collection. Recycling would also reduce the impact on resources and disposal capacity, and encourage participation in and support of the collection program.

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APPENDIX TO SECTION IV.A.
BERKELEY HOUSEHOLD SURVEY

Methodology

A survey was conducted by four students in the Environmental Science Senior Seminar: Djon Gentry, Nancy Knappenberger, Michelle Pappé, and Cheryl Swanson. The purpose of the survey was to determine the extent of the use and disposal of hazardous household products and the attitudes of the Berkeley consumer on various issues concerning these products. The survey was adapted from a draft survey written by the Association of Bay Area Governments (ABAG), with specific questions from the surveyors added.

The survey was done by phone over a two week period in the beginning of February, 1984. The methodology for picking the phone numbers consisted of two random number generations. The first set was used to select a page number in the 1983 Oakland area phone book; only the page numbers with residential phone numbers were used (i.e., no governmental or company listings). The second set of random numbers was used to select one of four columns on each previously selected page. For each page and respective column number the tenth listing was chosen for the survey. If this listing was not a Berkeley resident, sequential listings were considered until a Berkeley resident was found.

Each number was pursued until there was a positive response, a definite rejection or some other factor preventing a positive or negative commitment by the resident (e.g., disconnected phone or a "no" answer by the end of the two week period). On the average, each survey took 15 minutes to complete.

Results

The total in-service phone numbers reached was 119. The total number of surveys completed was 69. Of the remaining there were 32 refusals and 18 were never reached. 51% of the respondents were female. 54% lived in houses. 16% had children under the age of six within the home.

Biases

Any survey is biased by factors including the selection of respondents, how the questions are written, and how the surveyors present the questions. The four major biases that should be considered when interpreting the data from this survey are listed below.

1. The population that answered the survey may be different from both the population that refused to answer and the population that was never reached. Those who refused may be less concerned about the issue of hazardous household substances than those who consented, and may have significantly different practices.

2. The answers given may not be complete or entirely honest, due to the nature of a telephone survey, and the nature of the questions asked. In a telephone survey the respondent may not take the time and attention to think through each response thoroughly. Also, since the questions are related to environmental concerns, respondents may feel uncomfortable about revealing their true practices and attitudes. In many households one household head may not be completely aware of how the other uses certain products.
3. The population may be slightly different from the Berkeley population, because those selected were those with listed numbers and addresses. Our sample population may not include many of the very rich and the very poor.
4. There were four different surveyors, and therefore four different deliveries of the same survey. Of the four surveyors, 3 were female and 1 was male. This may have produced a bias in the quality of answers received, as well as the number of rejections.