

**FIFTY HOUSEHOLD HAZARDOUS
PRODUCTS
THAT COULD POTENTIALLY
CONTAMINATE GROUNDWATER
WHEN DISPOSED IN A LANDFILL**

A REPORT TO THE GENERAL ASSEMBLY

Iowa Department of Natural Resources
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EXECUTIVE SUMMARY

The Household Hazardous Materials program was established as part of the Groundwater Protection Act in July, 1987. The two main objectives of the program are to educate the public on the proper use, storage and disposal of hazardous products in the home and to help people dispose of household hazardous waste in a safe and responsible manner, as provided through the Department's "Toxic Cleanup Days" (TCDs).

A list of 50 commonly used, household hazardous products, which constitute the greatest danger of contamination to groundwater when placed in a landfill, is provided to help accomplish these goals as mandated by Chapter 455 F.6(3) of the Code of Iowa.

To produce this list, information sources were used containing established, specific rating criteria of various characteristics of chemical ingredients found in household hazardous products. If a chemical ingredient in a product was given a high ranking in any of the categories of toxicity, acute health effects, chronic health effects, reactivity and flammability, the product was included in the list. In addition, data on household hazardous products use by Iowans were obtained by conducting a representative survey of Iowa households.

The Department of Natural Resources does not consider the list of the 50 products in this summary to be the definitive list of products that constitute the greatest danger of contamination to groundwater when placed in a landfill. Readers also are cautioned that chemical constituents in products change over time; each change could result in a revision of the list.

The "Top 50" list is generic, and can be used to identify product types that may contain chemical constituents that are potentially damaging to groundwater. For example, pesticides on this "Top 50" list include, but are not limited to, insecticides such as yard and garden sprays, roach powder, flea and tick products for pets, fly strips, moth balls, and personal "bug sprays or stick creams." Any rodenticide, fungicide, herbicide or algicide included in this list would be considered a pesticide.

The following page lists the "Top 50" commonly used household products which, due to level of toxicity, extent of use, nondegradability, or other relevant characteristics, constitute the greatest danger of contamination of the groundwater when placed in a landfill.

Table 1.1: HOUSEHOLD HAZARDOUS MATERIALS TOP 50 LIST
A Compilation Of Unranked Generic Products

Adhesives	Paint Removers/Strippers
Aerosols	Pesticides
Automotive Batteries	Photography Chemicals
Automotive Rubbing Compounds	Polishes
Brake Fluids	Radiator Flushes
Carburetor Cleaners	Resins/Hardeners
Caulking Compounds	Roof Coatings
Concrete Cleaners	Rust Inhibitors
Degreasers, auto & household	Rust Removers
Deoderizers	Sealants
Disinfectants	Septic Tank Cleaners
Drain Cleaners	Shellacs
Fertilizers (petroleum based)	Shoe Care Products
Floor cleaners	Solvent Based Paints
Fuel Additives	Solvents
Fuels	Spot & Stain Removers
Glazes	Thermometers
Glues	Thinners
Household Batteries	Toilet Cleaners
Lacquers	Transmission Fluids
Lubricating Oils	Varnishes
Motor Oil	Waxes
Motor Oil Filters	Wood Preservatives
Oven Cleaners	Wood Putties
Paints containing heavy metals	Wood Stains

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INTRODUCTION

This report to the General Assembly presents a listing of 50 household products that constitute a potential danger of groundwater contamination. Chapter 455F of the Code of Iowa established the "Household Hazardous Materials" program administered by the Waste Management Assistance Division of the Iowa Department of Natural Resources. This report is written as mandated by 455F.6(3) of the Code of Iowa:

The Department shall. . . Identify, after consulting with departmental staff and the listing of other states, no more than fifty commonly used household products which, due to level of toxicity, extent of use, nondegradability, or other relevant characteristics, constitute the greatest danger of contamination of the groundwater when placed in a landfill. The department may identify additional products by rule. (455F.6(3) Code of Iowa).

The Department of Natural Resources does not consider the "Top 50" list of products in this report as the definitive list of products. Rather, the Department views the list as a "base list" determined through an examination of the following characteristics of product ingredients:

1. Toxicity,
2. Flammability,
3. Reactivity,
4. Acute health effects,
5. Chronic health effects

The search for the top fifty hazardous products encompassed the above characteristics, which limited the chances of missing a specific product that should be considered in a "Top 50" list. Acute and chronic health effects result from chemical exposure by inhalation or skin contact. They also are considered due to the possibility of groundwater contamination should the chemical constituents of these products be disposed in landfills. "Extent of Use" of household hazardous products among Iowans is an additional criterion considered by this study that was determined through a survey of 400 Iowa households.

Readers of this report are cautioned that chemical constituents in products change over time; each change could result in a revision of the "Top 50" list. Further assumptions used in establishing the list and limitations of the research are expressed in more detail in the results and discussion section of this report.

METHODOLOGY

Methods used to determine a list of products that are potentially damaging to groundwater include sources that provide specific criteria for ranking chemicals for 1) toxicity, 2) flammability, 3) reactivity, 4) acute health effects, and 5) chronic health effects. For purposes of this report, chemicals with high rankings from each category were used. If a chemical was identified in one or more categories, any household hazardous product containing that chemical was included in the "Top 50" list. A telephone survey was conducted by a marketing research firm to determine the extent of use of household hazardous products in Iowa households.

Household hazardous products were matched with chemicals they contained based on research performed at Tufts University (Clark, 1987). For example, the chemical potassium cyanide, found in photography chemicals, is given the highest ranking of "six" on the toxicity list. Therefore, photography chemicals are on the list.

1. Toxicity

To determine toxicity characteristics of chemical constituents, Clinical Toxicology of Consumer Products (Gosselin, 1984) was consulted. This source places products and product ingredients into one of six categories. The toxicity rating of the categories is based on an estimate of mortality from a single dose of product, and is often based on laboratory studies rather than human data. It does not include long-term, chronic effects of products. For purposes of this report, only the "most dangerous" toxicity ratings of "5" or greater were factored into the final list of 50 products. The following is the key to toxicity ratings:

Toxicity Rating Probable Oral Lethal Dose

6 - Supertoxic.....	5 mg/kg	(7 drops)
5 - Extremely Toxic	50 mg/kg	(1 tsp)
4 - Very Toxic	0 - 500 mg/kg	(1 ounce)
3 - Moderately Toxic	5 - 5 g/kg	(1 pint)
2 - Slightly toxic	15 g/kg	(1 quart)
1 - Probably nontoxic	15 g/kg	

Note: Appendix A presents a list of chemical constituents that are rated as #4 or greater in toxicity.

2. Flammability

Flammable chemicals pose a risk to haulers, landfill workers and landfill sites. For this report, flammability data was obtained from the Instant Warning System for Dangerous Materials taken from the National Fire Protection Association Guide on Hazardous Materials, 9th Edition (Science Related Materials, Inc., 1985). The Association uses the following rating system for the identification of the fire hazards of materials:

Susceptibility of Materials to Burning

4 - Very flammable gases, very volatile flammable liquids, and materials that in the form of dusts or mists readily form explosive mixtures when dispersed in air.

3 - Liquids which can be ignited under almost all normal temperature conditions. Solids which form coarse dusts, solids in shredded or fibrous form that create flash fires, solids that burn rapidly, usually because they contain their own oxygen, and any material that ignites spontaneously at normal temperatures in air.

2 - Liquids which must be moderately heated before ignition will occur and solids that readily give off flammable vapors.

1 - Materials that must be preheated before ignition can occur. Most combustible solids have a flammability rating of 1.

0 - Materials that will not burn.

Note: For purposes of this report, chemicals with the greatest flammability characteristics (rated by the National Fire Protection Association as #4) were used as one factor in determining the final list of 50 products in Appendix B.

3. Reactivity

A material's reactivity describes its susceptibility to explosive reactions. Highly reactive chemicals can pose danger when landfilled and, therefore, were considered in this study. Reactivity characteristics of chemicals were obtained from the Instant Warning System for Dangerous Materials taken from the National Fire Protection Association Guide on Hazardous Materials, 9th Edition (Science Related Materials, Inc. 1985). The following is the Association's classification method for reactivity:

Identification of Reactivity

4 - Materials which in themselves are capable of detonation or of explosive decomposition or explosive reaction at normal temperatures and pressures. Includes materials which are sensitive to mechanical or localized thermal shock.

3 - Materials which in themselves are capable of detonation or explosive decomposition or explosive reaction but which require a strong initiating source or which must be heated under confinement before initiation. Includes materials which are sensitive to thermal or mechanical shock at elevated temperatures and pressures or which react explosively with water without requiring heat or confinement.

2 - Materials which in themselves are normally unstable and readily undergo violent chemical change but do not detonate. Includes materials which can undergo chemical change at elevated temperatures and pressures. Also includes materials that react violently with water or that may form potentially explosive mixtures with water.

1 - Materials which in themselves are normally stable but which may become unstable at elevated temperatures and pressures or which may react with water with some release of energy but not violently.

0 - Materials which are normally stable even under fire exposure conditions and which are not reactive with water.

Note: For this study, those chemicals with the reactivity characteristic of #3 and above were factored into the final list of 50 products as listed in Appendix C.

4. Acute Health Effects

Acute health effects result from chemical exposure by inhalation or skin contact. Inhalation of fumes can cause immediate toxic effects. Skin contact could result in destruction of skin or absorption of chemicals through the skin to harm the body internally.

Criteria for acute health hazard effects was determined by using the Instant Warning System for Dangerous Materials of the National Fire Protection Association information which uses the following rating system:

Instant Warning System of Dangerous Materials

4 - A few whiffs of the vapor could cause death; or the liquid could be fatal on penetrating the fire fighter's normal full protective clothing which is designed for resistance to heat. The normal full protective clothing available to the average fire department will not provide adequate protection against skin contact with these materials. Only special protective clothing designed to protect against the specific hazard should be worn.

3 - Materials extremely hazardous to health, but areas may be entered with extreme care. Full protective clothing, including self-contained breathing apparatus, rubber gloves, boots and bands around legs, arms and waist should be provided. No skin surface should be exposed.

2 - Materials hazardous to health, but areas may be entered freely with self-contained breathing apparatus.

1 - Materials only slightly hazardous to health. It may be desirable to wear self-contained breathing apparatus.

0 - Materials which on exposure under fire conditions with no health hazard beyond that of ordinary combustible material.

Note: For this study, chemicals with a rating of #3 or above were factored into the final list of 50 products. Appendix D lists the chemicals which can cause acute health problems and the products that typically contain these chemicals.

5. Chronic Health Effects

Chemical constituents, which may cause cancer, gene mutations, birth defects, fetal death, sterility, neurological damage, immune system disfunctions, kidney or liver damage, or other long term health effects, were considered by consulting Drinking Water Regulations and Health Advisories by the Office of Drinking Water, U.S. Environmental Protection Agency, Washington, D.C., February 1991.

The following codes were used by the U.S. Environmental Protection Agency for the status regulations of the chemicals:

STATUS OF REGULATIONS OF CHEMICALS FOR DRINKING WATER

F - final status

D - draft status

L - Listed for regulation

P - proposed (Phase II and V draft proposals)

Note: The EPA has set conservative policies with regard to carcinogenicity, relative source contribution, and less than lifetime exposures in chronic toxicity testing and only chemicals which had received a final status regulation were used. Appendix E contains the chemicals given a final status rating for regulation purposes which could cause chronic health effects and the products which contain the chemicals on this list. The product list is from research performed by Tufts University (Clark, 1987).

6. Extent of Use

For purposes of this report, "extent of use" was interpreted as the percentage of Iowans who have a given product on hand or have purchased a given product in the last year. The word "product" is subject to interpretation. For example, "cleaner" is a product; "window cleaner" is a product; and "Brand X Window Cleaner with Fast-Acting Ammonia" is yet another definition of "product." To determine extent of use, these products were defined generically under consolidated categories.

To determine the extent of use of household hazardous products among Iowa households, the Department contracted with Integrated Marketing Resource Systems to conduct a representative telephone survey of 400 households in Iowa. Respondents, specifically, were asked what household hazardous products they had on hand or had purchased in the last year. The results, by rank, are presented on the following page in Table 1.2: Extent of Use. All of the products that appear on the Top 50 list are included among the 70 ranked products in the survey. Household batteries, toilet cleaners, motor oil, furniture polish and air freshners were the highest ranked products in the "Extent of Use" survey that also appear on the Top 50 list.

Some products on the "Extent of Use" list are exempt from the Iowa Household Hazardous Materials list, but are listed as household hazardous products in other states. Exempt products in Iowa include laundry detergents, bleach, cosmetics, nail polish and nail polish removers, dishwashing detergents and rubbing alcohols. With the exception of rubbing alcohol, these were included in the list because they are considered household hazardous materials by some other states. An assessment of the use of these products may be needed if changes are made to the Iowa household hazardous materials list.

Table 1.2: EXTENT OF USE: PRODUCT RANKING BASED ON 1990 SURVEY OF IOWA HOUSEHOLDS

Rank	Rank Listing	% Use	Rank	Rank Listing	% Use
1.	Laundry Detergent	98	36.	*Transmission Fluid	43
2.	*Batteries-Household	95	37.	*Wood Stains	41
3.	Window Cleaners	90	38.	Smoke Detectors	41
4.	*Toilet Cleaners	90	39.	*Auto Batteries	40
5.	*Motor Oil	87	40.	*Floor Waxes	39
6.	Windshield Washer Fluid.	87	41.	*Thermometers	39
7.	Bleach	86	42.	*Fertilizers	39
8.	Cosmetics	84	43.	*Brake Fluid	38
9.	*Furniture Polish	81	44.	*Brush Cleaners	37
10.	All Purpose Cleaners	81	45.	*Varnishes, Shellacs	36
11.	*Air Fresheners	79	46.	*Solvents & Thinners	35
12.	*Disinfectants	76	47.	*Wood Putties	30
13.	*Aerosols	75	48.	*Herbicides	30
14.	*Glues, Adhesives	74	49.	*Sealants, General	29
15.	*Fuels-Gas, Kerosene	74	50.	*Metal Polishers	28
16.	*Lubricating Oil	69	51.	*Flea Treatments	25
17.	Nail Polish & Remover	68	52.	*Carburetor Cleaners	24
18.	*Floor Cleaners	68	53.	*Wood Preservative	23
19.	Rubbing Alcohol	63	54.	*Paint/Varnish Strippers	22
20.	Dishwasher Detergent	63	55.	*Wood Sealants	21
21.	*Shoe Care Products	60	56.	*Radiator Flushes	18
22.	Antifreeze/Coolant	58	57.	*Auto Degreasers	18
23.	*Oven Cleaners	7	58.	*Moth Balls	16
24.	*Spot Remover	56	59.	*Auto Rubbing Comp'ds	16
25.	*Rug Cleaners	53	60.	*Rust Removers	12
26.	*Motor Fuel Additives	53	61.	*Glazes	12
27.	*Drain Cleaners	53	62.	Roof Coating-Tar	12
28.	*Caulking Compounds	50	63.	Artists Paints	11
29.	Paint-Water Based	49	64.	*Resins & Hardeners	9
30.	*Pesticides	48	65.	*Rust Inhibitors	9
31.	Ammonia	47	66.	*Septic Tank Cleaners	8
32.	*Lighter Fluid	46	67.	*Concrete Cleaners	6
33.	*Auto Polishers	45	68.	Pool chemicals	4
34.	*Insecticides	45	69.	Acids	4
35.	*Paints-Oil Based	44	70.	Photography Chemicals	2

Note: An asterisk has been added to products which are found on the lists for toxicity, acute health, chronic health, flammability, and reactivity.

RESULTS AND DISCUSSION

Relevant characteristics of household hazardous products were examined in this report as mandated by legislation in order to determine a list of "no more than fifty commonly used household products" that pose potential groundwater contamination. The extent of use of household hazardous products by Iowa households was obtained by a survey. The Top 50 list of products was then developed according to data available on toxicity, flammability, reactivity, acute health effects and chronic health effects. Together, these components and their highest ratings were considered to encompass those chemical ingredients of products that posed the greatest threat to groundwater when disposed in a landfill. If a chemical was identified in one or more components, any household hazardous product containing that chemical was included in the Top 50 list. The list should be used as a base list that identifies potential problems inherent in certain product types.

Table 1.3, on the following page, presents the "Top 50" list, which represents a compilation of alphabetized and unranked generic products. Appendix F, p. 17, contains characterizations and rankings of all chemical constituents, as well as products that contain these chemicals.

**Table 1.3: HOUSEHOLD HAZARDOUS MATERIALS TOP 50 LIST:
A Compilation Of Unranked Generic Products**

Adhesives	Paint Removers/Strippers
Aerosols	Pesticides
Automotive Batteries	Photography Chemicals
Automotive Rubbing Compounds	Polishes
Brake Fluids	Radiator Flushes
Carburetor Cleaners	Resins/Hardeners
Caulking Compounds	Roof Coatings
Concrete Cleaners	Rust Inhibitors
Degreasers, auto & household	Rust Removers
Deodorizers	Sealants
Disinfectants	Septic Tank Cleaners
Drain Cleaners	Shellacs
Fertilizers (petroleum based)	Shoe Care Products
Floor cleaners	Solvent Based Paints
Fuel Additives	Solvents
Fuels	Spot & Stain Removers
Glazes	Thermometers
Glues	Thinners
Household Batteries	Toilet Cleaners
Lacquers	Transmission Fluids
Lubricating Oils	Varnishes
Motor Oil	Waxes
Motor Oil Filters	Wood Preservatives
Oven Cleaners	Wood Putties
Paints containing heavy metals	Wood Stains

APPENDICES

APPENDIX A

TOXICITY: Chemical Constituents with Characteristics of #4 (Very Toxic) or Above

CHEMICAL CONSTITUENT	TOXICITY	HOUSEHOLD HAZARDOUS PRODUCT
Potassium Cyanide	6	photography chemicals
Mercury	6	thermometers, household batteries
Mercuric Chloride	6	photography chemicals
Mercuric Oxide	6	household batteries
Arsenic, metals & salts of	5	wood preservatives, paint & varnish removers, pesticides & herbicides
Cadmium, metals & salts of	5	paints, household batteries
Iodine	5	photography chemicals
Nitrobenzene	5	furniture polishes, shoe polishes, hobby solvents & thinners
Chromium, metals & salts of	5	household batteries, carburetor flushes
Potassium Dichromate	5	acid & base radiator flushes, photography chemicals
Sodium Dichromate	5	base radiator flushes, photography chemicals
Organic Phosphorous comods	5	gasoline
Pesticides* (too many to list, examples are:	5 - 4	
Paraquat	5	herbicide
Carbaryl	4	herbicide
Chlordane	4	insect powders
Diquat	4	pesticides, herbicides
Dichlorvos	4	pesticides
Aromatic Hydrocarbons including:	4	hobby solvents & thinners, varnishes, lacquers
Benzene	4	gasoline, brush cleaners, wood stains, glues & cements
Toluene	4	gasoline, brush cleaners, paint thinners adhesives & glues, wood putties
Xylene	4	gasoline, brush cleaners, paint solvents, caulking compounds, paints and varnishes
Boric Acid	4	radiator flushes
Camphor	4	glues & cements
Carbon Tetrachloride	4	Spot & stain removers for fabric, upholstery & carpet, disinfectants, paint solvents, paints & varnishes
Cresol	4	carburetor cleaners, disinfectants, sealants, wood preservatives, fuel oils, roofing compounds
Diaminophenol Hydrochloride	4	photography chemicals, solvents & thinners, adhesives
Ethylene Dichloride	4	photo. chemicals, carb. cleaners, gasoline, solvents, adhesives
1,1,1 Trichloroethane	4	caulking compounds & cements
Tetrachlorethylene	4	degreasers, spot removers, paint strippers, hobby solvents & thinners
Hydroxylamine Sulfate	4	photography chemicals
Isoamyl Alcohol	4	hobby solvents, paint & varnish removers
Lead, metals & salts of	4	gasoline, brush cleaners, paint thinners, adhesives & glues, wood putties
Oxalic Acid	4	acid radiator flushes, bleach, metal polishes, toilet bowl cleaners, photography chemicals
Paraformaldehyde	4	deodorizers
Pentachlorophenol	4	wood preservatives
Phenol	4	hobby acids, paint & varnish removers, hobby solvents & thinners, disinfectants
Potassium Oxalate	4	photography chemicals
Pyrogalllic Acid	4	photography chemicals
Sodium Perborate	4	bleach coffee pot cleaners, denture cleaners

APPENDIX B**FLAMMABILITY: Chemical Constituents with Characteristics of #3 or Above**

CHEMICAL CONSTITUENT	FLAMMABILITY	HOUSEHOLD HAZARDOUS PRODUCTS
n-Butane	4	aerosol propellants, household fuel solvents
Petroleum Distillates	4	lubricating oils, transmission fluids, household degreasers, drain cleaners, floor cleaners & waxes, roof coatings, kerosene, automotive rubbing compounds
Methylene Chloride	4	automotive degreasers, household degreasers, oven cleaners, paints, strippers, septic tank cleaners, toilet bowl cleaners
Tertiary Butylamine Borane	4	photography chemicals
Petroleum Spirits	4	adhesives & glues, hobby paints & thinners, cements, solvents, solvent based paints, acid & base radiator flushes
Carbon Tetrachloride	4	spot & stain removers for fabric, upholstery & carpet, disinfectants, paint solvents, paint & varnishes
Ethylene Dibromide	4	gasoline, sealants
Pesticides - diquat	4	herbicides
Olefins	4	acid & base radiator flushes
Propane	4	household fuel, aerosol propellant

APPENDIX C

REACTIVITY: Chemical Constituents with Characteristics of #3 or Above

CHEMICAL CONSTITUENT	REACTIVITY	HOUSEHOLD HAZARDOUS PRODUCTS
Alkali, Concentrated	3	paint & varnish removers
Hydroxylamine Sulfate	3	photography chemicals
Alkyd Resin	3	car undercoatings (sealants)

APPENDIX D
ACUTE HEALTH EFFECTS: Chemical Constituents with Characteristics of #3 or Above

CHEMICAL CONSTITUENT	ACUTE HEALTH	HOUSEHOLD HAZARDOUS PRODUCTS
Potassium Cyanide	3	photography chemicals
Sodium Thiosulfate	3	photography chemicals
Methyl Chloroform	3	hobby solvents & thinners
Ferricyanide	3	photography chemicals
Diaminoddiethylamine-2,2	3	fiberglass resins & hardeners
Phenolic Resin	3	car undercoatings
Pentachlorophenol	3	wood preservatives
Cresol	3	carburetor cleaners, disinfectants, paint solvents, paint & varnish removers
1,1,1, Trichloroethane	3	caulking compounds, cements
Phenol	3	hobby acids, paint & varnish removers, hobby solvents & thinners
Alkali, Concentrated	3	paint & varnish removers
Sodium hydroxide	3	drain cleaners, oven cleaners, paint strippers, photography chemicals
Ammonium hydroxide	3	disinfectants, fireplace cleaners, floor cleaners & waxes, spot removers
Potassium hydroxide	3	carburetor cleaners, drain cleaners, oven cleaners
Alkyd Resin	3	car undercoatings
Sulfuric Acid	3	automotive batteries, drain cleaners, hobby acids, photography chemicals
Potassium Chrome Alum	3	photography chemicals
Sodium Bisulfite	3	acid radiator flushes
Nitric Acid	3	hobby acids
Carbon Tetrachloride	3	spot & stain removers for fabric, upholstery & carpet, hobby paint & varnish removers
Diaminiphenol Hydrochloride	3	photography chemicals
Hydrochloric Acid	3	acid radiator flushes, drain cleaners, toilet bowl cleaners, photography chemicals
Arsenic	3	wood preservatives, paint & varnish removers, pesticides & herbicides
Nitrobenzene	3	furniture polishes, shoe polishes, hobby solvents & thinners

APPENDIX E
CHRONIC HEALTH EFFECTS: Status of Regulations

CHEMICAL CONSTITUENT	CHRONIC HEALTH	HOUSEHOLD HAZARDOUS PRODUCTS
Toluene	F*	gasoline, brush cleaners, paint thinners, adhesives & glues, wood putties
Tetrachloroethylene	F	automotive rubbing compounds & degreasers, hobby solvents & thinners
Arsenic	F	wood preservatives, paint & varnish removers, pesticides & herbicides
Benzene	F	gasoline, brush cleaners, wood stains, glues & cements
Cadmium, metals & salts of	F	paints with this metal pigment, household batteries
Ethylene Dibromide	F	gasoline, sealants
Chromium, metals & salts of	F	rust removers, wood stains, wood preservatives
Carbon Tetrachloride	F	spot & stain removers for fabric, upholstery & carpet, hobby paint & varnish removers
Chlordane	F	flea powder
Trichloroethylene	F	automotive degreasers, septic tank cleaners, hobby solvents & thinners
Xylene	F	gasoline, brush cleaners, paint solvents, caulking compounds, paint & varnish removers
Mercury, metals & salts of	F	thermometers, household batteries
Phenol	F	hobby acids, paint & varnish removers, hobby solvents & thinners
Nitrate (asN)	F	petroleum based fertilizer

* F: Final status

APPENDIX F

Summary of Characteristics of Chemical Constituents in Top 50 products (Toxicity (T), Actute Health Effects (H), Flammability (F), Reactivity (R), Chronic Health Effects (C))

CHEMICAL CONSTITUENT	T	H	F	R	C	HOUSEHOLD HAZARDOUS PRODUCTS
Potassium Cyanide	6	3				photography chemicals
Mercury	6					thermometers, household batteries
Mercuric chloride	6					photography chemicals
Nitrobenzene	5	3	2			furniture polishes, shoe polishes, hobby solvents & thinners
Arsenic	5	3			P	wood preservatives, paint & varnish removers, pesticides & herbicides
Paraquat	5					herbicide
Iodine	5					photography chemicals
Cadmium Metal	5				F	paints
Sodium Dichromate	5	1		1		base radiator flushes, photography chemicals
Potassium Dichromate	5	1		1		acid & base radiator flushes, photography chemicals
Organic Phosphorous compounds	5			1		gasoline
Sodium Chromate	5					carburetor chemicals
Phenol	4	3	2			hobby acids, paint & varnish removers, hobby solvents & thinners, disinfectants
Cresol	4	3	2			sealant, disinfectant, roofing compound, wood preservative, fuel oil
Diaminiphenol Hydrochloride	4	3	2			photography chemicals
Pentachlorophenol	4	3	2			wood preservatives
1,1,1, Trichloroethane	4	3				caulking compounds, cements
Carbon Tetrachloride	4	3	4		F	spot & stain removers for fabric, upholstery & carpet, disinfectants, paint solvents, paint & varnish
Benzene	4	2	3		F	gasoline, brush cleaners, wood stains, glues & cements
Ethylene Dichloride	4	2	3			carburetor cleaners, gasoline, solvents & thinners, adhesives, photography chemicals, degreasers
Xylene	4	2	3		F	gasoline, brush cleaners, paint solvents caulking compounds, paint & varnish removers
Toluene	4	2	3		F	gasoline, brush cleaners, paint thinners, adhesives & glues, wood putties
Carbaryl (sevin)	4	2	2			flea powders, pesticides
Paraformaldehyde	4	2	1			deodorizers
Dichlorvos	4	2				degreasers, spot & stain removers, paint strippers
Perchloroethylene	4	2				degreasers, spot & stain removers, paint strippers, hobby solvents & thinners
Diquat	4	1	4		P	flea powders & pesticides
Ethylene Dibromide	4	1	4		F	gasoline, pesticides, solvents

APPENDIX F, CONTINUED

CHEMICAL CONSTITUENT	T	H	F	R	C	HOUSEHOLD HAZARDOUS PRODUCTS
Hydroxylamine Sulfate	4	1	3	3		photography chemicals
Aromatic Hydrocarbons	4	1	3			car undercoats, solvents & thinners, varnishes & thinners
Isoamyl Alcohol	4	1	2			hobby solvents, paint & varnish removers
Oxalic Acid	4	1	1			acid radiator flushes, bleaches, metal polishes, toilet bowl cleaners, photography chemicals
Camphor	4		2			glues & cements
Chlorinated Solvents	4					household degreasers
Diazinon	4					pesticides
Pyrogallic Acid	4					photography chemicals
Sodium Perboarate	4					coffee pot cleaners & denture cleaners
Chlordane	4				F	flea powders, insect powders
Potassium Oxalate	4					photography chemicals
Lead, metal & salts of	4				P	automotive batteries, gasoline, caulking compounds, wood stains
Ferricyanide	3	3				photography chemicals
Methylene Chloride	3	2	4			automotive & household degreasers, septic tank cleaners, paint strippers
Methyl Methacrylate	3	2	3	2		glues & cements
Dioxane	3	2	3	1		hobby solvents & thinners
Isopropanol	3	2	3	1		radiator flushes, window washers, concrete cleaners, brush cleaners, caulking compounds
Kerosene	3	2	3			automotive rubbing compounds, fireplace cleaners
Carbon Disulfide	3	2	3			hobby solvents & thinners
Methyl Isobutyl Ketone	3	2	3			shellacs & resins, thinners, solvent based paints, paint & varnish removers
Formaldehyde	3	2	3			disinfectants, glues & cements, photography chemicals
Dichlorobenzene	3	2	2			moth balls, septic tank cleaners, solvents & thinners
Mineral spirits	3	2	2			solvent based paints, paint solvents, glues & cements
Trichloroethylene	3	2	1		F	automotive degreasers, septic tank cleaners, solvents & thinners
Olefins	3	1	4	2		acid & base radiator flushes
Petroleum Naphtha	3	1	4			hobby paints, hobby thinners, glues & cements, solvents, solvent based paints
Petroleum spirits	3	1	4			adhesives & glues
Petroleum Distillates	3	1	4			lubricating oils, transmission fluids, household degreasers, drain cleaners, floor waxes
Petroleum Ether	3	1	4			radiator flushes, paint solvents, solvents & thinners

APPENDIX F, CONTINUED

CHEMICAL CONSTITUENT	T	H	F	R	C	HOUSEHOLD HAZARDOUS PRODUCTS
Ethyl Acetate	3	1	3			varnishes, solvents & thinners, nail polish removers
Butanol, n		1	4			radiator flushes, solvent based paints, paint strippers aerosol sprays
ethyl Ethyl Ketone	3	1	3			adhesives & glues, paint & varnish removers
Cyclohexane	3	1	3			hobby solvents & thinners
Aliphatic Hydrocarbons	3	1	3			automotive undercoats
Acetone	3	1	3			paint strippers, varnishes, glues & cements, paint & varnish removers
Methyl Acetate	3	1	3			glues & cements
Methanol	3	1	3			window washers, wood stains, hobby solvents, paint & varnish removers, rubbing alcohols
Sodium Hydroxide		3		1		drain cleaners, oven cleaners, paint strippers, photography chemicals
Potassium Hydroxide		3		1		carburetor cleaners, drain cleaners, oven cleaners
Nitric Acid		3				hobby acids
Hydrochloric Acid		3				acid radiator flushes, drain cleaners, toilet bowl cleaners, photography chemicals
Tertiary Butylamine Borane		2	4			photography chemicals
		2	3	2		gasoline
Butadiene		2	3	2		water based paints
Styrene Monomer		2	3	2		water based paints, sealants, paint & varnish removers
Vinyl Toluene		2	2	1		paint & varnish removers
Bis (2-chloroethyl) ether		2	2			paint & varnish removers
Napthalene		2	2			deodorants, fireplace cleaners, moth balls, rug cleaners
Urea Formaldehyde		2	2			adhesives & glues
Chlorotoluene, ortho		2	2			hobby solvents & thinners
Isophorone		2	2		L	paint & varnish removers
Tricresyl Phosphate		2	1			lubricating oils, cleaners, hobby solvents & thinners
Phosphoric Acid		2				concrete cleaners, metal polishes
Hexane		1	3			glues & cements
Butyl Acetate		1	3			nail polish & nail polish remover
Butanol, iso		1	3			fuel additives, paint & varnish removers
Methyl Styrene, alpha		1	2	1		paint & varnish removers
Potassium Permanganate			1			photography chemicals
Phenylenediamine, para					F	rust removers, wood stains, wood preservatives, paints with this pigment

APPENDIX F, CONTINUED

CHEMICAL CONSTITUENT	T	H	F	R	C	HOUSEHOLD HAZARDOUS PRODUCTS
Turpentine	3	1	3			paint solvents, hobby paints, waxes
Isoamyl Acetate	3	1	3			hobby solvents & thinners
Cyclohexanol	3	1	2			automotive rubbing compounds
Cyclohexanone	3	1	3			fiberglass resins & hardeners, paint & varnish removers
Ketones	3	1	2			hobby solvents & thinners
Ethylene Glycol	3	1	1			anti-freezes & coolants, floor cleaners, floor waxes water based paints, glues & cements
Diethylene Glycol	3	1	1			anti-freeze, floor cleaners & waxes, window cleaners, hobby solvents & thinners
Stoddard Solvent	3	2				transmission fluids
Glycol Ethers	3		2			roof coatings
Dichlorophene	3					flea powders
Sodium Tripolyphosphate	3					radiator flushes, coffee pot cleaners, household cleaners, laundry cleaners
Sodium Silicate	3					furnace cements
Sodium Dodecylbenzenesulfonate	3					household cleaners
Borax	3					stoves
Cuprous Oxide	3					water based paints
Ethanol	2		3			fireplace cleaners, polishes, varnishes wood stains
Alkali, Concentrated		3	3	3		paint & varnish removers
Alkyd Resins		3	3	3		car undercoatings
Phenolic Resins			3	2		car undercoatings
Sodium Bisulfite		3	1	2		acid radiator flushes
Potassium Chrome Alum		3	1	2		photography chemicals
Ammonium Hydroxide			3	1		disinfectants, fireplace cleaners, floor cleaners, floor waxes, spit & stain removers
Sulfuric Acid		3		2		automotive batteries, drain cleaners, photography chemicals

APPENDIX G

Methodology Limitations

Some of the limitations of the methodology used in this report were:

- 1) Synergistic effects of diverse chemicals in a landfill were not considered. For example, it is possible that two or more relatively "less dangerous" chemicals could, when combined in a landfill to form leachate, pose greater danger in groundwater. Nationally, the synergistic effects of various chemicals in landfills are not well known.
- 2) The study did not weigh various chemical characteristics; equal weight is given to, for example, the most highly toxic chemicals and to those with a high degree of flammability.
- 3) Life-cycle factors were not considered. Life-cycle factors assess a product from cradle (manufacture) to grave (disposal). "Life-cycle" refers not only to individual products, but also to the processes involved with manufacturing and uses of each product. The United States Environmental Protection Agency is presently conducting preliminary life-cycle analyses of selected products.
- 4) The study matched chemicals with those product types that have been shown to contain those chemicals. However, product constituents are subject to change, and individual products vary in terms of amounts, types, and concentrations of chemicals they contain. It was beyond the scope of this project to examine individual brands.
- 5) As previously discussed, "extent of use" was determined through a survey of Iowans. The survey asked for information on products Iowans have on hand or have purchased in the last year. It did not ask for disposal habits. This decision was based on evidence from other states that consumers tend to provide "socially acceptable" answers to questions on disposal (while in reality disposing of products using other methods). Information from Bomberg, et al., 1988, indicated that self-haul loads to landfills contained more household hazardous materials. When a need arises to clean out products in the home quickly, for example, moving, large amounts of household hazardous materials may be disposed of improperly as these materials can not be transported by moving companies.

It was beyond the scope of a statewide survey to determine the specific amounts of each hazardous product purchased and the specific amounts of each product used over time, and ways in which each product was disposed of.

- 6) This study was constrained by the legislative mandate to produce a list of "no more than 50" products. However, the authors do not view the resultant list as definitive. It is probable that other products that should be of equal concern do not appear on the list because of the size limitation of the list.

7) Other routes by which household hazardous products may reach our water supplies were not addressed. Research done by the Washington Toxics Coalition and presented at the Third National Conference on Household Hazardous Materials discusses household hazardous products which may reach our water supplies through routes other than the landfill.

Septic tanks - There are an estimated 300,000 to 400,000 Septic tanks in Iowa. Lightweight or volatile organic solvents may travel from the septic tank system and adjacent soil to nearby groundwater.

Storm drains - This passageway is often the discard route by householders for products such as motor oil, anti-freeze, gasoline, acid masonry products, paints and pesticides which to directly into local waters such as lakes rivers and streams. runoff from the ground may also put pesticides and fertilizer used on lawns and gardens in storm drains.

Household drains - Analysis at waste water treatment plants show chemical constituents from all the household hazardous materials listed in our report with the exception of fertilizer. Some chemicals may pass through the waste treatment plant and not be treated (Galvin, 1990).

Sinkholes - A study by the Department of Agriculture and Land Stewardship of 107 sinkholes in Iowa shows 57% contained household garbage (not broken down into types) and 7% contained chemical containers.

8) Use and storage factors are not considered. Some household hazardous products present more problems in this area than in disposal. An example is antifreeze. This product is not on the "Top 50 List" and would probably be broken down by microorganisms and not cause a problem in a landfill. However, used antifreeze may contain heavy metal contaminants which could be a potential source of groundwater contamination. Antifreeze is ranked as #3, moderately toxic, by Gosselin. This product is sweet tasting and situations of improper use and disposal may result in poisoning of pets and wildlife.

A survey conducted by Science & Engineering Associates, 1989, for the New Mexico Environment Health Department of Albuquerque estimates that antifreeze ranks second (motor oil being first) as being disposed of by households. For 107,000 single family households an estimated 22,053 gallons of antifreeze are disposed of in a year.

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