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Engineering & science applied to the earth & its environment

June 26, 1997

Mr. Jerry Delavan, P.G.
Arkansas Department of Pollution Control and Ecology
PO Box 8913
Little Rock, AR 72219-8913

Re: El Dorado Chemical Company Waste Minimization Plan
El Dorado, Arkansas
WC File No.: 97B061/5

Dear Mr. Delavan:

Enclosed please find two copies of the above-referenced report. Please contact either of the undersigned at 223-2582 if you have any questions or comments pertaining to this report. We appreciate your continued cooperation during the course of this project.

Sincerely,

Ray A. Quick, P.G.
Branch Office Manager

Mary D. Beck, C.I.H., C.H.M.M.
Project Scientist

Enclosures

cc: John Carver, EDC (w/enclosure)
Byron Smith, EDC (w/enclosure)

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FINAL

WASTE MINIMIZATION PLAN

JUNE, 1997

Prepared for
El Dorado Chemical Company
El Dorado, Arkansas

Woodward-Clyde

Woodward-Clyde
Three Financial Centre
900 S. Shackleford, Suite 412
Little Rock, AR 72211
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95B165-WMP

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1.0 INTRODUCTION

Pursuant to paragraph 23 of Consent Administrative Order (CAO) 95-070, El Dorado Chemical Company (EDC) is required to have a Waste Minimization Program for the facility's operations if the requirements set forth in Paragraph 22 were not met. In a letter dated May 13, 1997, EDC notified the Arkansas Department of Pollution Control & Ecology (ADPC&E) that EDC would have a written Waste Minimization Plan prepared and available for review by July 1, 1997. According to paragraph 23 of the CAO, the Waste Minimization Plan will apply to the generation of hazardous waste at the EDC facility. A Waste Minimization Plan for hazardous waste has been prepared for review by the ADPC&E and is contained in this document. This plan has been prepared following the Environmental Protection Agency's (EPA) "Guidance to Hazardous Waste Generators on the Elements of a Waste Minimization Program", 58 FR 32114 (May 28, 1993).

The major tasks involved in the preparation of the plan include the following:

1. Identification of all hazardous wastes from the plant.
2. Prioritization of waste streams according to the costs of management and environmental compliance.
3. Development of a waste reduction/elimination plan for waste streams.
4. Assessment of economic, regulatory, and technical feasibility for each alternative.
5. Selection of feasible plans.
6. Preparation of a written waste minimization plan incorporating information gathered in steps 1-5 and addressing the program elements from the EPA guidance document which are summarized in the following sections:

Section 2.0	Top Management Support
Section 3.0	Characterization of Hazardous Waste Generation and Waste Management Costs
Section 4.0	Waste Minimization Assessments
Section 5.0	Cost Collection System
Section 6.0	Technology Transfer
Section 7.0	Program Implementation and Evaluation

2.0
TOP MANAGEMENT SUPPORT

The management of EDC is committed to support a company-wide effort to reduce hazardous waste generation from operations at the EDC facility. The top management consists of the following personnel with positions and responsibilities indicated:

Jim Wewers, President, El Dorado Chemical Company
Mr. Wewers is the company official responsible for the fiscal management and operations of El Dorado Chemical Company. He will ensure that the necessary financial support from corporate will be ascertained in order to minimize the generation of hazardous wastes at the EDC plant.

John M. Carver, Vice President, Safety and Environmental Compliance, LSB Industries
Mr. Carver is responsible for directing matters relating to safety and environmental compliance for LSB Industries which is the parent company of El Dorado Chemical Company. Mr. Carver will lend corporate support to El Dorado Chemical Company for implementation of the waste minimization program.

Richard L. Milliken, Plant Manager, El Dorado Chemical Company
Mr. Milliken is responsible for plant management and will provide the necessary support to the waste minimization program at the plant level through company policies.

Ralph Freeman, Plant Engineering Manager, El Dorado Chemical Company
Mr. Freeman will be a member of the waste minimization team and will assist with technology transfer for modifying processes to reduce production of waste at the source where economically practical and technically feasible.

Byron Smith, Plant Environmental Manager, El Dorado Chemical Company
Mr. Smith will be responsible for reviewing and updating the waste minimization plan, as necessary, for hazardous waste generation from El Dorado Chemical plant operations.

3.0 CHARACTERIZATION OF HAZARDOUS WASTE GENERATION AND WASTE MANAGEMENT COSTS

3.1 WASTE STREAM CHARACTERIZATION

In order to characterize the hazardous waste streams generated from the EDC plant, a review was completed of the following plant records:

- Annual Hazardous Waste Reports for 1993, 1994, 1995, and 1996
- Uniform Hazardous Waste Manifests for 1993, 1994, 1995, and 1996
- Waste Profile Information and Analytical Test Results for Waste Materials
- Process Descriptions and Flow Charts

For each process the industrial wastes (non-hazardous) and hazardous wastes generated which are shipped off-site are shown in Figures 1-6. Each process area and the wastes generated in these areas are described as follows:

Nitric Acid Production

Weak nitric acid (approximately 55 % by weight) is produced by the exothermic reaction of ammonia vapor with compressed air, followed by absorption of water. The weak nitric acid is conveyed to storage for shipment or further processing. The weak nitric acid may be processed in a nitric acid concentrator (NAC), where strong sulfuric acid (93-94% by weight) is used to remove water from the weak acid to produce 98 % by weight nitric acid. The weak sulfuric acid is processed through a direct-fired concentrator where some of the water is removed by evaporation, and the sulfuric acid is then recycled back to the nitric acid concentrator. Three strengths of nitric acid (55%, 65% and 98% by weight) are produced by EDC. The products are shipped by rail or tank trucks.

Periodically, a sulfuric acid sludge which accumulates in the NAC tubes must be removed. The sulfuric acid sludge is a waste generated from the NAC process. It is a corrosive waste and contains lead and chromium at levels which are typically characteristically toxic based on the Toxicity Characteristic Leaching Procedure (TCLP). It carries the Environmental Protection Agency hazardous waste codes D002 (corrosive), D007 (chromium), and D008 (lead).

An industrial waste also generated from this process is the spent platinum gauze which is the catalyst used in the nitric acid production. Because platinum is a precious metal, the gauze is vacuumed by EDC to capture any dust and the vacuumed material and used gauze are returned to the manufacturer for recycling. This material is not categorized as a hazardous waste.

Sulfuric Acid Production

Sulfuric acid is produced from combustion of molten sulfur which produces a gas stream of sulfur dioxide and sulfur trioxide which are captured in an absorption tower with sulfuric acid, where sulfur trioxide gas combines with water present in the sulfuric acid to produce strong sulfuric acid (approximately 98 % by weight).

Some of the acid produced is used in the nitric acid concentrator and the rest is sent to storage for shipment as product, either in rail or tank trucks.

An industrial waste generated from this process area is the spent vanadium catalyst which is shipped off-site to the vanadium recycler (U.S. Vanadium). The spent vanadium catalyst is not categorized as a hazardous waste.

A one time production waste was generated from the removal of a concrete foundation. The sulfuric acid production equipment had been removed from the concrete foundation The foundation was removed because it was not suitable for additional equipment. The concrete foundation waste was classified as a hazardous waste because of TCLP-Lead (D008). It was generated during 1996 and shipped off-site for proper disposal to U.S. Pollution Control, Inc. in Waynoka, OK.

Ammonium Nitrate, Liquid and Granular ("Prills")

Superheated ammonia vapor is reacted with hot nitric acid in the "Ammonia Neutralizers." to produce a 90 % aqueous solution of ammonium nitrate (AN) which can be stored at the liquid nitrate tank farm for future shipping as a product, or it can be further concentrated and flash-dried to produce granular "prills" of ammonium nitrate.

The AN prills are produced by the quick drying of a heated, highly concentrated aqueous solution of ammonium nitrate inside a forced-air drying tower (the Prill Tower), where the liquid solution is sprayed at the top to form droplets which free-fall and dry before hitting the bottom of the tower.

A waxy coating material, Galoryl, is added to the prills as they are dried and screened. Talc is also added to the prills at the time of shipment to provide cushioning during transportation. The ammonium nitrate prills are stored in cone-bottom bins from which they are transported by a belt to the rail car and truck loading stations.

There are no hazardous wastes produced from this process area. The industrial wastes include spilled or spent additives, (Galoryl and talc), ammonium nitrate mixed with soil from product spills during loading in the rail or truck loading areas. The contractors utilize tarps to minimize the loss of ammonium nitrate product in the loading areas. The waste Galoryl and talc are shipped off-site to the Union County Landfill (UCL).

Water Treatment and Boiler House

The EDC plant obtains all of its industrial and sanitary water from five deep supply wells located on the EDC property. The groundwater is generally very soft with low levels of suspended and dissolved solids, and requires minimal treatment for use as process cooling water and for sanitary purposes.

The well water is used as boiler make-up for steam generation, however, it is subjected to demineralization before being fed into the condensate system. The cation and anion exchange units are regenerated approximately every 24 hours. The regeneration wastes are discharged into the plant's sewer to the wastewater treatment system.

The water treatment chemicals are completely utilized within this area and there is no hazardous waste generation from the process. EDC uses a re-pour system for small volumes of the water treatment chemicals left in the 55-gallon plastic drums. When a drum nears empty and the chemicals can not be pumped from the bottom of the barrel, the liquid is consolidated into another drum until a full drum of chemical is accumulated for use. This is a cost savings measure as well as a waste reduction measure for the water treatment chemicals.

Production Quality Control Laboratory

The laboratory is a source of hazardous waste generation on an intermittent basis. The laboratory is required to use hazardous chemicals as reagents or solvents in chemical analysis methods. Outdated chemical reagents or spent solvents become hazardous wastes. These are usually generated in small quantities and are disposed of in "lab packs." A lab pack is a drum filled with absorbent material surrounding the containers of small quantities of compatible hazardous chemicals. The lab pack is transported to an off-site treatment, storage, and disposal facility (TSDF) for disposal generally by incineration. Based on four years of hazardous waste manifest data reviewed from the EDC plant, laboratory waste was only generated during 1996.

Plant Maintenance Activities

Plant maintenance activities occur throughout the plant and include waste which are generally classified as industrial wastes and not hazardous wastes. These include asbestos containing materials, used oil, and parts washer solvents. In 1996, prior to analytical testing, EDC's spent parts washer solvent was assumed to be a hazardous waste. After testing of the spent parts washer solvent, the material was classified in 1997 as an industrial waste. The waste is transported by Safety-Kleen to a recycling facility.

Used oils are tested prior to disposal by EDC. The used oils have been classified as non-hazardous according to TCLP testing. The used oils are transported to off-site used oil reclamation companies.

Asbestos containing materials are sometimes generated from the maintenance of insulated equipment or piping. The asbestos containing materials are handled as an industrial waste and transported to the UCL for disposal.

The manufacturer information for the fluorescent light bulbs was reviewed by EDC for disposal information. The manufacturer information indicates that the light bulbs are not classified as a hazardous waste.

Other Areas

Hazardous wastes were generated from an one-time landfill cell remediation activity in 1993, where soil which contained lead (D008) and chromium (D007) was removed from EDC's solid waste landfill and transported off-site for proper disposal to LWD, Inc. in Calvert City, KY. The landfill was subsequently closed in 1995. The ADPC&E approved the closure of the EDC landfill in the same year.

3.2 HAZARDOUS WASTE AMOUNTS BY YEAR

The total amounts of hazardous waste generated and shipped off-site by EDC during the past four years (1993, 1994, 1995, and 1996) are shown in the column chart, Figure 7. The annual amounts of hazardous waste are also shown in Table 1.

Table 1. El Dorado Chemical Company - Hazardous Waste Generation Amounts

Year	Total Haz. Waste Shipped Off-site (lbs)
1993	439,540 lbs
1994	13,200 lbs
1995	43,250 lbs
1996	498,071 lbs

The annual total amounts of hazardous waste shown in Table 1 do not include de minimus spills or leaks of nitric acid or sulfuric acid that may have been reported in the past. EDC is committed to addressing these de minimus spills and leaks through a pollution prevention program which will emphasize source controls. Currently, de minimus spills or leaks in the process area enter the wastewater treatment system and are treated though neutralization.

The hazardous waste streams, source areas, and amounts identified from the waste characterization include the following shown in Table 2:

Table 2. Hazardous Waste Stream Characterization, Amounts Generated by Year

Source	Waste Stream	1993 (lbs)	1994 (lbs)	1995 (lbs)	1996 (lbs)	Total (lbs)
Nitric Acid Production	Sulfuric Acid Sludge	4400	13200	42350	30083	90033
Sulfuric Acid Production	Concrete Foundation removal (one-time)	0	0	0	460840	460840
Production Laboratory	Lab waste	0	0	0	7080	7080
Plant Maintenance	Parts washer solvent	0	0	0	68	68
EDC Landfill (Closed)	Landfill cell remediation (soil) (one-time)	435140	0	0	0	435140

Figures 8-12 also show a column graph of the amounts for each waste stream by year.

As can be seen from the waste stream characterization and amounts generated, there is only one hazardous waste stream which is generated continuously from the plant, that is the sulfuric acid sludge from the NAC. The sulfuric acid sludge totaled 90,033 lbs for the last four years. It should also be noted that the amount of sulfuric acid sludge generated decreased from 1995 to 1996. This is a result of a change in process with a new nitric acid production unit which utilizes a Direct Strong Nitric Acid (DSN) process instead of the NAC. The DSN process does not generate the sulfuric acid sludge waste. EDC is currently utilizing the DSN process in preference to the NAC process, whenever practical, to reduce the production of hazardous waste at the plant. The NAC process is still in operation on the older Nitric Acid Production Unit and is used when necessary to meet production demand. BASED ON PRODUCTION

3.3 WASTE STREAM COSTS

The waste transportation and disposal costs by year for each waste stream are shown in Table 3. This information was gathered through a review of the purchase order requisition information in the hazardous waste manifest files at the plant.

Table 3. Hazardous Waste Stream Characterization, Costs by Year

Source	Waste Stream	1993 ($)	1994 ($)	1995 ($)	1996 ($)	Total ($)
Nitric Acid Production	Sulfuric Acid Sludge	1837	3077	9865	6858	21637
Sulfuric Acid Production	Concrete Foundation /Soil removal (one-time)	0	0	0	81000	81000
Production Laboratory	Lab waste	0	0	0	6956	6956
Plant Maintenance	Parts washer solvent	0	0	0	511	511
EDC Landfill (Closed)	Landfill cell remediation (soil) (one-time)	65000	0	0	0	65000

Since the foundation removal from the sulfuric acid production area and the landfill cell remediation from the EDC solid waste landfill were one-time waste disposal events, these waste streams can not be addressed with waste minimization strategies for the future. The sulfuric acid sludge from the NAC can be addressed with a plan, as well as production laboratory waste.

4.0 WASTE MINIMIZATION ASSESSMENTS

4.1 WASTE MINIMIZATION STRATEGIES

Waste minimization can be achieved through several strategies. Figure 13 shows the various waste minimization strategies. Source reduction, recycling and reuse, and treatment are the three major waste minimization strategies in order of preference by the United States Environmental Protection Agency.

Source reduction is the best solution for waste minimization, because it eliminates the generator's liabilities and other problems associated with transportation and disposal of waste. The source reduction strategy may be the most expensive strategy to implement due to changes in technology. However, some reduction of hazardous waste volume may be gained through improved housekeeping practices, proper segregation of waste, product substitution, or process modification.

Recycling and reuse are the second choice for waste minimization strategies; however, this alternative has limitations due to the low number of commercial recyclers. Recycling on-site is not always an economically feasible alternative.

Treatment should be considered the last alternative for waste minimization. In some cases, treatment may be the only feasible alternative to land disposal, since source reduction and recycling may not be feasible due to economic reasons. Treatment technologies include physical, chemical, thermal, and biological.

4.2 WASTE MINIMIZATION STRATEGIES IDENTIFIED FOR EDC HAZARDOUS WASTE STREAMS

Specific waste minimization strategies for each source area and waste stream are shown in Table 4.

TABLE 4. Waste Minimization Strategies for EDC Hazardous Waste Streams

Source Area: Waste Stream	**Waste Minimization Strategy**	**Technology or Procedure**
Nitric acid production: Nitric Acid Concentrator (NAC) Sulfuric Acid Sludge	Source Reduction Recycle	Process Change: Utilize Direct Strong Nitric Acid (DSN) to produce 98% Nitric Acid instead of NAC process, whenever feasible. Sulfuric acid recycled through NAC system. NAC Sulfuric Acid Sludge sent to off-site recycler.
Sulfuric Acid Production: Concrete foundation (one-time disposal)	NA	NA
Solid Waste Landfill: Landfill cell remediation (one-time disposal)	NA	NA
Production QC Laboratory: Laboratory Wastes	Source Reduction Source Control/Treatment	Housekeeping improvements: Rinsing container glassware; Purchase smaller quantities of chemicals w/ expiration dates; Segregation/Neutralization of Acidic or Basic Wastes
Maintenance Departments: Parts Washer Solvent	Source Reduction	Product Substitution: Combustible product used instead of flammable product.

5.0
COST COLLECTION SYSTEM

The costs for the hazardous waste disposal for 1993 through 1996 were summarized in Table 3 by waste stream. Copies of purchase order requisitions and invoices are usually kept with the hazardous waste manifest files in the EDC environmental specialist's office.

In order to maintain the cost collection system for 1997 and future operations, the cost information will continue to be maintained with the waste manifests to track waste disposal costs.

The waste disposal costs for each waste stream shall be summarized and reviewed on a yearly basis (January 1 - December 31). This information will allow EDC to evaluate alternative waste minimization technologies and to allow the economic feasibility of the technology to be evaluated against the current waste disposal costs.

6.0
TECHNOLOGY TRANSFER

In order to promote technology transfer, the engineering and environmental groups at EDC will continue to work closely together to promote the waste minimization strategies of source reduction, recycle/reuse, and treatment alternatives.

Wherever possible the most economically feasible source reduction alternatives including good housekeeping practices, proper waste stream segregation, and process modification should be utilized by EDC.

To promote the technology transfer, the top management will continue to financially support this effort and provide leadership for EDC by promoting environmental stewardship and responsibility.

An annual review will be made by the engineering and environmental staff of the EDC plant to evaluate developing technologies and to promote technology transfer for waste minimization strategies which are economically feasible.

The waste minimization plan will be updated annually to reflect any changes in those waste minimization strategies.

7.0
PROGRAM IMPLEMENTATION AND EVALUATION

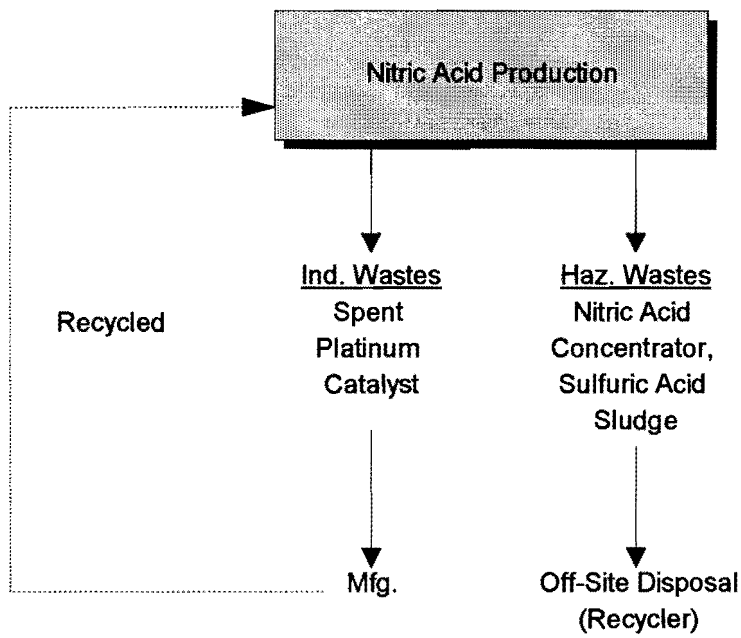
The waste minimization strategies identified in Section 4.0 of this plan will be implemented by July 1, 1997 at the EDC Plant. The strategies identified in Table 4.0 are those that are already existing and/or are economically practical to implement at the plant.

An annual evaluation of the effectiveness of this plan will be made by the environmental and engineering groups at the plant. The cost summary information will be compared to any potential new technologies which could be transferred to the EDC plant for waste stream minimization.

The annual update of this waste minimization plan shall be completed by January 31 following the end of the previous calendar year. Updates of the plan shall be kept for three years from the time of preparation.

FIGURES

ROUTINE INDUSTRIAL AND HAZARDOUS WASTES
SHIPPED OFF-SITE FOR PROCESS UNITS
EL DORADO CHEMICAL COMPANY



* Hazardous Waste not generated when using Direct Strong Nitric Acid (DSN) process. EDC is utilizing DSN process to reduce this waste stream.

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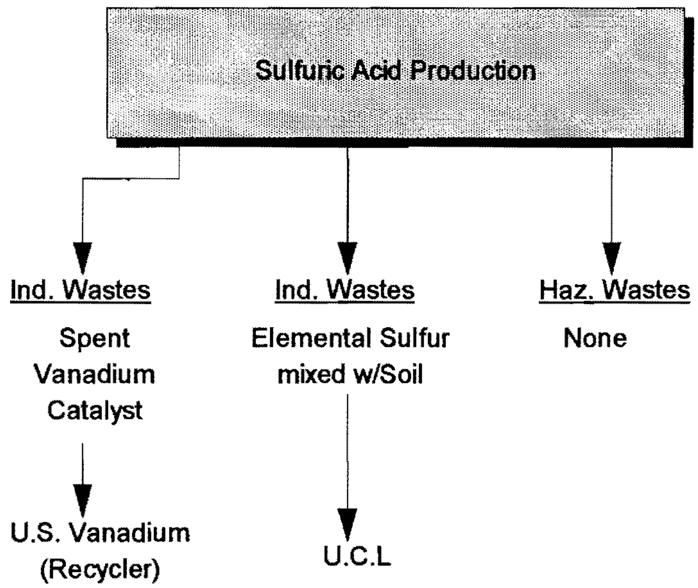
Figure 1. Nitric Acid Production

ROUTINE INDUSTRIAL AND HAZARDOUS WASTES
SHIPPED OFF-SITE FOR PROCESS UNITS
EL DORADO CHEMICAL COMPANY

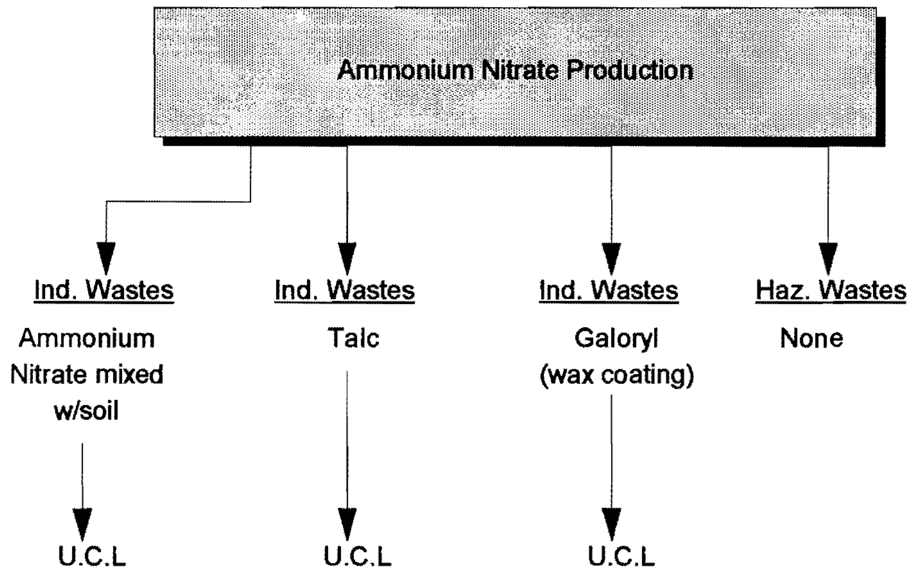


U.C.L. = Union County Landfil

EDC-HAZ2.AF2

Figure 2. Sulfuric Acid Production

ROUTINE INDUSTRIAL AND HAZARDOUS WASTES
SHIPPED OFF-SITE FOR PROCESS UNITS
EL DORADO CHEMICAL COMPANY



U.C.L. = Union County Landfil

Figure 3. Ammonium Nitrate Production

EDC-HAZ3.AF2

ROUTINE INDUSTRIAL AND HAZARDOUS WASTES SHIPPED OFF-SITE FOR PROCESS UNITS EL DORADO CHEMICAL COMPANY

Production Quality Control Laboratory

↓

Hazardous Wastes
Contaminated Glassware (98% Nitric Acid)
Spent Lab Chemicals/Solvents (periodically generated)
("Lab Packs")

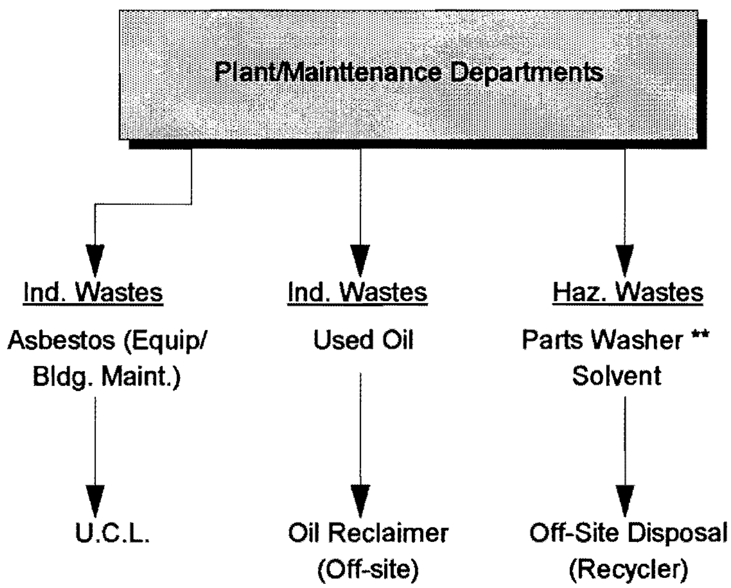
↓

Off-Site Disposal
(Incineration or Fuel Blending)

EDC-HAZ4.AF2

Figure 4. Production Quality Control Laboratory

ROUTINE INDUSTRIAL AND HAZARDOUS WASTES
SHIPPED OFF-SITE FOR PROCESS UNITS
EL DORADO CHEMICAL COMPANY



** Initially assumed to be hazardous, but after testing, waste determined to be non-hazardous.

U.C.L. = Union County Landfill

Figure 5. Plant Maintenance Dept.

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ROUTINE INDUSTRIAL AND HAZARDOUS WASTES
SHIPPED OFF-SITE FOR PROCESS UNITS
EL DORADO CHEMICAL COMPANY

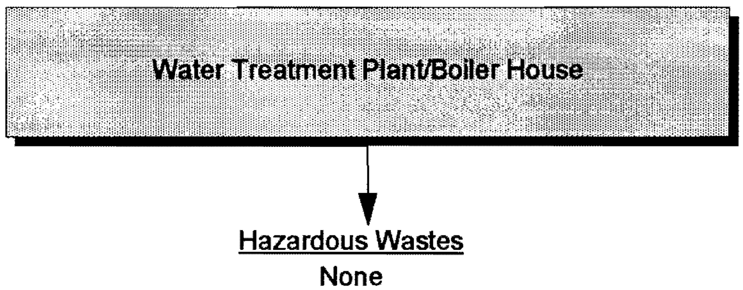

Figure 6. Water Treatment Plant/Boiler House

El Dorado Chemical Company
Hazardous Waste Generation Amounts by Year

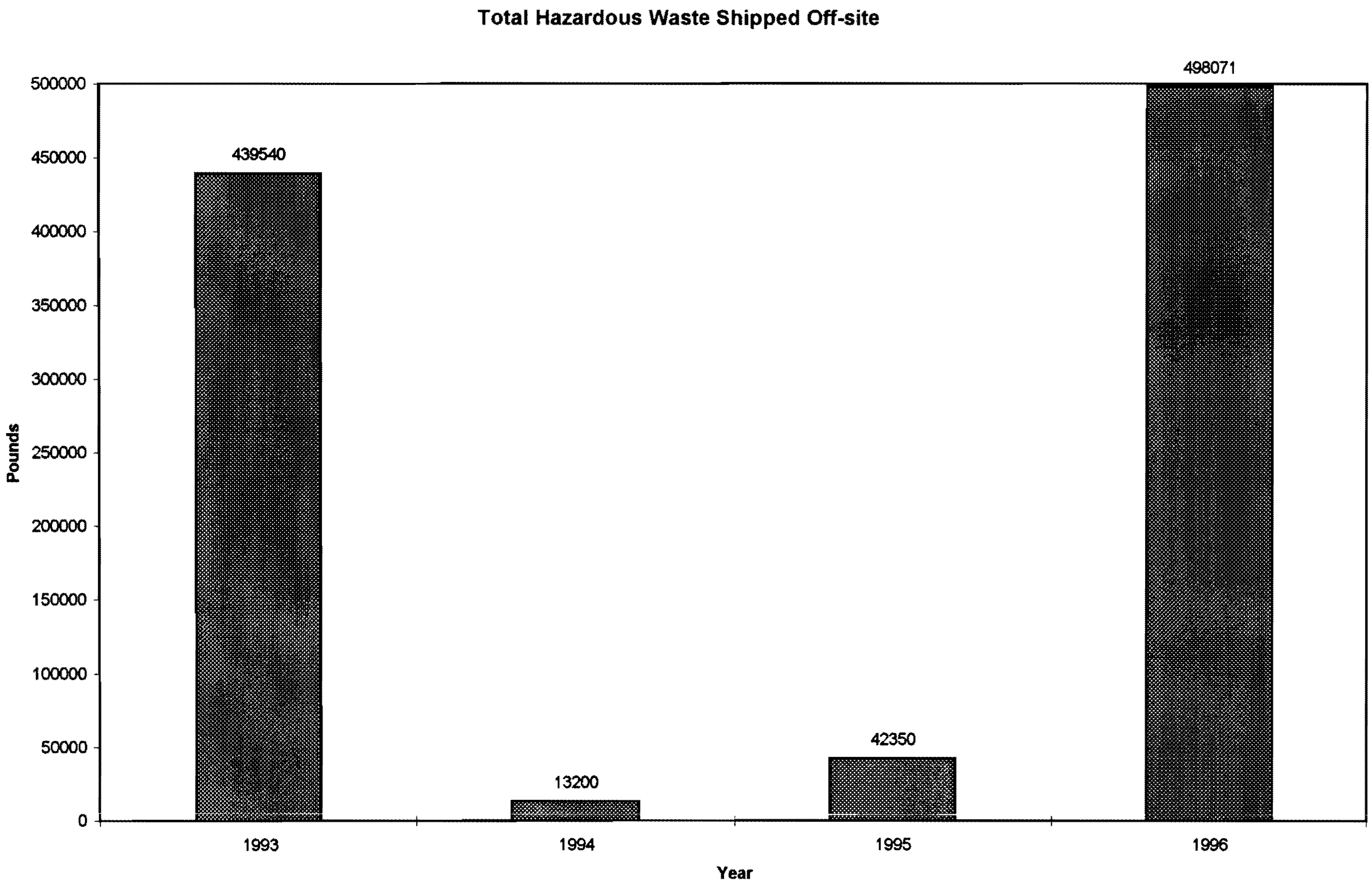

FIGURE 7

El Dorado Chemical Company
Hazardous Waste Generation Amounts by Year

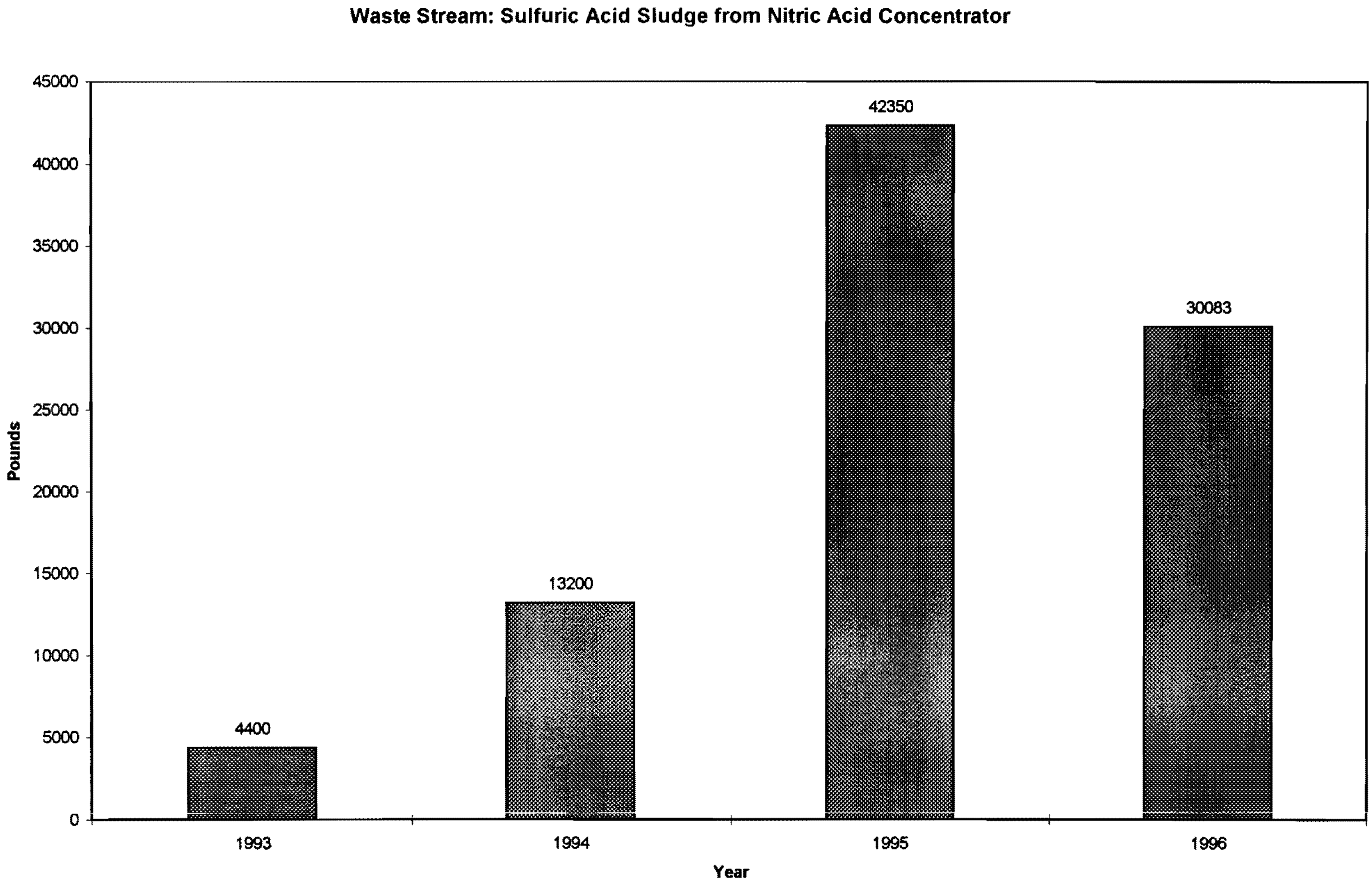

FIGURE 8

El Dorado Chemical Company
Hazardous Waste Generation Amounts by Year

Waste Stream : Landfill Cell Remediation (Soil)

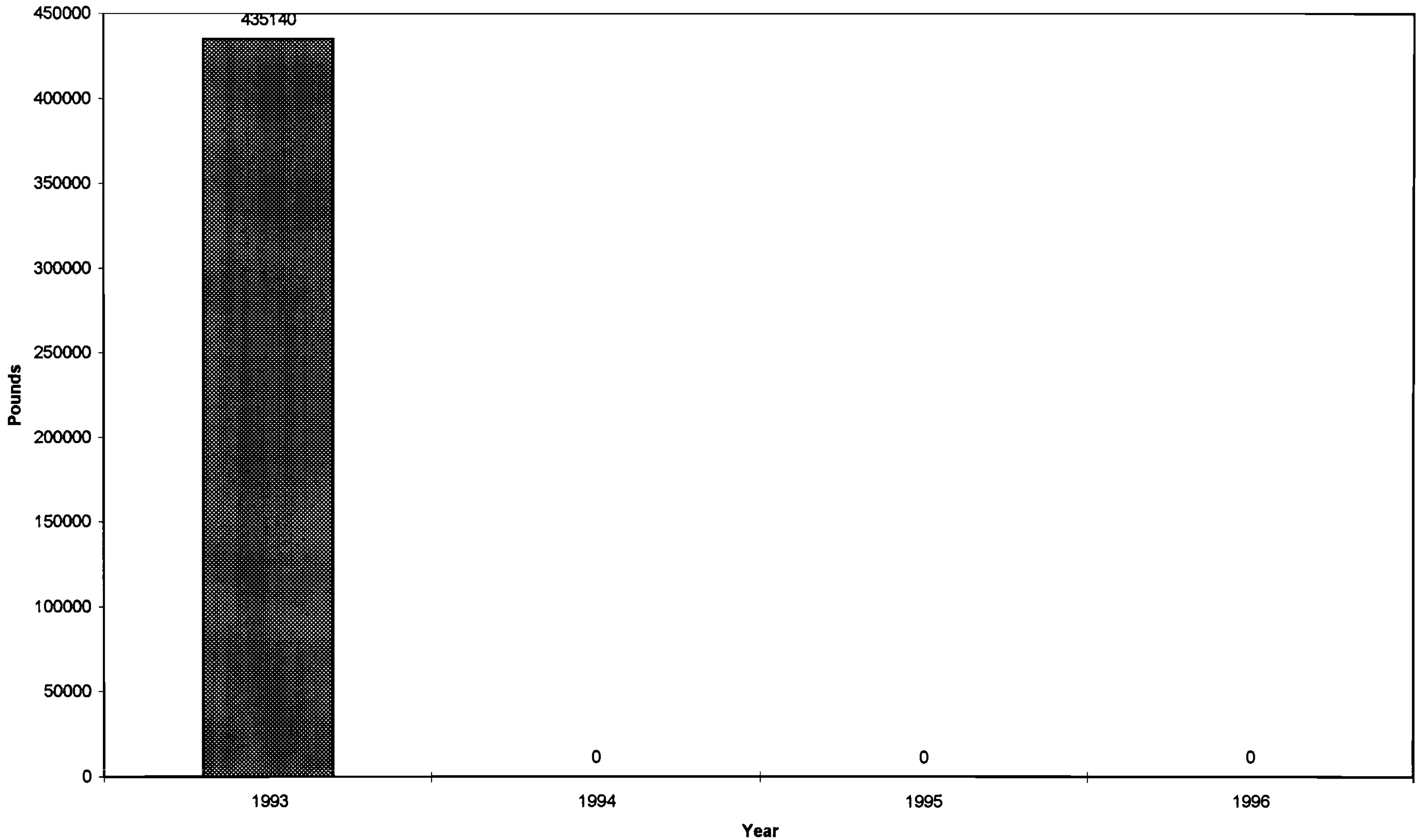

FIGURE 9

El Dorado Chemical Company
Hazardous Waste Generation Amounts by Year

Waste Stream: Laboratory Waste/Lab Packs

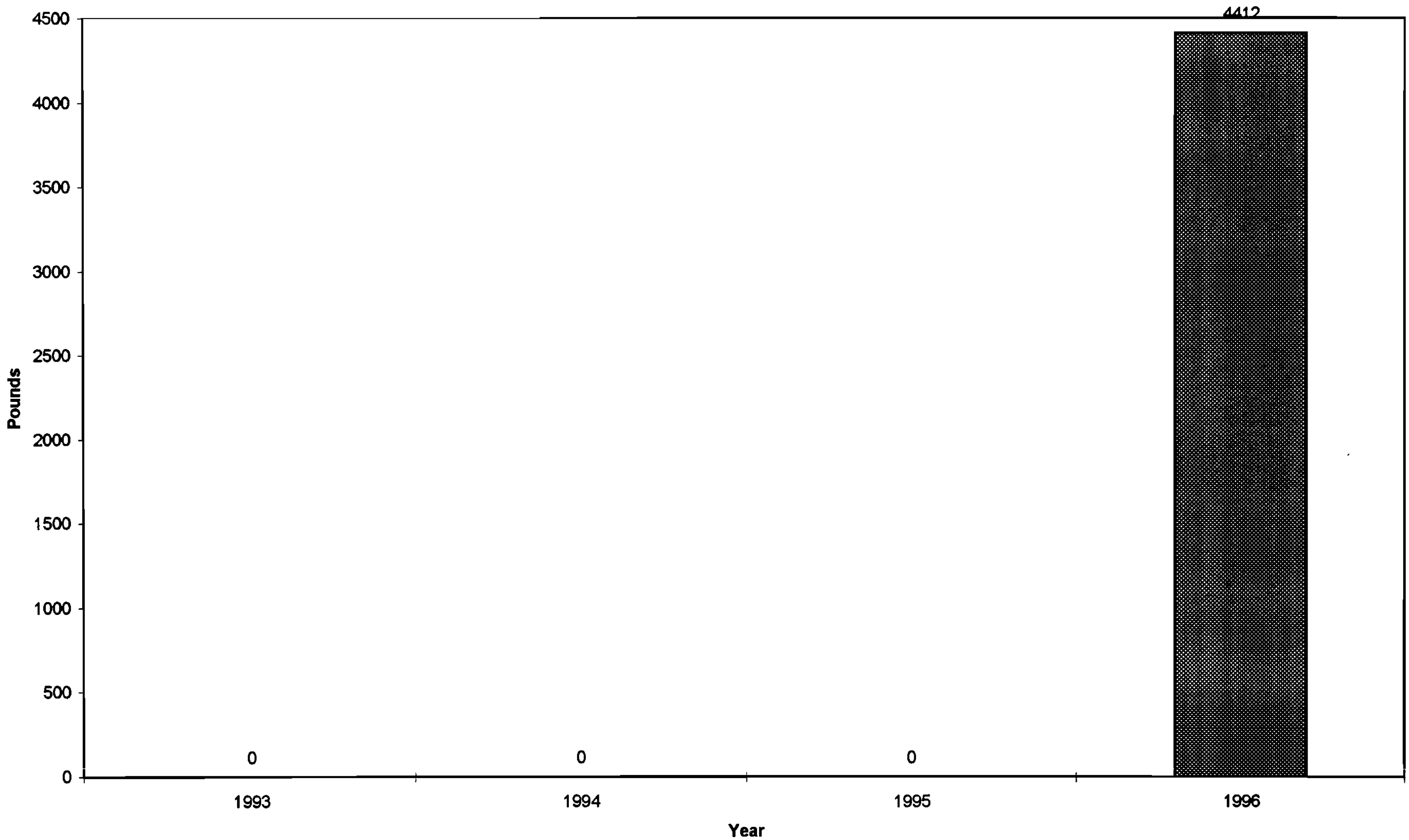

FIGURE 10

El Dorado Chemical Company
Hazardous Waste Generation Amounts by Year

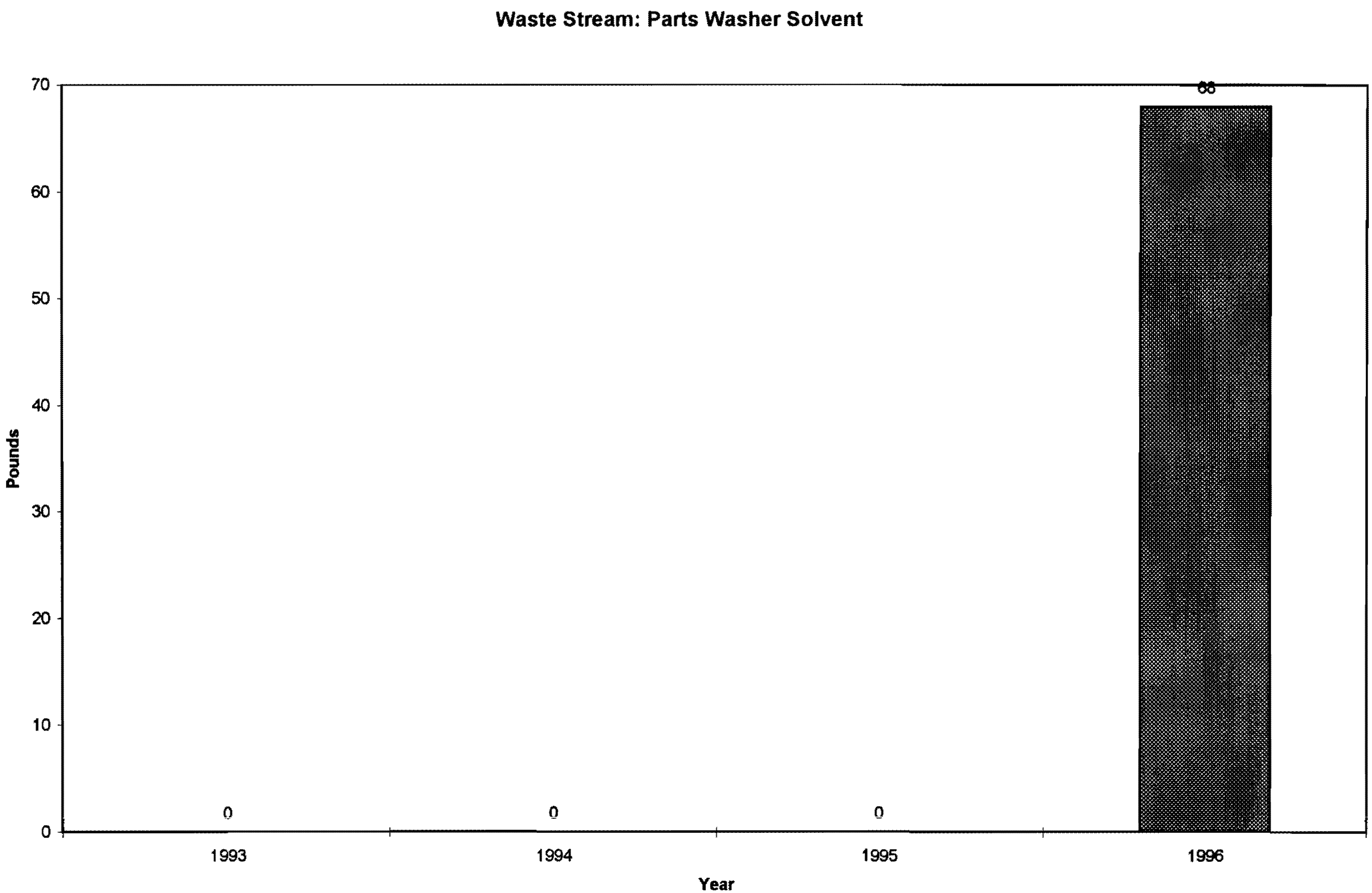

FIGURE 11

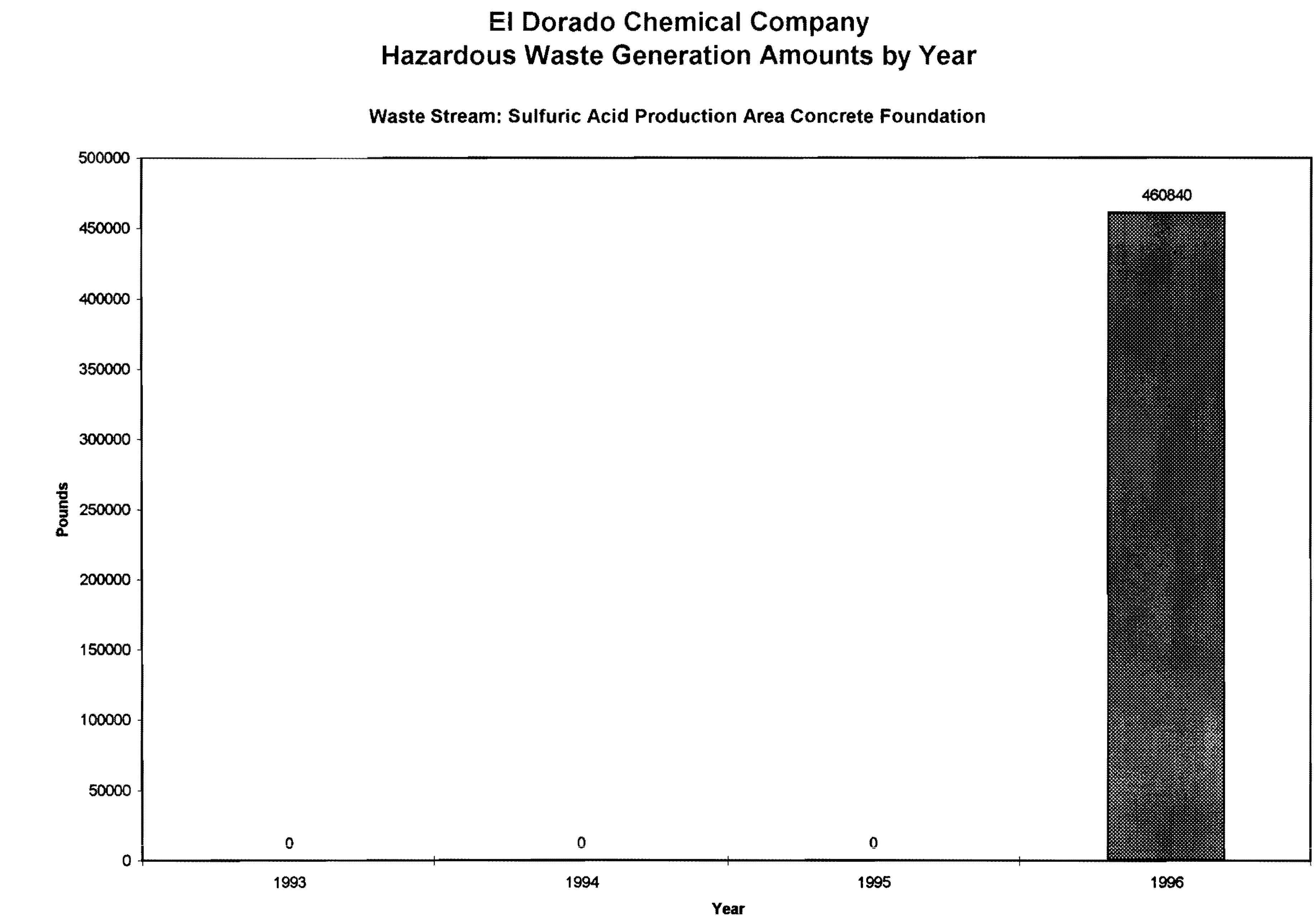
El Dorado Chemical Company
Hazardous Waste Generation Amounts by Year
Waste Stream: Sulfuric Acid Production Area Concrete Foundation
500000
450000
400000
350000
300000
250000
200000
150000
100000
50000
0
Pounds
460840
0
0
0
1993
1994
1995
1996
Year

FIGURE 12

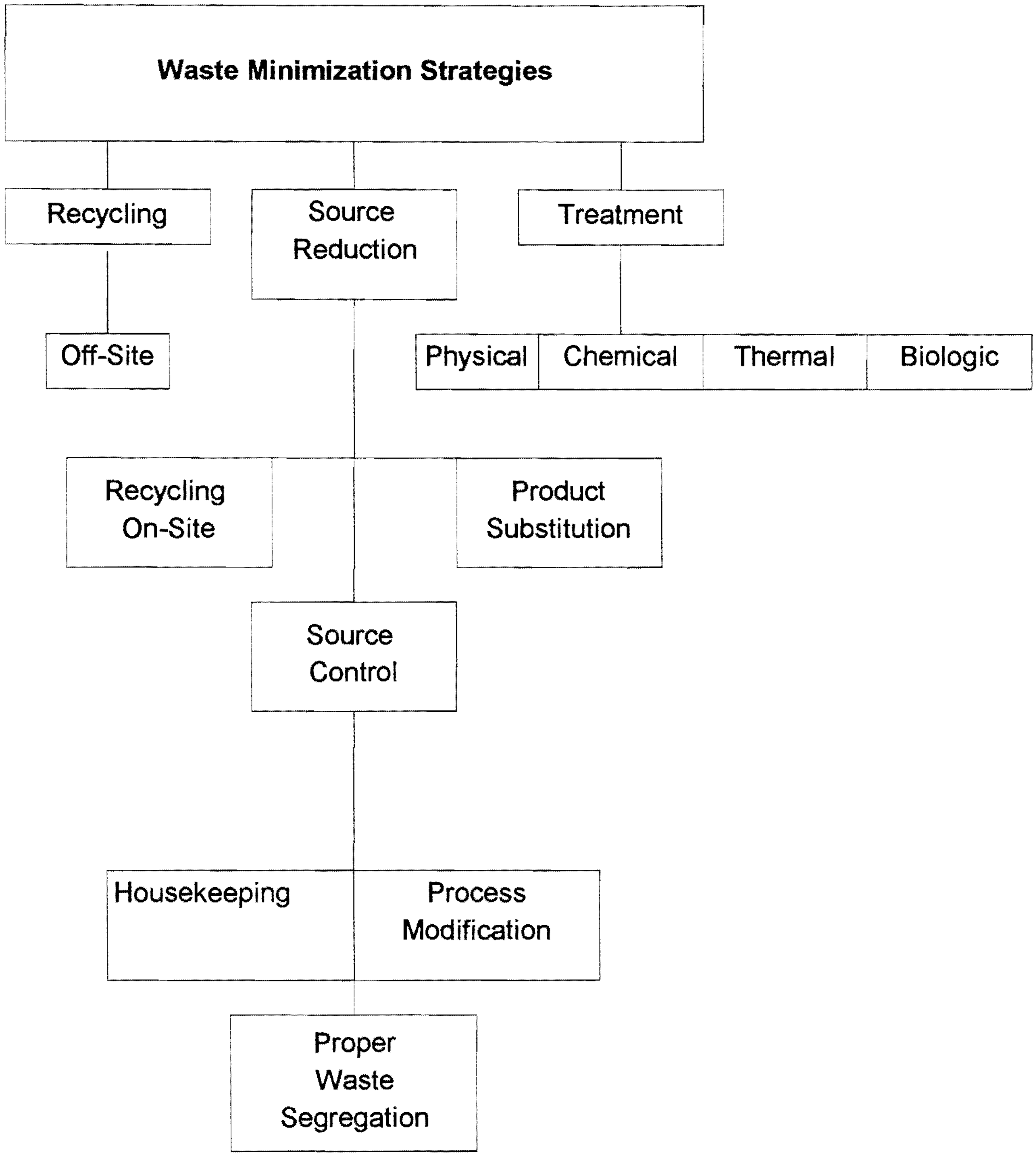

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Figure 13. Waste Minimization Strategies