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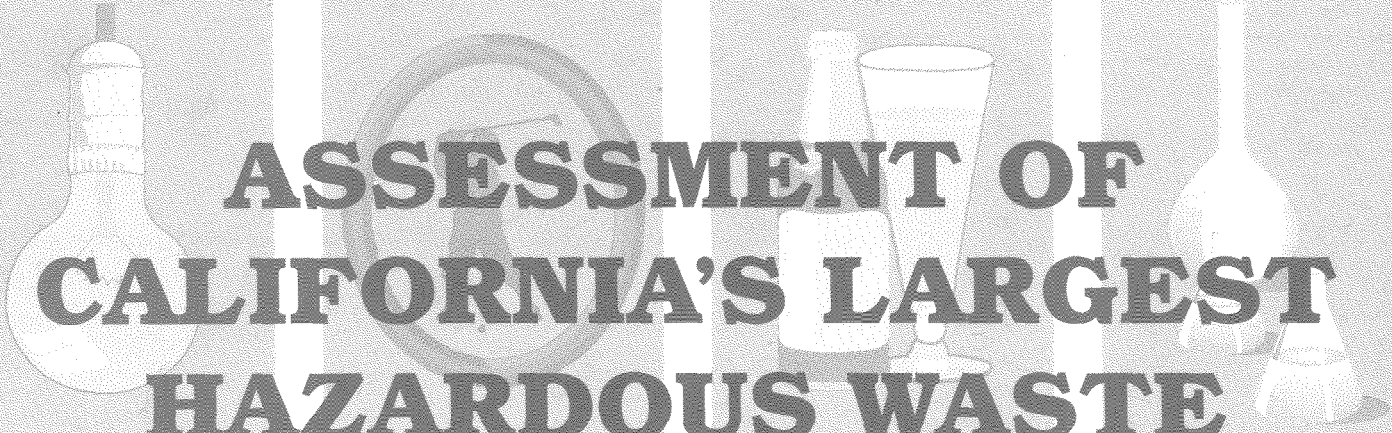


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ASSESSMENT OF CALIFORNIA'S LARGEST HAZARDOUS WASTE



GENERATORS' SOURCE REDUCTION PLANNING EFFORTS



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SEPTEMBER 1998



Pete Wilson, Governor
State of California



Peter M. Rooney, Secretary
California Environmental Protection Agency



Jesse R. Huff, Director
Department of Toxic Substances Control

CALIFORNIA ENVIRONMENTAL
PROTECTION AGENCY



DEPARTMENT OF TOXIC
SUBSTANCES CONTROL

OFFICE OF POLLUTION PREVENTION
AND TECHNOLOGY DEVELOPMENT

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Prepared by Phil Loder

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GOLDEN GATE UNIVERSITY

State of California Environmental Protection Agency
Department of Toxic Substances Control
Office of Pollution Prevention and Technology Development

September 1998



This report was prepared under the direction of Alan Ingham and Kim Wilhelm.
Office of Pollution Prevention and Technology Development

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Disclaimer

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REPORT OVERVIEW

This report summarizes the Department of Toxic Substances Control's (DTSC) source reduction assessment of some of California's largest generators of Resource Conservation and Recovery Act (RCRA) hazardous waste. This assessment is based on information contained in source reduction documents submitted to DTSC for review as required by the Hazardous Waste Source Reduction and Management Review Act of 1989 (SB 14). Source reduction documents were selected from companies required to complete the United States Environmental Protection Agency's (U.S. EPA) Biennial Generator Report (BGR) as well as companies captured by recent Toxic Release Inventory (TRI) data.

California manufacturers involved in this assessment are some of the largest hazardous waste generators as identified by recent BGR data. The waste generated by these facilities also includes aqueous hazardous waste streams. For many companies involved, the aqueous waste is by far the largest individual waste stream generated amounting in some cases to thousands of tons annually.

SB 14 documents were requested from 28 facilities that included a variety of industries. The documents were reviewed for completeness and for information regarding source reduction efforts and for other factors that influence hazardous waste generation. Waste generation comparisons were made for the period 1990 to 1994. Some facilities have reduced their waste generation through source reduction while others have experienced a decrease due to other factors such as a decline in business activity. Still others have decreased their hazardous waste generation while experiencing an increase in business activity. Most facilities reported a decrease in hazardous waste generation when comparing 1990 generation totals with those of 1994. Individual waste reductions range from more than 322,000 tons to an increase of over 147,000 tons. Facilities were contacted to verify the information derived from their SB 14 documents.

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SB 14 required generators, who produced more than 12,000 kilograms (13.2 tons) of hazardous waste or more than 12 kilograms (26 pounds) of extremely hazardous waste in 1994, to have prepared two key documents by September 1, 1995. This evaluation and document preparation deadline repeats every four years (September 1, 1999, 2003, etc.). The Source Reduction Evaluation Review and Plan (Plan), identifies all major hazardous waste streams produced at the generator's site and evaluates options for reducing or eliminating hazardous waste generation at the source. The Hazardous Waste Management Performance Report (Report), assesses the effectiveness of hazardous waste management procedures previously implemented by the generator, including an assessment of recycling and treatment activities.

The intent of SB 14 is to promote hazardous waste source reduction by requiring a waste stream audit, and source reduction evaluation. SB 14 leaves selection of source reduction measures up to the generator to select those measures that are both technically and economically feasible. Feasible measures thus contribute to the company's financial strengths. Whenever source reduction is not practical, the generator is encouraged to recycle hazardous waste and treat any residuals before disposal in a manner that will pose the least impact on both public health and the environment while meeting all hazardous waste management requirements.

Under the provisions of SB 14, DTSC is required to select at least two categories of hazardous waste generators by Standard Industrial Classification (SIC) code every two years and request that selected generators submit a Plan, and a Report for review. The focus of this report is on California facilities generating large amounts of hazardous waste including hazardous waste water. This report includes source reduction information from manufacturers representing many SIC codes. All reported information was collected from a review of Plans and Reports prepared by these generators and supplemented by subsequent telephone contact and fax.

The facilities identified in this report represent a variety of large, medium and small companies. All share the common denominator that in recent years they have generated some of California's largest quantities of hazardous waste. Some of these facilities have accomplished significant reductions in hazardous waste generation since 1990 and before and should be recognized for their efforts. This report acknowledges and addresses their success.

The submitted source reduction documents were reviewed to meet the following objectives.

- Compliance with statutory requirements of the Act;
- Identify viable source reduction and other measures that could be of value to other facilities unable to identify feasible alternatives;
- Identify source reduction barriers that could become future research areas for U.S. EPA or university programs or to identify needed changes to the law.

After the submitted documents were reviewed, successful source reduction approaches were identified. This information is included in this report and will be incorporated into fact sheets, or other publications, and incorporated into presentations for distribution back to industry and other interested parties.

As part of this assessment, various approaches were taken to identify California facilities that have been recent large generators of hazardous waste. This report considered only documents prepared by facilities under the requirements of SB 14.

Initially, data from the U.S. EPA's TRI list was reviewed to identify facilities for document call in. The TRI database is available to the public and contains specific toxic chemical release and transfer information from manufacturing facilities throughout the United States. Manufacturing facilities that have 10 or more full-time employees and meet the established thresholds for manufacturing, processing, or otherwise using listed chemicals must report their releases and transfers each year to the U.S. EPA. The latest available data is from 1994. Some of the top California TRI facilities for hazardous waste generation were targeted for document call in.

Another database used for screening facilities for document review is the U.S. EPA's BGR listing. Facilities generating hazardous waste are required to complete the BGR if the site is a large quantity generator for the federal reporting year. A large quantity generator is defined for the purposes of the BGR as a site that meets one of the following criteria: (a) The site generated in any single month 1,000 kilograms (2,200 pounds) or more of RCRA hazardous waste; or (b) The site generated in any single month, or accumulated anytime, 1 kilogram (2.2 pounds) of RCRA acute hazardous waste; or (c) The site generated or accumulated anytime more than 100 kilograms (220 pounds) of spill cleanup material contaminated with RCRA acute hazardous waste. All facilities selected for this report review were required to complete the BGR due to criteria "(a)," generating in any single month 1,000 kilograms or more of RCRA hazardous waste. The information gathered in the BGR is used to provide U.S. EPA as well as states, local government and interested public with an understanding of hazardous waste generation, management and waste minimization activities nationwide.

From the latest available BGR data (1993), DTSC examined the top 100 facilities based on their RCRA hazardous waste generation data. Listed facilities that generated large quantities of RCRA waste water and non waste water RCRA generators were targeted for SB 14 document call in. Some of these large RCRA generators had already been called in by DTSC for an assessment of the petroleum industry's source reduction efforts. Relevant information from the petroleum industry assessment is presented in summary form in this document. The June 1997 petroleum industry assessment report is currently available from DTSC (request document number 536).

Military bases were excluded from this assessment. Military base source reduction documents are currently being reviewed by DTSC with details scheduled for a later publication.

DTSC initially contacted twenty-eight facilities and requested that they submit their SB 14 documents for review. All contacted facilities returned their Plans and Reports. Source reduction substitution and waste minimization abstracts were prepared from the submitted source reduction documents. These were organized to present technical information regarding source reduction efforts in a uniform format for easy comparison. When applicable, each abstract discusses replacement successes and obstacles. Economic considerations are presented when available. Inclusion of the abstracts in this assessment was made after SB 14 document reviews were completed on the affected facility. These abstracts do not contain trade secret information.

The IBM facility in San Jose was selected for an in depth case study documenting their source reduction/waste management successes. This case study is presented in Chapter 5.

SOURCE REDUCTION ACCOMPLISHMENTS / INDUSTRY ABSTRACTS

The following SIC codes represent the various industries participating in this assessment. They are listed in decreasing order of 1994 hazardous waste generation quantities. The number of participating facilities in each SIC code is shown in parentheses.

INDUSTRY	SIC	1994 Total (Tons)
Aircraft (2)	3721	542,138
Printed circuit boards (3)	3672	411,167
Semiconductor (2)	3674	363,924
Products of purchased glass (1)	3231	196,129
Petroleum refining (24)	2911	186,000
Malt beverages (1)	2082	57,002
Aerospace fasteners (2)	3451	49,612
Inorganic pigments (1)	2816	31,309
Steel mills (2)	3312	27,182
Electrical equipment and supplies (1)	3699	22,777
Computer storage devices (1)	3572	15,889
Guided missiles and space vehicle propulsion unit parts (1)	3764	14,342
Polishing and plating (2)	3471	12,339
Chemicals and allied products (1)	5169	10,080
Magnetic and optical recording media (1)	3695	3,102
Extruded aluminum products (1)	3354	497
Sporting goods (1)	3574	418
Electric services (1)	4911	152
Office machines (1)	3579	23

Hazardous waste generation totals for the participating facilities were grouped into a variety of categories. The two major groupings were waste generation totals for 1990 and 1994. These years represent the baseline (1990) and reporting (1994) years for the second SB 14 reporting cycle, the focus of this report. This grouping allows for a comparison of hazardous waste (both aqueous and non-aqueous) management and generation trends at individual facilities over the four year period. There appeared to be some misunderstanding with some companies in that aqueous hazardous waste streams were not always readily identified by participating facilities. For the purposes of reporting waste totals required under SB 14, all major waste streams considered hazardous at the point of generation must be evaluated and considered in the source reduction evaluation. Aqueous hazardous waste streams are those treated in a waste water treatment facility and then discharged to a publicly owned treatment works (POTW). Initial waste water treatment is usually conducted onsite at the individual facility.

Other non source reduction waste management totals were also evaluated including recycling, treatment and disposal activities. Some waste generation totals were not readily available from a few facilities for a variety of reasons. In some cases required data was not included in their

facility's SB 14 documents and had to be retrieved by follow up telephone and fax. In some cases this information was not available at the facility.

The following paragraphs present some significant waste generation numbers as reported by the participating facilities. These discussions include hazardous waste generation comparison when considering the baseline year (1990) with the reporting year (1994).

- Out of twenty-eight California facilities that submitted their documents, nineteen had usable 1990 hazardous waste data. These facilities reported generating a variety of hazardous waste streams totaling more than 1,630,000 tons during 1990. Of this amount, over 1,540,000 tons were aqueous hazardous waste treated in an onsite treatment facility before disposal to the local POTW. This amounts to approximately 94 percent of the total hazardous waste generated for the year. The remainder, approximately 93,000 tons, consists of non-aqueous waste that was either recycled, treated and/or simply disposed of as hazardous waste in a landfill. Individual facility totals ranged from 208 tons to almost 340,000 tons generated during 1990.

- For 1994, these same nineteen facilities reported generating a variety of hazardous waste streams totaling over 1,300,000 tons. Of this amount, more than 1,250,000 tons was aqueous hazardous waste treated in an onsite treatment facility before disposal to the local POTW. This amounts to approximately 96 percent of the total generated for the year for participating facilities. The remainder, approximately 55,000 tons, consists of non-aqueous waste that was either recycled, treated or simply disposed of as hazardous waste in a landfill. Individual totals for the nineteen reporting facilities ranged from approximately 224 tons to almost 404,000 tons generated for 1994. Five facilities reported 1994 hazardous waste generation data but did not report quantities for 1990. When these amounts are included with the previous 19 companies' data, total reported waste generation is over 1,750,000 tons for 1994.

- Nineteen facilities reported usable waste generation data for both 1990 and 1994. Twelve of the 19 facilities (63 percent) reported a decrease in the total generation of hazardous waste from 1990 to 1994. Some of these companies reported that implemented source reduction was responsible for the decrease. Others reported that combinations of implemented source reduction and a decline in business were responsible for the decrease. Total reductions amounted to almost 552,000 tons. Reductions in facility specific hazardous waste generation ranged from 22 tons to over 322,000 tons. Reductions in hazardous waste water were reported by nine of the 19 reporting facilities (47 percent). Total waste water reductions amounted to more than 520,000 tons for the 19 facilities from the period 1990 to 1994. Facility specific hazardous waste water generation decreases ranged from 50 tons to almost 322,000 tons for individual facilities during the same period. Eighteen of the 19 companies (95 percent) that had usable data, reported reductions had occurred in non-aqueous hazardous waste generation from 1990 to 1994. Total reductions amounted to almost 40,000 tons. Facility specific reductions for generation of non-aqueous hazardous waste ranged from approximately 12 tons to more than 18,000 tons.

- Seven of the 19 reporting facilities (37 percent), with usable data for both 1990 and 1994, indicated that they had experienced an increase in the total generation of hazardous waste from 1990 to 1994. Some participating facilities stated in their documents that this was due to an increase in business activity. The remaining facilities indicated that the increase was due to other activity, such as shut down of production lines, etc. Total increases for these facilities amounted to over 222,000 tons during 1994 as compared with the baseline year, 1990. Increases in facility specific hazardous waste generation ranged from 36 tons to more than 147,000 tons.

ABSTRACT INFORMATION

The following section presents selected information in abstract format from the participating companies regarding hazardous waste generation data. Specifically, a comparison between 1990 and 1994 data is made with highlights on successful waste minimization projects that include in process recycling, reuse and source reduction strategies. These facilities were selected due to the availability of waste generation data that would allow a valid comparison between the two applicable years, 1990 and 1994 as well as the presentation of implemented waste minimization techniques and technologies. Though some facilities accomplished significant source reduction and waste minimization from 1990 to 1994, their abstracts may not reflect the full details of their success over this period due to the brevity of the abstract format.

Facility Description - A brief description of the facility is presented at the beginning of each abstract. This description presents the types of products manufactured, how long the company has been in business at the site, the number of employees at the location and the SIC code.

Data - To allow for ease of interpretation, a data table is used for displaying specific hazardous waste generation information. Some waste generation data was unavailable for 1990 and/or 1994. This is due to a variety of reasons including, natural phenomenon, computer data losses, facility not in business at the time, etc. When this occurred, the tables reflect this with "N/AV" meaning "Not Available" under the applicable year. For some of these facilities, the nearest available year with available information was used. The applicable years for comparison are displayed in the waste generation table.

Implemented hazardous waste minimization information regarding the years 1990 to 1994 (in addition to other years) follows the abstracts in narrative form with information from facilities' SB 14 documents. The majority of data has been supplemented with telephone and fax contact with appropriate company personnel. Data displayed in these abstracts represents hazardous waste quantities in tons unless otherwise noted.

Obstacles - In some cases, facilities chose to explain some of the factors that affected waste generation and some obstacles that may have prevented source reduction and waste minimization efforts.

Source Reduction and other Waste Minimization Measures - A central purpose of SB 14 is to encourage source reduction whenever possible. Source reduction offers the best and most effective means to accomplish economic savings while lowering future hazardous waste liability. Most facilities throughout California including those participating in this report, have successfully implemented many types of source reduction approaches. Other waste minimization techniques such as reuse, recycling and treatment are also desirable if source reduction is not currently appropriate. Implemented waste minimization (excluding source reduction) was successful at many participating facilities and is included in the abstracts. These techniques for the reporting facilities include onsite recycling and reuse of oils, solvents and hazardous waste water. Onsite treatment of hazardous waste water is the most common type of waste minimization technique reported by the facilities in this document. The distinction will be made in the abstracts whether source reduction or waste minimization measures have been highlighted from a facility's SB 14 document. Source reduction and waste minimization information was selected from SB 14 documents due to various factors. For example, the measure(s) may have dramatically reduced hazardous waste generation, the measure may have incorporated a unique and innovative technol-

ogy, it may have changed a waste into a usable raw material or the measure may have been a combination of several of these factors.

Date of Implementation/Economics - Implementation dates for all waste minimization projects were included in the facility abstracts whenever possible. Source reduction economic data on implemented source reduction and waste minimization measures has been presented when available. This may include capital costs, maintenance costs, hazardous waste management savings and return on investment.

AEROJET / SACRAMENTO

FACILITY DESCRIPTION: Aerojet Sacramento operations develop and produce liquid rocket engines, solid rocket motors and advanced propulsion systems for major national space and defense projects. Aerojet has been in business at this site since 1942 and employs approximately 1,660 people. The SIC code is 3764, guided missiles and space vehicles' propulsion unit parts.

	1990	1994	Percent Change
Aqueous	22,832	13,845	-39
Non aqueous	660	498	-25
Recycling	N/AV	N/AV	N/AV
Treatment / Disposal	22,832	13,845	-39
Total (Tons)	23,492	14,342	-39

FACTORS AFFECTING WASTE GENERATION AND BUSINESS: Business activities at Aerojet are sensitive to the political climate, which has affected the number and the type of processes conducted at the facility. Over the years there has been a general decline in aerospace activities at Aerojet and other similar companies. For example, in June 1991, Aerojet employed approximately 3,100 full-time employees; however, by September 1995, the number of full time employees had decreased to fewer than 1,700. Although difficult to quantify, the decline in military contract activity plays a major factor in reducing hazardous waste generation quantities. For example, several manufacturing processes and R&D projects have been eliminated due to the lack of business resulting in less hazardous waste generation.

During the period 1990 to 1994, Aerojet designed and installed an aqueous emulsion cleaning system to replace a large 1,1,1-TCA vapor degreaser used to clean parts for tactical solid rocket motors. The new aqueous cleaning system was qualified and accepted by customers during 1994.

Aerojet was also able to reduce the amount of hazardous waste water generated by the Advanced Medium Range Air-to-Air Missile hogout process. This was achieved by using recycled process water instead of using once through hogout water. Hogout is a method of removing propellants with high pressure water. This production process change has reduced Aerojet's waste water generation by approximately 600 tons.

Of the sixteen identified major waste streams in Aerojet's SB 14 documents, eight (50 percent) were identified as having been affected by changes (decrease) in business activities. In addition, Aerojet states that actual waste reduction by implementation of waste minimization projects is difficult to quantify because of various factors that affect waste generation quantities.

ANHEUSER BUSCH, INC./VAN NUYS

FACILITY DESCRIPTION: Anheuser Busch, a U.S. corporation, owns and operates the Van Nuys brewery. The facility has been operating at this site since 1952 and employs approximately 1200 people. The SIC code is 2082, malt beverages.

	1990	1994	Percent Change
Aqueous	31,995	56,945	+78
Non aqueous	69	57	-17
Recycling	69	57	-17
Treatment / Disposal	31,995	56,945	+78
Total (Tons)	32,064	57,002	+78

FACTORS AFFECTING WASTE GENERATION AND BUSINESS:

- 1) **Food Plant** - As a regulated food processing plant, the Anheuser Busch brewery looks for ways to reduce water use and, therefore, waste water generation within the context of cleanliness and product quality needs. While cleanliness cannot and should not be reduced, the brewery is experimenting with a reverse osmosis filtration system enabling cleaning water reuse. (See below)
- 2) **Aseptic Processes and Packaging** - The use of aseptic (disease and contaminant free) processes for Anheuser Busch's packaged draft beers requires great attention to cleanliness in the packaging area. Food-grade detergents are used to maintain the purity inside pipes and vessels. Waste water generated in cleaning is treated in a new Bio-Energy Recovery System, which recovers methane from waste water. As explained below, the methane is used by the brewery for boiler fuel and lowers the need for fossil fuels.
- 3) **Export Product** - Opportunities to produce Budweiser for export to the Pacific Rim nations and brewing of beers under a partnership with Kirin of Japan has meant growth and opportunity for the Los Angeles brewery. The additional waste water volume generated is a challenge that Anheuser Busch is approaching in the same way it attempts to minimize waste generation from domestic production.

IMPLEMENTED/PROPOSED WASTE MINIMIZATION AND SOURCE REDUCTION MEASURES

Bio-Energy Recovery

Anheuser Busch uses an innovative technology to turn process waste water into an asset — usable energy. The company's Bio-Energy Recovery System (BERS) began operating at the Los Angeles brewery in the summer of 1995 to pre-treat brewery waste water. This water contains nutrients from the cooking of grains and other natural ingredients used to brew beer, as well as the regulated, food-grade detergents used to clean brewery pipes and vessels.

The BERS involves the use of traditional waste water treatment equipment enabling the recovery of methane from waste water. The captured methane is directed back as boiler fuel. Recovered methane provides up to 20 percent of the Los Angeles's brewery boiler fuel needs. Once the gas is collected, the pre-treated waste water is sent to the Los Angeles municipal waste water treatment facility for final treatment.

Beyond the environmental benefits from the use of a renewable resource, BERS also helps the environment of the Los Angeles area in other ways. The Los Angeles waste water treatment facility produces 50 percent less waste solids from handling waste water, and uses significantly less electricity to do the same job. Carbon dioxide releases related to the treatment of brewery waste water at the municipal facility are 75 percent less if not employing BERS.

Reverse Osmosis

The Los Angeles brewery is now pilot-testing a reverse osmosis membrane filtration process. Under this initiative, water used in cleaning is filtered through the reverse osmosis membrane so it can be reused for cleaning. This treatment enables wash water recycling and reduces the amount of water and waste water used at the brewery. If successful, this process could be used in full scale production beginning in 1998.

BERS and reverse osmosis treatment are two of the leading pollution-prevention initiatives Anheuser Busch is using in Los Angeles. They are part of Anheuser Busch's efforts to integrate environmental considerations into everyday business activities. Anheuser Busch's corporate Environmental Management System promotes this integration. The Los Angeles brewery has earned the California Integrated Waste Management Board's "Waste Reduction Awards Program" (WRAP) for the past three years. Its Bio-Energy Recovery System was honored earlier this year with the California Water Environment Federation "Plant of the Year" award for overall waste minimization.

PRODUCTION RATE	1990 - 11,641,600 units	1994 - 10,302,498 units
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ASSOCIATED PLATING / SANTA FE SPRINGS

FACILITY DESCRIPTION: Associated Plating is a metal finishing company that performs plating operations applying coatings of copper tin, tin/lead and nickel. This facility has been in business at this location since 1952 and employs approximately 40 people. The SIC code is 3471, plating and polishing.

	1990	1994	Percent Change
Aqueous	3,128	5,296	+69
Non aqueous	38	19	-50
Recycling	N/AV	N/AV	N/AV
Treatment / Disposal	3,128	5,296	+69
Total (Tons)	3,165	5,314	+68

WASTE MINIMIZATION HIGHLIGHTS: Most aqueous waste streams are minimized and recycled at Associated using deionized rinse waters and ion exchange to regenerate spent rinse solutions. After each processing step, parts are rinsed in counter flowing, deionized rinse waters recycled through an ion exchange system. The rinse waters are first pumped through sand filtration to remove particulates and carbon filtration to remove organics and chlorine. The stream then moves to the ion exchange unit where metals are removed. The effluent from the exchange unit is recycled back to the counter flowing rinse tanks where they pass through the system again. When the capacity of the ion exchange system is reached, the resin is regenerated. This is accomplished by passing sulfuric acid and sodium hydroxide through the system to strip the resin of metals. The regenerates are batch treated for metals recovery.

To minimize the loss of chemicals, heated process baths are followed by dedicated drag out tanks. The tank used as the initial rinse before the standard counter flowing rinse operation allows the system to be used at a lower flow rate and still yield parts that have been effectively rinsed. Savings from using a dedicated drag-out tank include decreases in process and treatment chemicals used, less waste water to be treated and less hazardous sludge going to disposal. Cost savings associated with the management of these hazardous wastes are also reduced.

BECKMAN INSTRUMENTS / PORTERVILLE

FACILITY DESCRIPTION: Beckman Instruments is a manufacturer of printed circuit boards and electronic subassemblies. Beckman has been in business at this site since 1966 and employs approximately 240 people. The SIC code is 3672, printed circuit boards.

	1990	1995	Percent Change
Aqueous	7,488	4,898	-34
Non aqueous	51	56	+10
Recycling	22	56	+154
Treatment /Disposal	7,488	4,898	-34
Total (Tons)	7,539	4,954	-34

FACTORS AFFECTING WASTE GENERATION AND BUSINESS: Since the major product manufactured at this facility is printed circuit boards, a representative unit measure of business activity is the area of board produced. From 1990 to 1995 the area of printed circuit board produced increased by 14 percent while the amount of hazardous waste water generated decreased by over 30 percent. This amounts to an annual reduction in hazardous waste water of approximately 2,600 tons. Non-aqueous hazardous waste generated during this period has increased by almost 10 percent. This amounts to about a 5 ton annual increase in hazardous waste generated.

SOURCE REDUCTION HIGHLIGHTS: Beckman's Porterville facility achieved reductions in hazardous waste water generation from 1990 to 1995 using the following implemented source reduction measures.

- 1) The plating baskets were redesigned to have an angular (not flat) bottom, thus reducing bath solution drag out into the subsequent rinse stations.
- 2) The sulfuric acid concentration in the etch baths was reduced from 20 percent to 10 percent. Sulfuric acid is used to strip tin from boards and for cleaning. The reduction of acid concentration resulted in less acid rinsed from circuit boards and thus results in extended rinse baths service.
- 3) Pre-treated chemicals were purchased for the multi layer process, eliminating the black oxide line completely. The black oxide process removes contaminants and conditions the panel to promote adhesion of outer board layers during the multi layer lamination process. This was a multi step bath process that has been eliminated.

CALLAWAY GOLF COMPANY / CARLSBAD

FACILITY DESCRIPTION: The Callaway Golf Company is a manufacturer of golf clubs consisting of both metal and graphite shafts. Golf clubs are assembled from components manufactured at offsite locations. Callaway Golf started production in 1986 and has been conducting operations at its Carlsbad facility since 1992. There are approximately 2,000 people currently employed at this facility. The SIC code is 3574 , sporting goods.

	1990	1994	Percent Change
Aqueous	—	0	—
Non aqueous	—	418	—
Recycling	—	71	—
Treatment / Disposal	—	315	—
Total (Tons)	—	418	—

FACTORS AFFECTING WASTE GENERATION AND BUSINESS: Waste generation was significantly affected by a rapid increase in product demand since 1992 and the identification of new reportable hazardous waste streams. Both factors contributed to an increase in hazardous waste generation at the facility.

SOURCE REDUCTION HIGHLIGHTS: Waste carbon filters were produced from a lacquer spray operation. In an effort to maintain compliance with air pollution regulations, the carbon filters were changed three times a day, resulting in excessive hazardous waste generation. Callaway Golf elected to eliminate the lacquer spray operation and replace it with an ultraviolet cure coating process. The clubs are now sprayed with a nonflammable, ultra-low VOC coating and cured using ultraviolet light. The new coating process contributes to a safer work environment for employees. VOC releases are less with the new coating process as well. The new coating operation was completed in December 1995 and resulted in a reduction of hazardous waste generation by approximately 142,600 pounds per year. Capital cost for the project totaled \$330,000. Eliminating hazardous waste carbon filter disposal resulted in savings of \$255,000 per year based on 1994 data. Using these figures, the new coating system paid for itself by the second year of operation. The coating process is entirely automated with the exception of placing and removing clubs from a conveyor.

DOUGLAS AIRCRAFT COMPANY / LONG BEACH

FACILITY DESCRIPTION: Douglas Aircraft Company manufactures commercial aircraft and employs approximately 10,000 people at this site. Douglas Aircraft has been in business at this location since 1942.

Fabrication work at the Long Beach facility focuses on the production of specialized medium to high complexity, medium to large sized aerospace components which support the Long Beach assembly operations. Operational capabilities include sheet metal forming, spar milling, metal finishing, painting, welding and conventional machining and tooling. The SIC code is 3721, aircraft.

	1990	1994	Percent Change
Aqueous	253,536	403,023	+59
Non aqueous	3,166	843	-73
Recycling	977	556	-43
Treatment / Disposal	255,816	403,341	+58
Total (Tons)	256,703	403,866	+57

FACTORS AFFECTING WASTE GENERATION AND BUSINESS: Some waste streams at Douglas Aircraft have decreased due to a decrease in aircraft production. Total annual aircraft production at this facility has decreased from 144 to 47 during the period 1990 to 1994.

The quantity of waste metal finishing rinse water from processes increased by approximately 60 percent from 1990 to 1994. This increase is attributed to the elimination of onsite water reclamation/recycling processes and the redirection of metal finishing waste streams into the pretreatment system.

SOURCE REDUCTION HIGHLIGHTS: The following source reduction measure was successfully implemented at McDonnell Douglas which has helped to decrease their generation of hazardous waste during the period 1990 to 1994.

Process(es) generating the waste - Metalworking fluids (coolant) are used to dissipate heat and reduce friction during machining operations. This fluid becomes contaminated during machining operations thereby reducing its effectiveness. The contamination is caused by metal particles, machining lubricants, hydraulic fluids and bacteria that grow in the coolant feeding primarily on the tramp oils. The waste coolant is classified as an unspecified oil containing waste - CWC 223.

Quantity of waste - Waste coolant from machining operations accounted for over 2.5 million pounds (71.2 percent) of the Douglas Aircraft CWC 223 waste stream in 1990.

Implemented source reduction measure - A variety of input changes, operational improvements and other recycling measures were implemented to address this waste stream. A comprehensive coolant management program involves several elements, including the monitoring of fluid quality and levels in various machine sumps, maintenance of the sumps (i.e., fluid adjustments, top-off), tramp oil removal, and coolant recycling.

Quality control (QC) tests performed on a routine basis include coolant concentration (daily), mold and bacteria count, pH, percent fines and tramp oil (weekly). Adjustments to the fluid are made as a result of the QC testing. When the fluid is no longer usable, the coolant is removed from the sump and sent for onsite recycling. The recycling system employs filters to remove metal fines, a high speed centrifuge to remove tramp oils and a pasteurization sequence which reduces the biological count. The processed fluid is reconstituted with additions of new coolant concentrate and other depleted additives (e.g., biocide, dye, odorant) to return the fluid to manufacturer specifications.

High bacteria count is the principal reason for rejection of fluid from the machine sumps. Bacteria growth is spurred by the presence of tramp oil which acts as a food source. The management program therefore includes identification and repair of all major hydraulic leaks in machining operations which contribute to the tramp oil problem. Finally, in order to reduce total dissolved solids levels in the metalworking fluid, and specifically chloride levels, all fluid adjustments are made with demineralized water.

Economic review - Full implementation of the coolant management program will result in a 95 percent reduction in the coolant waste stream. An annual cost avoidance of \$994,100 (\$732,000 in coolant disposal and \$262,100 in new coolant purchases) are estimated. The annual cost of the program for the Long Beach facility is estimated at \$528,000, resulting in an annual cost savings of \$466,100.

The cost to implement this source reduction measure is negligible. Implementation requires establishing a service contract with a firm capable of providing the desired services.

Estimated source reduction - A 95 percent reduction in the coolant waste stream is equivalent to 2,430,000 pounds per year based on 1990 data.

DOW CHEMICAL COMPANY / PITTSBURG

FACILITY DESCRIPTION: Dow Chemical manufactures a variety of agricultural chemicals as well as other industrial chemicals and materials. The Pittsburg facility has been operating since 1897 and employs approximately 475 people. The SIC code is 5169, chemicals and allied products.

	1990	1994	Percent Change
Aqueous	0	6,650	—
Non aqueous	6,654	3,430	-48
Recycling	248	403	+62
Treatment /Disposal	6,406	6,764	+6
Total (Tons)	6,654	10,081	+51

*Prior to 1992, the Pittsburg facility did not use the local POTW for hazardous waste water treatment and disposal. At the time, Dow used generated waste water to produce a salt brine slurry used as a raw material for the production of chlorine at the facility. When the shutdown of the chlorine plant occurred in 1991, Dow began generating this aqueous hazardous waste stream requiring treatment and disposal in the POTW.

WASTE MINIMIZATION HIGHLIGHTS: Piping modifications were made to allow some of the reaction catalyst to be recycled within the plant. This reduces the amount of processed tar generated in the onsite Halogen Acid Furnace. This technology innovation received a Dow Chemical Technology Center Award in 1991.

The volume of the waste stream is set by the amount of fresh catalyst loaded into the system. By reusing the catalyst several times, the quantity of fresh catalyst required for a given amount of production is greatly decreased. This project is responsible for a reduction in hazardous waste generation by approximately 888 tons per year. The capital cost of this technology was approximately \$127 million with an ROI of 221%.

E.I. DUPONT / ANTIOCH

FACILITY DESCRIPTION: The Dupont Corporation manufactures a variety of chemical additives and products used in paints and paper manufacturing. The facility has been in operation since 1957 and employs 170 permanent and 23 contract personnel. The SIC code is 2816, inorganic pigments.

	1990	1994	Percent Change
Aqueous	3,100	3,050	-2
Non aqueous	29,839	28,259	-5
Recycling	26,600	24,900	-6
Treatment / Disposal	3,239	3,330	+3
Total (Tons)	32,939	31,309	-5

WASTE MINIMIZATION HIGHLIGHTS: One of the major waste streams generated from the pigments process consists of metal chlorides. Prior to 1986 metal chlorides were treated and landfilled as hazardous waste. A multi-disciplinary team of Dupont employees developed an outlet for this waste stream by neutralizing and chemically fixing the acidic solids with portland cement. This renders the mixture nonhazardous and allows the material to be used as a commercial product called Sierra-Crete®. This product is sold in the local area as a road base. It is lighter, stronger and more water resistant than the conventional crushed rock road base. The entire plant production of this waste stream is now converted to Sierra-Crete® and has been marketed to the road construction industry since 1990. This waste stream amounts to approximately 25,000 tons annually. This production process change had a capital cost of \$3,500,000 for a permanent Sierra-Crete® facility. This change saves approximately \$5,000,000 per year in disposal costs and realizes \$240,000 per year revenue from Sierra-Crete® sales.

Note: Dupont stopped production of Sierra-Crete® in 1997.

HADCO CORPORATION formerly ZYCON CORPORATION / SANTA CLARA

FACILITY DESCRIPTION: Zycon Corporation is a major printed circuit board manufacturer located in Santa Clara. Zycon Corporation began operations in 1976 and currently operates from a new 250,000 square foot state-of-the-art facility. Zycon Corporation produces circuit boards for many leading computer manufacturers such as Compaq, Cisco, Apple, Hewlett Packard and IBM. Zycon Corporation employs approximately 1,600 people. The SIC code is 3672, printed circuit boards. Note: Zycon was purchased by HADCO Corporation in 1997.

	1990	1994	Percent Change
Aqueous	352,033	395,012	+12
Non aqueous	355	1,098	+209
Recycling	355	156,138	+43,828
Treatment / Disposal	352,033	395,012	+12
Total (Tons)	352,388	396,110	+12

FACTORS AFFECTING WASTE GENERATION AND BUSINESS: The printed circuit board industry is extremely competitive not only among U.S. facilities but abroad as well. Zycon's ability to remain healthy and grow in this environment depends upon manufacturing a quality product to the exacting standards of its customers. The thrust of competitive factors, the challenge of meeting increasingly higher environmental standards while conforming to customers' needs, limit Zycon's ability to experiment with production processes.

Despite the challenge of rapidly changing technology and heightened environmental awareness, Zycon Corporation has continued dramatic growth while continually improving the safety and productivity of its manufacturing facility. Continued growth means Zycon Corporation continuously updates its facility as newer state-of-the-art equipment or processes become available. The transition to newer more efficient and environmentally sound equipment and processes illustrate management's strong commitment to improve safety and reduce waste while maintaining the highest product quality.

WASTE MINIMIZATION HIGHLIGHTS: During the period from 1990 to 1994, hazardous waste generation has increased at Zycon by approximately 12 percent. Production, however, has increased by 66 percent during the same period. Source reduction implemented at Zycon has helped it to achieve reduction in hazardous waste generation. The following source reduction efforts have been implemented at Zycon during the period 1990 to 1994.

A proximity sensor was installed that enables process water to be shut off if there is no printed circuit board going through the process. This has reduced energy and water usage.

The in process recycling of rinse waters through an ion exchange unit has increased solution life which in turn reduces hazardous waste water generation.

The drag-out of the automated racks was modified in the Black Oxide Line. The equipment was reset to move the racks at a slower rate to ensure better drainage of process waters back into the tanks prior to encountering the next bath. This has contributed to a reduction in the usage of process solutions with a corresponding decrease in hazardous waste generation.

Zycon installed double walled piping system with leak detectors for up to 85 percent of the chemical transportation to and from storage tanks to process tanks. The remainder of the chemicals are transferred using specific equipment and trained personnel. This measure has enabled Zycon to maintain better control over chemical usage and reduced the chance of spills or leaks. In addition, it has improved worker health and safety.

A sump was added to the post clean line equipment to collect the rinse water from the second "high pressure" rinse and added another pump to return this water to the rinse located just after the first "high pressure" rinse. This has reduced hazardous waste water generation from the post clean line equipment.

HARTWELL CORPORATION / RANCHO CUCAMONGA

FACILITY DESCRIPTION: Hartwell manufactures, finishes and assembles small fasteners for the aerospace industry. Operations include forming, cleaning, stripping and electroplating. The facility has been in business at this location since 1968 and employs approximately 90 people. The SIC code is 3451, aerospace fasteners.

	1990	1994	Percent Change
Aqueous	N/AV	10,365	N/AV
Non aqueous	173	45	-74
Recycling	N/AV	18	N/AV
Treatment / Disposal	N/AV	27	N/AV
Total (Tons)	N/AV	10,500	N/AV

SOURCE REDUCTION HIGHLIGHTS: Hartwell has been successful in reducing some of its hazardous waste streams since 1990. For example, the volume of hazardous filtercake has reduced by more than 90 percent since 1990. This amounts to greater than a 150 ton reduction when comparing 1990 with 1995 quantities. This was achieved by switching from a powder type chemical to all liquid chemicals in the waste water pre-treatment system. This has reduced the amount of solids introduced into the treatment system. In addition, a 900° F dewatering dryer has been installed to reduce the weight and volume of filtercake generated from the waste water treatment system. The second source reduction measure that has helped reduce hazardous waste generation is the installation of conductivity control sensors in the plating shop counterflow rinse tanks. This has resulted in a 50 percent reduction of water usage and has also reduced the influent to the local POTW.

In September 1995, Hartwell Corporation also discontinued the use of the solvent 1,1,1-trichloroethane. Hartwell is using an aqueous cleaner in their heated parts washer to remove oily film and other surface contamination. The cleaner is used at 160° F with spinning agitation. This solvent replacement has resulted in eliminating approximately 9 tons of waste 1,1,1-trichloroethane disposed during 1990.

HI-SHEAR CORPORATION / TORRANCE

FACILITY DESCRIPTION: Hi-Shear manufactures sophisticated high strength fasteners and fastening systems with associated customized installation tools for use in the aircraft and aerospace industries. Hi-Shear has been at this site since 1943 and employs approximately 480 people. The SIC code is 3451, aerospace fasteners.

	1990	1994	Percent Change
Aqueous	53,576	38,429	-28
Non aqueous	782	683	-13
Recycling	679	499	-26
Treatment / Disposal	54,071	44,625	-17
Total (Tons)	54,358	39,112	-28

FACTORS AFFECTING WASTE GENERATION AND BUSINESS: Due to a downturn in the aerospace industry, Hi-Shear experienced a decrease in business during 1994 by nearly 80 percent based on a comparison with 1990 earnings. This downturn accounts for a notable decrease in waste generation. However, since 1994 business has increased substantially.

SOURCE REDUCTION HIGHLIGHTS: In spite of the business downturn, Hi-Shear has made source reduction progress. A key example follows: Plating processes generate hazardous waste water. These waste waters require treatment prior to disposal to the local POTW. In order to decrease the generation of hazardous waste water a variety of source reduction techniques have been implemented. Administrative steps have been taken to instruct all operating employees on the proper use of control equipment such as total dissolved solids meters, probe cleaning and calibration procedures. Plating bath standards are used to determine acceptable solution concentrations. As a result, hazardous waste water generation decreased by approximately 3,500 tons annually. This amounts to a 10 percent reduction over previous years. Capital costs for these implemented changes was approximately \$5,000 with a return of investment of only one month.

IMATION CORPORATION / CAMARILLO

FACILITY DESCRIPTION: The Camarillo facility was constructed in 1963. The facility employs approximately 650 full time people and operates year round, 24 hours per day. Products manufactured today include magnetic recording media configured as reel to reel computer tape and data cartridges. These products are used to store information and serve to backup data stored on computer hard disks. The SIC code is 3695, magnetic and optical recording media.

Manufacturing operations involve preparing and coating magnetic iron oxide dispersion on a plastic substrate. Organic solvents are evaporated from the coated web in heated ovens. The dry coated web is then slit into strands which are wound onto reels or hubs and subsequently finished into final product form. The finished product is packaged and warehoused for customer shipments.

	1990	1994	Percent Change
Aqueous	11,419	0	-100
Non aqueous	5,277	3,102	-41
Recycling	16,599	3,014	-82
Treatment / Disposal	97	88	-10
Total (Tons)	16,696	3,102	-81

WASTE REDUCTION HIGHLIGHTS: The Camarillo facility first installed and operated the first major processes for onsite hazardous waste recycling, recovery and reuse in 1975. Additional hazardous waste recycling processes were installed over the next two years. These processes represented a capital expenditures commitment exceeding several million dollars and was done at a time when investment in this type of technology was not commonplace. This new commitment was made within the concept of a program developed by 3M Corporation (now Imation) in 1975 called Pollution Prevention Pays, or "3P" for short. The 3P program prioritizes waste minimization at the source, both in products and manufacturing processes, rather than managing waste after it has been created. In it's first 17 years (1975 - 1991) 3P's effort cut Imation's Camarillo facility's pollution per unit of production in half, prevented generation of more than 600,000 tons of pollutants saving the facility \$573 million.

In 1994, hazardous waste generated at the Camarillo facility declined to 18 percent of the amount generated in 1990. Most of this decline is attributed to the identified measures which were all successfully implemented by 1994. These measures required a capital investment exceeding \$15 million, and resulted in a reduction of 11,500 tons of generated hazardous waste. Total hazardous waste generated in 1994 amounted to approximately 3,100 tons. Of this, approximately 3,000 tons (97 percent) was processed through recycling facilities for recovery and reuse. 2.1 percent was used as a fuel substitute. The remaining 0.7 percent was incinerated offsite.

IMPLEMENTED SOURCE REDUCTION - Key to the production of magnetic recording media is the deposition of magnetic dispersion on a plastic substrate. The mixed solvents that are contained in the dispersion are evaporated from the coated media, inside of special heated ovens.

The resulting gaseous mixture of air and solvents is then cooled and adsorbed onto activated carbon to remove the solvents component from the air stream prior to discharge. When the carbon bed becomes saturated with solvents, it is isolated and live steam is injected to heat and steam strip absorbed solvent from the carbon. The hot gaseous mixture is then condensed and separated into solvent and water phases. The water phase contains up to 9 percent mixed solvents and is a hazardous waste due to ignitability. This hazardous waste water was historically treated separating the solvents from the water. Most of this treated water was then discharged through the local POTW.

In 1990, Imation Corporation identified programs which would eliminate this solvent contaminated hazardous waste water stream. The waste water was eliminated by replacing the carbon adsorption processes, which use live steam, (source of the water) for stripping the solvent from the carbon, with one using hot nitrogen gas in a closed loop recirculation system. This process not only eliminated the water problem but improved overall solvent recovery and reduced air emissions substantially. The project was completed and was operating by January 1, 1993. Consequently, this successfully implemented source reduction project resulted in the elimination of almost 11,500 tons of hazardous waste water being generated at Imation's Camarillo facility.

Other benefits were derived from this project as well. The use of Fin Fan cooling reduced the operating burden on cooling towers which in turn reduced the volume of waste water blow down, reduced evaporated water losses and make up water demand, as well as reduced the consumption of water treatment chemicals. Similar benefits were realized through boiler water and treatment chemical conservation due to the elimination of steam lost through stripping solvent from spent activated carbon.

As a result of installing the hot nitrogen-based stripping system, the Camarillo facility has eliminated spent carbon as a hazardous waste stream. Recently, the plant also eliminated the waste streams of MEK and toluene by working with chemical manufacturers. In the manufacturing processes, the MEK and toluene contained in the resin mixes used by the factory are recovered and returned to the supplier for reuse in new resin mixes, creating a closed loop cycle of these two chemicals.

Its voluntary environmental efforts (3P program) have earned Imation/3M's Camarillo plant recognition and several awards including:

- The 1993 Governor's Environmental and Economic Leadership Award for leadership in economically compatible resource conservation and environmental protection.
- Ventura County Economic Development Association's Excellence in Environmental Leadership award for its new emissions reduction technology in 1993.
- The Engineering Project of the Year award in the development category from the Ventura and Santa Barbara's Counties' Engineers Week Committee in 1993.
- American Institute of Plant Engineers (AIPE) and Plant Services magazine's Plant Services Award of Excellence and the AIPE Foundation's Facilities Management Excellence (FAME) Award in 1993.
- Ventura County Chapter of the American Lung Association's first Clean Air Award for its emissions reduction efforts and leadership in 1991.
- The California Air Resources Board's Clean Air Award in 1993.
- City of Camarillo's WasteWatch Award in 1992, 1993 and 1995 recognizing the plant's recycling, conservation and reduction efforts.

INTEGRATED DEVICE TECHNOLOGY, INC / SAN JOSE

FACILITY DESCRIPTION: Integrated Device Technology, Inc. (IDT) is an international designer, manufacturer and marketer of microprocessors and integrated circuits for a wide range of growth markets including desktop computer, workstation/server, graphics/visualization, data communications and office automation. IDT has been in operation at the San Jose site since 1991 and employs approximately 1,100 people. Accurate waste generation data is available beginning for calendar year 1993. The SIC code is 3674, semiconductor and related devices.

	1993	1994	Percent Change
Aqueous	194,418	233,354	+20
Non aqueous	76	122	+60
Recycling	N/AV	N/AV	N/AV
Treatment / Disposal	194,494	233,354	+20
Total (Tons)	194,494	233,476	+20

FACTORS AFFECTING WASTE GENERATION AND BUSINESS - Since the first SB 14 documents were developed by Integrated Device Technology, Inc, all waste streams have increased due to demand increases in the semiconductor business.

WASTE MINIMIZATION AND SOURCE REDUCTION HIGHLIGHTS: IDT has implemented a number of waste reduction and source reduction measures since operations began in 1991. Some of the more successful measures implemented at IDT are described below.

- Waste segregation
- Purchasing chemicals on an as-needed basis
- Storage and inventory control
- Recycling filter cake offsite instead of land disposal
- Equipment modification to "dry" pumps
- Less frequent solvent changes
- Offsite cleaning of contaminated parts using carbon dioxide process in lieu of water
- Waste water conservation measures
- Replacing sodium hydroxide with magnesium hydroxide
- Eliminating Class I and Class II ozone depleting chemicals
- Improved employee training in waste minimization and general environmental awareness

WASTE MINIMIZATION HIGHLIGHTS SINCE 1993

Reduced Solvent Use Through Process Modification Change: IDT has installed recirculators in the photoresist stripper baths. This has reduced the drag-out/drag-in of particles into the

isopropyl alcohol baths. The reduced drag-in of particles has allowed a decrease in the number of times the solvent baths have to be changed resulting in a decrease in the amount of solvent used for photoresist stripper. Below is data from 1994 through 1996 for this solvent use:

Solvent Use, tons:

<u>1994</u>	<u>1995</u>	<u>1996</u>
37.8	62.5	65.6

Standardizing Data in Pounds/Product:

<u>1994</u>	<u>1995</u>	<u>1996</u>
1.09	1.59	1.56

Water Conservation Measure through Input/Operational Changes: Conservation efforts have been realized from the Reverse Osmosis/DeIonized Water process. The reclaim of this water is based on conductivity. The reclaimed water is collected in the Non-Potable Water (NPW) tank. The water is pumped to the systems feeding the fume scrubbers, bottle washer aspirators and used as cooling water for the megasonic sinks.

Water conservation has also been achieved from the fabrication reclaim loop, where low flow water from sinks in idle condition is reclaimed. The reclaimed water use is controlled by two pH meters.

Additional conservation has occurred from applying ultra filters (UF) to the DeIonized Water system. One hundred percent of the water entering the UF system is recovered with 50 percent diverted to a storage tank and 50 percent diverted to the front end of the Reverse Osmosis makeup system.

Average weekly reclaim from the Reverse Osmosis/DeIonized Water and FAB reclaim is approximately 200,000 gallons (830 tons).

Average weekly reclaim from the UF is approximately 68,000 gallons (282 tons).

Standardizing Data in Gallons of Water/Product:

<u>1993</u>	<u>1994</u>	<u>1995</u>
764	642	713

The data indicates a decrease from 1993 levels. The increase from 1994 is an indication of IDT's growth.

INTERNATIONAL EXTRUSION CORPORATION / ALHAMBRA

FACILITY DESCRIPTION: The International Extrusion Corporation operations are extremely diverse and include smelting, foundry, extrusion, anodizing, chemical conversion coating and painting. The facility has been in operation since 1963 and employs approximately 240 people. The SIC code is 3354, extruded aluminum products.

	1993	1994	Percent Change
Aqueous	224	224	0
Non aqueous	236	273	+15
Recycling	201	180	-10
Treatment / Disposal	460	497	+8
Total (Tons)	460	497	+8

FACTORS AFFECTING WASTE GENERATION AND BUSINESS: The most significant factor affecting the management of hazardous waste at International Extrusion Corporation is the state of the economy. The International Extrusion Corporation has committed a great deal of money to reduce hazardous waste generation, however, at the same time has sacrificed some business.

SOURCE REDUCTION AND WASTE MINIMIZATION HIGHLIGHTS: The International Extrusion Corporation has initiated a comprehensive environmental management program. Highlighted in this program are greatly improved hazardous materials handling, accountability, documentation, source reduction, training and disposal. In addition to applying source reduction measures, all hazardous waste generated is targeted for recycling wherever feasible. Land disposal is used only as a final option. Three of the most successfully implemented measures at the International Extrusion Corporation are the paint shop thermal oxidizer, the anodizing caustic recovery process, and the discontinued use of disposable absorbent for oily waste. These three are discussed in more detail below.

Paint Shop — Thermal Oxidizer - Prior to the installation of the thermal oxidizer unit, VOC laden air from the painting spray booths and the curing oven was discharged to activated carbon where the VOC's were adsorbed. This was necessary to achieve compliance with the local air quality management district rules and regulations. Once the carbon was saturated (when breakthrough occurred), it was regenerated by injecting high-pressure steam into the carbon vessel which thermally separated the VOC's from the carbon. The steam, now containing the VOC's was condensed and the VOC's and water were then processed through a phase separator where the mixture was used for closed-loop paint equipment cleaning. The water was reused in the boiler. When contaminated from the paint equipment cleaning operation, the spent solvent was sent to an offsite TSDf for use as an alternate fuel source.

When the local air pollution control district rules demanded greater VOC-removal efficiency, from 75 percent to 95 percent, the International Extrusion Corporation's management voted to fund the purchase and installation of a Thermal Oxidation System for the paint shop operation. This Thermal Oxidizer equipment was installed and began operating in February 1995 and resulted in an annual reduction of over 18 tons of waste solvent generated. In addition, reduction of VOC's to the atmosphere were reduced by more than 98 percent. This enabled the paint department to be able to operate for longer periods than before prior to reaching the permitted emissions limits. Capital costs for the thermal oxidation unit was approximately \$1,000,000. This enabled the company to continue to conduct business in California's Los Angeles County.

Anodizing Caustic Recovery Process - After aluminum has been extruded, the surface must be prepared in order to uniformly receive the anodic coating and subsequent dye. After cleaning using an aqueous alkaline solution, the part is etched in an aqueous solution of sodium hydroxide to provide, among other things, the desired mat-finish. Because the concentration of dissolved aluminum increases in the sodium hydroxide solution over time, and the cost of sodium hydroxide treatment and disposal was on the rise, in 1990, the International Extrusion Corporation installed a Caustic Recovery System. In addition to increasing the life of the etch solution, the Caustic Recovery System solution produces aluminum trihydrate which is sold to an aluminum reclaimer. However, when the process is not properly maintained, the aluminum trihydrate seed-crystals, critical to the operation, catalyze and the system ceases to perform. The result, is aluminum hydrate, which has no value, and is classified as a hazardous waste. When properly operated however, the caustic recovery process removes dissolved aluminum very effectively in a well controlled reaction vessel. By assigning a full-time operator, and improving the process, the results are an annual reduction of over 36 tons of waste aluminum hydrate. Savings amounted to \$1,000 per year in raw material and disposal cost. Additional savings are achieved by reduced sanitation district surcharge fees.

Extrusion Presses — It is almost impossible to maintain 50 year old hydraulic extrusion presses without an occasional leak. In the past when hydraulic leaks occurred, the oil was absorbed with clay material, placed into drums and sent to a TSDF. Now, sumps are used, above ground tanks installed and oil is captured for temporary storage followed by offsite recycling. This new process results in an annual reduction of over 14 tons of oily solid waste. This represents more than a 96 percent reduction for this waste stream. Since the cost of offsite recycling is approximately the same as disposal, there is no cost savings.

JENNINGS TECHNOLOGY CORPORATION / SAN JOSE

FACILITY DESCRIPTION: The Jennings Technology Corporation manufactures electronic capacitors, relays, high voltage interrupters and R.F. switches. The Jennings Corporation has been in business since 1944 and employs approximately 190 people. The SIC code is 3699, electrical equipment and supplies.

	1990	1994	Percent Change
Aqueous	30,025	11,445	-62
Non aqueous	29,420	11,332	-61
Recycling	139	84	-39
Treatment / Disposal	30,227	11,525	-62
Total (Tons)	59,445	22,777	-62

SOURCE REDUCTION HIGHLIGHTS: Significant reductions have occurred in hazardous waste generation between 1990 and 1994. Specifically, in the process baths, waste water reductions have been as great as 37,500 tons. This was accomplished during 1992 and 1993. Plating and cleaning process lines were replaced with modernized equipment. Single stage rinses were replaced with three stage counterflow tanks enabling rinse water reduction in each stage which also reduced the amount of required make-up water. Automated conductivity monitors, control equipment and automatic valves were installed to control make-up water flow. Plating racks and power supplies were upgraded for more efficient control of the plating processes. These measures helped reduce drag out to the rinse tanks and lessened the tank chemical replenishment frequency.

In addition, Jennings evaluated alternate cleaning products to replace the solvent 1,1,1-trichloroethane (TCA) and freon during 1992 and 1993. The final selection for replacing TCA for degreasing oily parts was Kleer Flow F-99, a petroleum based degreaser using a washer with flow agitation. Also the freon degreasing process was replaced by an aqueous solution with a mild nonionic surfactant used in an ultrasonic agitation bath.

K/J PLATING / GRAND TERRACE

FACILITY DESCRIPTION: K/J polishes and electroplates automotive and motorcycle parts and accessories. K/J's plating shop is very small and only services specific demands so that any change must be tailored to their size and capabilities. All electroplating is nickel-chrome. K/J has been in operation since 1973 and has 9 employees and is considered a small business. The SIC code is 3471, polishing and plating.

	1990	1994	Percent Change
Aqueous	7,000	7,020	+0.3
Non aqueous	46	4	-91
Recycling	24	4	-82
Treatment / Disposal	7,024	7,004	-0.3
Total (Tons)	7,046	7,024	-0.3

Note: These amounts do not reflect the fact that since 1990, K/J has installed a water treatment system which significantly improves the quality of the rinse waters discharged to the POTW as well as reduces the amount of solid waste generated.

FACTORS AFFECTING WASTE GENERATION AND BUSINESS: K/J is a small plate shop with a manual plating and rinse system. K/J needs clear, potable water to run the plating line. It is infeasible at this time, to recycle plating and/or rinse waters using present technology. K/J understands that this technology is presently being developed but is far from practical.

WASTE MINIMIZATION HIGHLIGHTS: The main impact of SB 14 has been to make K/J management aware of the possibilities to reduce or eliminate the generation of hazardous waste at their facility. K/J has made minor operational changes such as the installation of splash guards on plating tanks and the provision of employee training on the importance of hazardous waste minimization has measurably improved the shop's environmental regulatory compliance status.

Since 1990, K/J has installed an effective waste water treatment plant which reduces hexavalent chromium to trivalent chromium, coagulates the heavy metals and filters them out of the waste water before discharge to the POTW. Also, they have installed a computerized inventory control system for improved monitoring. In addition, K/J is currently considering a major reconstruction of the plating line which will modernize and help reduce hazardous waste generation at the facility.

NATIONAL SEMICONDUCTOR / SANTA CLARA

FACILITY DESCRIPTION: National Semiconductor Corporation's Santa Clara production site and corporate offices have been in operation since 1967. This facility employs approximately 4,500 employees plus 1,500 resident contractors. National conducts a series of processes including the development, manufacturing and marketing of a broad range of semiconductor components, including the production of integrated circuits. The SIC code is 3674, semiconductor manufacturing and related devices.

	1990	1994	Percent Change
Aqueous	249,437	130,131	-48
Non aqueous	720	317	-56
Recycling	495	205	-59
Treatment / Disposal	2,696	503	-81
Total (Tons)	250,158	130,448	-48

Note: Primary reason for the 48 percent reduction in waste water from 1990 to 1994, is due to the shut down of fabrication lines.

FACTORS AFFECTING WASTE GENERATION AND BUSINESS - Closing of several fabrication areas while other areas expand results in variations in waste volumes and types. The fabrication process for manufacturing semiconductors is constantly changing as new technologies are developed. These changes also affect hazardous waste generation.

OBSTACLES TO SOURCE REDUCTION - The need for high purity chemicals and processes in the production of semiconductors can result in reduced bath life and increased chemical usage and waste generation. Also, due to highly complex chemical processes and the associated high cost of process development, there is a reluctance to modify a working process in an attempt to solely reduce waste generation.

SOURCE REDUCTION HIGHLIGHTS: One of the more significant success stories involves an effort to improve the quality of deionized (DI) water which resulted in a significant decrease in sulfuric acid consumption. National's DI water plant implemented a production process change in its reverse osmosis (RO) units which yielded a 37 percent reduction in the quantity of sulfuric acid used at the plant. This production process change additionally yielded a significant quality improvement in DI water.

To make DI water, city water is initially filtered to remove particles as small as 5 microns in diameter. This water is then pumped to the RO units, where it moves through the RO membranes, further reducing ionic contaminant levels. The RO water is then pumped through dual bed DI units which remove positive and negative ions from the water. Finally, the water flows through a mixed DI bed of cationic and anionic resin as a final polish prior to its delivery to the fabrication areas as high purity DI water.

The process change in the RO units involved converting from cellulose acetate membranes to teflon membranes. This change improved the quality of water delivered to the DI beds. The improved water quality resulted in the cationic resin beds requiring regeneration on a less frequent basis. In the past, the cationic resin bed underwent a regeneration approximately once per week. Now, with the new membranes, the beds need regeneration only once every two weeks. Since the cationic resin beds are regenerated with sulfuric acid, the RO process change resulted in a 37 percent annual reduction in the quantity of sulfuric acid needed for DI water production.

NORTHROP GRUMMAN CORPORATION / SOUTHERN CALIFORNIA

FACILITY DESCRIPTION: Northrop Grumman Corporation manufactures aircraft as well as components and tooling for commercial and military aircraft. Northrop Grumman employs approximately 1,300 people. The SIC code is 3721, aircraft.

	1990	1994	Percent Change
Aqueous	162,213	137,200	-15
Non aqueous	4,700	1,071	-77
Recycling	N/AV	N/AV	N/AV
Treatment / Disposal	166,913	138,271	-17
Total (Tons)	166,913	138,271	-17

FACTORS AFFECTING WASTE GENERATION AND BUSINESS: The decrease in government military contracts occurring with a general decline in defense spending has resulted in notable hazardous waste reductions.

HIGHLIGHTS: Hazardous waste generation has decreased approximately 77 percent (not including waste water) during the period 1990 to 1994. When waste water is included in waste generation numbers, the decrease is approximately 17 percent.

PROCESS GENERATING THE WASTE - Vapor degreasing of aerospace parts is the principal solvent use. This degreasing must remove oily contamination that would interfere with chemical processing such as anodizing, deoxidizing, chemical conversion coating or adhesive bonding. Insufficient degreasing is a cause for paint adhesion failures and, more importantly, structural bonding failures.

IMPLEMENTED SOURCE REDUCTION MEASURE - An entirely new environmentally acceptable degreasing method needed to be implemented at Northrop. A significant process change such as this required an extensive research and development program consisting of the following tasks:

- 1) Vendor and industry surveys were conducted to determine the best possible degreasing processes and candidate degreasing materials.
- 2) Evaluation testing was performed on five candidate degreasers to determine which cleaner to qualify. Evaluation included various shop soil removal tests, corrosion tests, adhesive bonding tests and paint adhesion tests.

3) Qualification/characterization testing was performed on the best candidate degreaser. Since Northrop manufactures aircraft parts for other aerospace customers, extensive qualification testing needed to be performed on the new candidate cleaner. All customer specification requirements needed to be met by the new degreasing method. Characterization testing was performed to determine the new degreaser operating parameters such as temperature, concentration and recyclability.

4) Production validation was conducted in a full size production tank. Production and test parts were processed in a new production-sized degreaser to verify the new process and to solve any scale-up technical problems.

5) Full production implementation was achieved with cooperation of facilities, maintenance, process control, manufacturing technology and materials and process functions.

As a result of this research and development program, Northrop successfully implemented an aqueous degreaser to replace the use of the solvent, 1,1,1-trichloroethane (1,1,1-TCA). A 4,000 gallon and a 1,500 gallon aqueous production tank have been operating satisfactorily since 1994 and continue to meet all of Northrop's requirements.

QUANTITY REDUCED - Approximately 250 tons annually of liquid 1,1,1-TCA and waste water were eliminated.

CAPITAL COST - Approximately \$300,000

PAYBACK PERIOD / ROI - The use of the new aqueous cleaner has saved Northrop approximately \$77,000 per year in disposal costs of 1,1,1-TCA. The ROI for this project is 3.8 years.

YEAR WHEN IMPLEMENTED / COMPLETED - 1994

RICOH ELECTRONICS / IRVINE

FACILITY DESCRIPTION: Ricoh Electronics manufactures photocopier machines and prepares and coats photocopier drums. Ricoh also recycles photocopier drums at this facility. The Irvine facility has been in business since 1972 and employs approximately 180 people. The SIC code is 3579, office machines (photocopiers).

	1990	1994	Percent Change
Aqueous	913	0 <small>*20,000 tons</small>	-100
Non aqueous	79	23	-70
Recycling	72	22	-69
Treatment / Disposal	6.8	1.2	-82
Total (Tons)	992	23	-98

* Note: The aqueous figure for 1994 represents waste water reuse back into the coating removal process thus eliminating discharge to the local POTW from this process.

SOURCE REDUCTION HIGHLIGHTS: Copier drums for recycling must be stripped of their selenium coating prior to reprocessing. Previously, this was accomplished by using high pressure water jets. This coating removal process caused three problems: 1) The used drums were sometimes damaged by the water jets; 2) The resultant waste water required filtration prior to discharge to the POTW; and 3) The process was unreliable, and had high operating and maintenance costs. In 1993, Ricoh installed a new process for the removal of the selenium coating from photocopier drums. This process is achieved with a recirculating low pressure, high volume water abrasive slurry. Process effectiveness is enhanced by the introduction of compressed air into the guns used for the selenium removal. The compressed air bath accelerates and atomizes the slurry as it is directed at the selenium coated drum. The media that is used to help the water remove selenium is recirculated and returned back into the process. Originally, a high efficiency filter was installed to capture selenium particulates prior to recirculating the water for abrasive reentrainment or water discharge to the local POTW. After designing the new coating removal unit, the use of the filter was replaced with a centrifuge which separates out the slurry components and waste selenium from the water. This centrifuge has enabled Ricoh to eliminate discharge to the local POTW from this process. This new selenium removal system has also resulted in lower labor costs and less damage to the aluminum drums. Capital cost for the new system was approximately \$180,000 with a pay back period of 1.5 years.

A second process modification was implemented in 1991 for aluminum drum core preparation. The **old process** involved machining the edges of the cores using a lathe with a coolant. The drums were then cleaned in a large methylene chloride vapor degreaser. The surface of the drums were then turned by a lathe using kerosene as a coolant. The surface was then cleaned in a large perchloroethylene degreaser, and sent on to the coating process.

The **new process** involves machining the edges of the cores with a lathe using a coolant. The cores are then cleaned in a smaller, more efficient perchloroethylene vapor degreaser. The surface of the cores are machined using a “Water Jet” which uses very fine, high pressure streams of water to remove the outer surface of the aluminum. The cores are then dipped into hot DI water and sent to the coating process.

This process change helped reduce hazardous waste generation at Ricoh by eliminating the generation of spent kerosene and methyl chloride as well as reducing the generation of spent perchloroethylene by 60 percent.

SOUTHERN CALIFORNIA EDISON COMPANY / SAN ONOFRE

FACILITY DESCRIPTION: The Southern California Edison Company (SCE) is a privately-owned electric utility with facilities throughout Southern California. SCE owns and operates 13 fossil fuel, electric generating stations, more than 25 hydro-generating stations, one nuclear station, dozens of transmission substations and various other support service facilities. SCE's San Onofre nuclear station is located in San Diego county. This facility consists of three pressurized water reactors of which only two are currently operating. Their total output capacity is approximately 2,200 megawatts. San Onofre has approximately 2,100 employees. The SIC code is 4911, electric services.

	1990	1994	Percent Change
Aqueous	N/AV	N/AV	N/AV
Non aqueous	199	128	-36
Recycling	N/AV	N/AV	N/AV
Treatment / Disposal	199	128	-36
Total (Tons)	208	152	-27

FACTORS AFFECTING WASTE GENERATION AND BUSINESS: Of San Onofre's three units, units 2 and 3 have been in operation since 1983 and 1984 respectively. Unit 1, which had been in operation since 1967, was permanently shut down in November 1992. Due to the timing of its shutdown, the impact of Unit 1 on the total quantity of waste streams produced was very significant in 1992 and throughout 1993. Decommissioning of a nuclear power plant is a slow process; therefore, future decommissioning procedures will likely continue to contribute increased levels of generated hazardous waste.

OBSTACLES TO SOURCE REDUCTION - Variations in decommissioning activities from year to year affect hazardous waste generation for each Unit. Also, due to the facility's age, painting is an ever increasing waste generating activity. However, hazardous waste generation for each painting event has decreased due to source reduction implementation as described below.

SOURCE REDUCTION HIGHLIGHTS: Due to the plant's age and proximity to the ocean, salt air and water are extremely harsh on the system's buildings and components making continuous repainting to eliminate/reduce corrosion a necessity. The following source reduction and waste minimization techniques have been implemented to reduce waste paint and related spent cleaning solvents.

Mix Paint According to Need - The majority of paints currently used are two component paints that remain useable for only a few hours after mixing. Paint that has not been used up after this

time period must be discarded as waste. Paint minimization is currently underway with the amount of paint mixed, based on the job requirements. Procedures have been implemented in which paints are supplied in 1 to 5 gallon cans and mixed in 1.5 gallon buckets. Previously, most two component paint was mixed in 5 gallon batches. Of the 5 gallons mixed, generally 3 gallons would be used and 2 gallons would end up as waste.

Rigid Inventory Control of Cleaning Solvents - Inventory control of cleaning solvents is achieved by a review process of all necessary solvents by site groups, including Environmental Protection, Chemistry and Safety. This allows control of inventory, ensures that there are no duplicated products and maintains the lowest number of containers for each product. Better administrative control ensures that products are used prior to shelf life expiration.

Use of Efficient Application Equipment - The use of high volume, low pressure spray guns has been implemented. These guns allow high volumes of paint to be applied while minimizing loss of paint due to wind carry or over spray. This also avoids unnecessary clean up of surrounding areas and equipment.

Use of Enclosed Cleaning Stations - Enclosed washers are now used to clean painting equipment. Spray equipment is inserted into the enclosed container and solvent is sprayed to flush the inside and outside of the equipment. This process allows for recycling and reuse of the solvent. An enclosed washer is located in every paint booth.

Recycle Thinner/Solvent - Recycling of solvent is conducted offsite.

These measures have helped reduce this unspecified solvent mixture waste stream by 43 percent when comparing 1990 to 1994. This amounts to almost a 20 ton annual reduction.

Lubrication Oil / Hydraulic Oil - Waste oil and mixed oil, were also identified for reduction. This stream is generated from maintenance and leaks from plant equipment. Reductions were achieved through the following: Eliminating leaks in the lube oil system; rerouting leaks back to the lube oil tank instead of to the floor drain; removing water from the oil prior to pumping into the separator. Probably the largest reduction to this waste stream has been the replacement of traditional hydraulic fluid with synthetic high quality fluids. This oil is changed only once every five years as opposed to once every two years with the non-synthetic oil. This change has been responsible for much of the nearly 70 percent reduction reported in the generation of this waste stream. This has resulted in an 80 ton annual reduction from 1990.

STANLEY HOME DECOR / CHATSWORTH

FACILITY DESCRIPTION: During 1990 the Chatsworth facility was operated by Monarch Mirror and Door Company, Inc. (Monarch). Stanley purchased the facility from Monarch and began operations in 1992. This facility employs approximately 120 people and manufactures mirror products. The SIC code is 3231, products of purchased glass.

	1990	1994	Percent Change
Aqueous	N/AV	195,638	N/AV
Non aqueous	692	715	+3
Recycling	N/AV	10	N/AV
Treatment / Disposal	N/AV	481	N/AV
Total (Tons)	N/AV	196,129	N/AV

FACTORS AFFECTING WASTE GENERATION AND BUSINESS: The purchase of Monarch by Stanley placed a financial burden on Stanley which did not allow implementation of source reduction measures, including low-lead based paint, for Chatsworth as proposed by Monarch in their 1990 SB 14 Plan. The ability to use low-lead paint in the coating process would allow Stanley to manage scrap waste mirror as non-hazardous waste. Based on the low-lead paint evaluation process conducted at their Tupelo, Mississippi plant, Stanley plans to implement a similar process at their California Chatsworth facility.

In January 1994, the Chatsworth facility experienced significant damage from the Northridge earthquake. Operations were severely restricted for approximately 4 months while damage was repaired. Financial and scheduling burdens caused by the earthquake significantly affected implementation of proposed source reduction measures.

OBSTACLES TO SOURCE REDUCTION - The availability of low-lead paint that meets quality control and non-hazardous content for lead/environmental permits is the primary barrier.

HIGHLIGHTS

WASTE STREAM / CWC - Scrap mirror / 181

PROCESS GENERATING THE WASTE - Over 100 different sizes of mirror product are cut from master sheets during the assembly process resulting in scrap mirror waste, or trimout. This trimout consists of unusable mirror pieces.

IMPLEMENTED SR MEASURE - Stanley is currently in the process of evaluating alternatives to the lead-based paint used in the roller painting process at Chatsworth. The paint currently contains 9 to 10 percent total lead. In order to maintain product quality and meet the regulatory

criteria of non-hazardous waste for scrap mirror, the paint must contain approximately 1.5 percent total lead.

The first step taken by Stanley was to modify the volatile emission control technology used in the painting process. The lead-based paint contains mineral spirits which are collected in a carbon adsorption emission system. However, low-lead based paints contain n-butyl acetate alcohol solvents which cannot be recovered by the current emission control system. Therefore, Stanley has installed a catalytic oxidation unit to replace the carbon adsorption unit. This unit has also required a permit from the South Coast Air Quality Management District for operation.

After implementing these improvements, Stanley will then begin to rebuild the existing roller painting process to begin testing low-lead based paint. Each paint will be evaluated individually to determine if it meets product quality specifications as well as to ensure compliance with lead limits.

QUANTITY REDUCED - 688 tons

OTHER

Aqueous waste / Silver recovery system

In 1996, the silver recovery system was upgraded for phase separation of the silver in the aqueous hazardous waste stream. The new filtration/gravity system has allowed Stanley to reduce the amount of influent and has also increased the silver recovery rate. The new system has helped reduce the silver discharge to the local POTW by three to five times compared to discharge prior to the upgrade.

New Paint process

A catalytic oxidation unit has been installed to recover emissions from the painting process. This has allowed Stanley to use the newest paint technology for sealing mirrors. Rebuild of the roller coat paint application system has also been completed which will allow for further evaluation of low-lead paint.

With these modifications completed, Stanley has been able to test low-lead paints twice each month beginning in December 1996. The goal is to be running a low-lead paint in production by end of August 1997. The pay back for this project is a two year ROI. (The lead content of the paint (sealant) on the mirror back requires that scrap mirror (with paint) be managed as hazardous waste. By reducing the sealing paint lead content, painted scrap mirror could be handled as non hazardous waste).

Copper recovery process

Mirrors are copper coated on the back over the silver reflective surface in order to protect it from oxidizing. Waste copper is recovered for reuse with ion exchange units. In 1996 Stanley upgraded their onsite copper recovery system to eliminate copper discharge to the POTW for this coating process. The benefits from this upgrade were numerous. In addition to zero copper discharge, the quality and quantity of recovered copper also increased as compared to before the recovery system upgrade. In addition, sulfuric acid and ammonia use have been reduced by 50 percent and 65 percent respectively without affecting product quality.

TAMCO / RANCHO CUCAMONGA

FACILITY DESCRIPTION: TAMCO manufactures steel reinforcing bar (rebar) from steel scrap received offsite. The SIC code is 3312, blast furnaces and steel mills. TAMCO has operated at this site since 1983 and employs 350 people.

	1989	1994	Percent Change
Aqueous	N/AV	N/AV	N/AV
Non aqueous	7,666	8,492	+11
Recycling	0	8,492	N/AV
Treatment / Disposal	7,666	0	-100
Total (Tons)	7,666	8,492	+11

FACTORS AFFECTING WASTE GENERATION AND BUSINESS: TAMCO melts scrap steel to a molten state in an electric arc furnace (EAF). Particulate emissions are created as the temperature of the molten steel reaches 3000°F. The South Coast Air Quality Management District (SCAQMD) requires TAMCO to use a pollution control device called a baghouse to capture particulate emissions created by the melting of steel scrap in the EAF. In addition, TAMCO's baghouse is required by the SCAQMD to have a particulate capture efficiency of greater than 99 percent. The baghouse captured particulates are regulated by the U.S. Environmental Protection Agency as a hazardous waste. In addition, any solid waste mixed with these hazardous emissions also becomes a hazardous waste.

OBSTACLES TO SOURCE REDUCTION: In order to increase steel rebar production, more scrap is consumed by the EAF and in turn more hazardous waste called baghouse dust is generated. In addition, TAMCO is required by the SCAQMD to make a "good faith" effort to increase baghouse capture efficiency.

Due to the nature of TAMCO's operation, direct source reduction and pollution prevention opportunities are limited. TAMCO is legally obligated to maintain a particulate capture efficiency of over 99 percent, so pollution prevention cannot include reduction of this efficiency. If TAMCO is to increase production, the amount of steel scrap cannot be reduced. However, TAMCO was able to identify direct and indirect source reduction and pollution prevention opportunities. During the period from 1989 to 1994 the facility increased its production of steel rebar by nearly 65 percent. During the same period, TAMCO's largest waste stream, baghouse dust, increased by only approximately 10 percent. While there was a quantitative increase in waste generation, relative to production, it decreased.

PRODUCTION

1989 - 284,953 tons of steel rebar

1990 - 284,953 tons of steel rebar

1994 - 449,217 tons of steel rebar

HIGHLIGHTS: One effective direct pollution prevention/source reduction measure implemented was switching from a powdered type lime flux additive used during the production of steel, to a pelletized lime product. This resulted in less lime dust being captured by the baghouse and therefore avoided its contamination with hazardous steel melting particulates. Thus a decrease in total hazardous waste baghouse dust resulted.

Another effective direct pollution prevention/source reduction method was the construction of concrete pads in the scrap yard storage area. When scrap is stored on the concrete pads there is less chance of dirt and soil being fed to the electric arc furnace and captured in the baghouse as hazardous waste.

TAMCO also identified other pollution waste minimization opportunities. In 1991, TAMCO worked with the California Department of Environmental Protection (Cal/EPA) to find a solution to the challenge of managing used oil filters. Eventually, a recycling exemption for used oil filters was promulgated. Used oil filters would still be managed as hazardous waste, unless the filters were drained, crushed or shredded, the oil sent to an approved recycling facility and the filter canisters sent for metal reclamation. Since 1991, TAMCO has recycled more than 56 million used oil filters. The net result is that for every ton of used oil filters recycled, 1700 pounds of steel rebar is produced, 31 gallons of used oil is recovered and 10 cubic yards of landfill is conserved. In addition, similar used oil filter recycling programs have begun throughout the country. Due to the California recycling program, manufacturers of oil filters ceased putting lead terne plating in their product. So, in effect, recycling of used oil filters caused the filter manufacturing industry to invoke source reduction by eliminating lead from their product.

Another successful waste minimization opportunity identified by TAMCO was the recycling of steel drums and containers that met the Cal/EPA contaminated containers exemption. Companies were encouraged to remove the contaminants from these drums and containers instead of merely crushing them prior to shipment to hazardous waste landfills. The steel drums and containers, once empty, are then shipped to TAMCO for recycling into rebar. Since the inception of the program in 1991, TAMCO has recycled approximately 542 tons (1,082,980 pounds) of steel containers and drums into rebar. As a result of these programs, several companies list TAMCO directly or indirectly in their pollution prevention documents.

U.S. CIRCUIT, INC. / ESCONDIDO

FACILITY DESCRIPTION: U.S. Circuit, Inc., manufactures printed circuit boards. U.S. Circuit has been at this site since 1985, employs approximately 100 people and claims small business status for the purposes of SB 14 document preparation. The SIC code is 3672, printed circuit boards.

	1990	1994	Percent Change
Aqueous	9,000	10,000	+11
Non aqueous	68	103	+52
Treatment/Recycling	68	103	+52
Total (Tons)	9,068	10,103	+11

OBSTACLES TO SOURCE REDUCTIO: U.S. Circuit is a small business that produces printed circuit boards. Their source reduction goal in recent years has been approximately a 20 percent reduction in hazardous waste generation during this period. In mid 1995, U.S. Circuit became subject to waste water effluent discharge changes imposed by U.S. EPA. The impact of this was to reduce discharge limits causing the company to resort to additional offsite waste disposal of previously in-house treated waste water. Presently, U.S. Circuit is re-introducing treated waste water on a gradual basis in order to determine quantities that may be added to facility discharge without compromising regulatory compliance.

SOURCE REDUCTION HIGHLIGHTS: U.S. Circuit, Inc., is continuing to explore process changes which will enable the company to continually achieve source reduction despite increases in production. Specifically, they have invested \$160,000 in a direct metalization process designed to eliminate the need for the conventional electroless copper process. This new process was in place by 1996. Additional source reduction methods are also being considered. Printed circuit board production has increased by more than 70 percent from 1990 to 1994 while hazardous waste generation has increased by only approximately 11 percent during the same period.

USS-POSCO INDUSTRIES / PITTSBURG

FACILITY DESCRIPTION: US Steel Corporation has been at this site since 1929. In 1986, a 50-50 joint venture was established between subsidiaries of US Steel and Pohang Iron and Steel Co., LTD. (POSCO) of South Korea, forming UPI. This facility employs approximately 970 people. The SIC code is 3312, steel mills.

	1990	1994	Percent Change
Aqueous	14,275	17,200	+20
Non aqueous	7,985	1,490	-81
Recycling	4,191	8,744	+109
Treatment / Disposal	22,260	18,690	-16
Total (Tons)	22,260	18,690	-16

WASTE REDUCTION HIGHLIGHTS: Many waste reduction efforts at USS-POSCO occurred prior to 1990 when major retooling projects were implemented, which included the replacement of inefficient and outdated equipment with modern steel finishing technologies and equipment. These accomplishments occurred through the following general programs:

PRIOR TO 1990

- 1) Installation of a new Pickle Line Tandem Cold Mill (PLTCM) which included a hydrochloric acid recovery system. The hydrochloric recovery system eliminated the generation of 35,000 tons per year of acid and waste water by recycling the pickling acid solution within a closed loop system. Additionally, the recycling process produces a valuable iron oxide product and has reduced hydrochloric acid purchases by over 95 percent.
- 2) Upgraded the Terminal Water treatment Plant, which included the installation of a dual stage pH control system. Under normal circumstances this pH control system is capable of maintaining the pH within 1 percent of the target. Upgrading the treatment plant included adding a filter press and allowing for closure of several open ponds, thus reducing the potential for uncontrolled air releases. This also decreased the amount of sludge produced and reduced the potential for contamination to the soil and groundwater.
- 3) A contractor was located onsite to produce a salable fuel oil from the previously waste oil sludge. As much as 40,000 gallons per month of fuel oil is now produced and sold from the waste oil sludge.

1990 TO 1994

1) A chromium recovery system was installed to produce reusable product from the chromium contaminated rinse waters on the tin plating processing lines. This system is capable of recycling enough chromium solution to reduce the requirement of purchasing sodium dichromate solution by up to 70 percent. Additionally, by installing a comprehensive secondary containment system in the chromium chemical processing area, the amount of chromium found in the Terminal Water Treatment Plant sludge was reduced by over 90 percent, thus resulting in a reduction of over 5,500 tons per year of hazardous waste.

2) Three recirculating "ultrafiltration" units have been installed on sodium hydroxide based cleaner systems in the Sheet and Tin Processing Mills. These in process filtration systems extend the useful life of the cleaning solutions by removing oils and dirt that accumulate from the cleaning process. The oil removed in this filtration process is converted into fuel oil and sold as a product. By extending the cleaner life, USS-POSCO has reduced waste by over 3,600 tons.

FACILITY COMPARISON AND DATA NORMALIZATION

This chapter presents information on data normalization for those facilities that had production numbers in their SB 14 source reduction documents. Approximately half the twenty-one facilities that submitted documents did have some information on production from 1990 to 1994.

Changes in production rate and output from one year to the next can result in significant variations in waste types and quantities generated by a facility. Consequently, a meaningful picture on hazardous waste reduction within a facility cannot be obtained without tying the amount and type of waste generated to the number and types of output produced (i.e., normalizing data). Without data normalization, a comparison of annual changes in waste stream generation over multiple years does not provide insight on that quantity of waste reduced due to source reduction measures. A company may have a waste reduction program in place but if the production level is increasing, it becomes impossible to isolate the waste generation change attributable to the source reduction activity. Conversely, a company with a decreasing production level might reveal a reduction of the total hazardous generated without carrying out any source reduction measures. A couple of facilities that participated in this report did present normalized data for process specific waste streams in their source reduction documents.

SUCCESSFUL SOURCE REDUCTION EFFORTS

These facilities are grouped together due to the fact that from their SB 14 documents they have successfully **identified and implemented source reduction** measures from 1990 to 1994. In addition, some of these facilities offer production numbers to compare with hazardous waste generation data. In some cases production has increased while hazardous waste generated has decreased during the same period. One of these companies is **Beckman Instruments**. From 1990 to 1995, Beckman experienced an increase in printed circuit board production of approximately 14 percent. At the same time they reduced their hazardous waste generation by 34 percent. This reduction occurred primarily in the waste water stream as a result of simple source reduction techniques. Another facility, **Hadco Corporation, formerly Zycon**, also experienced an increase in production with a corresponding decrease in hazardous waste generation. Hadco's production of printed circuit boards from 1990 to 1994 increased by approximately 66 percent while generated hazardous waste decreased by 12 percent during the same period. This was accomplished through simple source reduction such as drag out reduction on metal finishing lines. **U.S. Circuit** is a facility that had sales numbers to compare with hazardous waste data. During the period 1990 to 1994 this facility's hazardous waste generation increased by approximately 11 percent while their sales increased by more than 70 percent during the same period. They implemented source reduction such as production process changes in their printed circuit board line. U.S. Circuit claims small business status and their SB 14 documents state that additional source reduction activities are planned for this site. Another company, **National Semiconductor**, stated that technology advancements in semiconductor manufacturing affect hazardous waste generation quantities. Even though, National presented normalized data based on production numbers that showed a decrease in hazardous waste generation as a result of source reduction activities. For example, the conversion of membranes in the reverse osmosis units from cellulose acetate to teflon membranes yielded more than a 37 percent reduction in the quantity of sulfuric acid used at the plant during the period 1990 to 1994.

Imation Corporation and **Ricoh Electronics** were not only able to reduce their hazardous waste generation and on site treatment of hazardous waste water, but their in-process recycling systems for waste water may also enable these facilities to **reduce regulatory costs** associated with the hazardous waste permitting process. **Callaway Golf Company** also installed an in-process waste water recycling and reuse system as part of their aqueous slurry shaft slotting operation. They have also introduced other input and operational changes that have helped reduce hazardous waste generation since the facility began operations in 1992. Their SB 14 documents also include future plans and goals to implement source reduction at the site.

The **Jennings Technology Corporation** was able to reduce their hazardous waste water generation through production process changes in their plating lines. These changes helped achieve a 62 percent reduction in hazardous waste water generation in 1994 when compared with 1990. Jennings also eliminated the use of CFC solvents in 1993. The **Northrop Grumman Aircraft Division** implemented production process source reduction measures from the period 1990 to 1994 to achieve a 77 percent reduction in non-aqueous waste plus they found a successful replacement for the solvent 1,1,1-TCA. Modifying cleaning tank agitators, counterflow rinsing and eliminating process steps are some of the successfully implemented techniques. In addition, Northrop prepared very complete and thorough SB 14 documents that also show the company's plans for future source reduction success at this facility. **USS-POSCO Industries** has implemented source reduction and recycling measures from 1990 to 1994. Production process changes

have helped reduce hazardous waste generation by 16 percent. From 1987 to 1994 this facility has decreased its hazardous waste generation by more than 65,000 tons. In addition, USS-POSCO's SB 14 documents state additional source reduction and recycling efforts are planned for the future.

One of the companies in this report is in the business of manufacturing products from scrap material designated for recycling. The **TAMCO** steel company experienced an increase in hazardous waste generation of approximately 11 percent while their production increased by more than 60 percent during the same period. Two simple, effective source reduction measures, input and production process changes, were identified by Tamco as helping to keep generated hazardous waste quantities low relative to production. Another facility, the **Southern California Edison Company**, was captured as a large quantity generator due to the decommissioning of one of their nuclear power units. This type of waste is exempt from SB 14 when determining applicability and when evaluating waste streams for source reduction opportunities. Despite these exempt wastes, this facility generates enough (>12,000 kilograms) applicable wastes requiring the preparation of source reduction documents. Two areas that the Edison Company targeted for source reduction were facility painting and equipment lubrication/hydraulic oil. The implemented administrative, production process and input measures helped reduce this facility's hazardous waste generation by almost 27 percent for the period 1990 to 1994. In addition, the Edison Company is planning future source reduction activities.

Another company that gave standardized data, comparing solvent and water generation per product manufactured, is **Integrated Device Technologies**. This company began business at the site in 1991 with accurate waste generation data available for 1993. The facility implemented a production process change by installing recirculators in the photo resist stripper baths to reduce the contamination rate of solvent and thus reduce solvent use and related generated wastes. In addition, when comparing water use against product manufactured, a decrease in water use per unit of production was realized. This was accomplished by implementing input, operational and recycling changes in the reverse osmosis/deionized water process and in the fabrication lines process at Integrated.

UNTAPPED SOURCE REDUCTION OPPORTUNITIES

Facilities listed in this section may have not yet implemented beneficial source reduction measures. Facilities were placed in this category if they have shown a marked increase in the generation of hazardous waste from 1990 to 1994. Supporting this classification even more is the fact that two of these three companies show a decrease in production during the same period. The third facility did not state their production numbers.

Anheuser Busch's non-aqueous hazardous waste streams decreased by approximately 16 percent during 1994 as compared with 1990. These reductions occurred with waste streams such as paint wastes, rags, inks and cleaning solvents. As stated in their SB 14 documents, source reduction including operational improvements and production process and administrative changes have helped reduce these waste streams. However, Anheuser's hazardous waste water generation increased by 78 percent during the same period. This occurred even though the facility's production rate dropped by approximately 11 percent from 1990 as compared with 1994. The SB 14 documents state that product package cleaning requirements and export standards for their product have required the use of cleaning chemicals in the process water and have rendered the effluent hazardous due to pH. This waste water is treated on site before discharge to the local POTW. Anheuser's SB 14 documents also state that source reduction activities were planned for the period 1994 to 1998 to reduce this large aqueous hazardous waste stream. (Anheuser Busch's SB 14 documents are some of the most complete and thorough of those evaluated for this report).

Though **Douglas Aircraft** has successfully reduced its generation of non-aqueous hazardous waste by almost 75 percent, overall their hazardous waste generation has increased by more than 50 percent from 1990 to 1994. This is due to an increase of approximately 59 percent in the generation of aqueous hazardous waste. According to Douglas, this occurred with the elimination of on site water reclamation and recycling systems and with the redirection of metal finishing waste streams into the pretreatment system pursuant to a U.S. EPA Consent Order. These increases occurred despite a 67 percent decrease in aircraft production at Douglas during the same period, 1990 to 1994. Source reduction and recycling efforts were successful with other waste streams, such as with machining coolant. Please see the facility abstract section in this report for details.

Associated Plating did not give production numbers or normalized data (difficult in plating operations due to varying part configuration) but did experience a substantial increase in hazardous waste generation from 1990 to 1994. Most of this increase was due to hazardous waste water generation. Associated's SB 14 documents did not reveal the reason for the increase in these aqueous waste streams. Even though their documents state that some source reduction and recycling techniques have been implemented at Associated, such as counter flow rinsing and ion exchange systems, their increase in aqueous waste in 1994 as compared with 1990 is unexplained. An increase in business activity, or other factors could also contribute to the noted increase.

UNDETERMINED SOURCE REDUCTION BENEFITS

The facilities listed in this category are those whose source reduction and/or waste minimization efforts during the period 1990 to 1994 are not clearly identified as having a direct effect on hazardous waste generation. In addition, other facilities' lack of data did not allow for a complete evaluation of source reduction and waste minimization efforts.

Aerojet experienced a 39 percent reduction in hazardous waste generation from 1990 to 1994. They have also stated that 50 percent of their identified major waste streams have been affected by changes (decrease) in business activities. No production data was given in their SB 14 documents. They also state that it is difficult to correlate waste stream reductions directly to any of their implemented waste reduction projects. Aerojet has implemented recycling and source reduction techniques to decrease hazardous waste generation at the facility but attributing quantified reductions to source reduction and waste minimization was not possible based on information provided in the SB 14 documents.

Dow Chemical's generation of hazardous waste increased by approximately 50 percent during 1994 as compared with 1990. Formerly, generated hazardous waste water was used in the manufacturing process of products at the Pittsburg facility before 1992. When that process shut down, the waste water was treated and disposed at the local POTW rather than used in manufacturing process as before. This increased their overall hazardous waste generation during 1994 as compared with 1990. During the same period, Dow states that overall business activities have decreased. Also, Dow implemented operational improvements, production process changes, and other source reduction activities in addition to recycling to manage their hazardous wastes during the period 1990 to 1994. Dow is planning source reduction and recycling activities for the next reporting period, 1994 to 1998.

Dupont's hazardous waste generation decreased slightly (5 percent) during 1994 as compared with 1990. However, since 1990, approximately 25,000 tons (80 percent) of this annual amount is reprocessed and sold locally as a road base component. This is not source reduction, recycling, reuse or waste minimization. In fact, DTSC has been evaluating the reprocessing and use of this waste by Dupont for several years. During October 1997, Dupont stopped generating and reprocessing this waste stream. U.S. EPA has established land disposal restrictions for this type of waste effective July 1998. Dupont's SB 14 document states that source reduction activities are planned for implementation for the period 1994 to 1998.

Production process changes and operational improvements were implemented at the **Hartwell Corporation** as well as other waste minimization techniques for the period from 1990 to 1994. By installing conductivity control sensors in the plating shop counterflow rinse tanks they were able to reduce their water usage by 50 percent. The effect that this may have had on the generation of hazardous waste water is unknown as 1990 aqueous waste generation data was not available from this facility. Only non-aqueous data was available for comparison. Hartwell reduced their non-aqueous hazardous waste by more than 70 percent during 1994 as compared with 1994. However, the non-aqueous waste accounts for only approximately 1/2 of 1 percent of the total hazardous waste generated in 1990. Since most waste data was not available for comparing 1990 and 1994, determining the effectiveness of Hartwell's source reduction activities is difficult.

International Extrusion Corporation's hazardous waste generation increased by approximately 8 percent from 1990 to 1994. Their SB 14 documents did not state if this was due to an increase in business activities or other factors. The facility stated that they have sacrificed business in order to reduce the generation of hazardous waste. The International Extrusion Corporation did implement source reduction and waste minimization techniques that helped reduce process specific hazardous waste streams from 1990 to 1994. Recycling and recovery processes have also been implemented at the facility. Their SB 14 documents did not evaluate hazardous waste water for source reduction opportunities for the period 1994 to 1998.

Stanley Home Decor took over operations from the previous owner in 1992. This purchase, combined with the 1994 Northridge earthquake placed financial and physical burdens on this facility, thus limiting source reduction implementation. Stanley's SB 14 documents propose many source reduction and recycling techniques for the period 1994 to 1998. One ongoing project that Stanley is evaluating is low lead content paint used on the mirror backing. If Stanley is successful in finding acceptable low lead paint, they could probably eliminate this waste stream that accounts for the vast majority of their non-aqueous hazardous waste generation. Stanley hopes eventually to find a replacement paint that does not contain any lead. It appears from their SB 14 documents that Stanley did not evaluate hazardous waste water for source reduction opportunities for the period 1994 to 1998.

The Hi-Shear Corporation, experienced a significant drop in business during the period from 1990 to 1994. Though they experienced a business downturn, they were able successfully to implement administrative and operational source reduction measures into their waste water treatment operation. This waste stream realized a 10 percent reduction in their hazardous waste water generation with a return on investment of only one month. It is difficult to determine if the implemented source reduction measure is responsible for the entire reduction or if it was also affected by the business downturn. Hi-Shear's SB 14 documents include future plans for source reduction activities at the site.

Though **K/J Plating** classifies themselves as a small business, they appear on the RCRA list of largest hazardous waste generators. K/J states that they will be implementing operational and administrative source reduction measures that they state will reduce their hazardous waste generation by approximately 5 percent. Their SB 14 documents do not explain the reduction in non aqueous hazardous waste generation at the facility during 1994 as compared with 1990. Their documents do not give production numbers for normalized data since this is difficult to establish for plating shops.

FACILITY DESCRIPTION: The IBM, San Jose facility manufactures data storage systems and components including tape and disk storage systems such as thin-film hard disks, thin film heads and tape heads. The San Jose site has been in business since 1956 and employs approximately 8,400 people. The SIC code is 3572, computer storage devices.

	1990	1994	Percent Change
Aqueous	336,158	14,602	-96
Non aqueous	2,280	1,286	-44
Recycling	1,120	931	-17
Treatment / Disposal	336,158	14,602	-96
Total (Tons)	338,438	15,889	-95

FACTORS AFFECTING WASTE GENERATION AND BUSINESS: IBM has achieved a six-fold increase in production during the period of 1990 to 1994. The fact that IBM has decreased hazardous waste generation during the same period demonstrates the increase in production efficiency at IBM's San Jose facility.

OBSTACLES TO SOURCE REDUCTION - Increasing product complexity, shorter product development cycles and the requirement to provide cost competitive, high quality products while protecting worker health and safety make it increasingly difficult to modify existing processes to reduce hazardous waste.

HIGHLIGHTS: IBM achieved the following net waste reductions and benefits from source reduction efforts during the period from 1990 to 1994.

- * A net reduction in total hazardous waste shipped offsite of 576 tons in spite of a six fold increase in production during the same period. This represents a 25 percent decrease in offsite waste shipments.
- * Hazardous waste generation and chemical usage is reduced by 2,400 tons annually.
- * Waste water generation is reduced by 151,000 tons annually.
- * Hazardous waste sent to landfills is reduced from 20 percent of total waste shipped offsite to 7 percent of total.
- * Savings of \$6.7 million.

EXAMPLES OF SOURCE REDUCTION, 1990 -1994:

WASTE STREAM / CWC - Spent Solvent / 214

PROCESS GENERATING THE WASTE - Magnetic coating of computer hard disks

IMPLEMENTED SOURCE REDUCTION MEASURE - Production process change / IBM developed a new disk coating process that uses an improved method to apply the magnetic coating on the computer disk. The new process generates less waste solvent and less solvent contaminated solid hazardous waste.

QUANTITY REDUCED - 253 tons of solid hazardous waste and 41,000 tons of waste water annually

CAPITAL COST - > \$1,000,000

PAYBACK PERIOD / ROI - Not determined

YEAR WHEN IMPLEMENTED / COMPLETED - 4th quarter 1991

WASTE STREAM / CWC - Other Organic Solids / 352

PROCESS GENERATING THE WASTE - Texturing of computer disks

IMPLEMENTED SOURCE REDUCTION MEASURE - Production process change / Reduced abrasive and deionized water use in disk texturing process.

QUANTITY REDUCED - 21.6 tons of solid hazardous waste and 333 tons of waste water.

CAPITAL COST - \$25,000

PAYBACK PERIOD / ROI - < One year

YEAR WHEN IMPLEMENTED / COMPLETED - December 1994

WASTE STREAM / CWC - Plating and etch waste water / 132

PROCESS GENERATING THE WASTE - Plating computer heads with an automated nickel plating tool.

IMPLEMENTED SOURCE REDUCTION MEASURE - Operational improvement / Water flow controllers were installed on the plating lines to shut down or reduce flow when lines are not in use.

QUANTITY REDUCED - 18,300 tons of hazardous waste water.

CAPITAL COST - \$20,000

PAYBACK PERIOD / ROI - Four months

YEAR WHEN IMPLEMENTED / COMPLETED - August 1992

OTHER ACCOMPLISHMENTS

IBM has continued to work on pollution prevention for the computer disk texturing process since the last SB 14 report was written in 1994. During 1995, an additional 12 tons of generated hazardous waste was reduced due to the continued phase out of the mechanical disk texturing process. By 1996, mechanical texturing was discontinued with all disk production using a new laser texturing process. This new texturing process associated with the conversion of 2.5" disks from aluminum substrate to glass has contributed to the overall substantial hazardous waste reductions that have occurred at IBM during the 90's. The conversion from aluminum to glass disk substrates alone accounted for a reduction of almost 90 tons of hazardous waste generated in addition to the elimination of 39,340 tons (9,440,000 gallons) of hazardous waste water. Overall pollution prevention activities at IBM, from January 1991 through December 1996, have resulted in the elimination of 3,240 tons of non-aqueous hazardous waste generated as well as the elimination of 258,000 tons (62,000,000 gallons) of hazardous waste water.

The new disk texturing process and the substitution of aluminum for glass disk substrate is described below.

ENVIRONMENTAL ACHIEVEMENT - IBM Storage Systems Division's VACUUM TEXTURED GLASS DISK

DESCRIPTION

The environmental accomplishment achieved is the elimination of chemical processes for plating, polishing and texturing nickel phosphorus (NiP) layers on aluminum magnetic recording disks. This provides a major reduction in chemical waste discharged, as each of these processes are chemically intensive. Moreover, this is a source elimination of nickel, a heavy metal listed and monitored by the U.S. EPA as a specific ecological risk.

Until 1995, all IBM thin film magnetic disks and nearly all disks produced within the industry were based on aluminum substrates coated with a layer of NiP. The NiP layer promotes adhesion, reduces corrosion, and allows the substrate surface to be polished to the surface finish required for disk drive applications. Today, all of IBM's 2.5" disks employ a glass substrate which does not incorporate a NiP layer, nor does it substitute an alternative chemical process. Thus, the heavy metal, nickel, is completely eliminated in the 2.5" disk process. By comparison, when aluminum substrates with NiP layers are employed, capture and abatement of nickel is required at the plating process step, and at both the polishing and texturing process steps. In these later processes, abrasive slurries are used to change the surface finish of the NiP layer, and the slurry waste discharged includes NiP debris as a solid and ionic nickel in solution.

By eliminating the NiP layer entirely, three process sources of nickel discharge are eliminated within IBM, and the finished disk is also made more readily recyclable. Finished disks and scrap disks made from aluminum substrates with NiP layers are recycled for aluminum content, but the recycling process is specialized because of the presence of NiP. Currently, only one recycler in the U.S. accepts aluminum disk rejects. By contrast, finished glass disks and rejects are recyclable as ordinary glass.

The innovative nature of the accomplishment is in the vacuum process used to texture the glass substrate. Glass substrates have been available for many years, but only in the last few years have glass disks been used in disk drive products. One reason glass was not used previously is cost; glass substrates are more expensive than aluminum substrates. This is less so today than previously, but cost is still a factor and is the reason that IBM continues to use aluminum substrates for 3.5" disks. For 2.5" disk drive applications, glass substrates provide a performance advantage (shock resistance) which aluminum substrates cannot match. However, glass substrates, like aluminum substrates, must be textured for most disk drive applications, and herein lies the innovation. The mechanical abrasive processes used to texture aluminum substrates are unsuitable for glass. Chemical processes for texturing glass have been developed outside of IBM, but substrates and disks produced from this approach have not been acceptable for IBM standards.

The innovative texture process developed and implemented by IBM is a vacuum sputtering deposition of an aluminum-based layer. The process generates no chemical waste discharge and the resulting disk product can be recycled as ordinary glass. In addition, the product has performance advantages. Our process is proprietary, and patent rights have been applied for. In 1997, IBM's 20 million glass disk production will represent 40 percent of glass disk usage in the industry.

ENVIRONMENTAL BENEFITS

By replacing mechanical textured aluminum disks with vacuum textured glass disks for all 2.5" products, the San Jose plant site effected a much needed reduction in the amount of nickel discharged in waste effluent. Industrial nickel discharge levels are a critical issue in Santa Clara County. IBM has responded with a 50 percent year-to-year reduction for 1996. The elimination of mechanical disk texture is credited with half of this reduction. This very visible demonstration of good corporate citizenship has been applauded by both the city and the county. A tangible result of this is that IBM has gained a reduction in environmental oversight by county agencies. The IBM disk process and product described here are industry leaders in both performance delivered to the customer and in environmental awareness.

California's petroleum industry represents some of the States' largest hazardous waste generators. As such, it deserves a special focus. In June 1997, DTSC completed its latest detailed review of this industry's source reduction efforts. For a discussion beyond the scope of this report, see DTSC's report number 536. The following section summarizes the results of DTSC's second assessment of the California petroleum industry source reduction planning efforts. These efforts are mandated by the California Hazardous Waste Source Reduction and Management Review Act of 1989 (the Act or SB 14). The petroleum industry was previously evaluated following its response to the initial 1990-1994 source reduction planning cycle under the Act. During the review, DTSC examined a total of eighteen sets of petroleum industry 1991 source reduction planning documents and released the first "Assessment of The Petroleum Industry Facility Planning Efforts" in December 1993. The data and subsequent analysis from this assessment are presented in this chapter separately from the waste generation data and analysis for the previously discussed facilities.

This second petroleum assessment is based upon a review of 1995 documents prepared by twenty-four facilities. Many of the eighteen facilities participating in the initial 1991 industry review are among the twenty-four 1995 documents reviewed. The source reduction documents prepared under the Act include information on the sources and types of hazardous waste generated and describe the source reduction steps taken to reduce the quantities or hazardous characteristics of generated waste. These documents also provide information on the progress made by 1) implementation of previously selected source reduction measures in 1991, and 2) any reduction achieved through recycling and treatment actions taken during the period 1991-1995.

In 1994, the largest hazardous waste streams generated by the petroleum industry were: 1) hazardous aqueous waste streams entering the onsite waste water treatment plant; 2) oil/water separator sludge; 3) tank bottom waste; and 4) spent catalyst waste. The "second assessment" report provides a comparison of 1990 versus 1994 waste generation and reduction data and discussion of hazardous waste streams and waste reduction measures. DTSC's second focus on petroleum industry documents provides an excellent opportunity to track waste reduction progress of California's largest hazardous waste generating industry. The Department's first focus in 1993 was based on the review of eighteen sets of 1991 source reduction documents. This review enabled the Department to project that the petroleum industry as a whole would reduce 20 percent of its hazardous waste by implementing more than 80 source reduction measures during the 1990-1994 SB 14 planning cycle. Actual data from the twenty-four facilities participating in the second review based on 1995 Performance Reports, the petroleum industry indicates a 32 percent reduction of hazardous waste generation during the 1990-1994 period. This amounted to more than 61,000 tons annually. The above data reflect all hazardous wastes except aqueous hazardous waste treated in the onsite aqueous waste treatment plants. Aqueous hazardous waste quantity data are provided separately in this summary.

With current hazardous waste disposal costs for petroleum waste ranging from \$125 to \$750 per ton, these reductions are estimated to have saved the petroleum industry \$7.6 to \$45.7 million annually. Based on our review of the latest documents (1995) produced under the Act, DTSC projects that the industry will implement 122 measures during the 1994-1998 SB 14 planning cycle. Based on this review of the 1995 planning efforts, it is projected that the industry non aqueous hazardous waste reduction can achieve an additional 31 percent (equivalent to more than 53,500 tons annually over the 61,000 tons reduced over the first 1990-1994 planning cycle) of hazardous waste reduction over the next several years. If fully achieved, this reduction will result in a total annual savings of \$6.7 to \$40.1 million.

FINDINGS

This report's findings are summarized in Table 1 and Table 2. The following discussion focuses on the findings displayed in each table.

Non Aqueous Waste Reduction Results 1990 versus 1994:

This is the second source reduction assessment report for the petroleum industry. During the first cycle, this industry - comprised of twenty-four sites - generated more than 192,000 tons of SB 14 applicable non aqueous hazardous waste. These quantities are based on 1990 calendar year data determined from a review of the industry's 1995 Waste Management Performance Reports.

Observed individual non aqueous waste quantities ranged from 38 to 49,000 tons annually.

During the 1994 calendar year (second cycle) the industry generated approximately 169,000 tons of SB 14 applicable non aqueous hazardous waste. This information was obtained from the 1995 Source Reduction Plans representing the industry's twenty-four sites affected by SB 14. Four out of the twenty-four sites increased their hazardous waste generation ranging from 28 to 283 tons (5 to 131 percent) from the 1990 calendar year to the 1994 calendar year. Unocal San Francisco attributed the increase in waste generation to an increase in the quantity of crude distillation; a normalization of data by production indicates that Unocal actually reduced its waste per unit of product.

The comparison does not include the Chevron El Segundo site (among three other sites) because Chevron only reported waste disposal quantities for 1990 as opposed to waste generated quantities. The amount of disposal of major waste streams for this site decreased by approximately 45 percent from 1990 to 1994.

In 1995, that portion of the petroleum industry affected by SB 14 projected its ultimate hazardous waste reduction to be 32 percent of that quantity generated by this industry in 1990. This reduction quantity will amount to more than 60,000 tons annually. These estimates do not include aqueous hazardous wastes treated onsite in waste water treatment plants.

Non aqueous Waste Reduction Goal:

Hazardous waste generation during 1994 ranged individually from 66 tons to 41,000 tons, with an average generation of approximately 7,000 tons per site. The average hazardous waste reduction goal is 31 percent per site and accounts for a total of more than 2,200 tons for each of the twenty-four SB 14 sites annually.

Eighteen out of the twenty-four sites reported their hazardous waste reduction goals ranged from 1 to 100 percent amounting from 7 to 17,000 tons for the next four years beginning in 1995. Powerine Oil was in the process of dismantling its plant prior to selling it overseas; therefore this facility could not provide a hazardous waste reduction goal information.

Twenty-four of the California petroleum sites collectively generated more than 169,000 tons of non aqueous, SB 14 applicable hazardous waste. Based on the estimated goal specified by these facilities in their Plans, we project the industry collectively is capable, under ideal conditions, of reducing approximately 31 percent of its present non aqueous hazardous waste generation amounting to more than 53,000 tons annually during 1994-1998 and beyond.

TABLE - 1
CALIFORNIA PETROLEUM INDUSTRY'S NON AQUEOUS WASTE(1)
REDUCTION RESULTS [1990 vs. 1994, WASTE GENERATION]

Site	1990 Quantity (Tons)	1994 Quantity (Tons)	Amount Reduced (Tons)	Amount Reduced (%)
ARCO, Los Angeles	12,110	4,963	7,147	59
CAL RESOURCES/(SHELL WESTERN), Bakersfield	1,248	446	802	64
CHEVRON, Richmond	7,300	6,967	333	5
CHEVRON, Bakersfield	3,152	2,577	575	18
CHEVRON, El Segundo	7,467 ⁽²⁾	34,569 ⁽³⁾	N/A ⁽³⁾	N/A ⁽³⁾
EXXON, Benicia	49,171	41,674	7,497	15
GATX TANK STORAGE, Carson	N/A	3,654	N/A ⁽⁴⁾	N/A ⁽⁴⁾
HUNTWAY, Benicia/Wilmington	345	277	68	20
MOBIL, Torrance	7,400 ⁽⁵⁾	1,163	6,237	84
PACIFIC REFINERY, Hercules	178	412	(234)	(131)
PARAMOUNT PETROLEUM, Paramount	868	640	228	26
POWERINE OIL, Santa Fe Springs	970	272	698	72
SHELL, Carson	N/A	197	N/A ⁽⁶⁾	N/A ⁽⁶⁾
SHELL, Martinez	24,490	15,110	9,380	38
TEXACO (Area 1&2), Bakersfield	6,968	723	6,245	90
TEXACO (Area 3), Bakersfield	38	66	(28)	(74)
TEXACO, Wilmington	28,015	16,100	11,915	43
TOSCO, Martinez	2,539	2,015	524	21
ULTRAMAR, INC., Wilmington	4,835	1,660	3,175	66
UNOCAL, Santa Maria	1,325	1,563	(238)	(18)
UNOCAL, Carson	12,125	9,290	2,835	23
UNOCAL, Wilmington	22,130	18,600	3,530	16
UNOCAL, San Francisco	5,800	6,083	(283)	(5)
WITCO CORP. OILDALE REFINERY, Oildale	1,288	610	678	53
TOTAL	192,295⁽²⁾	131,408⁽⁷⁾	61,084	32

TABLE 1 - FOOTNOTES

- (1) The waste data in Table 1 represents only non aqueous, SB 14 applicable, hazardous waste generated as reported in each site's SB 14 Hazardous Waste Performance Report. Non aqueous waste for SB 14 applicable hazardous waste can be defined as: "the hazardous waste stream which is not processed in a waste water treatment unit."
- (2) Hazardous Waste "disposed" quantity. Not included in the Total. Disposed quantities [major waste streams] for 1990 and 1994 are 7,476 and 3,880 tons respectively.
- (3) Since the 1990 quantity is disposed vs. 1994 quantity is generated the "Amount Reduced (Tons)" and "Amount Reduced (%)" can not be determined.
- (4) GATX mentioned that it was not captured during 1990 due to lower threshold SB 14 applicable hazardous waste generation quantity. Therefore its baseline and reporting years are same i.e. 1994. Hence "Amount Reduced (Tons) and Amount Reduced (%)" are not determined.
- (5) Revised figure - In 1990 the hazardous waste generation quantity was erroneously reported.
- (6) The Shell Carson plant is the result of a significant reduction in overall facility size and operation of what formerly was the Wilmington Manufacturing Complex. In December 1991 a portion of the refinery was sold. The refinery wrote their first SB 14 documents in 1994. Therefore the baseline and reporting years are same i.e., 1994. Hence "Amount Reduced (Tons)" and "Amount Reduced (%)" are not determined.
- (7) The 1994 total does not include the GATX quantity (3,654 tons) because 1990 data are not available. The total also does not include Chevron El Segundo quantity (34,569 tons).

Amounts noted in () indicate an increase in hazardous waste generation.

N/A = Not Applicable

Aqueous Hazardous Waste Streams And Projected Reduction:

Unlike non aqueous hazardous waste, aqueous hazardous waste quantities comparison between 1990 and 1994 is not applicable. For the initial documents prepared during the first cycle (September 1991), many of the petroleum industry generators did not address aqueous waste streams in their source reduction evaluation which are now included in their current 1995 documents. SB 1133 was enacted September 5, 1991 and clarified the requirements for evaluating both aqueous and non aqueous waste streams. For 1995 documents, due September 1, 1995, generators are required to determine the total quantity of waste water generated, then conduct an additional calculation excluding the consideration of waste waters to determine the major non aqueous waste streams.

Table 2 summarizes aqueous hazardous waste generation data analyzed during calendar year 1994 along with appropriate waste reduction information and applicable measures.

The applicable SB 14/SB 1133 individual site aqueous hazardous waste generation in 1994 ranges from 620 tons to 7.2 million tons. Aqueous waste is defined as the hazardous waste stream processed in a waste water treatment unit which discharges to a publicly owned treatment works or under a National Pollutant Discharge Elimination System (NPDES) permit as specified in the Federal Water Pollution Control Act, as amended (33 U.S.C. Sec. 1251 and following). [Reference: Health and Safety Code 25244.19(b)(3)(A) and (B)]. Twelve sites indicated that they did not generate SB 14/SB 1133 applicable waste during 1994; one site was not able to provide aqueous waste generation data by the time of report publishing.

Collectively, in 1994, the industry generated 16.78 million tons of aqueous waste. Approximately 46 percent of sites reported their aqueous wastes generation data for 1994. Most of the remainder did not generate hazardous aqueous wastes. The eleven sites reporting aqueous waste collectively selected 12 source reduction measures.

Only 3 sites individually targeted reduction of generated aqueous waste(s) which ranged from 13 percent (9,402 tons) to 25 percent (0.33 million tons) annually. Six sites were unable to provide a specific aqueous waste reduction goal or reduction tonnage.

It is estimated that collectively, the petroleum industry will reduce approximately 2.0 percent or 0.34 million tons annually of hazardous aqueous waste during 1994 - 1998 and beyond.

The petroleum industry generated a total of 16,949,931 tons of **aqueous and non aqueous SB 14/SB 1133 applicable** hazardous waste in 1994, and projected to reduce 393,030 tons annually after 1994. The non aqueous hazardous waste generation in 1994, and estimated reduction of non aqueous waste after 1994 amounted to be 1.1 and 0.4 percent of the total aqueous and non aqueous wastes generated in 1994.

When all of the selected measures are implemented, the industry will be saving between \$6.7 to \$40.1 million annually by reducing projected non aqueous waste alone. This figure will be even greater considering the large quantity of aqueous waste that will be reduced. Due to complexity of petroleum refinery processes it is difficult to figure dollar savings merited to the reduction of aqueous waste.

In general, DTSC felt that most participating facilities did an adequate job in preparing their SB 14 documents. There were however, two aspects of the documents that should have generally received closer attention. Hazardous aqueous waste streams that were treated onsite prior to disposal in the local POTW were not always or consistently identified in the SB 14 documents as waste streams that required evaluation for potential source reduction measures. Some facilities even stated that the only waste streams identified for listing waste generation totals and for evaluation were those manifested offsite. This of course would eliminate any non-aqueous and aqueous hazardous waste streams treated onsite. When determining SB 14 applicability, all waste streams that are hazardous at the point of generation must be included.

The second notable factor is the general need for facilities to carefully prepare their SB 14 documents and making the effort to verify the accuracy of included information. An attempt was made to contact all facilities whose SB 14 information was used in the abstracts listed in this assessment. The information from these abstracts was gleaned directly from the submitted SB 14 documents. These companies were then contacted and given an opportunity to review the waste generation data and other narrative information before publishing. The overwhelming majority of facilities chose to rewrite the narration and/or revise the data as it was presented in these report abstracts. Since many factors may affect waste generation information and source reduction measure implementation it is important to ensure the accuracy of information in one's source reduction documents. In addition, companies must revise source reduction information when changes occur at their facility due to changes in business or other factors. Information in one's SB 14 documents is available to the public and made be used and published without prior consultation with the facility. Care must be taken to ensure that the information presented in the documents is as complete, accurate and carefully prepared as possible.

The source reduction and waste minimization accomplishments achieved by the participating facilities during the period of 1990 to 1994 was possible for a variety of reasons.

Source Reduction - Many facilities successfully identified and implemented source reduction measures that directly resulted in decreases in the generation of hazardous waste. These measures included operational changes, administrative changes and input changes. Some of the most dramatic decreases were achieved by changing fundamental production processes and operations. Most facilities were able to implement some type of administrative measures to help decrease hazardous waste generation. Many facilities did state that specific reductions in hazardous waste generation were difficult to correlate to individually implemented source reduction measures. This was due to changes in business activity that also had significant effects on hazardous waste generation.

Recycling - Almost all the reporting facilities recycled some portion of their generated hazardous waste. Some of the most successful were those that had implemented onsite recycling that would allow for the reintroduction of the treated waste stream back into the same process. The remainder of the facilities conducted offsite recycling with the treated waste stream returned for reuse back into the process or reused at another facility.

During 1990, seventeen of the facilities with usable data, stated that they had recycled almost 52,000 tons of hazardous waste both on and offsite. In 1994, despite a decrease of over 300,000

tons of hazardous waste generated, these same facilities managed to recycle more than 204,000 tons.

Hazardous waste generation - Total hazardous waste generation for California's largest generators reporting facilities dropped 20 percent from approximately 1,630,000 tons down to 1,300,000 tons when comparing 1990 to 1994 data. Hazardous aqueous waste generation for the same companies decreased by approximately 19 percent from 1,540,000 tons to 1,250,000 tons when comparing the same years.