500 SOURCES OF INFORMATION

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Pollution prevention information can be found in textbooks and in reports published by governmental agencies, trade organizations and research institutions. A new trend in information publication is the posting or co-publishing of information using the Internet. Governmental reports which were historically available on microfilm are now often available via the Internet. Reports can be downloaded, viewed and reproduced with the photos, graphics and text formatting intact in a manner which reduced the cost and increases the speed with which information is sent to the reader.

This chapter provides examples of selected publications which are available as printed and/or Internet documents and then describes search strategies for locating industry, process or chemical specific pollution prevention information. The intent is to demonstrate the wide array of pollution prevention information which is available and thereby encourage stakeholders to seek out and adopt appropriate pollution prevention options.

501 SECTOR NOTEBOOK PROJECT (1995)

Starting in 1995, this project compiled information about environmental problems and solutions, case studies and tips about complying with regulations for 18 industrial sectors. These notebooks describe innovative methods developed by industry to undertake regulatory compliance by preventing pollution in the first instance. The report titles and document numbers are listed in Table 501-1.

These reports can be purchased from the US Government Printing Office (202) 512-2250, reviewed at depository libraries or downloaded from the Envirosense World Wide Website at http://es.epa.gov/comply/sector or the Western Regional Pollution Prevention Network at http://www.westp2net.org.

Table 501 - 1 Sector Notebooks Published by USEPA

Document Number	Titles Published in 1995
EPA/310-R-95-001	Profile of the Dry Cleaning Industry
EPA/310-R-95-002	Profile of the Electronics and Computer Industry
EPA/310-R-95-003	Profile of the Wood Furniture and Fixtures Industry
EPA/310-R-95-004	Profile of the Inorganic Chemical Industry
EPA/310-R-95-005	Profile of the Iron and Steel Industry
EPA/310-R-95-006	Profile of the Lumber and Wood Products Industry
EPA/310-R-95-007	Profile of the Fabricated Metal Products Industry
EPA/310-R-95-008	Profile of the Metal Mining Industry
EPA/310-R-95-009	Profile of the Motor Vehicle Assembly Industry
EPA/310-R-95-010	Profile of the Nonferrous Metals Industry
EPA/310-R-95-011	Profile of the Non-Fuel, Non-Metal Mining Industry
EPA/310-R-95-012	Profile of the Organic Chemical Industry
EPA/310-R-95-013	Profile of the Petroleum Refining Industry
EPA/310-R-95-014	Profile of the Printing and Publishing Industry
EPA/310-R-95-015	Profile of the Pulp and Paper Industry
EPA/310-R-95-016	Profile of the Rubber and Plastic Industry
EPA/310-R-95-017	Profile of the Stone, Clay, Glass and Concrete Industry
EPA/310-R-95-018	Profile of the Transportation Equipment Cleaning Industry
Document Number	**Titles Published in 1997**
EPA/310-R-97-001	Profile of the Air Transportation Industry
EPA/310-R-97-002	Profile of the Ground Transportation Industry
EPA/310-R-97-003	Profile of the Water Transportation Industry
EPA/310-R-97-004	Profile of the Metal Casting Industry
EPA/310-R-97-005	Profile of the Pharmaceutical Manufacturing Industry
EPA/310-R-97-006	Profile of the Plastic Resin & Man-Made Fibers Industry
EPA/310-R-97-007	Profile of the Fossil Fuel Electric Power Generation Industry
EPA/310-R-97-008	Profile of the Shipbuilding and Repair Industry
EPA/310-R-97-009	Profile of the Textiles Industry

As an example of the series content, most sector notebook lists one or two sentence pollution prevention options grouped in the following categories:

- production planning and sequencing,
- process or equipment modification,
- raw material substitution or elimination,
- loss prevention and housekeeping,
- waste segregation and separation,
- closed-loop recycling, and
- training and supervision.

In order to show the wide range of air pollution prevention options in the published literature, this report extracts relevant information from the Industrial Sector Notebooks.

501.1 DRY CLEANING INDUSTRY (EPA/310-R-95-001)

The primary releases from the dry cleaning industry are associated with the many solvents used. Because chemicals constitute a large cost for dry cleaners, particularly if drying exhaust is vented directly to the atmosphere, there are significant opportunities to reduce chemical use and possibly reduce operating costs. Reduced chemical use can, in turn, reduce the waste management costs associated with regulatory requirements as well as reduce potential financial liability. Some pollution prevention strategies may reduce risk but involve a higher energy consumption.

Several operating practices can reduce potential solvent exposure if they are used regularly. The practices of importance will vary based on the type of machine. For example, the major release in a transfer machine occurs when clothes are transferred. Because dry-to-dry machines wash and dry in a single container there are no such releases.

501.2 ELECTRONICS AND COMPUTER INDUSTRY (EPA/310-R-95-002)

This note book lists 77 pollution prevention options using one or two sentences to present the concepts. For example,

Process or Equipment Option 22
Implement evaporative recovery to reduce drag-out.
Costs and Savings: Capital Investment: $2,500.
Contact: NC Department of Natural Resources & Community Development; Pollution Prevention Pays Program, Gary Hunt (919) 733-7015

In addition, this report describes the case studies at Wacker Siltronic Corporation in which the use of a chlorinated solvent was eliminated and Freon 113 was recycled.

Solvent Use Eliminated
Wacker Siltronic Corporation, a semiconductor manufacturer, implemented a pollution prevention program which included several varied actions. A six month pilot project was implemented to reduce chlorinated solvent use resulted in elimination of 93 percent of Wacker's chlorinated solvent waste. Ultimately, the use of chlorinated solvents was eliminated completely.

Freon 113 Re-Use
Another project replaced an open-top still which was converted into a closed-loop system at a cost of $20,000. This conversion reduced the volume of Freon waste by 85 percent and saves the company $57,000 each year.

501.3 WOOD FURNITURE INDUSTRY (EPA/310-R-95-003)

Hedredon Furniture Industries saves approximately 18,512 gallons of raw material annually by using the more efficient high-volume low pressure (HVLP) spray guns to apply stains and other finishes to chairs, benches and other furniture. These savings equate to a reduction in VOC emissions of 126,060 pounds per year. The payback period for purchasing the new equipment was calculated at 3.5 months.

501.4 INORGANIC CHEMICAL INDUSTRY (EPA/310-R-95-004)

The relatively small size and limited resources of a typical inorganic chemical facility limits the number of feasible pollution prevention options. As a result, pollution prevention in the inorganic chemicals industry is somewhat restricted to the less costly options, such as minor process modifications, operational changes, raw material substitutions, and recycling.

Pollution prevention in the chemical industry is process specific. The best opportunity to reduce pollution outputs, conserve energy, and reduce costs in the chlor-alkali industry are in the conversion to the membrane cell process. In terms of energy consumption, the membrane cell process uses only about 77 percent of that of the mercury cell process and about 90 percent of that of the diaphragm cell process. The membrane cell process also generates significantly less airborne and waterborne pollutants and solid wastes.

501.5 IRON AND STEEL INDUSTRY (EPA/310-R-95-005)

Most of the pollution prevention activities in the iron and steel industry have concentrated on reducing cokemaking emissions, Electric Arc Furnace (EAF) dust, and spent acids used in finishing operations. Due to the complexity, size, and age of the equipment used in steel manufacturing, projects that have the highest pollution prevention potential often require significant capital investments. This sector notebook describes pollution prevention opportunities for each of the three focus areas (cokemaking, EAF dust, and finishing acids), and then lists some general pollution prevention opportunities that have been identified by the iron and steel industry.

501.6 LUMBER AND WOOD PRODUCTS INDUSTRY (EPA/310-R-95-006)

501.6.1 Surface Protection

One common alternative is to replace chemical treatment with another type of treatment. For example, the need for surface treatment would be decrease if efforts were made to dry the wood to reduce water content; high water content

leads to sapstain. Another pollution prevention option is the use of high velocity spray systems that generate fewer process residuals and less drippage.

Other pollution prevention strategies relating to surface protection include:

- local and general ventilation within the cutting process area to reduce dust which would accumulate on wood,
- blowing wood with air to further reduce sawdust on wood prior to surface protection,
- the use of drainage collection devices on roof tops to keep rainwater away from process wastes,
- For wastes that cannot be reduced at the source, generators may consider used surface protectant recycling as the next best option.

501.6.2 Panel Products

Air emissions from panel manufacturing are significantly greater than releases to water or land. The report discusses use of alternative fiber sources and alternative adhesives as pollution prevention options.

501.7 FABRICATED METAL PRODUCTS INDUSTRY (EPA/310-R-95-007)

501.7.1 Raw Material Substitution

A stamp lubricant may be used that can remain on the piece until the annealing process, where it is burned off. This eliminates the need for hazardous degreasing solvents and alkali cleaners.

Costs and Savings: Annual Savings: $12,000 (results from reduced disposal, raw material, and labor costs). Waste Throughput Information: The amount of waste solvents and cleaners was reduced from 30,000 pounds in 1982 to 13,000 pounds in 1986. Employee working conditions were also improved by removing vapors associated with the old cleaners.

501.7.2 Other Options

This sector notebook lists 130 other options, each a sentence or two in length. In addition, it profiles the Eastside Plating case study. Eastside Plating, an Oregon-based company, has made money complying with new environmental regulations. Under the direction of its Maintenance and Water Treatment Manager, the electroplating firm implemented operational changes that save more than $300,000 annually.

501.8 THE METAL MINING INDUSTRY (EPA/310-R-95-008)

This report discusses pollution prevention opportunities during mining of copper, iron ore, lead, gold, silver and zinc. The following topics are discussed:

- mining water control,
- waste rock disposal area and tailing impoundment design,
- wetlands,
- pump and treat,
- sludge disposal,
- mine planning,
- acid zone isolation, and
- innovative waste management practices.

Most of the options focus on water pollution and waste minimization. However, there are two examples relevant to air pollution prevention. For example, in metal parts cleaning, switching to semi-aqueous cleaners such as terpene and hydrocarbon cleaners or aqueous cleaners which are water based cleaning solutions can reduce or eliminate solvent emissions and liquid waste generation.

Another option to reduce air emissions involves metals recovery. The Bureau of Mines has developed a cost effective recycling process to treat the estimated 1.8 million annual tons of iron-rich dusts and sludges that are contaminated with heavy metals. This process mixes various dusts and wastes to produce recyclable metal pellets and has been proven on a 1,000 lb/hour pilot scale.

501.9 MOTOR VEHICLE ASSEMBLY INDUSTRY (EPA/310-R-95-009)

This sector report discusses:

- non-product material screening,
- used oil recycling,
- trichloroethylene reduction,
- elimination of chromium from radiator paint,
- lead-free ceramic paint,
- recovering lead from waste water,
- PCB elimination,
- solvent free spray adhesive for interior trim,
- reducing CFC use,
- plants switching to natural gas,
- solid waste recycling,
- facility emission control,
- paint booth operation,
- surface coating toxics reduction program,
- management standards for used antifreeze, and
- packaging reduction and recycling.

The emission reductions can be significant. Switching to aqueous cleaners at one plant dropped TCE emissions by 250,000 pounds annually and comparable reductions are expected at other plants world wide.

501.10 THE NONFERROUS METALS INDUSTRY (EPA/310-R-95-010)

AMPCO Metal Manufacturing Co. is participating in the development of new technologies. The project, sponsored by the US DOE and US EPA, consists of researching and developing the use of electric induction to replace fossil fuel combustion currently used to heat tundishes. Tundishes are used to contain the heated reservoir of molten alloy in the barstock casting process. The fossil fuel combustion process currently used requires huge amounts of energy and produces tremendous amounts of waste gases, including combustion products as well as lead and nickel emissions. According to new OSHA regulations, lead emissions from foundries must be reduced by 80 percent by 1998.

Heating the tundish by electric induction instead of fossil fuel combustion will substantially improve the current process, saving energy and reducing pollution. Energy efficiency will jump to an estimated 98 percent, saving 28.9 billion Btu/yr/unit. Industry-wide energy savings in 2010 are estimated to be 206 billion Btu/yr, assuming a 70 percent adoption in American foundries.

In addition to the energy savings, the new process also has substantial environmental benefits. Along with the elimination of lead and nickel gases, carbon dioxide, carbon monoxide, and nitrogen oxide emissions from combustion will decrease. The consumption of refractory (a heat-resisting ceramic material) will decline by 80 percent, resulting in a similar reduction of refractory waste disposal. In all, prevention of various forms of pollution is estimated to be 147 million pounds (66.7 million kg) per year by 2010.

Overall, AMPCO estimates an annual savings in operations and maintenance expenses of $1.2 million with the use of this technology. Assuming the same 70 percent industry adoption, economic savings by 2010 could reach $5.8 million. Without the new electric induction heating process, the capital costs required for compliance could be $3 million.

501.11 NON-METAL, NON-FUEL MINING INDUSTRY (EPA/310-R-95-011)

Opportunities for waste minimization may include raw material substitutions, though these opportunities are somewhat limited for mining facilities because of the transportation costs involved in using ores or concentrates produced in other regions or countries. In elemental phosphorous production, raw materials substitution generally takes the form of improving the separation of value from the raw ore during beneficiation, so that the furnace operations would begin with a higher grade of ore concentrate. Processing a feedstock with a higher concentration of phosphorous results in decreased slag generation, although presumably increasing the generation of related beneficiation waste. Other source reduction opportunities may involve process modifications to increase efficiency during the furnace operation.

Other selected pollution prevention options include:

- utilize dust elimination technologies such as wet suppression systems to reduce dust created during excavation and transport,
- use dust suppressant agents such as magnesium chloride to reduce dust in solid piles and tailings, and
- use plant cover and landscape alteration to reduce erosion, dust, and runoff contamination**.**

501.12 ORGANIC CHEMICAL INDUSTRY (EPA/310-R-95-012)

The leaders in the organic chemical industry, similar to those in the chemical industry as a whole, have been promoting pollution prevention through various means. The most visible of these efforts is the Responsible Care® initiative of the Chemical Manufacturer's Association (CMA). Responsible Care is mandatory for CMA members who must commit to act as stewards for products through use and ultimate reuse or disposal. One of the guiding principles of this initiative is the inclusion of waste and release prevention objectives in research and in design of new or modified facilities, processes and products. The Synthetic Organic Chemical Manufactures Association (SOCMA) also requires its members to implement the Responsible Care® Guiding Principles as a condition of membership. SOCMA is instituting Responsible Care® management practice codes on a phased-in basis to assist its approximately 110 non-CMA members, which are primarily small and batch chemical manufacturers, in successful implementing their program. Using pollution prevention techniques which prevent the release or generation of pollution in the first place have several advantages over end-of-pipe waste treatment technologies. Table 501-2 presents the Direct and Indirect Benefits of pollution prevention in this industrial sector.

It is critical to emphasize that pollution prevention in the chemical industry is process specific and often times constrained by site-specific considerations. As such, it is difficult to generalize about the relative merits of different pollution strategies.

Table 501 - 2 Pollution Prevention Benefits in the Organic Chemical Industry

Direct Benefits
- Reduced waste treatment costs
- Reduced capital and operating costs for waste treatment facilities
- Reduced off-site treatment and disposal costs
- Reduced manufacturing costs due to improved yields
- Income or savings from sale or reuse of wastes
- Reduced environmental compliance costs (e.g., fines, shutdowns)
- Reduced or eliminated inventories or spills
- Reduced secondary emissions from waste treatment facilities
- Retained sales (production threatened by poor environmental performance or sales

Indirect Benefits
- Reduced likelihood of future costs from:
  - Remediation
  - Legal liabilities
  - Complying with future regulations
- Use of emission offsets (internal and external)
- Improved community relations
- Increased environmental awareness by plant personnel and management
- Reduced societal costs
- Improved public health

501.13 PETROLEUM REFINING INDUSTRY (EPA/310-R-95-013)

Pollution prevention in the petroleum refining industry is expected to become increasingly important as federal, state, and municipal regulations become more stringent and as waste disposal costs rise. According to the American Petroleum Institute, the industry currently spends a significant amount of money every year on environmental quality and protection. This provides the industry with a strong incentive to find ways to reduce the generation of waste and to lessen the burden of environmental compliance investments. For the petroleum refining industry, pollution prevention will primarily be realized through operating procedures, increased recycling, and process modifications.

501.13.1 Process or Equipment Modifications

An Amoco/EPA joint study estimated that VOC losses from storage tanks could be reduced 75 to 93 percent by placing secondary seals on storage tanks and documented the efficacy of a leak detection and repair (LDAR) program.

A LDAR program uses portable VOC detecting instrument to detect leaks during regularly scheduled inspections of valves, flanges, and pump seals. A LDAR program could reduced fugitive emissions 40 to 64 percent, depending on the frequency of inspections.

Install vapor recovery for barge loading is another option to reduce air emissions. One of the largest sources of VOC emissions identified during the Amoco/EPA study was fugitive emissions from loading of tanker barges. It was estimated that these emissions could be reduced 98 percent by installing a marine vapor loss control system**.**

501.13.2 Eliminate use of open ponds

Open ponds used to cool, settle out solids and store process water can be a significant source of VOC emissions. In many cases, open ponds can be replaced with closed storage tanks.

501.13.3 Remove Unnecessary Tanks From Service

Since storage tanks are one of the largest sources of VOC emissions, a reduction in the number of these tanks can be a significant impact. The need for certain tanks can often be eliminated through improved production planning and more continuous operations.

501.14 PRINTING AND PUBLISHING INDUSTRY (EPA/310-R-95-014)

Printers use various chemicals throughout their facilities. The payoff from many of the possible changes in the printing process or product choice is unlikely to have a significant effect on a facility's overall emissions profile because these chemicals and chemical formulations are often used in relatively small quantities. Instead, pollution prevention for printers involves a longer-term reorientation of production staff and management priorities so that opportunities are recognized and acted upon as they arise.

During printing, the image is transferred to a substrate of paper or some other material. Typical waste streams include: inks, substrate, cleaning solutions, and in the case of lithography, fountain solutions. Pollution prevention options include:

- Improving housekeeping and better operating practices, such as covering reservoirs and containers, scheduling jobs according to increasing darkness of ink color, using wipes as long as possible and controlling inventory, can all minimize solvent losses from inks and cleaning solutions,
- Reducing ink vaporization by using diaphragm pumps which do not heat ink as much as mechanical van pumps,
- Recycling of certain waste inks where possible,
- Using alternative ink and cleaning products with reduced VOC emissions,
- Using fountain coolers to reduce evaporation from the dampening fountain.

501.15 PULP AND PAPER INDUSTRY (EPA/310-R-95-015)

Many recent pollution prevention efforts in the pulp and paper industry have focused on reducing the release of toxics, in particular, chlorinated compounds. Pollution prevention techniques have proven to be more effective in controlling these pollutants than conventional control and treatment technologies. Most conventional, end-of-pipe treatment technologies are not effective in destroying many chlorinated compounds and often merely transfer the pollutants to another environmental medium. Efforts to prevent chlorinated releases have, therefore focused on source reduction and material substitution techniques such as defoamers, bleaching chemical or wood chip substitution to reduce the industry's use and releases of chlorinated compounds.

501.16 RUBBER AND PLASTIC INDUSTRY (EPA/310-R-95-016)

In the plastic industry, there are substantial pollution prevention options for most environmental concerns including chemical spills, waste water (including solvents in waste water), plastic pellet loss, and plastic product disposal. Pollution prevention for leaks and spills of chemical additives during compounding or finishing operations is as simple as covering containers as often as possible and training employees to properly handle and dispose of chemicals. The issue of plastic resin pellet loss to the environment during the manufacturing process is being addressed by most manufacturers through participation in "Operation Clean Sweep".

Some mixing facilities have practically eliminated particulate emissions by purchasing their chemicals in small pre-weighed, sealed polyethylene bags. The sealed bags are put directly into the banbury mixer and the bag itself becomes part of the rubber matrix. Other option include:

- careful transportation mechanisms,
- sealed containers,
- automatic dispensing,
- reduce toxic chemical usage,
- computer inventory management, and
- spills and sweeping protocols.

501.17 STONE, CLAY, GLASS AND CONCRETE INDUSTRY (310-R-95-017)

501.17.1 Glass

In the glass manufacturing industry, one opportunity for pollution prevention is increasing the use of waste glass, or cullet as a feed stock. The primary environmental benefit of increasing cullet use is the reduction of the amount of cullet requiring disposal. Currently, about 67 percent of all cullet is landfilled or stockpiled. Glass manufacturers typically use 30 percent cullet along with raw material to make glass. Waste glass which is not reused on site can be used in the production of road material which is known as "glasphalt".

One available process improvement is called "Rapid Melting Systems", which involves preheating the batch prior to melting. This practice reduces process time, energy consumption, and air emissions.

501.17.2 Concrete

Source reduction in the concrete industry can be achieved through raw material substitution. For example, many concrete product manufacturers have moved from volatile organic compound (VOC) mold release agents to trichloroethane (TCA) based agents due to air quality restrictions on VOC material. However, TCA has been added to the list of ozone depleting substances and will be phased out by 2002. Concrete product manufacturers that use TCA as a mold release are working with mold release manufacturers to develop alternatives, such as waster based mold-releases.

Alternative cement finishing processes, including the use of water-based and powdered coatings, can reduce the amount of paint-related wastes generated by manufacturers of cement products.

501.17.3 Cement

One approach to pollution prevention in the cement industry is to minimize the production of cement kiln dust. There are three primary means to decrease the amount of dust generated by a kiln. Dust can be minimized by reducing gas turbulence in the kiln and avoiding excessive flow velocities. The use of chains

near the cool end of the kiln can also minimize dust by trapping the dust before it is released in the kiln exhaust. Most kilns are already equipped with such cool end chains. The use of fuels with a low ash content, such as liquid hazardous waste, can also reduce the amount of cement kiln dust generated.

Cement kiln dust generated from the baghouse dust collectors can be reused both on-site and off-site. Direct return of dust to the kiln is common recycling practice.

Gaseous emissions from cement manufacturing plants are mainly nitrogen oxides and sulfur dioxide. Process controls, including balancing the alkali content in raw material and fuels, increasing oxygen partial pressure, increasing dust load, and reducing kiln volume load, can reduce sulfur emissions in the process. Process controls to reduce nitrogen oxide emissions include avoiding excessive sintering temperatures and staged combustion in the calciner. Other measures may reduce emissions, including the use of ammonia to control nitrogen oxide emissions.

501.18 TRANSPORTATION EQUIPMENT CLEANING INDUSTRY (EPA/310-R-95-018)

The transportation industry moves people and materials using four principal transportation modes: truck, train, vessel and airplane. Almost all material and goods in the US are distributed by one of these modes. It is estimated that over 700 different commodities are transported through the US, including petroleum products, coal, organic chemicals, inorganic chemicals, compressed gases, fertilizers, pesticides, food products, paints, inks, glues, and soaps. Pollution prevention opportunities presented in this sector notebook for the transportation equipment cleaning industry are primarily aimed at reducing the amounts of wastewater generated, recycling/reusing cleaning solution and heels, and effectively removing heels from tanks. However, these efforts also often reduce the amounts of hazardous wastes generated and air pollutants emitted.

502 SECTOR NOTEBOOK PROJECT (1997)

In 1997, each notebook follows the following outline:

I. Introduction to Sector Notebook Project
II. Introduction to Industry Sector
III. Industrial Process Description
IV. Chemical Release and Transfer Profile
V. Pollution Prevention Opportunities
VI. Summary of Applicable Federal Statutes and Laws

The following additional reports were published in the 1997 series:

Document Number	Title
EPA/310-R-97-001	Air Transportation Industry
EPA/310-R-97-002	Ground Transportation Industry
EPA/310-R-97-003	Water Transportation Industry
EPA/310-R-97-004	Metal Casting Industry
EPA/310-R-97-005	Pharmaceuticals Industry
EPA/310-R-97-006	Plastic Resin and Manmade Fiber Industry
EPA/310-R-97-007	Fossil Fuel Electric Power Generation Industry
EPA/310-R-97-008	Shipbuilding and Repair Industry
EPA/310-R-97-009	Textile Industry

502.1 AIR TRANSPORTATION INDUSTRY (EPA/310-R-97-001)

This sector notebook discusses pollution prevention in industries included in Standard Industry Classification (SIC) code 45 and includes establishments engaged in furnishing domestic and foreign transportation by air and also operating airports, flying fields and furnishing terminal services. Sector members have creatively implemented pollution prevention techniques that improve efficiency and increase profits while at the same time minimizing environmental impacts. Airlines and airports are reducing material inputs, re-engineering processes to re-use by products, improving management practices, and employing substitution of toxic chemicals. Some operations are able to get below regulatory thresholds by reducing pollutant releases through aggressive pollution prevention policies and practices. This sector notebook does not include detailed case reviews but does present a general overview of pollution

prevention examples.

502.1.1 Examples of Pollution Prevention Options

Opportunities in the air transportation industry are available for many operations including air craft and vehicle maintenance and repair, washing and cleaning, deicing, fueling, aircraft modification, and aircraft layout. They include:

- The Dry Shop Principle encourages spills to be cleaned immediately, without waiting for the spilled fluids to evaporate into the air, to transmit to land, or to contaminate other surfaces.
- Reduce the air emissions of waste cutting oils and degreasing solvents by substituting water soluble formulations. While water-based parts washers may be more expensive than solvent-based parts washers, the costs of the parts washer can be quickly recovered as the cost of disposing or recycling hazardous solvents as well as the cost of any required training for workers handling the solvent are eliminated. This will reduce the amount of hazardous waste generated from cleaning operations.
- Keeping lids closed, when not in use, is a simple management practice which reduces volatile organic compound (VOC) emissions to the air, improves worker safety, and allows the solvent to be used longer.
- Replace methylene chloride with non-halogenated paint strippers is one way to comply with the Aerospace National Emission Standards for Hazardous Air Pollutants (NESHAP) which places stringent limitations on the use of chemical strippers containing hazardous air pollutants which took effect on September 1, 1998.
- Alternative Fuel Vehicles can reduce the air emissions from aviation support vehicles. Alternatives to gasoline and diesel include units powered by electricity, ethanol, methanol, natural gas and propane. In 1997, there were alternative fuel vehicle programs at virtually every major airport in the United States. The alternative vehicle usage at airports runs the gamut from taxis, shuttle busses, passenger busses, transport buses, minivans, trucks, cars, tractors, belt loaders to catering trucks. The 1990 US Clean Air Act contains incentives to encourage the use of alternative fuels such as tax deductions for each alternative fuel vehicle ($2,000 to $50,000) and up to $100,000 for refueling stations.

- Increases in fuel efficiency can reduce fuel consumption and decrease the cost of operations. Since 1976, the introduction of more fuel efficient aircraft has reduced fuel consumption per passenger mile by approximately 50% according to the Boeing Company.

502.2 GROUND TRANSPORTATION INDUSTRY (EPA/310-R-97-002)

This notebook examines prevention opportunities in the ground transportation industries belonging to the following North American Industrial Classes (NAIC): Transportation (482), Trucking (484 and 492), and Pipelines (486).

502.2.1 Examples of Pollution Prevention Options

Examples pollution prevention options from this sector notebook include:

- Switch to waster based solvents,
- Conduct facility audits of spill possibilities and educate employees.
- Switch to water based paints,
- Purchase paints in recyclable and/or returnable containers,
- Minimize fuel spills and air pollution by proper use of self-locking fueling nozzles,
- Use drip pans, promptly transfer used fluids to proper containers, manage waste,
- Freon or other air conditioning refrigerants can be recycled on-site,
- Alternative Fueled Vehicles can reduce air emissions,
- Pipeline leak detection can minimize pollution which occurs, and
- Pipeline defect testing can locate damaged sections before pollution occurs.

Also, pipeline operators interviewed in a Department of Transportation study of remote control spill reduction technology indicated that operator training was the critical link in reducing the number and volume of pipeline spills.

502.3 WATER TRANSPORTATION INDUSTRY (EPA/310-R-97-003)

Pollution prevention activities in the water transport industry can be focused on

three major areas: vessel maintenance, fueling, and discharges from on-board tanks. Fugitive dust emissions that occur as a result of cargo loading activities can also be reduced through pollution prevention techniques.

502.3.1 Vessel Maintenance

The major waste streams are chemical paint stripping wastes, abrasive blast and surface preparation wastes, painting and painting equipment cleaning wastes, solvent wastes, and engine overhauling and repair wastes. Source reduction is the best pollution prevention approach for reducing the amount of wastes produced. Source reduction can be achieved through material substitution, process or equipment modification, recycling, or better operating practices.

502.3.2 Chemical Stripping Wastes

Methylene chloride may be replaced with less toxic alternatives, including dibasic esters, semi-aqueous terpene-based products, aqueous solutions of caustic soda, and detergent-based strippers. Storing and reusing or recycling used strippers also are effective waste minimization techniques. Solvent strippers, particularly stripping baths can generally be reused several times before their effectiveness is diminished. Both spent caustic and organic stripping solutions can be treated to remove the contaminants. Segregating the spent stripping wastes from other waste streams will help facilitate cost-effective reuse and recycling of contaminated strippers.

502.3.3 Abrasive Blasting and Surface Preparation Wastes

Research and testing are underway on a number of innovative alternative paint removal and surface preparation techniques including: plastic media blasting, steel shot slingers, water jet stripping, thermal stripping, dry ice pellets, laser paint stripping, and cryogenic stripping. However, an alternative as economically viable and easy as chemical paint stripping has not been found.

502.3.4 Painting and Painting Equipment Cleanup Wastes

Options for minimizing paint and painting equipment cleanup wastes include tight inventory control, material substitution, and minimizing fugitive oversprays. Tight inventory control techniques such as monitoring employee operations or limiting access to solvent and paint storage areas force employees to stretch the use of these materials.

502.3.5 Solvent Wastes

To minimize solvent waste generation, the best techniques are good housekeeping, reuse and recycling. Good housekeeping practices, including storage area leak control and containment, improvements in drum location, and product transfer leak collection, can provide very effective source reduction.

502.3.6 Machine Shop Wastes

Material substitution and recycling are the two best means to reduce the volume of these wastes.

502.3.7 Fueling

Pollution prevention opportunities for marine facility refueling operations primarily focus on the prevention of fuel spillage and the associated air, water and hazardous waste pollution. Using color-coded dyes to identify fuel grades is a commonly used technique to prevent the mixture of fuel and to find fuel leaks easily. One technique to prevent fuel spills is to install spill and overflow protection. All leaking pipe joints, nozzle connections, and any damage to the fueling hose should be reported immediately to reduce the amount of pollution to the environment. Using dry cleanup methods for the fuel area will prevent increased water-related pollution.

Pollution prevention techniques for refueling include the following:

- Inspect fueling equipment daily to ensure that all components are in satisfactory condition,
- Employ proper grounding and bonding techniques for a safe fueling operation,
- If refueling occurs at night, make sure it is carried out in lighted area.
- Do not refuel a vehicle during maintenance as it might provide a source of ignition,
- While refueling, check for leaks and make certain that the fueling operator has a clear view of control panel,
- Never leave nozzle unattended during fueling or wedge or tie nozzle trigger in the open position,
- Discourage topping off of tank,
- Self-locking nozzles minimize the risk of both fuel spillage and air pollution by ensuring a secure seal between the fuel source and tank, and
- Two other ways to reduce emissions from vehicles are the use of battery operated vehicles and switching to alternative fuels.

502.3.8 Cargo Handling Operations

Cargo handling operations do generate wastes and hazardous air emissions. Dry bulk-transfer operations generally have dust control problems because dust is generated each time the cargo is transferred. Liquid bulk-transfer operations can be a source of hydrocarbon emissions that are readily converted into photochemical smog by ultraviolet radiation from the sun.

Pneumatic conveyers and slurry pipelines have been used to reduce the amount of dust emissions. Additional steps to control air emissions include enclosing the conveyor transfer points in buildings, using steam or spray as a sealant over the open end of the hopper, placing the loading chute as close as possible to the cargo pile in the hold, and installing telescoping chutes which eliminate the need for slingers.

502.4 METAL CASTING INDUSTRY (EPA/310-R-97-004)

Most of the pollution prevention activities in the metal casting industry have concentrated on reducing on reducing waste sand, waste electric arc furnace (EAF) dust and desulfurization slag, and increasing the overall energy efficiency of the process." This sector notebook describes several processes which minimize landfill costs of sand disposal and other non-air related pollution prevention options. One example of air emission reductions is increased energy efficiency.

Increases in energy efficiency in metal casting operations may have the dual pollution prevention effect of reducing the amounts of wastes generated from furnaces and curing ovens (e.g. hazardous desulfurization slag, dust, VOCs, etc.). Since energy costs can be a large portion of a metal caster's overall operating costs, increases in energy efficiency can also result in significant cost savings.

Currently, many foundry furnaces are less than 35 percent energy efficient. Facilities using reverberator or crucible furnaces may have opportunities to improve their furnace efficiency and stack emissions by upgrading their combustion system**.**

502.4.1 Use Alternative Fuels for Melting

Some melt furnaces can utilize natural gas or fuel-oil as a fuel source. Particulate emissions from fuel oils tend to be much greater than emissions from natural gas combustion. Proper maintenance of furnaces will also help to reduce air emissions. Inefficient fuel/air mixing may generate excess particulate emissions.

502.4.2 Reduced VOC Emissions

502.4.2.1 Cooling and Quench Water

The best method for reducing air emissions from cooling towers and quench baths is to use fewer additives or to use additives containing no VOCs or Hazardous Air Pollutants (HAPs).

502.4.2.2 Die Lubes

These emissions consist of VOC, particulate matter, and HAPs. VOC emissions from die lube application can be reduced by the use of water-based lubricants or solid lubricants. Eliminating the volatile components of petroleum-based lubricants will also reduce VOC emissions when wet milling finishing techniques are used. However, it is important to note that lubricants which reduce VOC emissions may not necessarily reduce HAP emissions and, in some cases, HAP emissions my be greater from water-based lubes. Apparently, some of the solvent replacement additives in water-based lubricants may result in increased HAP emissions. It is important to thoroughly evaluate the potential implications for air emissions before alternative lubricant products are used.

502.4.3 Reduced Particulate Emissions

In the same manner as VOC emissions, alternative lubricants can be used to reduce particulate emissions from the application of die lubes. However, lubricant-specific evaluations should be performed to determine the particulate emission reduction potential of individual lubricant changes.

502.5 PHARMACEUTICAL MANUFACTURING INDUSTRY (310-R-97-005)

502.5.1 Waste Minimization

The bulk manufacturing processes of the pharmaceutical industry are characterized by a low ratio of finished product to raw product. Therefore, large quantities of residual waste are generated, especially in fermentation and natural product extraction. Chemical synthesis processes generate wastes containing hazardous spent solvents and reactants, combined with residual wastes such as reaction residues. Equipment cleaning water and residues, often containing hazardous chemicals, also are a major waste stream. Source reduction is one method by which the industry aims to reduce these wastes. However, source reduction methods such as process modifications and material substitutions may not be as easily implemented in the pharmaceutical industry as in other manufacturing sectors. This is because any significant change to the production

process of an existing product, may need approval from the Food and Drug Administration (FDA). As a result, many pharmaceutical companies are looking at ways to minimize waste in future production processes at the research and development stage.

502.5.2 Material Substitution

Substituting raw materials to lessen the volume and/or toxicity of waste generated is a type of source reduction. One of the most common opportunities for material substitution in the pharmaceuticals industry is found in the tablet coating process. Until recently, many tablet coating operations involved the use of methylene chloride and other chlorinated solvents. By switching to aqueous-based coating films, many firms have reduced the hazardous waste content in their air and effluent waste streams, as well as the cost of purchasing chemicals. Aqueous-based cleaning solutions are also being used more frequently for equipment cleaning instead of solvent-based solutions.

502.5.2.1 Case Studies of Material Substitution

Schering-Plough Pharmaceuticals will market a new inhaler for the treatment of asthma, which is free of chloroflurocarbons (CFCs). At its West Point, PA, facility, Merk removed 1,1,1 - Trichloroethane (TCA) from its production operations. TCA was used in stripping labels off bottles and other cleaning operations, printing, and manufacturing. A citrus-based solvent was substituted for cleaning packaging equipment. For cleaning manufacturing equipment, a petroleum-based solvent was substituted, the waste from which is used for energy recovery in an off-site facility.

At its Cherokee plant in Riverside, PA, Merk developed an innovative new manufacturing chemistry which substitutes toluene for dichloromethane. The change has resulted in a 98 percent reduction in releases and transfers of dichloromethane.

Riker Laboratories in Northridge, CA recently replaced several different organic solvent coating materials used on medicine tablets with a water-based coating

material. The substitution prevents 24 tons per year in solvent emissions.

In producing an anti-viral drug, the solvent methyl isobutyl ketone (MIBK) was used in an extraction process and was a major source of fugitive emissions. A new process reduced hazardous waste by 20,000 pounds and eliminated over one million pounds of MIBK. The project payback period was 2.7 years.

Glaxo-Wellcome, Inc. developed an innovative aqueous coating method that eliminated the use of methylene chloride, isopropyl alcohol, methanol, and ethanol in their Zantac tablet coating operations. The capital investment for this equipment was $1.5 million. However, the company annually saves $286,800 in organic solvent purchases and $322,900 in disposal costs of more than 479 tons of hazardous waste generated by the old system every year. The estimated payback period for the modifications is three years. In addition, the new system cut VOC emissions to the air from almost 15,000 pounds to zero.

The Eli Lilly Cleaning Technology Center in late 1996 initiated a formal screening program to identify potential aqueous based cleaners as replacements for the various organic and chlorinated solvents currently used in bulk pharmaceutical manufacturing equipment cleaning. In one product line, 8,700 liters of acetone per cleaning was replaced with an alkaline aqueous based cleaner for an estimated annual reduction of 17,400 liters of acetone. An acid aqueous based cleaner replaced methanol in another product line, resulting in methanol reductions of 25,800 liters per year. In cleaning operations associated with another product, an alkaline aqueous based cleaner replaced 117,000 liters of methanol and 600 liters of ethylene dichloride per cleaning. This resulted in an estimated annual reduction of 368,000 liters of methanol and 1,200 liters of ethylene dichloride.

502.5.3 Process Modification

Process modifications are alterations to or modernization of existing processes to reduce waste generation. Process modifications can involve redesigning chemical transfer systems to reduce spillage and other material losses. For example, in batch operations, each loading and unloading of the reactors and

other equipment increases the risk of chemical spills and solvent vapor releases. Batch operations often require more frequent reactor clean outs using significant volumes of cleaning solution and solvents. With continuous operations, the reactor is loaded once and solvents and reactants are fed into the reactor continually, thereby reducing the risk of pollutant releases. Switching from batch to continuous operations may potentially reduce large volumes of waste.

502.5.3.1 Case Studies of Process Modification

As part of their “Environmental 2000" program, Bristol-Myers Squibb has started to look at Product Life Cycle (PLC) management as a way to implement pollution prevention. PLC involves investigating the environmental impacts of a product at every stage of production: R&D, manufacturing, and packaging. Pollution prevention options are now being investigated at the very beginning of the drug development. This eliminates the possibility of lengthy Supplemental Drug Approval applications with FDA. Using PLC, a process change was identified which reduced hazardous waste by 20,000 pounds and eliminated over one million pounds of methyl isobutyl ketone releases to air and water.

At its East Hanover, NJ facility, Sandoz Pharmaceutical Co. changed processes in its reactors to reduce solvent usage. An inert atmosphere above the reaction mixture is used during synthesis to protect the reaction from exposure to oxygen. In the previous process, nitrogen flowed continuously over the mixture, carrying away with it a certain amount of solvent vapors. The nitrogen blanketing process uses a non-flowing nitrogen layer that only bleeds a very small amount of nitrogen and solvent.

In their main drug development lab in Tippecanoe, IN, Eli Lilly and Company has implemented a pollution prevention program. Beginning in the R&D phase, the company assesses the environmental impacts of every new product and determines where waste can be minimized. As a result, Eli Lilly developed a new process which eliminated the use of methylene chloride, aluminum wastes, use of an odoriferous raw material, and all distillation steps from production of a drug under development for the treatment of osteoporosis.

In one of its manufacturing processes, Hoffman La Roche extracted a synthesized pharmaceutical intermediate from toluene into water, and then from water into chloroform. Because toluene was soluble in the extraction, it contaminated the chloroform and created a waste stream of the mixed solvents. The company eliminated the waste stream by steam-distilling the toluene from the water so that the toluene never came in contact with the chloroform. Chloroform use decreased by 76 percent which was sufficient to remove this material from the list of chemicals the facility was required to include in its Toxic Release Inventory report. The project saved $22,000 per year.

At its Flint River plant in Albany, Georgia, Merck used steam jets to produce a vacuum in the process vessel during the production of an antibiotic. This results in dichloromethane being mixed with steam and subsequently evaporating into the air. The steam jets were replaced with liquid ring vacuum pumps which reduced air emissions. Dichloromethane emissions were further reduced by maintaining the vacuum pump seal fluid at subzero temperatures which condenses the dichloromethane vapor so it can be recycled and reused.

In converting to a new process for bioconversion of a steroid intermediate, Pharmacia and Upjohn, Inc. has eliminated approximately 90,000 pounds of dimethylformamide waste and ~ 190,000 pounds of filter waste per year. Solvent handling was reduced from about 6 million pounds to about 600,000 pounds; aqueous waste was reduced more than 4 million pounds per year.

502.5.4 Good Operating Practice

One of the easiest and most economical ways to achieve source reduction is to implement good operating practices. Pharmaceutical companies already follow a list of Good Manufacturing Practices (GMP) guidelines outlined by the FDA. In some cases these involve good operating practices that will reduce raw materials use and waste generation. As a result, many companies have developed environmental policies for all of their facilities, both in the U.S. and abroad. Typically, policies may be written for employee training, employee health and safety, hazardous chemical spill cleanup procedures, equipment maintenance procedures, leak detection, and emergency response procedures.

502.5.4.1 Examples of Good Operating Practices

Computerized Inventory System

At its Kenilworth, NJ facility, Schering-Plough Pharmaceuticals has a central warehouse with a computerized inventory system. Raw materials come into the warehouse in large volumes. Material are weighed according to batch requirements, labeled, and then sent to different process areas through the facility. This eliminated excess raw material wastes and ensures that only the amounts needed are used.

Scheduling

Sandoz Pharmaceuticals has also developed a system to improve scheduling of batch operations in their facilities worldwide and domestically. Accurate scheduling reduces the chances of excess wastes and costs, which occur when a batch changeover takes place.

Leak Detection and Repair

At its Nutley, NJ plant, Hoffmann La Roche was able to identify and repair more than 900 sources of fugitive emissions. In addition, the company installed ultralow temperature condensers to remove solvents from vent streams. The captured solvents are recycled or treated off-site.

502.5.5 Recycling, Recovery and Reuse

In-process recycling, which includes the reuse or recirculation of a chemical within a process and may include recovery or reclamation, is considered a source reduction technique. The pharmaceutical industry often uses this form of recycling which is dedicated to and physically integrated with the pharmaceutical manufacturing process by means of piping or other form of conveyance. The types of solvent recovery employed include distillation, evaporation, decanting, centrifugation, and filtration. However, limitations exist with both on and off-site recycling and recovery since several types of solvents (including water),

reactants, and other contaminants may be present.

502.5.5.1 Case Studies of Recycling, Recovery and Reuse

Nycomed Inc. manufactures bulk pharmaceutical products by batch processing. In the production of a product for medical diagnostic imaging, the company installed closed loop distillation units to recover its methanol washes and methanol containing wastewater. The recovery system can distill ~ 2,000 gallons per day of 70 percent methanol to more than 99.5 percent methanol, which can be reused in the same process. Nycomed Inc. saved ~ 680,000 pounds of methanol in the first half of 1992 and $54,438 in the same period.

The Pharmacia and Upjohn, Inc. Chemical and Fermentation operation in Kalamazoo reuses more than 195 million pounds of solvent annually. Approximately 80% of the site's total solvent requirement and 90% of the sites's chlorinated solvent is met by reused solvent. The reused solvent demand is met through a combination of in process solvent reuse (150 million pounds) and distillation (45 million pounds). There are now six centralized distillation units. On site solvent reuse and recovery in chemical processes helped the company exceed its 33/50 Program goals. The achievement was commemorated by a National Performance Review Environmental Champion Award given to the company by Vice President Al Gore in 1995.

Pharmacia and Upjohn, Inc. Chemical Process Research and Development developed a proprietary distillation process for splitting Tetrahydrofuran (THF) from a mixture of alcohol, water, and other wastes. This process now recovers approximately 1 million pounds of THF per year. Pharmacia and Upjohn, Inc. is evaluating the possibilities of reusing waste solvent condensate produced from their cryogenic air pollution control equipment. They have identified one methylene chloride rich stream to recover as a trial. An estimated 2.5 million pounds of this waste solvent is generated annually. Recovery by an off-site recycler or on-site reclamation are being further evaluated.

502.5.6 Research

Because of comprehensive regulations from both the FDA and EPA, pharmaceutical companies are continuously researching new and innovative ways to reduce their wastes. Many companies are starting to look at pollution prevention options early in development and are collaborating with universities and other research institutions to develop new technologies that will help reduce or eliminate wastes. Some of these technologies, still in the research and testing stages, are discussed below.

502.5.7 Solvent Minimization

One potential research area which has been identified is in supercritical solvents. Supercritical fluids are known to be very effective solvents and can function as an alternative to traditional chlorinated and other toxic solvents used in pharmaceutical separations. These solvents are in a supercritical state, meaning that they are at a very high temperature and /or pressure. A relatively small change in temperature and//or pressure in supercritical state can lead to large changes in the solubility of chemicals in the solvent. This increase in solubility is ideal for separations because the overall volume of solvent is reduced.

502.5.8 Separation Improvements

Separation of active ingredients from solvents is one of the most important processes in the pharmaceutical industry. Research has been conducted to find separation methods which generate fewer by-products and less waste.

One technology with such a potential is inorganic membrane reactors which enable a continuous removal of product and a controlled addition of reactant. This increases the potential for higher yields and greater selectivity by chemicals, which could reduce the volume of solvents required, thereby reducing costs and wastes. Also, because the reaction and separation are combined in a single step, the emissions associated with the traditional transfer step between reaction and separation are eliminated.

502.6 PLASTIC RESIN AND MANMADE FIBER INDUSTRIES

(EPA/310-R-97-006)

Plastics today are one of the most used materials in US industrial and commercial life. The first plastics were invented in the 1800s when people experimented to produce everyday objects out of alternative materials. The first plastic was developed in 1851 when hard rubber, or ebonite, was synthesized**.** This sector notebook focuses on the plastic resin and manmade fiber industries**.**

502.6.1 Substitute Raw Material

The substitution or elimination of some of the raw material used in the manufacturing of plastic resin and manmade fibers can result in substantial waste reduction and cost savings. Raw materials can be substituted with less water soluble materials to reduce water contamination and less volatile materials to reduce fugitive emissions. Sometimes certain raw material can be eliminated all together. The need for raw materials that end up as wastes should be reexamined to determine if raw materials can be eliminated by modifying the process and improving process control.

Examples

A speciality batch polymer plant in the Northeast avoids highly toxic and hazardous substances in the facility's proprietary products and formulations. The company also minimizes waste by using water-based chemistry in place of organic-based chemistry whenever possible.

Du Pont substituted coal with butadiene in the production of nylon and substituted terephthalic acid for dimethyl terephthalate in the production of polyester. The substitutions eliminated generation of by-products, such as liquid methanol.

A manmade fibers and organic chemicals manufacturer eliminated benzene from its manufacturing processes. The facility simplified its compliance and record keeping procedures since it is no longer subject to the benzene NESHAP.

Other pollution prevention mentioned include:

- improved catalyst,
- optimize processes,
- adopt good operating practices,
- modify product,
- prevent leaks and spills,
- optimize cleaning practices,
- improve inventory management and storage,
- recover solvents, and
- recover raw material.

502.6.1.1 Case Studies

BP Chemicals switched from a series of programmable controllers and analog controllers to a distributed control system. The new control system has greater ability to report what is occurring in the reaction tank and provides operators with more opportunity to improve reaction consistency or correct small problems before they become big ones. This results in less reactor downtime and off-spec product.

A Du Pont polyester plant reduced its releases and transfers of 33/50 chemicals by 55 percent, or more than 1 million lb/yr between 1988 and 1993. By simplifying manufacturing processes, Du Pont eliminated use of ortho-xylene and generation of methanol and ethylene glycol byproducts. This change resulted in savings of over $1 million per year. The plant also made innovative process modifications which reduced process temperatures and VOC emissions.

502.7 FOSSIL FUEL ELECTRICAL POWER GENERATION INDUSTRY (EPA/310-R-97-007)

502.7.1 Clean Technology Demonstration Program

The Department of Energy (DOE) is charged with protecting the Nation's energy interests. In recognition of the vital role of coal as a sustainable energy source, DOE vigorously researches and promotes ways to reduce the

environmental impacts associated with coal combustion under the Clean Coal Technology (CCT) Program. Specific goals of the CCT Program include: (1) increasing the efficiency of electricity production and (2) enhancing the efficient and cost effective use of U.S. coal reserves, while ensuring achievement of national and environmental goals.

One way in which the CCT Program progresses towards these goals is by building a portfolio of advanced, coal-based technology demonstration projects. Included in the portfolio are technologies that resulted in improved efficiency with fewer environmental consequences. The technologies demonstrated under the CCT Program include commercially viable processes, as well as projects whose commercial viability is still being explored. These technologies may be categorized as (1) power systems, (2) environmental control devices, and (3) clean coal processing. Pollution prevention technologies being demonstrated under the CCT Program are included under the categories labeled "power systems" and "clean coal processing". Technologies categorized as "environmental control devices" may not be considered pollution prevention technologies; however, they may enable the recovery of pollutants for subsequent reuse/resale in products.

502.7.1.1 Emerging Technologies

Pollution prevention opportunities in advanced coal-fired power systems are realized by the increase in overall efficiency of the combustion (electricity produced per amount of fuel) resulting in the reduction of environmental pollutants released. Efficiency of a technology is determined by the portion of energy in fuel that is converted into electricity. Thus, the process of combustion and heat transfers are critical variables. In considering advanced technologies, one must consider the environmental transfer of wastes from one media to another.

502.7.1.2 Fluidized-Bed Combustion

Fluidized bed combustion (FBC) technology includes three designs: atmospheric, pressurized, and two-stage bubbling bed. Although FBC technology is not yet

widespread in the industry, it allows any kind of fuel to be burned while controlling the emissions of SO2 without the use of flue gas scrubbing device. In the process, a sorbent, such as crushed limestone, is introduced with pulverized coal in the combustion chamber. Air forced into the combustion chamber suspends the coal-limestone mixture. Sulfur, released from the coal, combines with the sorbent to form a solid waste that is relatively easy to handle and dispose of. The advantage of FBC technology is that it creates a turbulent environment conducive to a high rate of combustion and a high rate of sulfur capture and allows for lower operating temperatures than conventional boilers. Because operating temperatures are below the threshold of thermally induced NOX formation, NOX emissions are reduced. In addition, the operating temperature tends to be below the ash fusion range for coal, resulting in less wastes present in fireside wash waters and less frequent cleaning requirements**.**

502.7.1.3 Integrated Gasification Combined-Cycle

In the IGCC, coal is converted into a gaseous fuel, purified, and combusted in a gas turbine generator to produce electricity. The constituents react to produce a fuel gas. Heat from the exhaust gas is recovered and used to generate steam, which produces additional electricity. Gasification is a process in which coal is introduced to a reducing atmosphere with oxygen or air and steam. In some systems, a limestone sorbent is added to the gasifier for sulfur removal. The environmental advantages of IGCC include:

- High efficiency,
- Removal of nitrogen, sulfur, and particulate prior to the addition of combustion air, thereby lowering the volume of gas requiring treatment,
- Sulfur in the gas is in the form of hydrogen sulfide, which is removable to a greater extent than SO2,
- NOX removal of more than 90 percent, and
- Reduced CO2 emissions compared to traditional coal-fired boilers.

Currently, gas cleanup in IGCC requires the gas to be cooled; however, hot gas cleanup systems are being developed that will remove 99.9 percent of the sulfur and result in a saleable sulfur product. The IGCC system is well suited for repowering because it can use the existing steam turbine, electrical generator,

and coal-handing facilities in most cases.

502.7.1.4 Indirect-Fired Cycle

An indirect-fired cycle operates such that coal or biomass combustion products do not come in direct contact with gas turbine components. Instead, heated gases pass on the shell side of an air heater. On the tube side of the air heater, compressed gas is heated and passed through a gas turbine. The environmental advantage is that this eliminates the need for hot gas cleanup since the corrosive and abrasive fuel products do not come into direst contact with the turbines. Heat is recovered from air heater exhaust and is used to produce steam, which powers a steam turbine. In addition, corrosive gas products do not come into direct contact with the turbine, thereby eliminating the need for hot gas cleanup. Although the technology is still in the design stage, the efficiency is expected to be 20 percent greater than that of a pulverized coal plant. SO2 reductions of 90 percent, as well as reduced NOX and particulate emissions, are expected.

502.7.1.5 Integrated Gasification Fuel Cell

An integrated gasification fuel cell system consists of a coal gasifier with a gas cleanup system, a fuel cell, an inverter, and a heat recovery system. Coal gas, made through the reaction of steam, oxygen, and limestone, is introduced to a fuel cell composed of an anode and a cathode and separated by an electrolytic layer. The fuel cell converts the chemical energy of the gas to direct current electrical energy and generates heat, and an inverter converts direct current to alternating current. A heat recovery system delivers heat to a bottom steam cycle for further generation of electricity. Pollution prevention is realized by improved emissions reduction associated with the gas cleanup system and solid waste reduction**.**

502.7.1.6 Coal-Fired Diesel

Diesel generators are modified to accept a coal/water slurry as a fuel source. Environmental control systems are typically installed to remove NOX, S02, and particulates. The advantage of a coal-fired diesel system is that it is well suited

to small generators (below 50 megawatts). In addition, it is estimated to result in emissions reduction of 50 percent below New Source Performance Standards. Similarly, coal-oil mixture technology can replace up to 50 percent of fuel oil with pulverized coal for burning in conventional oil or gas burners.

502.7.1.7 Slagging Combustor

In a slagging combustor, coal is burned at very high combustion temperatures outside the furnace activity cavity, and combustion gasses pass into the boiler, where heat exchange takes place. In a conventional boiler, the ash enters the boiler and collects on boiler tubes, thus decreasing the efficiency of heat exchange. Alternatively, the high temperature of the slagging combustor causes ash to form slag, which is collected in cyclones. The advantage of the slagging combustor is that it prevents a loss in heat exchange efficiency that would occur from ash accumulation on boiler tubes.

502.7.2 Coal Processing for Clean Fuels

Pollution prevention entails removal of the pollutants from coal in the precombustion stage. This is accomplished through coal cleaning, whereby pollutants are removed without altering the solid state of the coal, or by conversions (gasification or liquefaction), which represent transformations in the state of the coal.

502.7.2.1 Coal Cleaning

A study cited in a report written by the Virginia Department of Environmental Quality compared two FBC conceptual plant designs using mine-run coal versus washed coal. The washed coal facility reduced SO2 emissions by more than 50 percent on the basis of equivalent heat input. In addition, the washed coal facility was physically smaller, had lower installation costs, required less storage area for limestone and ash, used less water, and generated less high-volume wastes.

502.7.2.2 Coal Gasification

Gasification is the process of converting coal to a gaseous fuel - coal gas - followed by chemical cleaning. Coal gas has the benefit of burning as cleanly as natural gas. The process entails coal gas reacted with steam and an oxidant in a reducing atmosphere. If air is the oxidant, a low-BTU gas results; if oxygen is the oxidant, a medium-BTU gas results.

502.7.2.3 Mild Gasification

In mild gasification, coal is heated in an oxygen-free reactor, which produces gaseous, solid, and liquid products. The environment in the reactor drives off the condensed, volatile hydrocarbons and leaves behind carbon. The benefit of mild gasification is that it produces multiple fuels and feedstocks using medium temperature treatment of coal.

502.7.2.4 Coal Liquefaction

Hydrogen added to coal increases the fuel's ratio of hydrogen to carbon to a level similar to that of petroleum fuels. Coprocessing is a liquefaction process, whereby heavy petroleum residue combined with coal produces a liquid fuel. The liquids can be cleaned of sulfur and ash prior to use as a fuel and have higher thermal efficiencies (60-70 percent range), high product yield, and potentially marketable byproducts, such as gasoline.

502.7.3 Cogeneration

Cogeneration is the production of electricity and heat from a single power source. Because of the heat recovery aspect, cogeneration itself is a pollution prevention strategy. In cogeneration, heat that would otherwise be released from a steam turbine, gas turbine, or diesel engine is recaptured and used to heat buildings or other industrial processes or to generate additional electricity. In fact, whereas the typical efficiency at a fossil fuel electric plant is around 33 to 38 percent, cogenerators can obtain up to 80 percent efficiency because of the heat captured. The heat recovered comes mainly from the flue gases.

DOE's Office of Industrial Technology (OIT) has several projects underway to

promote cogeneration, which is a commercially available technology. For example, OIT teamed up with Riegel Textile Corporation to design and test an innovative 4.3 MW high-back-pressure steam cogeneration system using a modified coal-fired boiler. The turbine exhaust (225 psig at 570 degrees Fahrenheit) is hot enough to be used for process heating and can also be used to drive an existing low-pressure turbine to generate additional electricity. In 1994, 17 such systems were in operation.

502.7.4 Repowering

Repowering is a way in which power generation facilities can improve and increase both the production and efficiency of standard thermal generating facilities. Repowering options include expanding a unit's size or changing the type or quality of the fuel used.

502.7.5 Fuel Cells

Natural gas fuel cells (NGFC) energy systems improve gas utilization and efficiency. Like batteries, fuel cells are based on the principles of electrochemistry, except that they consume fuel to maintain the chemical reaction. Fuel Cells, being electrochemical, are more efficient than combustion systems. In addition, emissions are reduced from typical gas systems because there is no combustion of fossil fuel. Although many fuel cells are being researched, developed, and demonstrated around the world, only one system is commercially available . It is a 200 kW phosphoric acid fuel cell system.

Because emissions are reduced, State and local air quality regulating agencies have begun to grant and/or consider exemptions from air quality permitting requirements. For example, after extensive emission testing, the South Coast Air Quality Management District has granted NGFC's exemption in the Los Angeles area. Exemptions have also been granted by the Santa Barbara Air Quality Management District, the Bay Area Air Quality Management District, and the State of Massachusetts. These exemptions may create economic incentives to install NGFC systems to avoid permitting fees and violation fines, or to take advantage of emissions credits. A Federal incentive program is being managed

by the DOE Morgantown Energy Technology Center to reduce the costs of the fuel cell by $1,000 per kW.

Additional information on this technology may be obtained from the North American Fuel Cell Owner Group (NAFCOG), an independent users group comprised of owners and operators of NGFCs.

Several other pollution prevention methods can be employed. Some of the methods are common solutions applicable to a wide range of facilities; others are more tailored to site-specific situations.

502.7.6 Chemical Substitutions

Several process modifications described previously have required material substitution (e.g. switching fuels). However, material substitutions are not limited to major processes. Sometimes chemicals are used unnecessarily on a wide-scale basis for a variety of operations and maintenance activities (e.g. cleaning, lubrication). By substituting less toxic chemicals, a facility can avoid unnecessary risks associated with worker exposure and the potential for release into the environment. The first step in determining the viability of material substitution is to inventory the chemicals used at the site. The chemical can be evaluated as to its hazard potential, its necessity, and possible alternatives. For example, San Diego Gas and Electric Company determined several different solvents onsite could be replaced by just a few different solvents. By eliminating the wide array of solvents, the company is now able to install a solvent recovery unit, which will reduce the amount of solvent waste.

502.7.7 Inventory Management and Preventative Maintenance

Fossil fuel electric power generation facilities, like many industrial facilities, use chemicals for everyday operations. Everyday operations include parts washing, lubricating, general cleaning, and degreasing application during plant and equipment maintenance activities. Often, chemical wastes generated by these operations are made up of out-of-date, necessary, off-specification, and spilled or damaged chemical products. Actual costs for materials used include not only the

cost of the original product, but also the costs of disposal. Inventory management and preventative maintenance are ways these facilities can decrease the amounts of chemical wastes generated in a cost-effective manner.

There are two categories of inventory management including inventory control and material control. Inventory control includes techniques to reduce inventory size, reduce toxic and/or hazardous chemical use, and increase current inventory turnover. Material control includes the proper storage and safer transfer of materials. Proper material control will ensure that materials are used efficiently to reduce waste and preserve the ability to recycle the wastes.

Corrective and preventative maintenance can reduce waste generation. A well run preventative maintenance program will serve to identify the potential for releases and correct problems before material is lost and/or is considered a waste. New or updated equipment can use process materials more efficiently, producing less waste.

502.7.8 Waste Segregation and Separation

Fossil fuel electric power generation facilities can reduce their waste disposal costs by careful segregating their waste streams. In particular, facilities should segregate RCRA nonhazardous wastes from hazardous waste to reduce the quantity of waste that must be disposed of as a hazardous waste.

502.7.9 Training and Supervision Options

While the major pollution prevention gains are achieved through process controls and reuse/recycling, many day-to-day common sense practices are relatively easy and inexpensive to incorporate. Through training, these practices can become effective means of pollution prevention. Examples of proactive employee behavior includes training for careful use and disposal of cleaners and detergents to prevent them from entering floor and yard drains.

502.7.10 Demand-Side Management Programs

In the past, electric utilities have implemented demand-side management programs to achieve two basic objectives: energy efficiency and load management. Through these demand-side programs, the utilities have successfully reduced toxic air emissions and achieved cost effectiveness for both the utility and the consumer, mainly by deferring the need to build new power plants. The energy efficiency goal has been achieved primarily by reducing the overall consumption of electricity from specific end-use devices and systems by promoting high-efficiency equipment and building design.

502.8 SHIPBUILDING AND REPAIR INDUSTRY (EPA/310-R-97-008)

This sector notebook provides a narrative discussion of pollution prevention opportunities, but does not contain specific examples of emission reductions or cost savings data.

502.8.1 Painting and Coating

Painting and coating operations are typically the largest single source of VOC emissions from shipyards. Using low VOC paint formulations is one option to reduce air emissions. Also, the use of equipment with high transfer efficiencies minimizes the amount of paint loss. General housekeeping practices can control and minimize spills and leak, as well as product loss during transfer. Evaporation can be controlled by using tight fitting lids, spigots, and other equipment. The reduction in evaporation lessens air emissions, increases the amount of available material and results in lower solvent purchase cost. A significant portion of paint waste is the paint that remains inside a container after the container is emptied. Residual paint which is not used, often becomes out dated or non-spec. Shipyards can consolidate paint use to facilitate the purchase of paint in bulk. Since large bulk containers have less surface area than an equivalent volume of smaller cans, the amount of paint waste is reduced. In addition, large bulk containers can sometimes be returned to the paint supplier to be cleaned for reuse. Since solvent-based coatings can lead to high costs to meet air and water quality regulations, alternative coatings have been developed that do not require the use of solvents and thinners.

Metal substrates can be coated with certain resins by applying the powdered resin to the surface, followed by application of heat. The heat melts the resin, causing it to flow and form a uniform coating. The three main methods in use for applying the powdered coating are fluidized bed, electrostatic spray, and flame spraying. The elimination of environmental problems associated with many liquid based systems is one of the major advantages of powered coatings. The use of powdered coatings eliminates the need for solvents and thereby emits negligible volatile organic compounds (VOCs). Powder coatings also reduce the waste associated with unused two-part coatings that have already been mixed. Since powder over spray can be recycled, material utilization is high and solid waste generation is low. Recent case studies demonstrate that powder coatings can be cleaner, more efficient, and more environmentally acceptable, while producing a higher quality finish than many other coating systems.

502.8.2 Solvent Cleaning and Degreasing

Shipyards often use large quantities of solvents in a variety of cleaning and degreasing operations including parts cleaning, process equipment cleaning, and surface preparation for coating operations. The final cost of solvent used for various cleanup operations is nearly twice the original purchase price of the virgin solvent. The additional cost is primarily due to the fact that for each drum purchased, extra disposal cost, hazardous materials transportation cost, and manifesting time and expense are incurred. With the rising cost of solvents and waste disposal services, combined compliance costs, reducing the quantities of solvents used and solvent wastes generated can be extremely cost effective.

Control of solvent air emissions can be achieved through equipment modification and proper operation of equipment. Simple control measures include installation and use of lids, an increase of freeboard height of cleaning tanks, installation of freeboard chillers, and taking steps to reduce solvent drag-out. For tanks that are continuously in use, covers have been designed that allow the work pieces to enter and leave the tank while the lid remains closed.

In operations such as vapor degreasing, use of lids can reduce solvent loss from 24 to 50 percent. Reduction in solvent usage, by freeboard chillers, can be as

high as 60 percent.

502.9 TEXTILES INDUSTRY (EPA/310-R-97-009)

Most of the pollution prevention activities in the textile industry have focused on reducing chemical use, reusing process water, and reducing all solid waste.

502.9.1 Less Polluting Raw Materials

Raw material quality control can be implemented by establishing specific and appropriate purchasing, packaging, and inventory control policies to prevent the ordering and use of untested materials. The benefits include decreased production of off-quality goods, less rework and increased production consistency.

At its Monore, North Carolina facility, Bloomsburg Mills scours, dyes and finishes about 22 million yards of fabric per year. The facility used dye carrier chemicals, such as tetracholoroethylene, biphenyl, and tetrachlorobenzene to promote level dyeing. In order to reduce regulatory reporting requirements, the company substituted a dye carrier containing methyl napthalene with non-photochemically reactive solvents. This reduced the release of hazardous air pollutants by 91 percent from 64,713 pounds in 1988 to 5,932 pounds in 1993.

Mills in the United Kingdom adopted purchasing policies as a way to reduce pollution. By specifying in company purchasing policies that they would not accept woven fabric containing Pentachlorophenol (PCP), the presence of PCP in wastewater was reduced by 50 percent.

502.9.2 Less Polluting Chemical Reagents

By replacing solvents, facilities can reduce waste, reduce costs associated with treatment systems, and increase worker safety.

- Bloomsburg Mills substituted a solvent containing isopropanol and heptane as a suitable spot-washing alternative for 1,1,1, trichloroethane, a

hazardous air pollutant. No loss of quality was noted.

- Guilford Mills replaced a solvent based chemical system used in the heat setting process with a water based chemical system. The new system uses an acrylic latex emulsion to dissolve gum which stabilizes fabric edges and prevents curling. This change accounted for most of the plant's reduction in VOC emissions, from 246.8 tons per year in 1993 to 93.7 tons in 1995.
- Cleveland Mills Company reduced formaldehyde emission to the air by 84 percent by switching to low-shade change resins in the production process. Formaldehyde emissions at the mill dropped from 3, 500 to 580 pounds per year.

502.9.3 Less Polluting Processes

Waste can be reduced by replacing chemicals in some processes with mechanical or other chemical treatments.

- JP Stevens and Company, Inc. Substitutes chemical biocides, used in disinfecting air washers and cooling towers, with the use of ultraviolet (UV) light. During a 6 month test period, results showed improved worker safety, reduced discharge of biocides, reduced chemical inventory and handling, improved workplace air quality, and reduced pH and foaming problems in wastewater. The facility also showed enhanced air washer performance and more consistent control of workplace air quality. The UV system operated with no required maintenance or repairs during the test. Based on chemical savings, the payback is estimated to be 11 to 18 months.
- At its Lumberton, North Carolina facility, Alamac Knits upgraded jet dyeing machinery. This modification resulted in a decrease of between 60 and 70 percent of consumption of dye chemicals.
- Cleveland Mills Company replaced coal-fired boilers with natural gas fired boilers and eliminated 220,000 pounds of fly ash each year.

502.10 SECTOR NOTEBOOK SUMMARY

500 SOURCES OF INFORMATION

This report has extracted information from the US EPA Industrial Sector Notebooks, published in 1995 and 1997, in order to highlight the type and scope of air pollution prevention information which can be found in the published literature. In the future, the US EPA, Office of Compliance is planning to add the following topics to their Industrial Sector Notebook series:

- Aerospace,
- Agricultural Chemicals,
- Agricultural Crop Production,
- Agricultural Stock Production,
- Coal Mining,
- Oil and Gas Exploration and Production, and
- Local Government.

Information on the publication of these reports may be obtained by viewing the Internet site at http://es.epa.gov/oeca/sector/ or calling (202) 564 - 7017.

Next, the use of the Internet to locate air pollution prevention information is described.

503 INTERNET INFORMATION

The Internet has recently replaced microfilm as the popular method to distribute technical reports. When US EPA published Pollution Prevention 1997: A National Progress Report, a computer file was posted at the US EPA Web site which allowed interested individuals to copy the file and print out the 277 page report.[1] (Also, see "htpp://www.epa.gov/opptintrp2_97/ ".) Now, it has become routine for government documents from Martian photographs to Federal Register Notices to be posted on the Internet.

In order to facilitate finding relevant information, the Internet user can:

- access the links created on existing Web pages,
- use "search" programs,
- correspond with E-mail, and
- subscribe to list serves.

503.1 WORLD WIDE WEB (WWW)

The ARB Web page (http:\\www.arb.ca.gov) provides information on ARB programs as well as links to other Web sites, including numerous pollution prevention sites. Each of these sites provides other links. Each site is analogous to a different TV channel; the user can move from channel to channel and view the informational broadcast. Unlike television viewing, the Internet user can save information and print it out. Tables 503-1 lists selected sites for general as well as industry specific information. Each of these sites has other links which can be accessed as the user finds relevant reports.

503.2 SEARCHING STRATEGIES

Since an individual site can contain numerous documents, and there are thousands of potential sites to visit, site specific search programs and universal search programs have been created. For example, the ARB Web site has an search program at http://www.arb.ca.gov/db/search/search.htm or it can be accessed by using the "search" icon on the ARB Home Page. Finding useful Web sites can be aided by multi-site search programs, often called search engines, which use keywords to help direct the user to the desired information. Many sites use boolean logic searches, named after George Boolean, the English mathematician. Searches using keywords can be further refined by the logical operators "AND", "OR" and "NOT". Searching the Internet is an acquired skill. Using boolean terms, a search could be conducted for "methyl AND ethyl AND ketone". Searches for information on methyl ethyl ketone using "mek" will not be successful since "mek" is also a computer term for music sound files. Using a specific search term such as the Chem Abstract Number (e.g. CAS#78-93-3) or the full chemical name (e.g. "methyl ethyl ketone") is more efficient. If the initial list of documents is too large, many search engines offer advanced search strategies to narrow the scope and focus on intended subject matter. The Web site for each search engine often provides site specific guidance. Another source of information is a book entitled Search Engines for the World Wide Web.[2] For more information, see www.peachpit.com.

503.3 E-MAIL CORRESPONDENCE

Electronic mail or E-mail allows individuals or groups to communicate on an ad hoc or regular basis. Information can be exchanged and documents can be transferred in a variety of computer file formats. Many companies and government agencies are including E-mail address on their Web sites, in telephone directories and in publications to facilitate exchange of ideas. The E-mail addresses of the staff contacts for the US EPA Sector Notebook Project are listed on the US EPA Web page at http://es.epa.gov/oeca/sector/index.html**.** The E-mail addresses for ARB staff are available at http://www.arb.ca.gov. In addition, there are Internet Web Sites such as "www.switchboard.com" which can be used to locate E-mail addresses.

503.4 LIST SERVES

List Serves are a special type of e-mail. A group of subscribers can send and receive e-mail as a group. A list serve is somewhat like a telephone conference call. P2TECH is one example of a pollution prevention list serve what allows subscribers to exchange pollution prevention technical assistance. Subscribers post questions to the e-mail address ("p2tech@great-lakes") and other subscribers can respond to the all subscribers or prepare individual response to the original message sender. Several other list serves exist including pollution prevention regulations (p2reg), training (p2trainer) and pollution prevention for the printing industry (printech). Some list serves are archived and allow searching of previous postings. Additional information on P2 List Serves is available on the Internet at P2West maintained by the Western Regional Pollution Prevention Network; the address is "www.westp2net.org".

504 NAMES, ADDRESSES AND PHONE NUMBERS

Air Resources Board
2020 L Street
P. O. Box 2815
Sacramento, CA 95814

Business Assistance Center	(800) 272-4572
Compliance Assistance Program	(916) 327-7211
Compliance Training Section	(916) 322-8272

California Department of Toxic Substances Control
400 P Street
P. O. Box 806
Sacramento, CA 95812

Pollution Prevention & Technology	(916) 322-3670

National Technical Information Service (NTIS)
55285 Port Royal Road
Springfield, VA 22161
(703) 487-4650

National Pollution Prevention Roundtable
2000 P Street NW, Suite 708
Washington, D.C. 20036
(888) PIKP2P2 or (888) 745-7272

Northeast States for Coordinated Air Use Management (NESCAUM)
129 Portland Street, 6th Floor
Boston, MA 02114
(617) 367-8558
E-mail: newmoa@tiac.net

Northeast Waste Management Officials' Association (NEWMOA)
129 Portland Street, 5th Floor

Boston, MA 02114 (617) 367-8540

504 NAMES, ADDRESSES AND PHONE NUMBERS

Pollution Prevention Center for Higher for Higher Education (NPPC)
430 East University Avenue
Ann Arbor, MI 48109-1115
Telephone: (734) 764-1412
E-mail: nppc@umich.edu

State and Territorial Air Pollution Program Administrators (STAPPA)/
Association of Local Air Pollution Control Officials (ALAPCO)
444 North Capitol Street, N.W., Suite 307
Washington, D.C. 20001
Telephone: (202) 624-7864

United States Environmental Protection Agency
Pollution Prevention Library, Region IX
75 Hawthorne Street
San Francisco, CA 94105
Telephone: (415) 744-1508
E-Mail: sundheim.karen@epamail.epa.gov

United States Environmental Protection Agency
401 M Street, S. W.
Washington, D. C. 20460
Pollution Prevention Information Clearinghouse (PPIC)
Telephone: (202) 260-1023
E-mail: ppic@epamail.epa.gov

Sector Notebook Project
Telephone: (202) 564-7017
E-mail: heminway.seth@epamail.epa.gov

Small Business Compliance Assistance Center
Telephone: (202) 564-7066
E-mail: vendinello.lynn@epamail.epa.gov

505 ARB COMPLIANCE DIVISION

California leads the nation in cleaning up the air. In 1955 the Bureau of Air Sanitation began identifying the air pollution levels that could endanger public health. Recognizing cars and trucks as a major cause of smog problems, the State formed the Motor Vehicle Pollution Control Board (MVPCB) in 1960 to regulate tailpipe emissions. California was the first state to adopt vehicle emission standards for hydrocarbons (HC) and carbon monoxide (CO).

In 1967 the MVPCB and the Bureau of Air Sanitation were combined to create the Air Resources Board (ARB). With this merger, the authority to define the health threat of air pollution and to regulate its causes was united in a single organization. Since then, the ARB, working with county air pollution control districts (APCDs) and regional air quality management districts (AQMDs) has created one of the world's most comprehensive air quality control programs.

In July 1991 the California Environmental Protection Agency was formed to bring together under a single, accountable, Cabinet level agency these entities: the Department of Pesticide Regulation, the Department of Toxic Substances Control, the Office of Environmental Health and Hazard Assessment, the Integrated Waste Management Board, the State Water Resources Control Board, nine Regional Water Quality Control Boards, and the Air Resources Board.

What does the ARB do? As the primary statutory authority, the ARB establishes and enforces standards to limit pollutant emissions from motor vehicles, stationary sources and consumer products. The ARB does more:

- Conducts inspections, in cooperation with APCDs, to ensure compliance with air pollution regulations by applying consistent and evenhanded

enforcement.
- Develops suggested rules and regulations to assist local APCDs in their efforts to improve the air quality.
- Establishes air quality standards to protect the health of the most vulnerable citizens and to prevent damage to property and crops.
- Evaluates the effectiveness of pollutant control strategies for vehicles and industrial sources.
- Monitors air quality throughout the State.
- Conducts extensive research programs.

The ARB's past efforts have reduced the pollution emitted from vehicles and large sources. Now, and for the future, the ARB is focused on smaller, individual sources of pollution. However, successfully regulating a very large number of very small, diverse sources poses even greater challenges than previous clean air measures. Continuing to improve the air quality requires hard work and careful planning.

506 COMPLIANCE ASSISTANCE PROGRAM

The Compliance Assistance Program (CAP), created in 1988 by ARB, assists local air districts in conducting more comprehensive, consistent, and accurate facility compliance inspections. The CAP program also provides industry with information and tools, in the form of self-help publications, which clarify compliance requirements and help explain how to stay in compliance with air pollution rules and regulations. CAP also assists industry in establishing their own compliance inspection programs. By conducting routine compliance inspections, facilities can stay in compliance on a daily basis and can thereby avoid costly air pollution violations.

Enforcement audits of some industrial sources have shown noncompliance rates as high as 50 percent. Improving these rates can bring rewards to everyone. Based on the idea that sources will comply if they understand what is required of them, CAP identifies requirements of regulations and presents them in several more readily understandable formats. These CAP publications can assist

industries to monitor themselves and to conduct their own daily inspections, thus increasing their compliance rates, and reducing costly violations. Through the development and distribution of these rule-specific publications, CAP creates a flow of information in a variety of useful forms:

Handbooks. Easy-to-read, colorfully illustrated handbooks are developed for the industrial labor force. Most **can be read in 10 minutes or less** and all contain helpful self-inspection checklists.

Pamphlets. Quick-reference pamphlets contain detailed flow charts, checklists, and helpful diagrams. These are designed for facility managers and industry's environmental managers.

Technical Manuals. Detailed technical inspection manuals are developed for industry environmental managers, ARB inspectors, and local air district inspectors. These contain rule information, process description, and step-by-step procedures for compliance inspections.

Ordering information for these publication is available from Wendy Slabaugh at (916) 327-7211 or on the ARB Web site. The handbook and manual information is located at:

- http://www.arb.ca.gov/cd/cap/handbks.htm, and
- http://www.arb.ca.gov/cd/cap/manuals.htm

507 COMPLIANCE TRAINING

The Compliance Training Section:

- Trains air pollution inspectors and professionals,
- Trains other professionals for cross-media inspections, and
- Provides consultation source for business with help.

The courses provide practical, usable, and valuable information for a wide range of air pollution professionals including:

- Government personnel,
- Environmental compliance professionals,
- Public interest groups, and
- Consultants.

Purpose

The dynamic transitions occurring in business and government, including the rapid changes in technologies and sweeping new legislation, continue to challenge the environmental community. These changes are mandating redefined priories and increased workloads--that must be accomplished on ever shrinking budgets. Today, more than any time in the past, it is essential that the professionals in the air quality field receive quality training to keep current with this accelerated evolution.

The Air Resources Board (ARB) Compliance Division proudly offers this essential training. The purpose of this program is to provide comprehensive education to further the professional development of environmental specialists. The course listed in this catalog provide current, practical, usable and cost-effective information for both new and highly experienced air pollution authorities including: government and industrial personnel, environmental compliance professionals, public interest groups and consultant.

Curriculum

These nationally recognized and award winning programs offer a standardized core curriculum and are classified from entry level to advanced continuing education. The presentations are multi-media based with videos, slides, computer programs, Internet access and hands-on training used in the best mixture for the applicable subject. The courses encourage and facilitate communication and networking among all air pollution personnel with the goal of achieving emission reductions and

solving problems through knowledge, assistance and teamwork.

Designed and presented by instructors with many years experience in air pollution control, these courses cover subjects ranging from air pollution history, to the procedures required to properly evaluate stack plume density to the in-depth analysis of actual source process theories, applications, source emissions, and control techniques. The focus is on compliance and includes a thorough review of applicable laws and regulations. Wherever possible, each course includes a field visit to exercise the practical applications of the lessons. The courseware is designed so the students have the skills to be immediately productive upon course completion. In addition, the curriculum can be customized and tailored for the specific regional needs of a group or industry and instructed at any location, thus greatly reducing client travel costs.

Instructors and Staff

The instructors act as an interdisciplinary research team and their education includes business, engineering, aeronautical science, health science, biological science, law enforcement and more. Experience ranges from source testing and source permitting to compliance inspection and field enforcement. Source type inspection backgrounds are also diverse: ports, oil refining, power production, industrial boilers, reciprocating and turbine engines, military bases, chemical plants, coatings facilities, waste incinerators, glass manufacturing, etc. The instructors are highly experienced in adult education and are experts in developing courses, seminars, workshops, and conferences. The training staff, and the management of the ARB, have a commitment to excellence which assures the program meets the sophisticated needs of today's environmental professional.

REGISTRATION INFORMATION

Enrollment for most courses is limited based on the classroom facilities.

500 SOURCES OF INFORMATION

You are encouraged to register as early as possible for all courses. The current schedule of classes is available on the ARB Web site at: http://www.arb.ca.gov/cd/training.htm. Please contact the Registrar, Nancy Thompson, for enrollment and administrative information. Registration will be accepted four ways:

1. Telephone: (916) 322-8272
2. FAX: (916) 445-5745
3. E-mail: cdtrain@arb.ca.gov
4. Mail: Nancy Thompson
   Air Resources Board
   Compliance Division
   P.O. Box 2815
   Sacramento, CA 95812

All registrations will be accepted in the order received.

508 REFERENCES

1. US EPA, Pollution Prevention 1997: A National Progress Report,

2. Search Engines for the World Wide Web, by Alfred and Emily Glossbrenner, ISBN 0-201-69642-8, Peachpit Press, 1998. For more information, see www.peachpit.com.