RESPONDING TO ENVIRONMENTAL CHALLENGE

A discussion among people from industry, government and environmental groups

The Petroleum Industry and Pollution Prevention

Pollution prevention is a multimedia concept that reduces or eliminates pollutant discharges to air, water or land, and includes the development of more environmentally acceptable products, changes in processes and practices, source reduction, beneficial use and environmentally sound recycling.

(API definition of pollution prevention)

PREVENTING POLLUTION: MEETING THE CHALLENGE

"Our goal is to tell the story of pollution prevention from an advocacy and educational standpoint."

—Mark Nordheim, Chairman, API Pollution Prevention Task Force, Chevron

Preventing pollution is becoming one of today's hottest environmental topics. Governments and industries are looking critically at materials and production methods to find ways to cut waste at the source, seeking beneficial uses of once unwanted by-products, and pursuing innovative methods to recycle and reuse materials. Consumers, too, are beginning to look at ways to eliminate or recycle waste—instead of disposing of it.

The petroleum industry is seeking better ways to prevent pollution. Individual companies and the industry's major trade association, the American Petroleum Institute (API), are looking at new ways of measuring progress in reducing releases, taking a closer look at releases already identified, and researching potential equipment changes at refineries and other operations to make them more environmentally sound. The industry is not only looking to the expertise of experienced petroleum engineers and pollution prevention experts, but to regulatory agencies and other organizations to help guide its efforts.

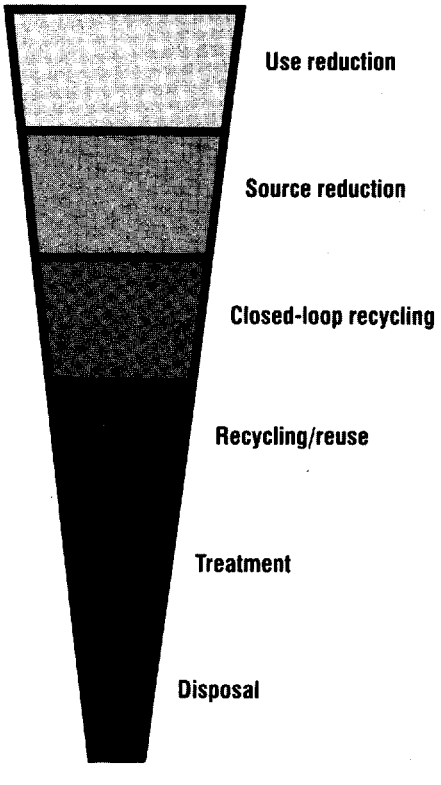
Though people often think of the petroleum industry as one industry, in reality it is a collection of many diverse businesses, each with different pollution prevention concerns. The search for new energy supplies in the Gulf of Mexico presents different challenges from a refinery that produces gasoline or a service station that provides the industry's products directly to customers. Similarly, environmentally sound pollution prevention practices that work in

A CONTINUING TRADITION

Maine may not always work in Texas—because climate and topography vary.

Overall, the petroleum industry is striving to meet the challenges of pollution prevention by reducing or eliminating discharges to air, water and land, by developing better products, and by changing processes and practices.

Waste Management Hierarchy



As the hierarchy shows, the goal of pollution prevention is to avoid generating wastes in the first place instead of treating or disposing of them.

The petroleum industry is striving to meet the challenge of improved environmental performance demanded by the public. Pollution prevention is key to this effort.

API amended its bylaws in 1990 to incorporate an environmental mission statement and 11 guiding environmental principles. Acceptance of the principles is a condition of API membership. They serve as the foundation of a long-term commitment to improve environmental performance by API member companies.

Building on this foundation is a wide array of existing programs as well as new initiatives—to foster the search for environmental excellence throughout the industry.

For example, many of the nation's largest petroleum companies are participating in the U.S. Environmental Protection Agency's (EPA) voluntary 33/50 Program. It aims to cut the releases of 17 targeted toxic chemicals by 33 percent by 1992 and 50 percent by 1995.

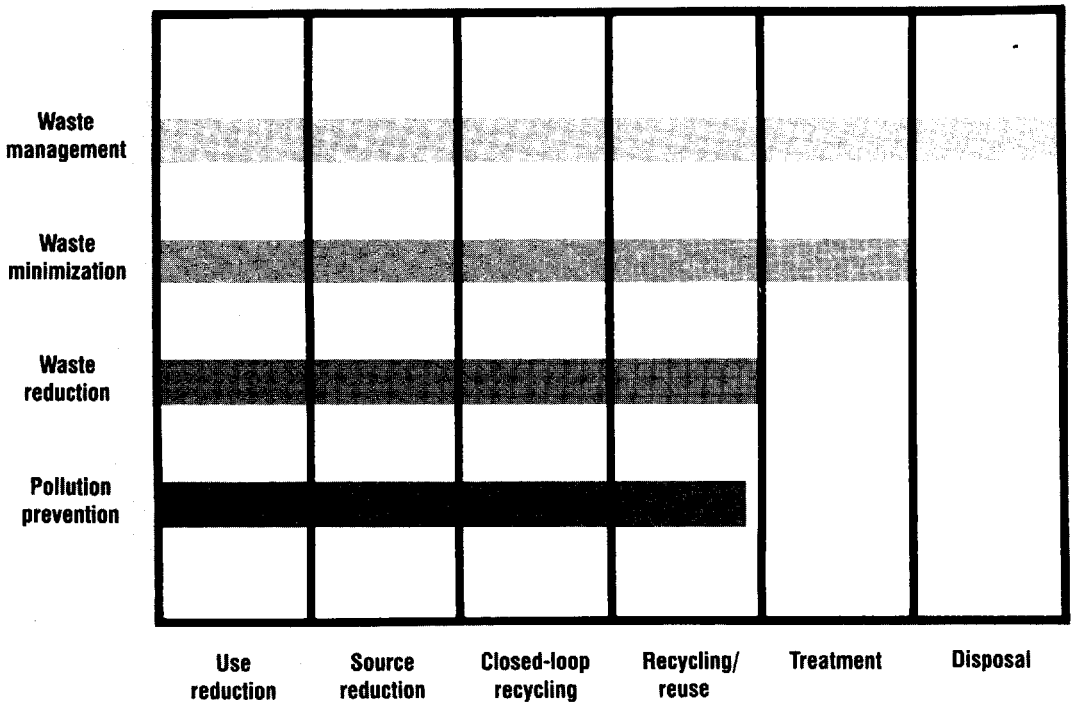
Even before EPA announced its 33/50 Program, petroleum companies had taken innovative steps to prevent pollution in their operations nationwide. Individual companies launched programs such as Chevron's SMART (Save Money and Reduce Toxics) and Texaco's WOW (Wipe Out Waste) to promote pollution prevention efforts.

These programs have already substantially reduced waste. For example, the Council on Environmental Quality's 1990 Annual Report profiled Chevron's SMART program. It reported that SMART cut the company's disposal of hazardous wastes by nearly half in the first year.

Other efforts include the industry's oil spill research program with the U.S. Department of the Interior, research on cleaner fuels and engines undertaken jointly with the auto industry, establishment of the Marine Spill Response Corporation, rerouting tanker traffic off sensitive areas along the California and Florida coasts, and Unocal's program to "buy back" old, high-polluting cars on the roads in California.

To learn more about this important environmental challenge, API invited experts from federal and state government, from public interest groups and from the petroleum industry to discuss pollution prevention as part of the October 1990 annual meeting of the Health and Environment General Committee. The discussion is summarized in the following pages.

Waste Management Vocabulary



As the waste management vocabulary has grown, descriptive terms have acquired meanings that encompass different tiers of the waste management hierarchy.

THE FEDERAL PERSPECTIVE

"I think you will see over the next two years, a new approach at EPA making pollution prevention the hallmark of our new direction."

—Nancy Firestone, Associate Deputy Administrator, U.S. Environmental Protection Agency

In November 1990, Congress passed the Pollution Prevention Act of 1990, helping to establish an effective national pollution prevention policy. The act stressed the importance of source reduction as a major part of pollution prevention—keeping the role of recycling and treatment separate. The act also committed EPA to establishing an office to develop and implement a strategy to promote source reduction. This new office will also help businesses adopt source reduction techniques.

In addition, EPA is taking many steps on its own to develop a pollution prevention strategy. The first major step is finding ways to evaluate control strategies across media lines—looking at the emissions of a plant holistically, rather than focusing on the plant's waste, water or air emissions.

"At EPA we have managed quite successfully to divide the world into air, water and waste. Not only have we been able to do that, we have been able to build brick walls between those offices," Firestone said. As a result, waste often gets transferred from one medium to another.

For example, the Clean Water Act's effluent standards have successfully minimized much of the waste discharges to water. But some companies solve their water discharge problems by collecting the waste water and managing it as a solid waste. EPA statistics indicate that 50 to 90 percent of Resource Conservation and Recovery Act (RCRA) waste is largely water. This approach does not eliminate waste, it simply reclassifies it.

To change this situation, EPA has begun a series of "clustering" projects, which are designed

to foster a more integrated approach to key environmental issues and key industries that affect them. EPA's first cluster is the oil refining industry. By clustering pollution sites with similar characteristics, such as oil refineries, EPA hopes to pool existing information spread throughout the agency. Pooling this information will help EPA develop an environmental management system that is most effective in reducing pollution for the cluster as a whole.

Another major part of EPA's pollution prevention strategy is risk prioritization. EPA hopes to improve the benefits of its environmental programs by regulations that promote wiser and more efficient use of the estimated $100 billion annually spent on environmental protection in the United States. For example, much of the money spent on environmental protection goes to cleaning up hazardous waste facilities. EPA is developing a way to prioritize the potential risks from these facilities and then see if the money spent on them appropriately matches the level of risk they pose.

EPA is also exploring several "non-traditional" approaches to environmental protection. These include using public information as an environmental tool, establishing programs to encourage technology transfer and development, using market-based incentives to accomplish environmental goals and encouraging voluntary action.

In addition to the 33/50 Program, EPA has undertaken other voluntary emissions reductions efforts. It asked the chief executive officers of nine companies emitting butadiene to voluntarily reduce emissions—accelerating pollution prevention. The companies were asked to develop a plan to reduce their emissions. Six to eight months later, all the companies had reported back with plans. Collectively, these plans reduced the emissions of butadiene by 80 percent within the affected communities. If EPA had used normal means, it might have taken years to produce any reduction in emissions.

EPA hopes that applying these new measures—clustering, risk prioritization, and voluntary non-traditional approaches—will lead to a pollution prevention strategy that is both effective and practical.

THE STATE PERSPECTIVE

"Technical assistance is one of the relative strengths the states enjoy."

—Al Innes, Co-founder, Waste Reduction Institute for Training and Applications Research

Over the past several years, over half the states have adopted some form of pollution prevention legislation. This legislation has ranged widely in its focus and intent. State pollution prevention legislation tends to focus on the environmental and industry issues that are most important in each state, allowing states to better address statewide or regional issues.

Legislative approaches have varied in other important aspects as well. Some states have simply established technical assistance programs to help companies develop pollution prevention plans for new facilities and to help revise old waste disposal and treatment methods at existing facilities. Others have developed statutes that approach traditional "command and control." The difference is that these statutes require pollution prevention planning and activity, but attach no penalties for falling short of pollution reduction goals.

In October 1989, California passed the Hazardous Waste Source Reduction and Management Review Act. The California law has three main goals:

- Reducing the generation of hazardous waste.
- Reducing the release of harmful chemical contaminants into the environment.
- Documenting and making available hazardous waste management information to state and local government.

The law also establishes a technical and research assistance program, focused on small businesses, under the California Department of Health Services. The law allows state agencies to focus on particular industries to determine

management techniques that work well so these techniques can be shared with other industry members. This approach will also help California ensure that all members of the industry are complying with the legislation.

In stark contrast, Massachusetts developed the stiffest state pollution prevention legislation in the nation in 1990. This law is the first comprehensive mandatory law on pollution prevention in the United States. The Massachusetts act focuses on toxic use reduction. It sets a statewide target of 50 percent reduction in toxic releases by 1997. The list of chemicals regulated by the act will eventually include all 1,038 chemicals listed in federal Superfund legislation. Cuts in the emission of these chemicals must be made either by source reduction or closed-loop recycling. Other forms of pollution prevention are not included.

Beginning in 1995, Massachusetts will identify industry sectors that require priority action. These businesses may then be targeted for specific regulatory legislation. The state may also set performance standards for individual facilities within an industry segment if the majority of the facilities in that segment fail to achieve a "reasonable" reduction in toxic releases. The state could also set performance standards if a number of facilities in the segment fall below the state norm for reductions in the use of a particular toxic chemical.

Though only about half of the states have specific pollution prevention legislation, 46 states have some form of pollution prevention or waste reduction program, according to Al Innes of the Minneapolis-based Waste Reduction Institute for Training and Applications Research (WRITAR). Many of these programs focus on technical assistance.

State technical assistance programs may become especially important for smaller businesses that do not have the means or know-how to develop pollution prevention plans. According to Mr. Innes, the most effective of these programs are done outside the "regulatory sphere." Their emphasis is on constructive involvement with facilities in the planning stage, rather than simply on regulation.

Education is another important aspect of state pollution prevention programs. Many states are developing or have developed study programs for professional engineers, vocational technical school students, and even high school students. In conjunction with these programs, states are also setting up pollution prevention research grants. Six states have started research institutes.

Most states fund their programs through fee-based systems. Some states have established progressive fees for the amount of hazardous waste a facility produces. Massachusetts, however, simply sent bills to all companies over a certain size that used any of the chemicals on the toxics list in production processes. Additional revenues come from fines and the general state fund.

States have entered the pollution prevention arena rapidly and are now major forces. While a few states have done little to encourage pollution prevention, the majority have established programs and are increasing their efforts.

THE PUBLIC INTEREST GROUP PERSPECTIVE

"If you investigate the sources of the major environmental problems that we are all concerned about, you trace them back to decisions about what manufacturing processes to employ and what products to produce . . . what chemicals to use in the manufacture of those products."

—Mike Belliveau, Executive Director, Citizens for a Better Environment

Environmental and public interest groups are also actively involved in promoting pollution prevention. Though the views of many public interest and environmental organizations often differ from those of the petroleum industry, their perspective on pollution prevention is critical to understanding and addressing the industry's challenges. Many of these groups have had a major influence on pollution prevention legislation, especially on the state level. For example, state chapters of the Public Interest Research Group (PIRG) played important roles in debates about legislation adopted by Oregon and Massachusetts. Citizens for a Better Environment (CBE), a California-based group that supports environmental proposals such as the recently defeated "Big Green" initiative, has been a factor in shaping that state's environmental legislation.

CBE views citizen and government involvement in pollution prevention programs as a necessary step. Company management, workers, concerned citizens and government authorities should share decisions about products and production processes, especially in areas where environmental problems or concerns exist.

Determining what is included under pollution prevention and what isn't, including which environmental medium receives the emphasis, is also a critical step. Belliveau noted that "there has been far too much emphasis on reducing the hazardous waste stream when in fact environmental risks associated with some of the same releases into the air are much higher."

An integral part of this step is determining what level of exposure to a toxic substance is

THE INDUSTRY PERSPECTIVE: EXPLORATION AND PRODUCTION

considered safe. Safe exposure and use levels are often an area of debate between environmental activist groups and industry. CBE does not support the use of risk assessment. CBE believes that risk assessment is often abused or manipulated, rather than being used to prioritize environmental problems.

Most critical of all for CBE, pollution prevention should focus on use reduction and on reducing pollution by creating more environmentally acceptable products. Belliveau feels that the emphasis should be on consumer products rather than on facilities' waste stream volumes. "I would submit that it is the products of the oil industry that are the primary environmental problems, not the waste streams from facilities."

DOW Chemical Corporation is one company that has taken such an "enlightened, self-interested perspective," according to Mr. Belliveau. DOW has recently begun encouraging the conservation of some of its products, including halogenated solvents that are considered hazardous. Although this may hurt profits in the short run, it may also prevent some of the chemicals from being banned outright and retain a market in the long run.

The DOW example could be well utilized by the petroleum industry, Belliveau said. If petroleum companies voluntarily work towards addressing important issues, such as carbon dioxide reduction, the industry could better secure its long-run position, without facing as much regulatory and public pressure.

"Once you put down how you are planning to manage and dispose of waste . . . that sets the basis for how you do waste minimization, how you can improve the management of that waste, how you can look at alternatives."

—Jim Collins, Production Committee on Environmental Conservation, ARCO

The exploration and production (E&P) sector of the industry includes all the operations involved in looking for oil and natural gas, and taking them out of the ground once they have been found. Many of the pollution prevention problems in this sector of the industry center on produced water—water brought to the surface with the oil and natural gas with which it shares space in underground "reservoirs."

At an average production facility, 98 percent of the waste is produced water. This salty water lies beneath the lighter oil and gas. When an oil well is first drilled, the well produces almost no water. But, as production continues, more and more water comes to the surface.

The geology of each reservoir is the main determining factor in how much water a well produces. After five years of production, the typical oil well is bringing more water to the surface than oil. Depending on local factors, the cost of separating and disposing of this water may lead to closing the well, even though over half the reservoir's oil supply has not yet been pumped. Produced water is normally disposed of by pumping it back down into the ground through an "injection" well.

Because there are no ways of pumping petroleum to the surface without also bringing up produced water, opportunities to reduce pollution at the source are limited. But the oil industry is working to ensure that produced waters are properly managed.

API has developed a guidance document to assist some 20,000 small oil and gas producers, who may not have the technical ability to make environmental assessments or experience with waste disposal techniques. The aim is to help them identify environmentally acceptable ways to manage produced water.

"Muds" used when wells are drilled make up most of the other two percent of E&P wastes. Rather than dispose of drilling muds after a well is drilled, efforts focus on collecting and recycling them for use at other drilling sites.

Properly closing or "abandoning" wells presents another pollution prevention challenge for the E&P sector. Plugging abandoned wells, sometimes to depths of several hundred feet, prevents petroleum and salty water from seeping into fresh water supplies. E&P experts have developed documents explaining the proper techniques of plugging an abandoned well to help prevent any contamination of drinking water sources.

The E&P sector is implementing a successful pollution prevention program through the use of environmentally sound waste management practices. However, most of the waste produced in this sector is salt water that is normally returned to the ground from which it came. Strategies to minimize and properly manage other E&P wastes—less than one-tenth of one percent of the total waste stream—include reclaiming and reuse.

THE INDUSTRY PERSPECTIVE: REFINING
EPA/AMOCO YORKTOWN PROJECT

"We will have a chance to look at all of the emissions and then assess where we stand on a variety of environmental issues. We are hopeful that the methods and data that we develop here will be useful elsewhere."

—Howard Klee, Yorktown project director, Amoco Corporation

The petroleum industry's refining sector is responsible for turning crude oil into gasoline and other products. A single refinery may produce a wide array of products – ranging from gasoline and airline fuels to heating oils, petroleum coke and even paraffin wax.

Refineries have several different types of pollution prevention challenges. The process necessary to separate gasoline from crude oil often results in some emissions to the air. In addition, vapors can evaporate from the refineries' storage facilities. Refineries also produce several types of solid waste, including sludges, during the refining process. Finally, refineries produce waste water from certain production processes and from rain water mixing with oily materials in the plant itself.

A special joint project between Amoco's Yorktown, Virginia, refinery and EPA is underway. It is producing a careful study of all the different releases of the refinery and assessing their environmental impacts. The results of this study, the first comprehensive, multimedia analysis of an oil refinery, may have major impacts on the petroleum industry's future pollution prevention practices. The study is also important because it is the first cooperative research effort between EPA and a major oil refining company.

The study requires a multi-step process: preparing an inventory of all the releases from the Yorktown facility; exploring possible source reductions, recycling and emission control options; and assessing the costs and benefits of each of these options. The final step is

to determine potential barriers—including technical and economic concerns as well as regulatory restrictions—and incentives for each of these options.

The study's first step, developing an inventory of releases, has already been completed. This inventory was developed by taking a series of more than 1,000 air, water and soil samples. These samples were then subjected to 10 to 20 separate analyses that determined the content of the sample. The sampling was rapid, but thorough, producing results that apply specifically to the Yorktown site.

The inventory showed that the major releases from the refinery were air emissions. Evaporative losses during the loading and unloading of tank barges—the principal means of moving both crude oil and refined products at the Yorktown refinery—and releases from "coker" ponds were the two largest sources of air emissions.

The sampling also showed that very little soil or groundwater contamination had occurred—mostly due to natural soil conditions, the use of high grade piping, and the fact that the facility has had no major spills.

To complete the multimedia sample, EPA and Amoco also studied the transfer of pollutants from one environmental medium to another. The study showed that no significant transfers had occurred, because most of the chemicals emitted from the facility don't dissolve easily in water.

After completing the inventory of source emissions, the project looked at a wide range of different pollution prevention options to reduce these emissions. For the largest source of emissions, the coker pond, the investigation focused on ways of changing the coker operation. For the second largest source of emissions, barge loading, EPA and Amoco looked into vapor recovery and other methods of capturing loading losses. Vapor recovery practices are already being used in many operations, so this option may prove feasible and could help to eliminate emissions.

The final results of this project, which has been underway since November 1989, should come at the end of 1991. The project has already shown that it is possible to get good emissions sampling data for an oil refinery, pinpoint emission sources and develop strategies for reducing emissions. This cooperative project cost well over a million dollars to conduct, making it economically impossible to perform at every facility. But new methods of testing and other innovations may be developed to make pollution prevention practical for most refineries.

THE INDUSTRY PERSPECTIVE: MARKETING

"We have many environmentally-driven considerations that we have to consider in the design of a retail facility for the future. We expect that these changes will come rapidly."

—Sully Curran, Marketing Environmental Subcommittee, Exxon Company USA

Almost everyone in the country is familiar with the largest area of operations in the marketing sector—service stations. But the marketing sector also includes a chain of distribution and transportation facilities made up of storage tanks, pipelines and delivery vehicles. In the marketing sector, pollution prevention challenges center around reducing emissions of gasoline vapors, preventing leaks from storage tanks, and limiting the amount of solid wastes that result from servicing automobiles.

Distribution facilities are usually made up of large aboveground storage tanks and an intricate series of pipes, valves and pumps necessary to handle the changing demand for different grades and types of fuel. Evaporative air emissions and waste waters are the major sources of pollution from these facilities.

API is developing a recommended practice, laying out the steps petroleum terminals should take before they discharge waste waters to water treatment plants or nearby surface waters. The recommended practice will be based on research performed by API over the past four years. Currently, several API member companies are using this research to design their waste water treatment facilities.

Truck loading is perhaps the greatest source of evaporative losses in the marketing sector. When tank trucks are filled at a distribution terminal or unloaded at a service station, part of the fuel vaporizes and is lost. This vapor is potentially harmful to both employee health and the environment because it can contribute to smog formation. Recovery techniques capture

these vapors and hold them until they can be condensed back into gasoline at the distribution terminal. Because this pollution prevention procedure can help conserve gasoline and eliminate harmful emissions, it offers both environmental and economic incentives.

Changes are also being made in aboveground storage tanks. Many of these storage tanks are equipped with a floating pan in addition to a fixed roof. An ever increasing number of these floating pans now use double seals to reduce evaporative emissions from volatile materials. These double seals capture about 95 percent of all vapors.

"Fugitive" emissions from the many valves, flanges and pumps at distribution terminals are also a pollution prevention concern. To reduce these emissions, many facilities schedule regular inspections to identify and repair or replace leaky valves and flanges.

Though many of the controls at distribution terminals are aimed at cutting evaporative emissions, pollution prevention measures are also being taken to protect surrounding soils and water. Tanks and piping are regularly inspected for corrosion and weakness so repairs can be done before a leak develops. Many new aboveground tanks in environmentally sensitive areas are being built with double bottoms in order to contain potential leaks. Impervious retention areas are also being built around some storage tanks. Storm drainage systems are being developed to keep rain water separated from oily water at terminals. And containment systems are being built beneath pumps and various connections to capture and clean oily water from any leaks that may occur.

Though most service stations face many of the same pollution prevention issues, their facilities are different—and so are their solutions.

Vapor recovery is an important pollution prevention issue for fuel retailers. At many service stations, when a truck unloads a delivery of fuel it collects vapors from underground storage tanks. It then takes them back to the terminal, where they are processed. Many stations also have vapor recovery systems that capture vapors released during automobile refueling.

In addition, the petroleum industry has been active in developing on-board vapor recovery systems for automobiles. They capture and process vapors from the vehicle's fuel tank.

Service stations have also developed pollution prevention controls for their underground storage tanks. Preventing leaks from underground storage tanks is important because such leaks might contaminate ground water or soil. To prevent them, many underground storage tanks now use secondary containment systems. And because most underground leaks at service stations come from piping connections, potential leaks from underground equipment are identified by piping leak detectors or averted by secondary containment systems.

Fuel retailers are also developing new ways of handling the waste produced by servicing automobiles. A station's service bay can contain oil drippings, antifreeze drippings, asbestos shavings from brake pads and other wastes at the end of a day of servicing automobiles. In the past, these wastes were simply washed down the drain. No longer. Absorbents are now used on

service bay floors so these wastes can be collected for proper disposal. Wet or dry vacuum cleaners are used to pick up water and dispose of it properly. Pollution prevention techniques have been developed to recycle used motor oil from automobiles. In the future, antifreeze may also be recycled. Some source reductions are being carried out as well. Elimination of asbestos from brake shoes and pads is one example.

Unfortunately, many small service station owners do not have the technical knowledge or the resources to employ all available pollution prevention techniques. Programs to improve pollution prevention education and provide technical assistance to petroleum product marketers are underway.

PLANNING FOR THE FUTURE

Gathering experts at preventing pollution from different sectors of the petroleum industry, environmental groups and the government provided valuable insights on challenges and new techniques.

Through API, the industry is sponsoring a wide range of research projects that seek to foster greater understanding of pollution prevention opportunities and environmentally sound operating practices. API has established a task force with representatives of various sectors of the industry to direct this effort. The industry's pollution prevention research program includes initiatives that will:

- Identify meaningful ways for measuring progress toward pollution prevention in the industry.
- Investigate refinery design to determine whether basic processing units could be redesigned to make their operations more environmentally sensitive.
- Conduct annual surveys of refinery wastes, determine how they are generated and managed, and document waste production trends over time.
- Produce a compendium of state-of-the-art waste minimization practices used in all petroleum industry sectors as a technology transfer tool.

As new insights are gained from this research, they are conveyed to federal and state regulators and legislators working to meet the nation's environmental goals. More importantly, these insights are helping the industry produce new practices, new plants and new products that fill the public's expectations for environmental excellence.

POSTER SESSION AUGMENTS DISCUSSIONS

Displays of posters and other materials—from government agencies, the University of California at Los Angeles (UCLA), the Chemical Manufacturers Association, petroleum companies and other industry groups—augmented the discussions at the 1990 annual meeting of the Health and Environment General Committee. Among the subjects of the exhibits were:

- U.S. Environmental Protection Agency pollution prevention efforts and U.S. Department of Energy research conducted by Pacific Northwest Laboratory. The goals of this research include identifying key industrial hazardous waste problems and defining related research and development needs.

- Scientific studies by professors and students at UCLA's chemical engineering department. The topics of their research include multimedia modelling of refinery pollutants, applying chemical mass balance techniques to refinery waste water systems, adsorption of trace organics with polymer adsorbents, and waste minimization by process synthesis.

- The Chemical Manufacturers Association's Responsible Care program, created in 1988 to raise the industry's level of performance in health, safety and environmental quality. The program is built around a set of guiding principles and six codes of management practices, among them a pollution prevention code "designed to improve the industry's ability to protect people and the environment by generating less waste and minimizing emissions."

- Waste management, waste minimization and other pollution prevention programs conducted by individual petroleum companies, including BP America, Chevron, Phillips, Shell and Texaco.

- Research on pollution prevention by the Petroleum Environmental Research Forum, an industry group that shares research costs and findings.

- An overview of the petroleum industry's perspective on proposed pollution prevention legislation, including an analysis of its goals, scope, programs and requirements.

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