POLLUTION PREVENTION: STRATEGIES FOR PETROLEUM REFINING

The pollution prevention practices described here have been developed specifically for the petroleum refining industry and have been implemented in other petroleum refining facilities.

What is pollution prevention?
Pollution prevention is the reduction or elimination of discharges or emissions to the environment. This includes all pollution: hazardous and non-hazardous, regulated and unregulated, across all media, and from all sources. Pollution prevention can be accomplished by reducing the generation of wastes at their source (source reduction) or by using, reusing or reclaiming wastes once they are generated (environmentally sound recycling).

Why practice pollution prevention?
Pollution prevention is good business. While most pollution control strategies cost money, pollution prevention has saved many firms thousands of dollars in treatment and disposal costs alone.

Many companies have already discovered the tremendous benefits of pollution prevention. The 3M Co.’s “Pollution Prevention Pays” Program has eliminated the annual generation of more than 500,000 tons of pollutants. Cumulative savings since the program began in 1975 are estimated at $426 million.

Smaller companies can also benefit. One firm reduced its hazardous waste disposal costs by 74% and decreased raw material costs by 16%.

By reducing or eliminating wastes a firm can:

- solve the waste disposal problems created by land bans
- reduce waste disposal costs
- reduce costs for energy, water and raw materials
- reduce operating costs
- protect workers, the public and the environment
- reduce risk of spills, accidents and emergencies
- reduce vulnerability to lawsuits and improve its public image
- generate income from wastes that can be sold

Each of the pollution prevention practices described in this fact sheet is an extension of the simple but powerful idea that it makes far more sense to eliminate the generation of waste than to develop complex and costly treatment schemes once it has been generated.
How do we get started?

A systematic approach will produce better results than piecemeal efforts. An essential first step is a comprehensive waste audit. The waste audit should systematically evaluate opportunities for improved operating procedures, process modifications, process redesign and recycling.

To conduct a waste audit, follow these steps:

- List all generated waste
- Identify the composition of the waste and the source of each substance
- Identify options to reduce the generation of these substances in the production or manufacturing process
- Focus on wastes that are most hazardous and techniques that are most easily implemented
- Compare the technical and economic feasibility of the options identified
- Evaluate the results and schedule periodic reviews of the program so it can be adapted to reflect changes in regulations, technology, and economic feasibility

Will pollution prevention work in petroleum refining?

Petroleum refinery wastes result from processes designed to remove naturally occurring contaminants in the crude oil, including water, sulfur, nitrogen and heavy metals. According to Department of Commerce figures in 1988, the petroleum refining industry spent approximately $2 billion on pollution control.

These costs provide petroleum refiners with tremendous incentive to find ways to reduce the generation of waste. The pollution prevention practices described here have been developed specifically for the petroleum refining industry and have been implemented in other petroleum refining facilities.

Setting up a pollution prevention program does not require exotic or expensive technologies. Some of the most effective techniques are simple and inexpensive. Others require significant capital expenditures, however many provide a return on that investment.

Improved Operating Procedures

Good operating procedures rely not on new technological developments, but on human adaptability. Small changes in personnel practices, housekeeping, inventory control, waste stream segregation, material handling and scheduling improvements, spill and leak prevention and preventive maintenance can mean big waste reductions. Some examples in petroleum refineries include:

- Segregate process (oily) waste streams from relatively clean rainwater runoff in order to reduce the quantity of oily sludges generated and increase the potential for oil recovery. A significant portion of the refinery waste comes from oily sludges found in combined process/storm sewers.
- Conduct inspection of petroleum refinery systems for leaks. For example, check hoses, pipes, valves, pumps and seals. Make necessary repairs where appropriate.
- Conserve water. Reuse rinse waters if possible.
- Reduce equipment cleaning frequency where beneficial in reducing net waste generation.
- Use correct pressures, temperatures and mixing ratios for optimum recovery of product and reduction in waste produced.
- Employ street sweeping or vacuuming of paved process areas to reduce solids to the sewers.
- Pave runoff areas to reduce transfer of solids to waste systems.
- Use water softeners in cooling water systems to extend useful cycling time of the water.
Recycling

Recycling is the use, reuse or reclamation of a waste after it is generated. At present the petroleum industry is focusing on recycling and reuse as the best opportunities for pollution prevention. Some examples are:

- Use phenols and caustics produced in the refining operations as chemical feeds in other applications.
- Use oily waste sludges as feedstock in coking operations.
- Regenerate catalysts. Extend useful life. Recover valuable metals from spent catalyst. Possibly use catalyst as a concrete admixture or as a fertilizer.
- Maximize slop oil recovery. Agitate sludge with air and steam to recover residual oils.
- Regenerate, filtration clay. Wash clay with naphtha, dry by steam heating and feed to a burning kiln for regeneration.
- Recover valuable product from oily sludge with solvent extraction.

Process Modifications

The petroleum industry requires very large, capital intensive process equipment. Expected lifetimes of process equipment are measured in decades. This limits economic incentives to make capital intensive process modifications to reduce wastes generation. However, some process modifications do reduce waste generation. They include the following:

- Add coking operations. Certain refinery hazardous wastes can then be used as coker feedstock, reducing the quantity of sludge for disposal.
- Install secondary seals on floating roof tanks: Where economically and technologically appropriate, replace with fixed roofs. This can eliminate collection of rainwater, contamination of crude oil or finished products, and oxidation of crude oil.
- Where economically feasible, consider:
  - Replacing clay filtration with hydrotreating.
  - Substituting air coolers or electric heaters for water heat exchangers to reduce sludge production.
  - Installing tank agitators. This can prevent solids from settling out.
  - Concentrating similar wastewater streams through a common dewatering system.

Process Redesign

Petroleum engineers have done a good job of designing and modifying processes and technologies to recover product and unconverted raw materials. In the past, they pursued this strategy to the point that the cost of further recovery could not be justified.

Now the costs of end-of-pipe treatment and disposal have made source reduction a good investment. Greater reductions are possible when process engineers trained in pollution prevention plan to reduce waste at the design stage. Designs that reduce waste can also reduce energy consumption and maintenance costs.
Who’s going to do it?

Pollution prevention requires a new attitude about pollution control. Traditional thinking places all the responsibility on a few environmental experts in charge of treatment. The new focus makes pollution prevention everyone’s responsibility. Preventing pollution may be a new role for production-oriented managers and workers, but their cooperation is crucial. It will be the workers themselves who must make pollution prevention succeed in the workplace.

Management commitment and employee participation are vital to a successful pollution prevention program. Management can demonstrate its commitment to pollution prevention and encourage employee participation by:

- Training employees in pollution prevention techniques
- Encouraging employee suggestions
- Providing incentives for employee participation
- Providing resources necessary to get the job done

ADDITIONAL PUBLICATIONS


Profit From Pollution Prevention, Monica Campbell and William Glenn, Pollution Probe Foundation, 12 Madison Avenue, Toronto, Canada, M5R 2S1, 1982.

Hazardous Waste Minimization Industrial Overviews, Edited by Harry M. Freeman. JAPCA Reprint Series RS-14, 1989, Air & Waste Management Association, P.O. Box 2861, Pittsburgh, PA 15230. (Call 412-232-3444)


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