Colorado Department of Public Health & Environment

NOVEMBER 2001

POLLUTION PREVENTION IDEAS FOR THE CHEMICAL AND ALLIED PRODUCTS SECTOR

The environmental aspects of chemical manufacturing are regulated by numerous federal and state regulations that address air emissions, hazardous waste management, and in some instances wastewater discharges. The Colorado Department of Public Health and Environment (CDPHE) prepared this bulletin to convey information about source reduction practices for businesses in the chemical and allied products sector. Source reduction, or pollution prevention (P2), practices complement emission control measures and waste management procedures required by regulations. CDPHE defines P2 as the reduction or elimination of pollutants or wastes at the source, by using less hazardous raw materials or using more efficient practices or processes. It includes reducing the use of energy, water, and other resources through increased efficiency or through conservation. For more information about regulations that apply to chemical manufacturing, contact Joyce Williams at (303) 692-3367 or visit the web sites included throughout this document.

HOTLINE!

Through June 2002, CDPHE is offering focused P2 research and implementation support through a P2 Hotline (303-312-8880). Take advantage of this free and confidential opportunity to obtain assistance investigating process improvements that are on your "wish list" or address waste streams that are expensive to manage or cause compliance problems. Call now!

The objective of this bulletin is to stimulate small quantity generators of hazardous waste to consider implementing various P2 strategies. Over the past 10 to 20 years, many fact sheets, books, and other forms of guidance on P2 opportunities for the chemical and allied products sector have been created. The level of detail and applicability of information in these resources varies considerably. CDPHE reviewed the readily available P2 material and this document presents references to resources it considers to be useful to businesses in the chemical and allied products sector.

After June 2002, contact the CDPHE P2 Program: Kirk Mills at (303) 692-2977 or Margo Griffin at (303) 692-2979. The CDPHE P2 Program (www.coloradoP2.org) provides confidential, non-enforcement, P2 assessments for Colorado businesses and follows up with a report that summarizes P2 opportunities.

Through the Michigan Source Reduction Initiative (MSRI), Dow Chemical reduced emissions of its targeted chemicals by 43 percent (593,000 pounds per year) and targeted wastes by 37 percent (11 million pounds per year). See pages 2 to 4 of this fact sheet for more information about MSRI and other case studies that resulted in cost savings and reduced waste generation at chemical and allied products sector facilities.

The products generated by businesses in the chemical and allied products sector vary and include manufacturing of pharmaceuticals, paint, laboratory chemicals, inks and also chemical purification. However, the processes that produce these chemicals and the type of wastes generated are similar across the entire sector. Most processes performed by businesses in the chemical and allied industry fall into the following general categories:

- ✓ Mixing
- ✓ Reactions
- ✓ Clean-up
- ✓ Heating, cooling, and drying
- ✓ Physical transportation
- ✓ Phase and chemical separation

Typical wastes generated by these processes include:

- Spent chemicals
- Laboratory chemical waste
- Waste oils
- Spent and dirty filters
- Process wastewater
- Empty product containers
- By-products
- Expired, obsolete, contaminated, or off-spec materials
- Reacted or polymerized chemicals
- Air emissions
- Tanker heels
- Process cleaning wastes

For the chemical and allied products sector, most P2 opportunities are related to improving process efficiency versus purchasing new technologies. Further, relatively few fundamental changes have occurred in the chemicals or processes commonly used by chemical manufacturers. Therefore, existing P2 literature created by the U.S. Environmental Protection Agency (EPA), many state environmental agencies, and other organizations continues to be relevant to chemical manufacturers. This bulletin highlights some case studies of successful P2 implementation at chemical and allied products sector businesses and summarizes some of the P2 material and information sources applicable to chemical manufacturing.

CASE STUDIES

Businesses in the chemical and allied products sector have many opportunities for environmental improvement. The sector also includes many examples of businesses that have successfully implemented P2. An outstanding case study for this sector is from the Michigan Source Reduction Initiative (MSRI). The MSRI involved a cooperative effort between Dow Chemical Company, the National Resources Defense Council (NRDC), a group of five community activists and environmentalists, and an expert P2 consultant. The Dow

facility in Midland, Michigan had been evaluated many times for P2 opportunities and all parties involved in the project were skeptical about further P2 implementation. Even so, the MSRI set ambitious P2 goals including reducing waste and emissions of 26 priority chemicals by 35 percent in 3 years using only P2 strategies. Through the course of the initiative, 17 P2 opportunities were implemented and Dow reduced emissions of its targeted chemicals by 43 percent (from 1 million to 593,000 pounds per year) and targeted wastes by 37 percent (from 17.5 million pounds to 11 million pounds per year). More details about the MSRI are included in a report titled Preventing Industrial Pollution at Its Source which is available at www.nrdc.org/cities/manufacturing/msri/msriinx.asp.

An adiponitrile plant in Orange, Texas installed an inexpensive solenoid valve on the line supplying process water to flush the seals of process pumps used in intermittent service. The solenoid, which is connected to the pump control system, shuts off flush water when the pumps are not running. As a result, the plant reduced its wastewater volume by 57 million gallons per year. The same facility upgraded the catalyst decanting system in a petrochemical process, increasing the catalyst recovery rate and process yield. Solid wastes were reduced by about 1,000,000 pounds per year. The investment in new equipment paid for itself in approximately 18 months.

As part of an overall effort that reduced waste generation by 98 percent, Dow Corning installed mechanical separators between a fluid bed reactor and a distillation column in a silane manufacturing process. The separators reduced the amount of solids that settle in the column. The process modification reduced the frequency of maintenance and lowered the amount of product lost when solids are pumped out of the column for disposal.

These and numerous other successful examples of P2 from the chemical and allied products sector reveal at least three common characteristics:

1. Many P2 opportunities are based on modifications to the mechanical and control systems used in the facility and do not require modification of the underlying process technology (or process chemistry).
2. Most of the waste reduction occurs on intermittent (e.g., maintenance-related) or ancillary process streams (e.g., process utilities such as steam, cooling water, etc), which are generally not included in the process flow sheet.
3. Many modifications could have been anticipated and incorporated at some stage in the design of the original plant.

The following resources each contain P2 case studies related to the chemical and allied products sector:

- EnviroSense Commercial Companies Case Studies: http//es.epa.gov/techinfo/case/comm./comm.html
- EnviroSense Minnesota Technical Assistance Program (MnTAP) http://es.epa.gov/program/regional/state/minn/mntap/mntap.html
- University of Texas El Paso Southwest P2 Success Stories Database http://p2.utep.edu/success/index.cfm
- TNRCC Pollution Prevention Ideas from Texas Industries: A Case Study Compendium Document AS-40. March 1996.

P2 INFORMATION SOURCES AND LINKS

The following table contains information about P2 information for businesses in the chemical and allied products sector.

TITLE AND REFERENCE INFORMATION	DESCRIPTION
Chemalliance Improving the Bottom Line, P2 Options for Chemical Manufacturers www.chemalliance.org/Columns/Improving/P2_Options_for_Chem_Manufacturers.htm	List of P2 options for chemical manufacturers organized by waste origin: ▪ Material input, storage, and handling ▪ Reactors ▪ Pumps ▪ Heat exchangers ▪ Distillation column ▪ Piping ▪ Furnaces ▪ Processing ▪ Laboratory wastes ▪ Cooling towers ▪ Equipment cleaning and changeover
Delaware Department of Natural Resources and Environmental Control **P2 Guide for Small Chemical Manufacturing Operations** www.dnrec.state.de.us/del-chem.htm	Fact sheet that discusses: ▪ Waste audits ▪ Improving operating procedures ▪ Production process and equipment modification ▪ Reusing and recycling other wastes ▪ Management support ▪ Follow-up ▪ Additional information sources
Pollution Prevention Methodology, Technologies, and Practices by K.L. Mulholland and J.A. Dyer	Recommended by Chemalliance as a thorough and useful book for P2 for the Chemical and Allied Products Sector; available though the American Institute of Chemical Engineers (www.aiche-mart.org)

TITLE AND REFERENCE INFORMATION	DESCRIPTION
P2 in Colorado www.coloradop2.org/19	Web site contains links to recycling and materials exchange resources.
Laboratory Waste Minimizations and Pollution Prevention www.seattle.battelle.org/services e&s/ P2LabMan/index2.htm	Laboratory waste minimization and P2 guide. Focus on school laboratories, but contains information applicable to many laboratory settings.

WEB PAGES

Chemalliance (www.chemalliance.org)

Chemalliance is a compliance assistance center supported by EPA Office of Enforcement and Compliance Assistance (OECA). Its mission is to assist small chemical manufacturers in improving environmental performance through compliance assistance and P2. It serves as a clearinghouse for compliance and P2 information.

American Chemistry Council (www.cmahq.com)

The American Chemistry Council (formerly known as the Chemical Manufacturers Association) represents the chemical industry on public policy issues, coordinates the industry's research and testing programs, and administers the industry's environmental, health, and safety performance improvement initiative, known as Responsible Care®. Responsible Care® is the chemical industry's commitment to the continuous improvement of health, safety, and environmental quality. It includes a self-evaluation process that helps evaluate the industry's performance, mutual assistance, and performance improvement measurements. According to the 2000 Responsible Care® Progress Report, Responsible Care Council Members and Partners reduced emission by 58 percent from 1988 to 1997 while increasing productivity by 18 percent. For more information about Responsible Care®, visit the American Chemistry Council web site.

EnviroSense (http://es.epa.gov)

EnviroSense is part of the EPA's web site and provides a single repository for P2, compliance assurance, and enforcement information and databases. It has a search engine that searches web sites inside and outside the EPA, and offers assistance in preparing a search.

- Information about solvent substitution alternatives is located at http://es.epa.gov/ssds/ssds.html
- Chemical Manufacturers Association (created before name change to American Chemistry Council) fact sheets are located at http://es.epa.gov/techinfo/facts/cma/cma.html

U.S. Department of Energy Office of Industrial Technology (OIT) (www.oit.doe.gov/chemicals/bp.shtml)

OIT maintains a web page with best environmental practices for the chemical manufacturing industry. The web site focuses on energy reduction opportunities for many operations relevant to chemical and allied sector businesses. The web site also includes publications, software, and a list of emerging technologies.

SolvDB® (http://solvdb.ncms.org/whatfind.htm)

National Center for Manufacturing Sciences (NCMS) maintains a web site with information on commercially available solvents. The NCMS solvent database, SolvDB®, can be searched and organized according to the following criteria:

- Health and safety
- Chemical and physical
- Regulatory responsibilities
- Environmental fate data

Solvent Alternatives Guide (SAGE) (www.clean.rti.org)

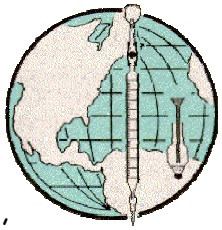
SAGE was developed by the Surface Cleaning Program at Research Triangle Institute in cooperation with the EPA Air Pollution Prevention and Control Division. SAGE is a comprehensive guide designed to provide P2 information on solvent and process alternatives for parts cleaning and degreasing.

EPA Office of Enforcement and Compliance Assurance (OECA) (http://es.epa.gov/oeca/main/compasst/chem.html)

OECA's web site has numerous resources for the chemical and allied products sector. The above web site has compliance information specific to the chemical and allied products sector. Additional resources available through OECA include:

- ✓ **Profile of the Agricultural Chemical, Pesticide, and Fertilizer Industry**
  http://es.epa.gov/oeca/sector/#agri
- ✓ **Profile of the Organic Chemical Industry**
  http://es.epa.gov/oeca/sector/#organic
- ✓ **Profile of the Inorganic Chemical Industry**
  http://es.epa.gov/oeca/sector/#inorganic
- ✓ **Profile of the Petroleum Refining Industry**
  http://es.epa.gov/oeca/sector/#petrol
- ✓ **Profile of the Pharmaceutical Industry**
  http://es.epa.gov/oeca/sector/#pharamin

National Microscale Chemistry Center (NMC2)
(http://host.silvertech.com/micorscale/index.html)



NMC2 was established to promote source reduction of toxic waste by using microscale chemistry. Microscale chemistry reduces chemicals used in laboratory experiments to the minimum level at which the experiments can effectively be performed. NMC2 focuses on providing workshops, seminars, and publications on the operation and advantages of conversion of laboratories to the microscale level.

ENVIRONMENTAL MANAGEMENT SYSTEMS

Many small chemical manufacturers are finding that Environmental Management Systems (EMS) can help them focus their environmental programs more effectively. A well-designed EMS can also be a powerful tool for identifying and implementing pollution prevention projects. In simple terms, an EMS is a systematic approach to managing the impacts of an organization's activities, products, or services on the natural environment. An EMS offers a management structure for setting and achieving environmental objectives and for demonstrating how such objectives are achieved. The key elements of an EMS are as follows:

- Environmental policy
- Planning
- Implementation and operation
- Checking and corrective action
- Management review
- Continual improvement

EPA funded the development of an "EMS Implementation Guide for Small- and Medium-Size Organizations" that is particularly useful for chemical and allied sector businesses considering an EMS. The second edition of this guide was published in January 2001 and can be obtained from www.epa.gov/owm/wm046200.htm#guide1 or by calling the EPA Water Resource Center at (202) 260-7786.