



Success Story #4



COMMONWEALTH OF PENNSYLVANIA • DEPARTMENT OF ENVIRONMENTAL PROTECTION

Process Change in the Pharmaceutical Industry

COMPANY	Merck & Company Inc. - Cherokee Plant
LOCATION	Northumberland County, Northcentral Region
PRODUCT/INDUSTRY	Manufacturer of pharmaceutical intermediates (SIC 28)
WASTE STREAM/CHEMICAL	Methylene Chloride
PROCESS	Synthesis of a component of the antibiotic PRIMAXIN
POLLUTION PREVENTION COST	\$34 million
SAVINGS/OTHER BENEFITS	Cost savings for one year period is about \$14 million
POLLUTION PREVENTION METHOD	Process Modification Raw material substitution

BACKGROUND

Merck & Company Inc. established a pharmaceutical manufacturing facility in Riverside, Northumberland County, in 1950. Since 1984, this facility has used methylene chloride, a volatile organic solvent, to synthesize imipenem, a component of the broad spectrum antibiotic drug PRIMAXIN. Methylene chloride is an animal carcinogen and is listed as a priority pollutant by the federal Environmental Protection Agency (EPA). Changes in the use of these chemicals can reduce environmental emissions of suspected carcinogens.

In April 1989, Merck voluntarily established environmental policy goals to reduce air emissions of carcinogens or suspect carcinogens by the end of 1991, then to eliminate or reduce air emissions by the end of 1993. Another goal was to reduce all environmental releases of toxic (SARA) chemicals, including transfers of materials off-site for treatment or disposal, by the end of 1995. Although manufacturing operations have grown, Merck met its 1991 goal.

The federal Clean Air Act Amendments of 1990 address methylene chloride emissions in the pharmaceutical industry through the Hazardous Organic National Emission Standards for Hazardous Air Pollutants (HON) regulations, which were proposed on Dec. 31, 1992. More regulations are due from EPA in November 1997.

PROCESS CHANGE

Methylene chloride was the major solvent used in the synthesis of imipenem. In order to meet its air emissions goals, Merck chemists and engineers developed a new manufacturing chemistry process that eliminated the use of methylene chloride in the synthesis of imipenem at a cost of \$34 million. As part of this change, Merck substituted smaller amounts of solvents which are viewed to have fewer environmental effects than methylene chloride. This new process was implemented at Merck's Cherokee plant in 1992.

Some of the other chemistry process modifications include:

1. Computer controlled ultrafiltration technique to filter extremely small particles. This method increases product yield and improved quality of imipenem.
2. Solvent recovery to reuse solvent, which reduces solvent consumption and disposal.

EQUIPMENT CHANGE

When the new process was installed, the factory area was upgraded with a computerized distributed control system (DCS) and equipment modularity. The number of imipenem processing operations was reduced by almost 50 percent with the DCS automated and sequenced chemical reaction steps. Key measurements are continuously monitored by a computer that operates valves, pumps and motors on the equipment to provide control of the chemical process. The DCS reduces the potential for human error.

ENVIRONMENTAL RESULTS

Reduced VOC Management

With the new process, Merck eliminated not only the purchase of significant quantities of methylene chloride, but also the storage and disposal of hazardous waste. According to Merck, the new chemistry process has also resulted in a 75 percent reduction of biological oxygen demand (BOD) load to the on-site waste water treatment plant. BOD is the amount of oxygen used by micro-organisms in the breakdown process of pollutants in polluted water and waste water.

Also, best available technology end-of-pipe controls were added with the installation of a fume incinerator. Toxic (SARA) air emissions were decreased more than 300,000 pounds a year in the antibiotic production area by this incinerator.

Bonuses from the new process were decreased risk of accidental spills of hazardous materials, increased employee protection, and ease of achieving compliance with more stringent environmental regulations. Additionally, Merck reduced its environmental liability by implementing pollution prevention into its manufacturing process.

COST SAVINGS

The improved process lowered production costs of imipenem. At an estimated savings of more than \$14 million per year, Merck & Company expects a short-term payback of their \$34 million investment for the new process.

POLLUTION PREVENTION GOAL

The goal of pollution prevention is to reduce the quantity or toxicity of waste generated within the production process. To achieve this goal and protect the environment, Merck's Cherokee Plant personnel developed an innovative manufacturing process that eliminated the use of methylene chloride, increased product yield and added manufacturing flexibility for future process changes.

These efforts were recognized when Merck won the Governor's Waste Minimization Award in 1990 and 1992.

This case study illustrates how industry can use innovation to protect the environment by preventing pollution before it is created, contain costs and boost productivity.

**For more information about
pollution prevention, contact:**

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This fact sheet and related environmental information are available electronically via Internet.

Access the DEP Web Site at <http://www.dep.state.pa.us>

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