Pollution Prevention

The 3M story
“Pollution Prevention Pays”
&
Extracting Principles

Testimony to U.S. Congress in 1993 by Dr. Robert P. Bringer, then VP at 3M:

“We believe that environmental interests and our business interests have merged.”

Primary goal:
SUSTAINABILITY
(responsibility toward future generations)

Basic approach:
INDUSTRIAL ECOLOGY
(imitation of nature)

Imitation of ecosystem:
ECO-INDUSTRIAL PARKS
(closing material loops, energy efficiency)

In addition:
GREEN TECHNOLOGIES
(pollution avoidance rather than pollution treatment)

POLLUTION PREVENTION
(green processes)
The 3M company has pioneered the way

Evolution of logos for the
3P (Pollution Prevention Pays) program at 3M,
since inception

Program was established in 1975
by Dr. Joseph Ling (then Staff VP)
and further developed
by Dr. Robert P. Bringer (then VP for manufacturing).

Pollution Prevention Pays (3P)

Over the last 34 years, the program has prevented more than 3 billion pounds of pollutants and saved nearly $1.4 billion based on aggregated data from the first year of each 3P project.

The 3P program helps prevent pollution at the source – in products and manufacturing processes – rather than removing it after it has been created. When 3P was launched in 1975, the concept of applying pollution prevention on a companywide basis and documenting the results was an industry first.

The 3P program is predicated on the belief that prevention is more environmentally effective, technically sound and economical than conventional pollution controls. Natural resources, energy and money are used to build conventional pollution controls, and more resources are consumed operating them. 3P seeks to eliminate pollution at the source through:

- Product reformulation
- Process modification
- Equipment redesign
- Recycling and reuse of waste materials.

The 3P program depends directly on the voluntary participation of 3M employees. Innovative projects are recognized with 3P Awards. A 3P Coordinating Committee representing 3M's engineering, manufacturing and laboratory organizations - and the Environmental, Health and Safety group - administers the program.
Projects must meet these criteria to receive formal recognition:

- Eliminate or reduce a pollutant;
- Benefit the environment through reduced energy use or more efficient use of manufacturing materials and resources;
- Save money through absence or deferral of pollution control equipment costs, reduced operating and materials expenses, or increased sales of an existing or new product.

3M employees worldwide have completed over 7,400 3P projects to date.

3P results in 2008 alone:
- 616 projects completed
- $122 million lbs of pollution prevented
- almost $91 million saved.

Waste Reduction by Electrode Redesign

A 3P project team from 3M's Valley, Nebraska facility reduced the inherent waste (waste inherent to the product design and process) from adhesive electrodes used in electrocardiogram (EKG) applications, by redesigning the electrode. The team changed the configuration of the electrodes on the card which reduced silver coating weight, adhesive coating weight, and the overall size of the electrode. The project prevented nearly 11 tons of waste and saved nearly $1,000,000 in its first year of implementation.

Reduction in Solvent Emissions from Tape Production

In 2005, a 3P team from 3M Brazil's Itapetininga facility replaced the solvent-based paper treatment process the plant used to manufacture packaging, medical and masking tapes with a new, water-based process.

As a result of this change, the facility reduced solvent emissions by over 45 tons per year. By preventing solvent emissions at the source, the plant also eliminated the need for pollution control equipment, reducing the plant's energy use and eliminating over 125 metric tons of CO2 emissions annually.

The project is expected to save the facility over $850,000 in its first year of implementation.
Four-pronged approach:

- Reduction of solid waste  
  **TARGET:** 20% reduction from 2005 to 2010  
  achieved 27%

- Reduction of releases in water  
  **TARGET:** 25% reduction from 2005 to 2010  
  achieved 30%

- Reduction of air emissions  
  **TARGET:** 25% reduction from 2005 to 2010  
  achieved 58%

- Improve energy efficiency  
  **TARGET:** 20% reduction from 2005 to 2010  
  achieved 27%

1) Solid-waste reduction: Accomplishments and issues

From 1990 to 2000, solid waste sent to landfills was reduced by 24%,  
from 295 million lbs in 1990 to 224 million lbs in 2000.  
2010 target reached in 2009.

![Total Waste (excludes recycling) chart](chart.png)

Issues being faced today:
- Highly fluctuating recycling markets (some declining)
- Reaching plateau → need to engage in product redesign
EXAMPLES

Dental Product Waste Becomes a Source of Revenue

3M Irvine, California manufactures dental products. As part of its operations, the facility generates platinum catalyst waste. In 2006, the facility implemented a 3P project which turned this waste into a raw material by working with a recycler to recover and process the waste so that it can be reused. Through this new process, the facility saves over $100,000 and prevent over 1,000 tons of platinum waste annually.

Tape Product Developed from Manufacturing Waste

In 2004, 3M Taiwan reformulated its carrier tape to be constructed from waste materials. The new formulation is made of 100% recycled materials, reducing the facility’s waste by 120 tons in the first year of the project alone. By using on-hand waste to make the new tape, the facility also eliminates the fees associated with raw material purchases and waste handling.

3M’s Valley, Nebraska Facility Reduces Packaging Waste

3M’s Valley, Nebraska facility has worked with its vendor to switch to reusable packaging for some of the components it purchases to make respirators. Before this project, Valley received the components on spools packaged in a box. The components vendor did not want the original boxes back, and the empty spools had to be returned to the vendor in new, different boxes.

The facility now uses a packaging system where both the empty spools and their containers are returned, reducing shipping waste by approximately 8 tons in the first year of the project and saving 3M Valley over $1,500 in packaging and disposal costs.

ADDITIONAL EXAMPLE

Returnable Steel Crates for International Shipment Reduce Waste

3M’s Cottage Grove, Minnesota, facility developed a collapsible, reusable steel crate that reduces waste and saves money.

Prior to the development of this 3P project, all shipments of automotive products to Germany went in a multi-piece wooden crate. When received in Germany, the automotive products were removed from the crate and the crate thrown away.

An employee team looked at many alternatives to reduce waste from these shipments and soon settled on the idea of using returnable packaging. After developing concepts, the team worked with an outside contractor to build prototypes for testing.

The final design had to be robust to hold 1,800 pounds of product, double stacked in a shipping container. As a result, the new crates are made of steel and collapse to one-third of their height for the return trip to the U.S.

The team’s work eliminated 315 tons of solid waste and produced $101,800 savings in the first year alone.
2) Reduction of releases to water: Accomplishments and issues

3M global operations released 1.2 million lbs to water in 2000, compared to 6.4 million lbs in 1990. Thus, from 1990 to 2000, 82% of water releases were eliminated, just shy of the 90% target.

These reductions were accomplished by means of pollution prevention projects (43%) and better pollution control (57%).

EXAMPLES

3M Spain Reduces the Water Used to Produce Scotch Brite Scourers

In 2007, 3M’s Rivas, Spain facility implemented a project to reuse the wastewater from cleaning the facility’s manufacturing equipment in the production of Scotch Brite Scourers. The facility installed new equipment and modified its Scotch Brite Scourer production process to allow the facility to put its cleaning waste water to good use.

State-of-the-art wastewater treatment at 3M Singapore

3M Singapore’s recent electronic products manufacturing plant was built with a state-of-the-art wastewater treatment system in which waste streams are separated to allow the most appropriate treatment of each waste.

99% of metals are removed, much of them for recycling and reuse. Following treatment, 50% of the water is reused in the plant’s manufacturing processes.

New systems for wastewater improvement

- 3M Cottage Grove Center in Minnesota has invested $3.5 million to better neutralize wastewater from a manufacturing process and help remove more metals and other solids.
- 3M operations in Decatur, Alabama and Cordova, Illinois installed systems to improve the removal of nickel and fluorine from their processes.
- 3M London, Canada has worked to remove alcohol from wastewater that goes to a city wastewater treatment facility.
3) 3M’s efforts in reducing air emissions

- 88% of air emissions were eliminated between 1990 and 2000 then 96% more from 2000 to 2009 (255 million lbs in 1990 → 10.9 million lbs in 2009)

- 55% of these reductions were accomplished by pollution prevention and 45% by improved pollution controls

- Much of the effort concentrated on solvent technologies
  reducing variety of organic solvents
  replacing organic solvents by water
  developing solvent-free deposition processes

- More recent efforts are focusing on reduction of greenhouse gas emissions

![VOC Emissions Graphs]

PROTOTYPICAL EXAMPLE: The manufacture of Scotch® tape

![4 Layers, Each Using a Solvent for Application]

4 layers, each using a solvent for its application!

One of 3M’s primary strategies for continuing to reduce air emissions has been the development of solvent-free technologies, for a variety of products including tapes.

Some new processes are hot-melt technology, ultraviolet curing and caustic wash materials.
POLLUTION PREVENTION

Rule of priorities according to the U.S. Environmental Protection Agency

1. Avoidance (search for an alternative)
2. Reduction (dematerialization, fewer defects, better tools)
3. Re-use (capture and reuse as is; ex: solvent)
4. Recycling (capture and reprocessing; ex: metal)
5. Energy recovery (burning at least to get the energy)
6. Treatment (hopefully down to benign products)
7. Safe disposal (last resort)
Design for Environment

Process changes
- Improved operating practices
  - Maintenance
  - Efficient management
  - Stream segregation
  - Better material handling
  - Inventory control
  - Training

Product changes
- Technology changes
  - Layout changes
  - Increased automation
  - Improved equipment
  - New technology

- Change of materials
  - Material purification
  - Less material variety
  - Avoidance of toxics

Realm of Pollution Prevention (P2)

1 → 4 in order of difficulty and commitment on the part of the company

An example

Solvent vapor degreaser. (Source: Thon and Higgins, 1995)
Often, a waste stream is a bad combination of good materials, and all that needs to be done is **SEPARATION**.

Fortunately, there exists a separation technology for about every possible combination:

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**Endorsement and promotion by the U.S. EPA**

http://www.epa.gov/p2/index.htm
BMW, too, follows the principles of Pollution Prevention
(from their 2003 Annual Report)

And there exists a non-profit organization entirely dedicated to pollution prevention that organizes an annual Pollution Prevention Week.

http://www.p2.org/
Pollution Prevention benefits

1. Money savings
2. Pollution prevention → lower cost of end-of-pipe treatment & waste disposal
3. Pollution prevention usually implies dematerialization → lower manufacturing cost
4. Products of higher quality
5. Manufacturing flexibility
6. Less regulatory hassle
7. Better image in front of public environmental organizations

Downsides

1. Difficult to generalize across industrial sectors
2. Companies are competitive → secretive processes not shared with others (but licensing can be sought.)