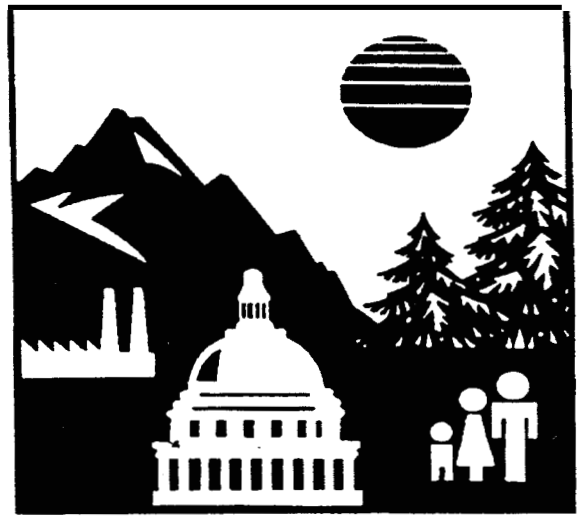
COLORADO POLLUTION PREVENTION CASE STUDIES COMPENDIUM



COLORADO
Prevenfion
PROGRAM

By Joni Canterbury and Neil Kolwey
Colorado Department of Public Health and Environment
Pollution Prevention Program

Sponsored by: *The* Colorado *Pollution Prevention* Advisory Board

September, I996

Preface

The case studies in this compendium were researched and written by Ms. Joni Canterbury, a graduate student intern of the Colorado Department of Public Health and Environment (CDPHE) Pollution Prevention Program. The project was sponsored by the Colorado Pollution Prevention Advisory Board (PPAB), and was supervised by Neil Kolwey of the CDPHE P2 Program, with input from Parry Burnap, the CDPHE P2 Program Manager.

We would like to thank the companies in these case studies for taking the time to help us document their pollution prevention successes and their willingness to share their information with other businesses.

Disclaimer. The names of specific products and vendors, included in the case studies, is for information purposes only, and does not imply any type of endorsement by CDPHE.

The CDPHE P2 Program

The P2 Program is a non-regulatory program within the Colorado Department of Public Health and Environment. It promotes pollution prevention as the environmental management tool of first choice throughout the State, through integrating pollution prevention awareness into the CDPHE environmental regulatory programs, and through outreach and education efforts to the business community. The outreach efforts emphasize pollution prevention assistance to small and medium-size businesses in Colorado, through workshops, written information, and site visits. (Note: Site visits are confidential, meaning that the P2 Program staff are not obligated to report any apparent violations of environmental laws or regulations, unless they are an "imminent threat to human health and the environment".) The P2 Program also offers awards and recognition for pollution prevention achievements by Colorado businesses, such as the Governor's Pollution Prevention Challenge Program.

The P2 Program works under the guidance of the Governor-appointed Pollution Prevention Advisory Board (PPAB) in all of the above activities. In addition the P2 Program and the PPAB administer a grants program funded through fees on the use of hazardous materials, authorized under the Colorado Pollution Prevention Act. The grants fund several small projects each year, emphasizing P2 technical assistance and education activities for small and medium-size businesses.

CDPHE P2 Program Staff:

Parry Burnap, P2 Program Manager	(303) 692-3009
Neil Kolwey, Professional Engineer	(303) 692-3309
Tamera Van Horn, Research Assistant	(303) 692-3017

CONTENTS

Introduction

The pollution prevention (P2) case studies assembled in this report are examples of improvements made voluntarily by Colorado businesses to reduce their impacts on the environment and go beyond what is required by the environmental regulations. These case studies include documented reductions of over **850,000 lb/year** of hazardous waste generation, over **8.3** million **gallons/year** of water discharges, and over **870,000 lb/year** of air emissions (VOCs and **HAPs).** At the same time, the total quantified cost savings resulting from the improvements described in the case studies is over **$2.5 million/year.** Additional emissions and waste reductions and cost savings were achieved but were not quantified.

The purpose of collecting and documenting these case studies is to make the information about these successful pollution prevention projects available to other businesses, so that they can do more to prevent pollution and reduce wastes.

What is pollution prevention? Pollution prevention means reducing wastes and emissions at the source (source reduction), prior to recycling or treatment, through using less hazardous materials or using more efficient practices or processes. For example, improved housekeeping practices can reduce wastes generated from spills and leaks. Another example is for a painting operation to switch to more efficient paint guns, which reduces the amount of paint material used and reduces paint overspray and emissions of volatile organic compounds (VOC)s. An example of using less hazardous materials is to switch to paints and coatings which have a lower VOC content.

If it is not possible to reduce the wastes/emissions at the source, reuse or recycling is the next most preferable option, for example, recovery/reuse of process chemicals in metal finishing processes or recycling/reuse of solvents used for cleaning. Source reduction and closed-loop recycling methods reduce the overall usage of hazardous materials and reduce the generation of wastes or by-products which ultimately go into the environment. Examples of both source reduction and recycling practices are included in the case studies in this compendium.

Treatment processes, on the other hand, although helpful in reducing the environmental impacts of wastes or by-products, tend to transfer pollutants from one media to another. For example, treatment of air emissions with a carbon adsorber removes the pollutants from the air stream but transfers them to the carbon which becomes a solid waste. Pollution control and treatment processes also tend to be expensive, whereas source reduction and recycling methods often reduce costs, as the case studies demonstrate.

The case studies were collected for eight industrial sectors which have been targeted for P2 technical assistance by the CDPHE P2 Program and the Colorado Pollution Prevention Advisory Board. These sectors were identified in a 1994 report by the CDPHE P2 Program, Pollution Prevention Priorities, based on the sectors' impacts on the environment and the opportunities for reducing these impacts through pollution prevention. The sectors and their main wastes and emissions are listed in Table I, at the end of this introduction. Agriculture and metal mining are also listed in the 1994 report and in Table I, but case studies were not collected for these sectors for this report.

Benefits of Pollution Prevention

Each case study in this compendium briefly discusses some of the main benefits to the company which resulted from the successful completion of the P2 project, as well as the main reason(s) why the project was implemented. The reasons mentioned the most often were to reduce costs and to reduce the regulatory burden or exposure to potential penalties. The main reasons for implementing P2 are analyzed in more detail in Appendix I. Appendix I also includes a discussion of the obstacles to implementing P2 which were mentioned by the companies.

For the case studies in this compendium, the businesses reported the following benefits from the P2 projects:

- reduced costs; including mainly raw materials costs and waste treatment/disposal costs
- reduced regulatory burden or reduced "exposure" to potential penalties .
- improved worker health and safety
- improved quality or increased production
- reduced liabilty for potential spills of hazardous materials or reduced "Superfund" liability for hazardous waste disposal
- improved business image

In addition although not a direct benefit to the business, many of the people contacted took pride in helping to reduce their facility's impact on the environment.

Key Elements of Successful P2 Programs

Many businesses have found that there is more involved in developing a successful pollution prevention program than simply finding the right technology. There are several key elements of successful P2 programs which apply to all types of businesses', and which the case studies in this compendium help to demonstrate:

- Management support
- P2 leader/P2 team
- Employee involvement
- Wastes/emissions inventory and tracking system
- Environmental accounting/financial evaluation of projects
- Technology transfer
- Continuous improvement

---

[1] See the "Facility level Pollution Prevention Benchmarking Study", Business Roundtable, 1993; and "Developing and Maintaining an Effective Pollution Prevention Program", Bob Pojasek, 1994. (Both available through the CDPHE P2 library, (303) 692-3028.)

Management support. Management support is critical to the success of P2 efforts. The management has to approve staff time and effort to work on pollution prevention, as well as the expenditure of financial resources on P2 projects. Basically, pollution prevention does not happen without the support and commitment of the management.

However, if the management is not immediately enthusiastic about using staff resources and money to make pollution prevention improvements, many environmental managers and production managers have found that it is possible to gain management support - by making the managers more aware of the real costs of the facility's wastes and emissions. These real costs include the costs of wasted or lost raw materials, treatment and disposal costs, and also other indirect costs such as sampling and analysis costs, operating and maintenance costs for pollution control equipment, and costs to hire contractors for permits or special environmental or safety training.

Assigned P2 leader/P2 Team. Whether the business is large or small, it is important to have one key person who is given the responsibility and the time to lead the pollution prevention efforts. This may include coming up with ideas for new projects, investigating their technical and financial feasibility, working with other employees to implement the projects, and tracking the results. For a small business, the P2 leader may do all of the above with little or no assistance from others. For example, at Colorado Coach Autobody the P2 leader developed and implemented several new P2 methods, including a new system to mix paint more efficiently, increased reuse of waste paint, and an improved system to clean paint guns. Management support and employee involvement were also important, but the P2 leader was mainly responsible for the successful implementation of these P2 methods. In a larger business, it may be helpful to form a "pollution prevention team" comprised of staff from various departments such as engineering, accounting, production, maintenance, etc. For example, Hauser Chemical formed a team to reduce emissions and wastes of methylene chloride. The team worked together to develop and implement several significant improvements, which would not have been achievable by one person working alone.

Employee involvement In addition to having a good leader of the P2 efforts, it is important to involve other employees, to obtain their input in identifying P2 opportunities, and their support in the implementation of P2 projects. For example, employee involvement and training is very important in the switch to more efficient paint guns (see case studies for Colorado Coach, Phelps-Tointon, and Woodleys). Printing press operators must be motivated and involved in order to successfully reduce the use of alcohol in the fountain solutions to reduce VOC emissions (see the case study for Johnson Printing).

Waste/emissions inventory and tracking system. When beginning a P2 program at a facility, it is important to identify and measure or estimate the facility's wastes and emissions. Many businesses have found process flow diagrams to be very helpful in illustrating all of the sources of losses/wastes from their processes. Based on the process flow diagrams, waste streams or hazardous chemicals can be targeted for reductions through potential P2 improvements. After implementing P2 projects, tracking the affected wastes or emissions is important to demonstrate the effectiveness of the projects, both to the management as well as externally to customers, the community, and regulatory agencies. For

example, Central Products uses materials balance calculations/estimates to track its emissions and wastes. This system has helped them build management support for the P2 program, and has also helped in prioritizing emissions and wastes for potential new P2 projects. Coors and Lockheed-Martin have both quantified significant reductions in emissions and wastes through their P2 efforts, which has effectively demonstrated their commitment to pollution prevention to the public and the regulatory agencies.

Environmental accounting/financial evaluations. It is important for the management, as well as the environmental/P2 program, to be aware of the total costs of the facility's wastes and emissions. As mentioned above, these include the direct costs of waste treatment and disposal and wasted raw materials; as well as indirect costs of maintenance of pollution control/waste treatment systems, permitting, sampling, and utilities. These indirect costs can be very significant in many cases? For the businesses in the case studies, generally the management was at least aware of the costs of raw materials and waste disposal. For many businesses, even the waste disposal costs are hidden-within the overhead costs, a practice which fails to give the management useful information about how to potentially reduce costs.

In addition to gaining management support for pollution prevention, there are three main ways in which proper accounting of environmental costs is helpful. First, assigning appropriate costs to the various emissions and wastes generated is a useful way for the P2 program to prioritize the wastes/emissions for potential improvements. Secondly, proper accounting of costs is important in the financial analysis of potential P2 projects to demonstrate their cost effectiveness to the management. Finally, tracking the environmental costs after implementing P2 projects is an importantway to demonstrate success to management.[3] Several companies in the case studies, including RTD and Geneva Pharmaceuticals, were able to build strong management support for the pollution prevention program by quantifying the cost savings of some of the initial P2 projects.

Mobile Tool in Westminster has recently begun to adopt "greener" accounting practices. Because of financial concerns, the management recently required each department to cut its costs by 12%, which would traditionally be accompanied by layoffs. At the same time, however, many of the facility's environmental costs were identified and assigned to each department. This has given the department managers the opportunity to "lay off" wastes rather than employees, by allowing them to meet the 12% reduction goal by identifying potential savings through pollution prevention.

What is an acceptable payback period or return on investment for a P2 project? Ideally, a business should require the same minimum return on investment for P2 projects as for its other business investments, allowing P2 projects to compete for capital on an equal basis. (This is not generally the case for most businesses.) Of course for projects for which a longer payback period is expected (such as 5 years or more), the business needs to consider whether the project fits

---

[2] Green Ledgers: Case Studies in Corwrate Environmental Accounting, World Resources institute, *1995*. This study found that in many cases the total environmental costs (including the direct and indirect costs of wastes/emissions) can be as much as 20% of the total costs of doing business.

[3] "Prioritizing P2 Opportunities with Activity-Based Costing", Bob Pojasek, *1995*.

in with its longer-term business plans such as possible product changes. On the other hand, in the evaluation of P2 projects it is also important to include other, difficult to quantify benefits of the P2 project such as reduced liabilities. For example, when RTD switched to a thermal cleaning system for their large engine parts, the payback period was estimated to be about 5 years, slightly longer than what is acceptable by most businesses. However, RTD decided to go ahead and implement the project because of the added benefits of reduced hazardous waste disposal liability and improved worker health and safety, which are not quantifiable.

Technology transfer. Most businesses tend to be independent and rely on their own internal resources as much as possible. However, for many of the successful P2 projects described in this compendium, the idea for the project was obtained from someone outside the company. Colorado Coach learned about HVLP paint guns through the Boulder County Health Department P2 Specialist. Rocky Mountain Metal Finishing learned about their new system to destroy cyanide and recover metals through an article in "Plating and Surface Finishing Journal". Rocky Mountain News learned about low VOC roller/blanket washes through Varn, a vendor of printing supplies. In addition vendors are often helpful in overcoming initial difficulties in the implemention of P2 projects. Some sources of additional pollution prevention information and assistance are listed at the end of this report.

Continuous Improvement. The continuous improvement approach allows the P2 program to implement new projects gradually over time. Working on one or two projects at a time allows the P2 program to focus its efforts on successfully implementing the projects and demonstrating their benefits before moving on to other projects. This approach helps to maintain management support and will tend to be more successful in the long run than trying to accomplish too much all at once. Several of the companies started their P2 program with one simple and inexpensive project, and then built on the initial success by implementing additional, more challenging and more environmentally significant projects. By building management and employee support, tracking reductions in wastes/emissions and costs, etc., many of the businesses in these case studies have implemented a continuous series of successful projects, and continue to look for ways to make further improvements.

Table I -
Prioritized Industrial Sectors for P2 Technical Assistance

Category	Primary Waste Streams	Number of Facilities'
1. Fabricated metal products, industrial machinery and equipment manufacturing (including plating and machine shops) (SIC codes 3400-3599, 3700-3799)	-spent solvents/solvent still bottoms -VOC emissions -paint wastes with heavy metals, solvents -ignitable, reactive wastes -plating/stripping solutions -heavy metal wastewater sludges -metal dust, grinding, cuttings - wastewater discharges containing metals	750
2. Electronics and electrical equipment and related products manufacturing (SIC codes 3600-3699, 3800-3899)	-spent solvents/solvent still bottoms -VOC emissions -paint wastes with heavy metals, solvents -ignitable, reactive wastes -electroplating and electroless copper plating/stripping/ etching solutions -heavy metal wastewater sludges -metal dust, grinding, cuttings -photoprocessing chemical waste	370
3. Chemicals and allied products manufacturing, including pharmaceuticals (SIC codes 2800-2899)	-spent solvents/solvent still bottoms -VOC emissions -paint wastes with heavy metals, solvents -ignitable, reactive wastes -off-specification or unused chemicals -wastewater -wastewater treatment sludge -wastewater discharges containing metals -spent catalysts, byproducts, reactor clean out wastes, container residues	130

[4] For the first four sectors, the number of facilities is based on the Colorado Manufacturing Directory. For the small business categories and agriculture, the number given is based on recently developed estimates by CDPHE and CSU Agricultural Extension Services, respectively. For metal mining, the number given is the total number of active metal mines in Colorado, according to the State Division of Minerals and Geology.

4. Wood products and furniture manufacturing (SIC codes 2400-2599)	-spent solvents/solvent still bottoms -VOC emissions ignitable, reactive wastes -ignitable paint, coating, adhesive wastes -spray booth wastes -rags, wipes, absorbent wastes -wood wastes -metal, wood dust grindings, cuttings	230
5. and 6. Auto Body/Auto Repair Shops (SIC codes 7532-7549, 7622-7699)	-spent solvents/solvent still bottoms -VOC emissions -spent fuels -paint wastes with heavy metals, solvents -spray booth wastes -waste oil, sludge -spent refrigerants -spent antifreeze -filler waste and sand dust (autobody repair) -rag and absorbent waste	~2,400
7. Print Shops (SIC codes 2711-2796)	-VOC emissions -used film -wastewater discharges, including dissolved silver in developing chemistries -spent fountain solutions, -spent blanket and roller washes -ink waste (heavy metals) -equipment cleaning wastes (lubricating oils, rags) -solid waste (packaging, paper, etc.)	~1,200
8. Drycleaners	-spent solvents (perchloroethylene, valclene, petroleum solvents), - hazardous air emissions, VOC emissions -still residues from solvent distillation -cooked powder residue (powder filter systems) -spent filter cartridges -cleaning chemicals (spotting agents, etc.) -packing wastes	~900
9. Agriculture (SIC codes 0111-0291)	-chemical fertilizers, pesticides, and other chemical applications -runoff, leaching of contaminated irrigation water -spills, leaks during storage, mixing, transport, application of chemicals, petroleum products -animal manure, process wastewater	~25,000
10. Metal Mining (SIC codes 1011-1099)	-acid mine drainage (heavy metals) -process chemicals, byproduct wastes, spills -metal dust, grinding, cutting -waste rock, mine tailings -wastewater	162

COLORADO POLLUTION PREVENTION CASE STUDIES:

GENERAL METHODS FOR ALL INDUSTRIES

Pollution Prevention Case Study

Chemicals and Allied Products: Solvent Management Policy to Reduce Solvent Wastes/Emissions

Company	Geneva Pharmaceuticals, Inc. 2655 W. Midway Blvd. Broomfield, CO 80038-0446
Person to Contact	*Gary* Long, Manager Safety & Environment Telephone: (303) 438-4233
Product or Service	Pharmaceuticals
Number of Employees	**850**
Waste Stream Targeted	Solvent waste, emissions
Original System	No formalized, written solvent management policy.
New System (with **P2** Modification)	Formalized, written Solvent Management Policy. **Summary** of policy: 1. Develop products without using solvents whenever feasible or use the minimum amount possible. **2.** Minimize use of solvents in analysis or testing of new products and use only when no reasonable alternative exists. 3. Use solvents that are environmentally and hygienically as "friendly" as possible but minimize their use, and recycle when feasible. **4.** The policy lists solvent use criteria and acceptable solvents for use. For example, for alcohols, the order of priority for selection is ethanol first, then IPA, and lastly, methanol (use of pure methanol blends in new products have decreased to about 5%). 5. Purchase equipment which uses environmentally "friendly" solvents such as aqueous or dry blends. 6. Track solvent usage trends with tools such as the Corporate Safety, Energy, and Environmental Protection (SEEP) report to measure waste, solvent reduction, cost/benefits to the company.

Company	**Geneva Pharmaceuticals, Inc.** 2655 W. Midway Blvd. Broomfield. CO 80038-0446
Major Benefits	**Emissions of methylene chloride were eliminated (over 2 tons/yr).** **Improved worker health and safety, liability reduction.** **Positive Business Image.** Eliminated the **5,000** gallon methanol storage tank (they now use 55 gallon drums instead) by increased substitution of ethanol. Reduced potential for hazardous material spills.
Obstacles	Time and costs associated with solvent substitutions, R & D, equipment modifications. Process/procedure/material changes are more difficult to implement in an FDA-regulated facility.
Time Since Implementation of P2 Modification	3.5 years.
Source/Supplier	None
Main Reason Implemented P2 Modification	Improve worker health and safety, reduce liability concerns and associated costs.
Key to Success in Making this P2 Modification	Management support/commitment to pollution prevention. It is important to include P2 and other safety & environmental concerns in employee performance objectives.

2/6/96

Pollution Prevention Case Study

Fabricated Metal Products and Metal Manufacturing: Integrated Management Structure

Company	**Coors Brewing Company** BC 395 Golden, CO 80401
Person to Contact	Robert Brady, Environ. Scientist Telephone: (303) 277-2 196
Product or Service	Malt beverages. metal beverage containers
Number of Employees	5.000
Waste Stream Targeted	**All waste streams.**
Original System	**No formalized Environmental, Health and Safety Management Structure.**
New System (with P2 Modification)	**Integrated Environmental, Health and Safety Management Structure** designed to coordinate activities and policies among these functions, to assign accountability for compliance and pollution prevention, and to establish and track facility and corporate goals. 1. Coors establishes comprehensive environmental, health and safety goals annually (hazardous waste generation, pollution prevention, safety, recycling, etc.). 2. Goals are set by a committee in each plant (division) in cooperation with the Environmental Health & Safety Department. Goals include both performance and cost-saving targets. 3. Waste minimization teams in each plant (division) work with operations, talk to industry representatives, develop individual plans. 4. Plans, goals are tracked with a quarterly status report. 5. Successes are relayed to other operations and implemented. 6. Coors publishes an annual Environmental Health & Safety Progress Report. 7. Greater emphasis is put on voluntary initiatives rather than mandated actions, incentives to encourage change, and partnership among &verse interest groups to achieve environmental improvement, especially at the local level.

Company	**Coors Brewing Company** BC 395 Golden, CO 80401
Cost Savings	During one year, about two dozen pollution prevention projects were either implemented or in progress. In addition to the environmental benefits of these projects, they are expected to provide cumulative annual cost savings of more than $750,000. Generation of process hazardous waste at Coor's Colorado facilities was cut in half in 1994. As a result, total cost savings for managing and disposing of the waste was ~$250,000. Coors hopes to achieve additional savings in the future with the implementation of new goals.
Major Benefits	Generation of process hazardous waste at Coor's Colorado facilities was cut in half from the previous year (48 tons). The can plant alone reduced hazardous waste by 65% (53,000 lbs.) Other facilities/operations also recorded significant reductions. Three projects completed during 1994 cut annual emissions of VOCs by ***55.6*** tons. Projects in progress in 1995 will achieve additional reductions. Improved business image. Improved worker health and safety, reduced liabilities.
Obstacles	Capital expenditures. Employee adjustment.
Time Since Implementation of P2 Modification	2 years.
Main Reason Implemented P2 Modification	The ultimate goal of the hazardous waste reduction efforts is to attain small quantity generator or lesser status for all Coors facilities.
Key to Success in Making this P2 Modification	Management suppodcommitment to pollution prevention.

1/12/96

Pollution Prevention Case Study

Chemicals and Allied Products: Continuous Improvement Process Suggestion System

Company	**Fel-Pro Chemical Products LP.** 6120 E. 58th Avenue Commerce City, CO 80022
Person to Contact	Catherine Griffith, Regulatory Affairs Manager Telephone: (303) 289-5651
Product or Service	Manufacturer of sealants, adhesives, lubricants, and epoxies for industrial applications.
Number of Employees	50
Waste Stream Targeted	**All wastes.**
Original System	**Management Hierarchy.** Team problem solving was not a part of the company policy. There was no formal quality improvement program, and generally no follow-up on employee suggestions. As a result, employee ideas disappeared.
New System (with P2 Modification)	To encourage recommendations on improving operations, waste elimination, and safety, Fel-Pro developed a **Continuous Improvement Process (CIP)** suggestion system to reward employees for good ideas. After an idea is submitted, a review committee from the employee's area evaluates the suggestion to make sure it meets the suggestion system guidelines. (Suggestions must support the company's goals of quality, timeliness, innovation, waste elimination, and safety). If it does, it is then forwarded to the appropriate operation area for evaluation and response within 10 working days. If the idea can be implemented, the employee receives an award. The first time a Fel-Pro associate submits an idea that is implemented, they receive a CIP suggestion system special award. With each additional idea implemented, an associated receives a lunch/merchandise ticket. For every five ideas implemented, an associate receives $150. In addition, the employee receives a CIP button with the number of suggestions implemented printed on the button. The best CIPs of the year are recognized and receive an award of $1,000.00. In addition managers and supervisors establish yearly goals to increase efficiencies, eliminate waste, and improve safety within their respective departments.
Cost Savings Operating/Material cost savings	The CIP approach has generated real savings within the organization. For example, a suggestion to install a waste compactor generated an **annual savings of $16,000.00**. Fel-Pro also achieved a **$35,000.00 savings** by deciding to label cans as they used them, thus requiring significantly less inventory. Suggestions have also led to shorter product production runs, which provided more timely deliveries and less waste.

Company	**Fel-Pro Chemical Products L.P.** *6120* E. **58th** Avenue Commerce City, CO *80022*
Major Benefits	**CIP approach has generated real savings within the organization at a low cost.** **By recognizing employee suggestions, CIP helps improve morale and productivity.** Suggestions have improved production levels within the manufacturing process and packaging operations and reduced waste. The CIP serves as a way to **alert** associates to identify potential problems which helps prevent pollution and reduce waste.
Obstacles	None
Time Since Implementation of P2 Modification	3 years.
Source/Supplier	None
Main Reason Implemented P2 Modification	Improve operations, eliminate waste, reduce worker health **and** safety concerns.
Key to Success in Making this P2 Modification	Employee recognition.

1/26/96

Pollution Prevention Case Study

Electronics Shops: Reduced Waste through Material Tracking and Inventory Control

Company	**NTI, Colorado Division** 6035 Galley Road Colorado Springs, CO 80915
Person to Contact	Frank Gorman, Tech. Director Telephone: (719) 574-4905
Product or Service	Circuit Board Manufacturer
Number of Employees	306
Waste Stream Targeted	**Process Chemicals, Waste Disposal**
Original System	**No Detailed Material Tracking and Process Monitoring System.** Previous practices allowed distribution of vendor samples without a controlled evaluation. No monthly tracking of raw materials, wastes, or process malfunctions to monitor chemical usage, unnecessary waste, or to identify associated costs. The major sources of pollution from plating operations are process chemicals. Process chemicals become pollutants through waste water generation, spills/leaks, spent solutions, sludge generation, and air emissions.
New System (with P2 Modification)	**Material Tracking and Process Monitoring System.** Computerized monthly tracking of production versus consumption and costs of water, energy, raw materials, waste generation/treatment/disposal, as well as process/procedure malfunctions. The system allows NTI to generate real time costs, and to target further P2/waste reduction efforts, including process, equipment, or procedural changes and employee training. Through employee training and exposure to real numbers, employees gain a better understanding of waste generation and P2/waste reduction methods.

Company	**NTI, Colorado Division** 6035 Galley Road Colorado Springs, CO 80915
Cost Savings	Some examples of cost savings are: (1) NTI decreased water usage by 11% through monitoring and control of water consumption. For example, if there is a production idle time, NTI shuts down rinse processes instead of leaving the machines on. By monitoring individual process water usage, NTI controls excessive rinse water waste. (2) Through tracking material costs and better control on chemical additions/over-adds, NTI reduced process chemical costs by 2%/year or $23,000/year. (3) NTI made several changes in waste treatment/disposal processes i.e., secondary use of spent sulfuric acid in ultrafiltration lines for cleaning instead of disposal, and chemistry changes to obtain a more concentrated copper/metal-bearing sludge. Through such modifications, waste treatment costs decreased by 50% or $50,000/year.
Major Benefits	**Material tracking and inventory control saves time and money!** Improved business Image. Tracking system brought attention to weaknesses in the system where changes could be made and money saved. Better control on addition of chemicals, reduced over-adds. Reduced hazardous waste inventory, treatment, and disposal. Reduced worker health and safety, liability concerns.
Obstacles	Employee training, adjustment - insuring proper data entry and proper allocation of material usage.
Time Since Implementation of P2 Modification	2 years.
Source/Supplier	None. Tracking/Inventory Control monitored on Microsoft Excel.
Main Reason Implemented P2 Modification	To improve processes/procedures through monitoring. To reduce costs. To be able to measure results of P2 efforts.
Key to Success in Making this P2 Modification	Management commitment/support to P2. Sharing of data and mformation with production operators to establish responsibility and ownership.

2/5/95

Pollution Prevention Case Study

Automotive Repair Shops: Inventory Control and Product Evaluation Process

Company	**Regional Transportation District** District Shops Facility 1900 31st Street, Denver, CO 80216
Person to Contact	David Genova Telephone: (303) 299-4038
Product or Service	Equipment/Vehicle Maintenance and repair.
Number of Employees	300
Waste Stream Targeted	**Hazardous Waste Reduction**
Original System	**No Formal Inventory Control and Product Evaluation Process.** The previous system allowed unlimited purchasing of products and unlimited distribution of vendor samples which often became hazardous wastes. There was no "first-in, first-out" practice for inventory control. Employees had unlimited access to supplies which led to inefficient use of raw materials.
New System (with P2 Modification)	**Formal Inventory Control and Product Evaluation Process.** This process provides an effective means of source reduction. **RTD** instituted policy and management changes in their inventory control system to ensure correct materials are purchased and used. A product evaluation process ensures only the correct quantity and type of materials are ordered, delivered and used in the business. A Product Evaluation Committee determines if there is a need for any new products. The safety/environmental division **(SSEC)** reviews the **MSDS** and other product information to determine if the product meets environmental/safety criteria for RTD. If it does, the product can be tested. After testing, **all** information on the product is submitted to the Product Evaluation Committee for final approval. Only the correct quantity and type of material is ordered, delivered, and **used.** New supplies cannot be ordered until older products are **used** up. Storage areas are monitored for improperly stored, labeled, or expired material which can become hazardous waste. Limited access to supplies prompts employees to conserve materials. RTD uses a product exchange program for products no longer used, and waste disposal is used **only** as a last resort.

Company	**Regional Transportation District** District Shops Facility 1900 31st Street, Denver, CO 80216
Cost Savings	Product control saves money through reduced purchase costs and reduced waste handlingldisposal costs. Staff time previously spent reviewing/evaluating unnecessary products has been eliminated.
Major Benefits	**Significant reduction of hazardous wastes, reduced liability. Improved worker health and safety.** Saves a **lot** of time. Before the new product control system was implemented, there were 40-50 product requests per month, now there are **2-3** requests **per** month! Positive Business Image.
Obstacles	Biggest hurdles are product control (orders, reorders, etc.) and employee adjustment to new, less hazardous products which are sometimes less effective.
Time Since Implementation of P2 Modification'	6 months
Main Reason Implemented P2 Modification	Improve worker health and safety. Reduce hazardous waste inventory and disposal and associated costs. Easier management of MSDS data base.
Key to Success in Making this P2 Modification	Management support for P2, partly as a result of previous successes and cost savings of P2 program.

0/10/95

Pollution Prevention Case Study

Fabricated Metal Products and Metal Finishing: Recycle/Reuse Wooden Pallets

Company	Mobile Tool International, Inc. 5600 West 88th Avenue Westminster, CO **80030**
Person to Contact	Rich Holston, Manager - Environmental Health & Safety Telephone: **(303)** 657-2177
Product or Service	Manufacture of Aerial Manlifts
Number of Employees	**350**
Waste Stream Targeted	Solid Wastes, Wooden Pallets
Original System	Wooden Pallets were not recycled. Wooden pallets used for shipping and storage purposes were used once and discarded as solid waste into the landfill.
New System (with P2 Modification)	Wooden Pallets are recycled. Material handlers salvage reusable pallets instead of discarding them after a single use. Pallets are stored and reused for shipping and storage purposes and discarded to the landfill only when they cannot be reused.
Cost Savings Initial Equipment Costs Operating Costs Material Cost Savings Waste Disposal Cost Savings Total Cost Savings	 None. **4** man-hours (OT) once/month is required to recycle pallets or ~$960.00/year. Mobile Tool purchases only 100 pallets/year @ ~$3.25 each under the new system. Recycling pallets saves in the purchase of ~1900 pallets/year or $6,200. Pallet recycling saves ~2 waste disposal hauls/month @ $225.00/haul or $5,400/year. Total annual cost savings is ~$11,600.
Major Benefits	Eliminates disposal of 1,900 pallets which would have gone to the landfill. Recycling pallets saves ~$11,600 per year in material and waste disposal costs. Improved business image.

Company	**Mobile Tool International, Inc.** **5600** West 88th Avenue Westminster, CO 80030
Obstacles	Increased labor costs to recycle pallets is minimal compared to the savings.
Time Since Implementation of P2 Modification	1 year.
Main Reason Implemented P2 Modification	Reduce wooden pallet waste and associated costs
Key to Success in Making this P2 Modification	Management support/commitment to pollution prevention.

3/5/96

Pollution Prevention Case Study

Fabricated Metal Products and Metal Finishing: Switch to Use of Plastic Pallets

Company	**Ball Corporation,** Metal Container Division 4525 Indiana Street Golden, CO 80403
Person to Contact	Joe Battaglia, Manager, Environmental Operations Telephone: (303) 273-7427
Product or Service	Manufacture Metal Beverage Containers
Number of Employees	350
Waste Stream Targeted	**Solid Wastes, Wooden Pallets**
Original System	**Wooden Pallets** were used in the storage and shipping areas for loadmg and unloading of metal beverage containers and ends. Ball was required to replace wooden pallets approximately every 2 years. These pallets were discarded as solid waste to a landfill.
New System (with P2 Modification)	**Plastic Pallets** have replaced wooden pallets in the storage and shipping areas. Plastic pallets are made of high density polyethylene (HDPE). They are more durable and require replacement approximately every 10 years. Plastic pallets are repairable, and all broken parts or pallets that cannot be repaired are sent back to the manufacturer where they are ground up and made into new pallets.
Cost Savings	
Initial Equipment Costs	None.
Material Cost Savings	Wooden pallets must be replaced every two years, compared to an 8-10 year life for plastic pallets. For eight years the cost of wooden pallets would be $80/pallet or $3.2 million. Over an 8 yr lifespan for the plastic pallets, the cost would be $37/pallet or $1.48 million, for a **material cost savings for an 8 yr period of $1.7 million or ~$210,000/yr!**
Waste Disposal Cost Savings	Wooden pallets cost $.50/pallet for disposal plus freight, for an annual cost of $10,000/yr. Ball receives $.15/pound for recycling plastic pallets, which covers the freight costs, resulting in a **waste disposal cost savings of over $10,000/yr.**
Total Cost Savings	**Total cost savings of ~$220,000/yr!**

Company	**Ball Corporation,** Metal Container Division **4525** Indiana Street Golden, CO **80403**
Major Benefits	**Eliminates disposal of 20,000 pallets/yr which would have gone to the landfill.** **Saves ~$220,000/yr in material and waste disposal costs.** Plastic pallets are more **uniform,** durable, better quality than wooden pallets. Customers prefer plastic pallets. Positive business image.
Obstacles	Plastic pallets are more expensive initially than wooden pallets, but are actually cheaper over the long-term and have other advantages. Some customers send the plastic pallets to other suppliers by mistake which requires Ball to be diligent in monitoring the pallets to maximize its investment.
Time Since Implementation	2 years
Source/Supplier .	Nucon 111 Pfmgsten Rd, **Suite 160** Deerfield, IL **60015-5615**
Main Reason Implemented	Reduce solid waste generation, improve quality, reduce costs.
Key to Success in Making this P2 Modification	Management suppodcommitment to pollution prevention.

3/5/96

Pollution Prevention Case Study

Fabricated Metal Products and Metal Finishing: Shop Rags are Reused/Recycled.

Company	Lockheed-Martin Astronautics **P.O.Box** 179 Denver. CO 80201
Person to Contact	J. T. Snyder, Project Manager Telephone: (303) 977-3322
Product or Service	Astronautic svstems
Number of Emplovees	8,200
Waste Stream Targeted	Contaminated Shop Rags
Original System	Disposable paper shop towels used in manufacturing and support activities are used once and then discarded. Generally, these towels are contaminated with solvents such as Isopropyl alcohol, MEK, and mineral spirits, which require the rags to be disposed of as hazardous waste.
New System (with **P2** Modification	Laundered shop rags are substituted for the disposable wipes in the factory. Laundered rags may be used **up** to four times before being disposed. Unusable rags are further recycled by the laundering service after cleaning by giving them to other industries for use as filler material (e.g., furniture mfg.). The substitution eliminated up to 9 tons of hazardous waste from disposal.
Cost Savings Initial Equipment Costs Material and Waste Disposal Cost Savings	$5,200 for the shop rags. This substitution saves -$134,000/year in material and hazardous waste disposal costs.
Major Benefits	Eliminates up to 9 tons of hazardous waste from disposal. Saves -$134,000/year. Improved business image.
Obstacles	none

Company	**Lockheed-Martin Astronautics** **P.O Box** 179 Denver, *CO* 80201
Time Since Implementation of P2 Modification	**4** years.
Source/Supplier	G & **K** Linen Services Denver. CO 80201
Main Reason Implemented P2 Modification	Waste reduction of contaminated rags and associated costs.
Key to Success in Making this P2 Modification	Management suppodcommitment to pollution prevention.

1/10/96

Pollution Prevention Case Study

Fabricated Metal Products and Metal Finishing: Solvent is Recovered On-site by Distillation.

Company	Mobile Tool International, Inc. 5600 West 88th Avenue Westminster. CO 80030
Person to Contact	Rich Holston, Manager Environmental Health & Safety Telephone: (303) 657-2177
Product or Service	Manufacture of Aerial Manlifts
Number of Employees	350
Waste Stream Targeted	Solvent wastes.
Original System	Parts washing solvent was picked up and hazardous solvent recovery/waste disposal performed off-site by an outside contractor.
New System (with P2 Modification)	Parts washing solvent is collected in a 55-gallon drum, and recycled on-site by distillation. Reclaimed solvent can be reused in the parts cleaning processes. Waste sludge is disposed of as hazardous waste off-site.
Cost Savings Initial Equipment Costs Material and Disposal Cost Savings Payback Period	 ~$4,000.00 (15-gallon distillation unit). ~3,000 gallon of spent parts cleaning solvent is recycled by distillation which saves ~$10,000/year in solvent purchase and hazardous waste disposal costs. Payback is less than 4 months.
Major Benefits	Reduces the quantity of hazardous waste generated. Cost savings of ~$10,000/year. Improved business image. Reduced hazardous waste storage, disposal costs and associated liabilities.

Company	**Mobile Tool International, Inc.** 5600 West 88th Avenue Westminster, CO 80030
Obstacles	Solvent must be manually transferred fiom the spent solvent container to the distillation unit. Still bottoms from the distillation process must still be removed and disposed of as hazardous waste.
Time Since Implementation of P2 Modification	5 years.
Source/Supplier	Recycling Products San Francisco, CA Telephone: (501) 496-2462
Main Reason Implemented P2 Modification	Reduce solvent parts cleaning costs. Reduced hazardous waste generation and associated liabilities.
Key to Success in Making this P2 Modification	Management support/commitment to pollution prevention.

3/5/96

Pollution Prevention Case Study

Painting Operations: Recycle/Reuse of Solvents used in Paint Equipment Cleaning.

Company	Coors Brewing Company BC 395, Golden, CO 80401
Person to Contact	Robert Brady, Environ. Scientist Telephone: (303) 277-2196
Product or Service	Malt beverages, metal beverage containers
Number of Employees	6.000
Waste Stream Targeted	Solvent Wastes
Original System	Solvents used in paint cleaning processes (to clean paint guns, paint pots, brushes, etc.) were used until they no longer cleaned effectively and then disposed of as hazardous waste. Typical paint solvents contain hazardous compounds such as methyl ethyl ketone, methyl isobutyl ketone, toluene, and xylene.
New System (with P2 Modification)	Spent solvents used in paint cleaning processes are recycled and reused. Similar solvents are used, but spent solvent is poured into a 55-gallon drum. The thinner/sludge mixture is allowed to settle and separate by gravity. Clean thinner can then be decanted using a drum pump and reused in the cleaning processes.
Cost Savings Initial Equipment Costs Material Cost Savings Waste Disposal Cost Savings Total Cost Savings	 ~$200 for a drum pump. Previously, 4 drums/quarter of solvent (16 drums/yr) were purchased @ ~$200/drum or ~$3,200/year. With reuse of the solvent, only 3/4 of a drum/quarter (3 drums/yr) is used @ ~$600/year. This is a material cost savings of ~$2,400/year. ~12 drums/year were disposed of @ ~$450/drum or $5,400/yr. With reuse of solvent, ~3 drums/year are disposed of as hazardous waste or $1,350/year. This is a waste disposal cost savings of $4,000/year. ~$6,400/year.

Company	**Coors Brewing Company** **BC 395,** Golden, CO 80401
Major Benefits	**Total Cost savings of ~$6,400/year.** **Reduced hazardous waste generation by -450 gal/yr.**
Obstacles	Employee adjustment.
Time Since Implementation	1 year.
Main Reason Implemented	Reduce hazardous waste disposal costs and associated liabilities.
Key to Success in Making this P2 Modification	Management suppodcommitment to pollution prevention.

COLORADO POLLUTION PREVENTION CASE STUDIES

for the

FABRICATED METAL PRODUCTS/METAL FINISHING INDUSTRY

Pollution Prevention Case Study

Fabricated Metal Products and Metal Finishing: Closed-Loop Plating System

Company	Elliot-Barry Company 94 Commerce Street Colorado Springs, CO 80907
Person to Contact	Gary Wimsett, Manuf. Manager Telephone: (719) 578-5017
Product or Service	Precious metal emblematicjewelry
Number of Employees	***25***
Waste Stream Targeted	Plating bath wastes (metals, acids)
Original System	Small Plating System for precious metals only (Nickel, Gold). Copper and other metals were sent off-site for plating. This system was not a closed-loop system. The plating rack held 38 metal emblems which were cleaned, plated, and then rinsed (in **6** gallon tanks). The nickel plating tank was equipped with a spray rinse over the plating bath to remove drag-out (washes drag-out directly back into the plating bath). Multiple rinse tanks were pH tested and discharged into the sanitary sewer system.
New System (with P2 Modification)	Tivian Industries MINNIE™ Plating System (Model TIL-MP\\01) designed for copper strike, nickel, and gold plating processes. This is a closed-loop plating system. The system consists of multiple counterflow rinsing tanks (30 gallon, D.I. water), and the plating rack holds 70 metal emblems. The plating tanks are equipped with a spray rinse directly over the plating baths to remove drag-out. Rinse water flows through an ion exchange unit. The ion exchange unit contains resins that selectively remove ions from the plating bath solutions. The treated water is of high purity and can be returned to the rinse system for reuse. Every 3-6 months, the ion exchange resins are recharged off-site and metals are recovered from the resins.

Company	**Elliot-Barry Company** 94 Commerce Street Colorado Springs, CO 80907
Cost Savings Initial Equipment Costs Operating Cost Savings	The new system allows an expansion of plating operations done on-site. The closed-loop system is far cheaper (total cost of ~$44,000) than the expansion of the waste water treatment and monitoring system which would have been required with a conventional discharge system (total estimated cost of ~$80,000). Operating costs are also much less than they would have been, but this comparison is difficult to quantify/estimate.
Major Benefits	**Closed-loop system eliminates waste water discharge and the associated regulatory burden and liabilities. Substantial cost savings versus conventional system allowed expansion of on-site plating capacity.** Improved business image.
Obstacles	Employee adjustment to the new system.
Time Since Implementation	~7 months
Source/Supplier	Tivian Industries Limited 65 Dexter Road Telephone: (401) 435-3125 East Providence. RI 02914
Main Reason Implemented	To allow cost-effective expansion of on-site plating capacity.
Key to Success in Making this P2 Modification	Other companies' input on innovative equipment.

12/5/95

Pollution Prevention Case Study

Fabricated Metal Products and Metal Finishing: Counter-flow Rinse System

Company	Mobile Tool International, Inc. 5600 West 88th Avenue Westminster. CO 80030
Person to Contact	Rich Holston, Manager Environmental Health & Safety Telephone: (303) 657-2177
Product or Service	Aerial Manlifts
Number of Employees	**350**
Waste Stream Targeted	Waste water discharge
Original System	Water was used once and discharged from the rinse tanks to the waste water treatment system. A 5-stage washing and rinsing system used for cleaning workpieces in preparation for paint application has multiple **(3)** rinsing tanks which discharged all of the rinse water directly to the waste water treatment system.
New System (with P2 Modification)	Water discharged from the rinse tanks is reused in the previous rinse tank (counter-flow rinsing). Fresh rinse water enters only the final rinse tank. This system significantly reduces water usage and wastewater treatment costs.
Cost Savings Initial Equipment Costs Operating Costs Treatment Costs Total Cost Savings Pavback Period	 **Less** than $500.00 (valves, pipes, installation costs). Recycling rinsewater saves ~1/4 million gallons/year or $500/yr. ~$1,200/year is saved in wastewater treatment costs. ~$1700/yr Payback is less than **4** months.
Major Benefits	Saves $1700/yr. Improved business image.
Obstacles	None
Time Since Implementation	**4** years.

Company	**Mobile Tool International, Inc.** 5600 West 88th Avenue Westminster, CO 80030
Source/Supplier	None.
Main Reason Implemented	Reduce water consumption and associated costs.
Key to Success in Making this P2 Modification	Management commitment to pollution prevention.

3/5/96

Pollution Prevention Case Study

Fabricated Metal Products and Metal Finishing: Rinse water Recycling/reuse.

Company	Lockheed-Martin Astronautics P.O. **Box** 179 Denver, CO 80201
Person to Contact	J. T. Snyder, Project Manager Telephone: (303) 977-3322
Product or Service	Astronautic systems
Number of Employees	8,200
Waste Stream Targeted	Waste Water, Caustic Soda from Etching Process Rinse Tanks.
Original System	Overflow from tank 5 rinse tank in the Factory Chem Mill **is** discharged to the waste water treatment plant. Reverse Osmosis (RO) water **is** added to tank 5 as makeup.
New System (with P2 Modification)	Overflow from tank ***5*** rinse tank is filtered and used as makeup for tank ***6*** which has a high evaporative loss (60 GPH). RO water is added to tank 5 as makeup.
Cost Savings Initial Equipment Costs Waste Treatment and Disposal Cost Savings Total Cost Savings Payback Period	 Equipment modifications cost $58,800. The modification reduces wastewater treatment costs by ~$67,500/ year and reduces hazardous waste disposal costs (for the sludge generated by the wastewater treatment) by ~$75,000/year. ~$142,000/yr about 5 months.
Major Benefits	Treatment and disposal cost savings of ~$142,000/year. Improved business image. Reduces waste water discharges by 2.7 million gallons/year. Conserves aluminum etching chemicals by returning them to the process tank.
Obstacles	None
Time Since Implementation	**4** years.

Company	**Lockheed-Martin Astronautics** **P.O. Box 179** Denver, CO 80201
Source/Supplier	None
Main Reason Implemented	Reduce waste water treatment costs.
Key to Success in Making this P2 Modification	Management suppodcommitment to pollution prevention.

Pollution Prevention Case Study

Fabricated Metal Products and Metal Finishing: Extend Rinse Tank Dump Cycle

Company	Lockheed-Martin Astronautics P.O. **Box** 179 Denver, CO 80201
Person to Contact	J. T. Snyder, Project Manager Telephone: (303) 977-3322
Product or Service	Astronautic systems
Number of Employees	8,200
Waste Stream Targeted	Water, sludge generation from rinse water treatment.
Original System	Dump cycle (drain, clean, refill) of all rinse tanks in the Factorv Chem Mill was 30 **davs.**
New System (with P2 Modification)	Extend dump cycles of all rinse tanks in Chem Mill from 30 to ***90*** days. Process rinse tanks were chemically tested to determine extended dump cycle periods.
Cost Savings Initial Equipment Costs Material/Operating Cost Savings Total Cost Savings	None. ~$33,000/year is saved in water, treatment, and disposal costs. Total cost savings are ~$33,000/year.
Major Benefits	Reduction in water consumption of –1.5 million gallons/year. Reduction in waste water treatment sludge generation of 10-15 tons/year. Cost savings of ~$33,000/ year. Positive Business Image.
Obstacles	None.
Time Since Implementation	**8 years.**
Source/Supplier	None.
Main Reason Implemented	Reduce waste water treatment and disposal costs.
Key to Success in Making this P2 Modification	Management support/commitment to pollution prevention.

1/10/96

Pollution Prevention Case Study

Fabricated Metal Products and Metal Finishing: Drag-out Reduction

Company	Majestic Metals 1400 East 66th Avenue Denver, CO 80229
Person to Contact	Denton R. Johnson Telephone: **(303)** 288-6855
Product or Service	Precision Sheet Metal Products
Yumber of Employees	98
Waste Stream Targeted	Chemical drag-out in conversion coating process.
Original System	The parts basket used in the chromate conversion coating process tanks had square tubing and a perforated sheet metal design. This design increased drag-out of chemical solutions in the process. Whenever possible, hanging racks are used in preference to a parts basket; however, odd-shaped or over- or under-sized parts require use of the parts basket. Rinse water is collected in a holding tank, pH adjusted, and discharged to the sewer system.
Yew System [with P2 Modification)	The parts basket was re-designed to minimize the total surface area of the basket and to reduce drag-out of chemical solutions. The sides and separators are stainless steel, round stock instead of perforated sheet metal and square tubing.
Cost Savings Initial Equipment Costs Material Cost savings	Design and fabrication of the new basket cost ~$500.00. The re-design of the basket reduced raw material costs by $250/year by reducing drag-out of the chemical solutions used in the tanks.
Major Benefits	Reduced drag-out by 55%. Reduces discharges of chromium and other pollutants to the POTW. Reduces raw material **costs** by $250/yr. Improved business image.
Obstacles	None

Company	**Majestic Metals** **1400** East 66th Avenue Denver, CO 80229
Time Since Implementation	2 years.
Source/Supplier	Received design assistance from the CSU Waste Minimization Assessment Center.
Main Reason Implemented	Reduce waste water discharges of chromium.
Key to Success in Making this P2 Modification	Management support/commitment to pollution prevention.

3/26/96

Pollution Prevention Case Study

Fabricated Metal Products and Metal Finishing: Reuse Blind Rinse in Ti-Cad Plating Line

Company	Sundstrand Aerospace/Sundstrand Corporation 2840 W. 70th Avenue Denver, CO 80221-2501
Person to Contact	Steve Kaufman Telephone: (303) 426-2962
Product or Service	Gear grinding/fabrication of aerospace products
Yumber of Employees	130
Waste Stream Targeted	Water, chemical, and metal wastes.
Original System	The Blind Rinse was not reused in the Ti-Cad (titanium-cadmium) plating process. Contaminated waste water fiom the first rinse tank (blind rinse) was drained with the other 2 consecutive tap water rinse tanks directly to the waste water treatment area.
New System [with P2 Modification)	The concentrated blind rinse is used to refill the Ti-Cad plating tank instead of being discarded with the tap water rinse tanks. This modification saves on water, chemical/metal usage and reduces waste.
Cost Savings Initial Equipment Costs Total Cost Savings	None Reuse of rinse waste water saves water, process chemicals, and waste treatment costs; although it was difficult to quantify for this case study. - 65 gallons/month of water is saved by use of the blind rinsewater to refill the plating tank. Generation of waste plating solution has also been reduced, but has not been quantified.
Major Benefits	Reduced water and process chemical usage. Reduced water, process chemical, and waste disposal costs. Improved business image.
Obstacles	The tight tolerance of the Ti-Cad bath requires additional analyses of the blind rinse before utilization.
Time Since Implementation	1.5 years.

Company	**Sundstrand Aerospace/Sundstrand Corporation** 2840 W. 70th Avenue Denver, CO 80221-2501
Source/Supplier	None
Main Reason Implemented	Reduce wastewater treatment and disposal costs. Reduce plating chemical costs.
Key to Success in Making this P2 Modification	Assistance/P2 ideas from February 1995 Metal Finishing P2 Workshop sponsored by AESF (trade association) and the CDPHE P2 Program

11/16/95

Pollution Prevention Case Study

Fabricated Metal Products and Metal Finishing: Switch to Aqueous Degreasing

Company	Lockheed-Martin Astronautics P.O. Box 179 Denver, CO 80201
Person to Contact	1. T. Snvder. Proiect Manager Telephone: (303) 977-3322
Product or Service	Astronautic systems
Number of Employees	8.200
Waste Stream Targeted	1,1,1-Trichloroethane (TCA) emissions
Original System	1,1,1-trichloroethane vapor degreasing is used in the factory Chem. Mill to remove dirt and debris from missile parts. TCA is a hazardous air pollutant (HAP). Because TCA contributes to depletion of the ozone layer, its production has been banned as of 12/3 1/95.
New System (with P2 Modification)	Missile parts are cleaned with an aqueous cleaning system using "Daraclean". Converted existing vapor degreasers to aqueous cleaning tanks by sandblasting and adding pump agitation, filtration, oil slumming, and spray rinsing equipment. This change eliminates HAPs and generation of hazardous waste in the degreasing operation.
Cost Savings Initial Costs Operating Cost Savings Pavback period	 $210,000 (modifications, materials) $250,000/year - materials costs for TCA, and hazardous waste disposal costs. –10 months
Major Benefits	Saves ~ $250,000/year in material, operating, and waste disposal costs. Positive Business Image. Better degreasing performance. Improved worker health and safety Reduced liabilitv.
Obstacles	Finding/designing a system that performs as well as the old one.

Company	**Lockheed-Martin Astronautics** **P.O Box 179** Denver, CO **80201**
Time Since Implementation	5.5 years.
Source/Supplier	None.
Main Reason Implemented	Reduce **TCA** emissions, reduce liabilities.
Key to Success in Making this P2 Modification	Management support/commitment to pollution prevention.

Pollution Prevention Case Study

Fabricated Metal Products and Metal Finishing: Switch to Aqueous-based Cleaner

Company	Sundstrand Aerospace/Sundstrand Corporation 2840 W. 70th Avenue Denver, CO 80221-2501
Person to Contact	Steve Kaufman Telephone: (303) 426-2962
Product or Service	Gear grinding/fabrication of aerospace products
Number of Employees	130
Waste Stream Targeted	Solvent wastes. solvent emissions
Original System	Perchloroethylene (Perc) was used in the Surface Temper Inspection Sequence tanks for cleaning ground gears and other small process parts (to remove oils, dirt, debris) prior to the etching process. Perc is a Hazardous Air Pollutant (HAP) and potential human carcinogen.
New System (with P2 Modification)	Magnaflux Zyglo 123 and Blue/Gold Aqueous-based Cleaners replaced the perchloroethylene in the Surface Temper line. Ground gears and other small parts are cleaned in separate tanks of Magnaflux and Blue/Gold prior to the etching process. No rinsing or drying is required. This substitution eliminates the use of HAPs in this process.
Cost Savings Initial Equipment Costs Material Cost Savings Disposal Cost Savings Total Cost Savings	 None –7 gallons/month of Magnaflux cleaner is used @ ~$10.00/gal. and 1 gallon/month of Blue/Gold @ ~$12.00/gallon ($984.00/year). –100 gallons/month of Perc. was used previously @ ~$16.00/gallon ($19,200.00/year). This is a material cost savings of ~$18,200/year. 94 gallons/month of Perc was disposed of as hazardous waste @ ~$1,500/month. There are substantial waste disposal cost savings with the new cleaners, but these have not been quantified. Use of Aqueous-based cleaners saves at least ~$20,000/year.

Company	**Sundstrand Aerospace/Sundstrand Corporation** 2840 W. 70th Avenue Denver, CO 80221-2501
Major Benefits	**Saves over $20,000/year.** **Eliminates HAPs from this process.** **Reduces hazardous waste generation.** **Improved worker health and safety.** **Improved business image.** Reduced potential for spills during transportation, storage, and handling of perc.
Obstacles	Finding products that work as well as perchloroethylene.
Time Since Implementation	3.5 years.
Source/Supplier	Magnaflux: Magnaflux Company Hardwood Heights, IL Telephone: (708) 867-8000 Blue/Gold: Modern Chemical Batesville, IN Telephone: (812) 934-5915
Main Reason Implemented	Reduce regulatory burden and costs involved with perchloroethylene. Improve worker health and safety.
Key to Success in Making this P2 Modification	Assistance from the 1995 Metal Finishing P2 Workshop sponsored by AESF (metal finishing trade association) and the CDPHE P2 Program.

11/16/95

Pollution Prevention Case Study

Manufacturing Industries: Switch to Corn Cob Tumbler for Cleaning Small Parts

Company	Samsonite Corporation 11200 East Forty-Fifth Avenue Denver, CO 80239-3018
Person to Contact	Kermit Hodge, Director, Health, Safety, & Environ. Compliance Telephone: (303) 373-7251
Product or Service	Manufacture luggage, carrying cases
Number of Employees	1200
Waste Stream Targeted	Solvent-based cleaners (VOC, HAP emissions)
Original System	Manual Sanding Operation followed by Stoddard Solvent Parts Washers were used to remove burrs from small metal parts and to clean oil and debris from the parts prior to plating operations. Stoddard-based solvents (mineral spirits or petroeum naptha) have a low flash point of 105°F (highly flammable) and typically contain hazardous chemicals such as toluene, xylene, or 1,1,1-trichloroethane (TCA). Stoddard solvents must be disposed of as hazardous waste.
New System (with P2 Modification)	Corn Cob Tumbler - replaces the manual sanding and solvent-based parts washers. Small parts are secured in the tumbler and tumbled with corn cob husk pellets. The process removes any rought edges or burrs and cleans the parts at the same time.
Cost Savings	
Initial Equipment Costs	The corn cob tumbler costs $18,000/unit.
Material Cost Savings	Solvents for the previous cleaning system cost ~$3,000/yr, vs. only $220/yr for corn cob materials, for material cost savings of $2800/yr.
Waste Disposal Cost Savings	Hazardous waste disposal costs were $9800/yr with the solvent cleaning system, vs. essentially no costs for the corn cob system, since hazardous waste is eliminated with this system. Total waste disposal cost savings are $9800/yr.
Total Cost Savings	**$12,600/yr**
Payback period	about 17 months

Company	**Samsonite Corporation** 11200 East Forty-Fifth Avenue Denver, CO 80239-3018
Major Benefits	**Cost savings of $12,600/yr.** **Elimination of solvent contamination of waste water.** Reduced **VOC** emissions. Improved business image. Improved worker health and safety. Reduced hazardous waste storage and disposal costs and associated liabilities.
Obstacles	Employee adjustment.
Time Since Implementation	**8** years
Source/Supplier	
Main Reason Implemented	Reduce hazardous waste generation and eliminate solvent contamination of waste water.
Key to Success in Making this	Follow through - keep working with a project until it **is** successfully implemented.

Pollution Prevention Case Study

Manufacturing Industries: Switch to Industrial Soap/Windex for Cleaning/Degreasing

Company	Samsonite Corporation 11200 East Forty-Fifth Avenue Denver, CO 80239-3018
Person to Contact	Kermit Hodge, Director, Health, Safety, & Environ. Compliance Telephone: (303) 373-7251
Product or Service	Luggage, carrying cases
Number of Employees	1200
Waste Stream Targeted	Methyl Ethyl Ketone (MEK) emissions
Original System	Methyl Ethyl Ketone was used as a cleaner/degreaser throughout the plant but especially in the Plastics area, with the use of rags, to remove oils, dirt, and debris fiom the product. **MEK** is a volatile organic compound **(VOC)** and a hazardous air pollutant (HAP).
New System (with P2 Modification)	MEK is replaced with an industrial soap, Aerosoap. Windex glass cleaner is used to clean up residue. Aerosoap and Windex clean as effectively as MEK.
Cost Savings Initial Equipment Costs Material Cost Savings Waste Disposal Cost Savings	 None. Not quantified. Under the original system, hazardous waste disposal costs (rags, solvents) were ~$100,000/year. Waste disposal costs dropped to ~$20,000/year after implementation of the new system. This is a waste disposal cost savings of ~$80,000/year.
Major Benefits	Cost savings of $80,000/year. Reduced VOC and HAP emissions Improved business image. Improved worker health and safety, liability reduction. Reduced hazardous waste storage and disposal costs and associated liabilities.
Obstacles	Employee adjustment - training; takes time.

Company	**Samsonite Corporation** 11200 East Forty-Fifth Avenue Denver, CO 80239-3018
Time Since Implementation	2 years
Source/Supplier	
Main Reason Implemented	Reduce VOC and *HAP* emissions and hazardous waste generation.
Key to Success in Making this P2 Modification	Staying with **a** project until it is proven to be effective.

1/15/96

Pollution Prevention Case Study

Fabricated Metal Products and Metal Finishing: Switch to an Aqueous Cleaning System

Company	CF & I Steel, L.P. Pueblo, CO 81002
Person to Contact	Carl R. Hund, Manager Environmental Telephone: (719) 561-6536
Product or Service	Manufacture railroad rail, seamless pipe, rod, bar, wire
Number of Employees	1.300
Waste Stream Targeted	1,1,1-Trichloroethane
Original System	1,1,1,-Trichloroethane Vapor Degreaser. The system consisted of an enclosed tank and vent system. Nails were fed through on a conveying system and 1,1,1-Trichloroethane was used to remove the lubricant remaining from the nail forming process.
New System (with P2 Modification)	Aqueous-based Nail Cleaning System. This system consists of an enclosed tank and vent system. Nails are fed through on a conveying system and an alkaline solution and water are used to remove the lubricant from the nails.
Cost Savings	
Initial Equipment Costs	The new system cost ~$498,000.
Operating Costs	~$120,000/year (includes operator , maintenance, and depreciation costs) compared to the old system @ ~$49,000/year. (Increase of ~$71,000/yr)
Material Cost savings	1,1,l-trichloroethane degreaser costs/year were ~$328,000/yr. The alkaline degreaser costs/year are ~$60,700. This is a material cost savings of ~$267,000.
Waste Disposal Cost Savings	Hazardous waste disposal costs have been eliminated with the new system at a cost savings of $76,300/year.
Total Cost Savings	~$273,000/yr
Pavback Period	Payback of –1.8 years.

Company	**CF & I Steel, L.P.** Pueblo, CO 81002
Major Benefits	**Total annual cost savings of ~$273,000.** **Improved business image.** Eliminated use of a hazardous chemical in the cleaning process. Reduced worker health, hazardous waste disposal, and liability concerns and associated costs.
Obstacles	Had difficult time finding an acceptable alternate system.
Time Since Implementation	***6*** months
Source/Supplier	Jensen Fabricating Engineers, Inc. 555 Wethersfield Road Berlin, CT 06037
Main Reason Implemented	To eliminate the use of TCA and reduce operating costs.
Key to Success in Making this P2 Modification	Management commitment to P2 and the need to find substitutes for TCA

Pollution Prevention Case Study

Fabricated Metal Products and Metal Finishing: Switch to Aqueous Cleaning

Zompany	**Schlage Lock Company** 3899 Hancock Expressway Security, CO 80911
Person to Contact	Dorinda Mancini, Mgr. of Safety Telephone: (719) 390-5071 **Ext.** 452
Product or Service	Door Handles/Locks/Door Jewelry
Vumber of Employees	900
Waste Stream Targeted	**Solvent for metal degreasing .HAPs**
Original System	**Perchloroethylene** ,a chlorinated hydrocarbon, is used for metal cleaning/degreasing prior to the plating processes. Perc is a hazardous air pollutant (HAP) and potential human carcinogen. Door accessories are shaped, ground, polished, and colored (addition of Tripoli, ***an*** iron oxide with animal fat) prior to plating. Debris (metal fines, fibers) from these processes are removed with Perchloroethylene in a vapor degreaser prior to plating with chromium, nickel, black nickel, brass, bronze, or stainless steel (bright, protective finish).
New System [with P2 Modification)	**Udylite 150, an aqueous cleaner,** is used as a replacement for perchloroethylene solvent in the plating line (preparation for plating). After cleaning, the door accessories pass through six rinse tanks. The last rinse tank contains a reverse osmosis (RO) treatment unit followed by carbon beds, allowing reuse of rinse water back to the rinse tanks and collection and disposal of waste sludge.
Cost Savings	Cost savings have not been quantified.

Company	**Schlage Lock Company** 3899 Hancock Expressway Security, CO 80911
Major Benefits	Reduced worker health and liability concerns associated with perchloroethylene. **Reduced Perchloroethylene emissions by over 300,000 lb/year.** **Positive business image.** Reduced hazardous waste generation and associated regulatory requirements.
Obstacles	Finding a new system that cleans as well as perc.
Time Since Implementation	
Source/Supplier	Industrial Process Equipment, Inc. Telephone: (714) 447-0171
Main Reason Implemented	Reduce worker health and liability concerns associated with the use of perchloroethylene.
Key to Success in Making this P2 Modification	Vendors were very helpful; numerous small-scale trials were performed to verify that the new system would work effectively.

10/26/95

Pollution Prevention Case Study

Fabricated Metal Products and Metal Finishing: Switch to a Water-Soluble Lubricant

Company	**Lockheed-Martin Astronautics** **P.O.** Box 179 Denver, CO 80201
Person to Contact	J. T. Snyder, Project Manager Telephone: (303) 977-3322
Product or Service	Astronautic systems
Vumber of Employees	8,200
Waste Stream Targeted	**Lubriplate grease, MEK**
Original System	**A Teflon grease dispersion/petroleum grease** was used to form Titan barrel skin sections on the Pacific Brake Press (the lubricant was used on a cloth wipe to lubricate the dyes when the metal is formed to prevent scratching). Lubriplate Brake Dye Lube contains methyl ethyl ketone (MEK), a Volatile Organic Compound (VOC) and Hazardous Air Pollutant (HAP) which is considered harmful to human health and the environment. Lubriplate Brake Dye Lube was difficult to remove from the metal panels and required extra labor to hand wipe grease off of each barrel skin. Rags were disposed of as hazardous waste.
New System (with P2 Modification)	Replaced Lubriplate Brake Die Lube with **Energy Plus Soap,** a viscous detergent cleaner which works as an effective lubricant. This substitution eliminated usage of **MEK** solvent and rags required for removal of Lubriplate grease. The water-based soap lube is readily removable in 3 minutes in a chem mill rinse tank.

Company	Lockheed-Martin Astronautics **P.O Box** 179 Denver, CO 80201
Cost Savings Initial Equipment Costs Material Cost Savings. Waste Disposal Cost Savings Total Cost Savings	 None. Rags cost ~$100/year. Purchase of 100 gallon/year of brake lube cost ~$500/year. **A** similar quantity of nonhazardous Energy Plus Soap is used @ ~$375/year. Total material cost savings of $200/yr. Hazardous waste disposal of rags cost ~$1,500/year. This was eliminated with the new system. Total cost savings of ~$1,700/year.
Major Benefits	Reduced use of MEK (and **VOCs** and HAPs) by 100 gallons/year. Eliminated hazardous waste disposal of MEK-contaminated rags. Total cost savings of ~$1,700/year. Positive Business Image. Reduced labor costs/improved production - allows **3-min.** rinsing of barrels instead of up to 6 man-hr of hand wiping.
Obstacles	None. Energy Plus Soap lubricates as well as the petroleum-based grease and **is** readily removable in a chem mill rinse tank.
Time Since Implementation	5 years.
Source/Supplier	EP 680 National Colloid Anaheim, **CA** 92806
Main Reason Implemented	Eliminate the use of MEK and associated costs/liabilities.
Key to Success in Making **this P2 Modification**	Management support/commitment to pollution prevention.

1/10/96

Pollution Prevention Case Study

Fabricated Metal Products and Metal Manufacturing: Switch to a Water-based Latex

Company	Coors Brewing Company BC 395 Golden, CO 80401
Person to Contact	Robert Brady, Environ. Scientist Telephone: (303) 277-2196
Product or Service	Brewery, metal beverage containers
Number of Employees	6.000
Waste Stream Targeted	Solvent-based latex
Original System	A solvent-based latex was used for lining the edges of can ends. Can ends are lined with latex to obtain a gas-proof seal in the cans. Residue from the latex material had to be cleaned with a solvent-based cleaner. The solvent in the latex and in the solvent -based cleaner contains volatile organic compounds **(VOCs)** and hazardous air pollutants (HAPs). The waste from this process was disposed of as hazardous waste.
New System (with P2 Modification)	A water-based latex replaced the solvent-based material for lining the edges of can ends. Residue from the water-based material can be cleaned with a soap solution, which eliminates the use of a cleaning solvent needed with the previous material. **This** switch significantly reduced emissions of HAPs, **VOCs,** and hazardous waste generation in the can end facility.
Cost Savings	Cost savings have not been quantified.
Major Benefits	Hazardous waste generation at the can end facility was reduced by two-thirds, to under four tons per year. Reduced HAP emissions by **100% (65,000** lb/yr). Reduced annual emissions of VOCs by **50%.** Positive Business Image. Improved worker health and safety, liability reduction.
Obstacles	

Company	**Coors Brewing Company** **BC 395** Golden, **CO 80401**
Time Since Implementation	1 year.
Source/Supplier	
Main Reason Implemented	Reduce HAP, VOC emissions and associated costs, liabilities.
Key to Success in Making thi P2 Modification	Management support/commitment to pollution prevention.

Pollution Prevention Case Study

Fabricated Metal Products and Metal Finishing: Bath Life Extension

Company	RBM Precision Metal Products, Inc. 720 Garden of the Gods Road Colorado Springs, CO 80907
Person to Contact	Lee Miller, SPC Coordinator Telephone: (800) 214-2235
Product or Service	Sheet metal computer parts
Number of Employees	23
Waste Stream Targeted	Zinc plating bath wastes.
Original System	No monitoring or problem-solving/maintenance methods were established to prolong the useful lives of the plating baths. Baths were automatically changed when product/process problems developed. Root cause of problems were not determined - it was assumed that the majority of problems were caused by the depletion of the plating baths.
New System (with P2 Modification)	Improved monitoring and maintenance techniques. The plating bath mileage is monitored through computerized records of area (sq. ft.) of parts plated per month. The system correlates the surface area through the baths and bath life. Trends are identified and the root causes of problems are analyzed. Under the new system, there have been significant savings in water usage and reductions in chemical recharge quantities required for the zinc plating lines. This detailed monitoring is performed for three tanks in the plating line: A. Soap/Soak tank B. Electro Clean Tank C. Type 111 Chromate Tank (clear Chromate)

Company	RBM Precision Metal Products, Inc. 720 Garden of the Gods Road Colorado Springs, CO 80907
Cost Savings Initial Equipment Costs Cost savings Waste disposal costs Total cost savings	None. A. Soap/Soak tank. Improved monitoring/maintenance techniques have resulted in one-half the dumps per year (from 6/year to 3/year). This saves 720 gal of chemical per year (240 gal per charge) and 4,800 gal of water (1,600 gal per charge). Total cost savings of $3,100 per year. **B.** Electro Clean Tank. Improved monitoring/maintenance techniques have resulted in one-half the dumps per year (6/year to 3/year). This saves 252 gal. of chemical **(84** gal./charge) and 2,400 gal. of water (800 gal. per charge). Total cost savings of $1,200 per year. C. Type **III** Chromate Tank. Improved monitoring/maintenance techniques have resulted in one-third the dumps per year (6/year to 2/year). This saves 320 gal. of chemical (80 gal./charge) and 3,200 gal of water (800 gal/charge). Total cost savings of $2,300 per year. Waste disposal costs are significantly reduced but have not been quantified. Total cost savings of over **$6,600** per year!
Major Benefits	Saves ~$6,600 per year in material costs. Reduced waste disposal costs. Improved business image.
Obstacles	Employee adjustment to new procedures.
Time Since Implementation	**1.5** years.
Source/Supplier	None
Main Reason Implemented	To improve quality control and reduce costs.
Key to Success in Making this P2 Modification	Management support/commitment to pollution prevention. Employee participation.

11/8/95

Pollution Prevention Case Study

Fabricated Metal Products and Metal Finishing: Eliminate Use of Chromated De-smutter

Company	Majestic Metals 1400 East 66th Avenue Denver. CO 80229
Person to Contact	Denton R. Johnson Telephone: **(303)** 288-6855
Product or Service	Precision Sheet Metal Products
Number of Employees	98
Waste Stream Targeted	Chromium discharges to sewer
Original System	A de-smutter containing chromic acid was used to remove weld smut from sheet metal products (parts were washed, rinsed, and then immersed in the de-smutting tank). Chromium (esp. in hexavalent form) is a recognized human carcinogens and may cause other adverse health effects.
New System (with P2 Modification)	Eliminated use of the chromated de-smutter through substituting an alternative de-smutter which contains nitric, sulfuric, and fluoroboric acids (but no chromic acid).
Cost Savings	There are no cost savings associated with this substitution.
Major Benefits	Reduced overall chromium use and wastewater discharges of chromium by 60%. Greater assurance of meeting discharge limits. Improved business image.
Obstacles	Assuring. performance of new material.
Time Since Implementation	2 years.
Source/Supplier	Fremont Industries
Main Reason Implemented	Reduce chromium discharges and associated regulatory exposure.
Key to Success in Making this **P2** Modification	Management support/commitment to pollution prevention.

3/26/96

Pollution Prevention Case Study

Fabricated Metal Products and Metal Finishing: Switch to Water-based Coatings

Company	Majestic Metals 1400 East 66th Avenue Denver, CO 80229
Person to Contact	Denton R. Johnson Telephone: **(303)** 288-6855
Product or Service	Precision Sheet Metal Products
Number of Employees	98
Waste Stream Targeted	Solvent-based paint wastes
Original System	Solvent-borne Coatings. Use of solvent-borne paints on precision sheet metal products required the use of solvents **for** cleaning and reduction. Typical solvent-borne coatings contain 40% to 60% volatile organic compounds **(3-5** lbs/gallon VOCs), many of which may be considered hazardous air pollutants (HAPs) and may be harmful to human health and the environment.
New System (with P2 Modification)	Replaced solvent-borne coatings with water-based paint in ***98%*** of the paint operations. Water-borne paints contain –0.8 lb./gallon **VOCs,** and water can be used for cleaning purposes.
Cost Savings Initial Equipment Costs	No additional equipment was needed. (Majestic Metals had already purchased HVLP spray gun equipment prior to this materials substitution, and this equipment works well with the new paints.)
Material cost savings	–4,900 gallons/year of water-borne paints are used @ ~$25.00/gallon or ~$122,500/year. **A** similar quantity of solvent-borne paints was used @ ~$40.00/gallon or ~$196,000/year. This is a material cost savings of ~$73,500/year.
Disposal cost savings	The volume of solvents required to clean the paint equipment has been reduced to a fraction of that used with solvent-borne coatings which saves ~ $2,800/year in hazardous waste disposal costs.
Total Cost Savings	**~$76.300/vr**

Company	**Majestic Metals** **1400** East 66th Avenue Denver. CO 80229
Major Benefits	**Reduced VOC emissions by –15,000 lb/year.** **Total cost savings of ~$76,300/year.** **Improved business image.** Improved worker health and safety, liability reduction. Reduced fire hazard.
Obstacles	Customer resistance to change and revision of specifications.
Time Since Implementation	1.5 years
Source/Supplier	Most major manufacturers have water-borne paint products.
Main Reason Implemented	Reduce hazards involved with solvent-borne coatings and associated costs and liabilities.
Key to Success in Making this P2 Modification	Management support/commitment to pollution prevention.

3/26/96

Pollution Prevention Case Study

Fabricated Metal Products and Metal Finishing: Recycle/Reuse of Spent Cutting Fluid

Zompany	**AMI Industries, Inc.** 1275 N. Newport Road Colorado Springs, CO 80916
Person to Contact	Art McCann, Env., Health & Safety Manager Telephone: (719) 380-0020
Product or Service	Airplane Seats
Number of Employees	160
Waste Stream Targeted	**Cutting Fluid Wastes**
Original System	**CIMCOOL Qualstar Coolant/Cutting fluid was not recycled or reused.** Every 3 months machine operations were shut down for 1 day to change coolant (~25 ***milling*** machines, lathes, etc.) in AMI's entire system. Machines were shut down, drained, cleaned, biocides added, and units refilled with fresh coolant. Spent coolant was used and disposed of into the sanitary sewer system (by permit).
New System (with P2 Modification)	**CIMCOOL Cutting Fluid Management System** consists of the CIMCOOL Full-Cycle Module (FCM) and the 90190 CIMCOOL Recovery Unit (CRU). The system **is used** to recycle metalworking fluids (PureTec 5154 HG water-based synthetic coolant) and recover tramp oil. The CRU is a power-driven unit designed for fastfeffective machine fluid cleanouts (removes used fluid, sludge, chips and returns clean, filtered fluid in minutes). A filtration system on the FCM removes oil **film** and further cleans the coolant for reuse. Spent coolant is reused/recycled until it no longer maintains good lubricity (tested with refractometer). Less coolant is used and, therefore, less is disposed of into the **sanitary** sewer system (by permit).
Cost Savings Initial Equipment Costs Material Cost Savings Production/labor Costs Total Cost Savings Pavback **Period**	~$41,000 for the CIMCOOL Cutting Fluid Management System with modifications and installation. Under the old system, ~2,000 gallon/year of CIMCOOL Qualstar coolant was used @ a cost of ~$6.50/ gallon or $13,000/year. PureTec synthetic biodegradable coolant costs ~$9.90/gallon. Under the new system, AMI uses ~12 drums per year of the PureTec coolant or 660 gallon @ **~$6,500/year. This is a material cost savings of $6,500/year.** The original system required 4-5 people and 11-12 hours/person to change out the coolant at a cost of ~$10,000/change (labor, production loss once every 3 months) or $40,000/year. The new system requires one person to operate the CRU system 2 hours/day or ~520 hours/year at a cost of **~$6,000/year. ~$34,000/year is saved in labor and production costs.** **Total costs savings of ~$40,500/year.** **Payback on the system is about 1 year.**

Company	**AMI Industries, Inc.** 1275N. Newport Road Colorado **Springs,** CO 80916
Major Benefits	**Cost Savings of ~$40,500/year.** **~70% reduction in coolant wastes that must be disposed to the sanitary sewer system.** **Positive business Image.** Improved worker health and safety. Employee satisfaction (reduced skin irritation).
Obstacles	Relatively **high** capital costs.
Time Since Implementation	2 years (power-driven CRU). Fibrous filter system **was** added 3 months ago.
Source/Supplier	CIMCOOL System: Cincinnati MILACRON, Products Division P.O. **Box** 9013 **Cincinnati,** OH 45209, 1(800)-On 2 time. PureTec Synthetic Coolant: NovaMax 1615 Johnson Road NW Atlanta, Georgia 30318 1(800) 366-6682
Main Reason Implemented	Reduce wastes and operating costs.
Key to Success in Making this P2 Modification	Management support/commitment to P2 and employee involvement.

10/26/95

Pollution Prevention Case Study

Fabricated Metal Products and Metal Manufacturing: Octolig Metal Removal System

Zompany	**Western Forge** 1607 Forge Road Colorado Springs, CO 80907
Person to Contact	Jim Clasquin, Process Engr. Mgr. Telephone: (719) 598-5070
Product or Service	Hand Tools
Number of Employees	1200
Waste Stream Targeted	**Heavy metals in electroplating waste water.**
Original System	**Chemical precipitation.** Dissolved toxic metal ions and certain anions are chemically precipitated from waste water in the nickel-chromium plating operation. Spent rinse water was used as makeup for evaporation from the process bath and then the waste water is treated and discharged to the P O W . Filter cake produced from the chemical precipitation process must be disposed of as hazardous and nonhazardous waste.
New System (with P2 Modification)	**Octolig ™ Metal Removal System. A** similar multi-tank counterflow rinse system is used in the cobalt-iron plating process (which replaced the nickel-chromium process). Waste water that contains heavy metals is pumped through a columnar unit that holds the Octolig ™ resins. The Octolig Metal Removal System utilizes immobilized ligand (bonded chemically to silica gel) which seek out metals in waste water with which to bond and avoids retaining other harmless, benign ions. **As** waste water passes through the immobilized ligand bed, Octolig removes heavy metals specified by the process. In bonding with Octolig, the metal concentrations are reduced to achieve low metal concentrations in the waste water (to 0.01 ppm and below) consistently. Regeneration from the Octolig system yields a rich sludge (20%-40% metal) that is smeltable or reusable in the process (instead of requiring disposl). Water can be recycled back into the process or discharged to the P O W .

Company	**Western Forge** 4607 Forge Road Colorado Springs, CO 80907
Cost Savings Initial Equipment Costs Material/Operating Costs	(2) 24 inch Octolig™ **MRS** columns were purchased at ~$37,000 each (plus a $600.00 freight and instruction charge in Colorado). For a **2** ppm rinse water, the total cost of electric power, regeneration chemicals, pH-adjustment chemicals and labor for treating 10,000 gallons per day for 22 days per month (2,500,000 gallons per year) is about $1.20 per 1,000 gallons or $3,000/yr. The original system cost - $5.00 per 1,000 gallons or $7500/yr. This is a **cost savings of ~$4500/yr.** There are additional savings for waste disposal, but these were not quantified.
Major Benefits	**Cost savings of more than $4500/yr.** Achieves low metal concentrations consistently, reduces liability. Reduced generation of hazardous waste fiom conventional waste water treatment. **High** quality regenerant solution yields "rich" sludge (20%-40% metal) that can be reused on-site or shipped off-site for metals recovery. Rinse water can be reused, which reduces water usage and wastewater discharge liabilities. Improved business image.
Obstacles	None.
Time Since Implementation	1 month.
Source/Supplier	Metre-General Inc. (MGI) 9085 Marshall Ct. Westminster, CO 80030 Telephone: (303) 430-0095
Main Reason Implemented	Reduce waste water discharge liabilities and associated costs.
Key to Success in Making this P2 Modification	Management suppodcommitment to pollution prevention. Vendor assistance and information.

3/6/96

Pollution Prevention Case Study

Fabricated Metal Products and Metal Finishing: Electrowinning Process to Recover Metals from Spent Plating Solutions and Destroy Cyanides

Company	**Rocky Mountain Metal Finishers** 3525 N. Cascade Avenue Colorado Springs, CO 80907
Person to Contact	Ron Schmitt, Owner Telephone: (719) 632-0004
Product or Service	Electroplating (hard tool plating to stained glass, brass/bronze plating).
Number of Employees	36
Waste Stream Targeted	**Metal, cyanide wastes**
Original System	**Spent cyanide plating solutions are shipped off-site as hazardous waste for treatment and disposal.** (The conventional treatment method for cyanide solutions is chlorination. The cost of chlorination is high; and complex cyanides and strong cyanide solutions cannot be adequately treated.)
New System with P2 Modification)	**Electrochemical Destruction of Cyanide and Electrolytic Metal Recovery (Electrowinning).** This method uses an electroplating barrel cathode and a packed-bed anode to recover metals and destroy cyanide simultaneously in waste plating solutions. The method is based on electrodeposition of metal ions at the cathode and oxidation of cyanide to cyanate, carbon dioxide, and nitrogen gases at the anode. The materials costs for this system are much less, hazardous waste generation is greatly reduced or eliminated, and the metals can be recovered. (Note: Permission of the POTW was obtained to discharge the treated cyanide baths. Because of this, a hazardous waste treatment permit is not required.)
Cost Savings	
Initial Equipment Costs	The unit was built in-house at a cost of $2,500 (includes rectifier, plating cell, barrel, pump, filter, and heater (manufacturers price would be ~$15,000).
Operating Costs	Utilities: ~$600/year. Labor: 5 hours @ $15.00/hr. = $75.00/week. Total operating costs are ~$4,250/year. Sellable wastes are produced (steel slug coated with copper, brass, cadmium, bronze alloys). Rocky Mountain Metal Finishers produces ~13-14 lb/yr of metal wastes which can be sold for $10-15.00/lb. (~$170/yr).
Waste Disposal Cost Savings	Hazardous waste disposal costs are ~$550.00/barrel, or ~$23,000/year. This cost is eliminated with the new system.
Total Cost Savings	**Total cost savings of ~$19,000/year.**
Payback Period	**Payback period of less than 2 months.**

Company	**Rocky Mountain Metal Finishers** 3525 N. Cascade Avenue Colorado Springs, CO 80907
Major Benefits	**Total cost savings of ~$19,000/year.** **Hazardous waste generation reduced by nearly 23,000 lb/year!** Reduced hazardous waste regulatory burden and liabilities. Reduced potential for accidents, spills. Positive business image.
Obstacles	Free cyanide levels must be maintained to allow effective conductivity.
Time Since Implementation	**2** months.
Source/Supplier	The unit was built in-house based on a June 1993 journal article: Zhou, C.D. and Chin, D.T., "Copper Recovery and Cyanide Destruction with a Plating Barrel Cathode and a Packed-Bed Anode", Plating and Surface Finishing Journal (6/93), pp. 69-77.
Main Reason Implemented P2 Modifcation	Reduce volume and costs of hazardous waste storage and disposal.
Key to Success in Making this P2 Modification	Management support/commitment to pollution prevention.

COLORADO POLLUTION PREVENTION CASE STUDIES

for

ELECTRONICS MANUFACTURING

Pollution Prevention Case Study

Electronics Shops: Parts Cleaning with Deionized water.

Zompany	StorageTek 2270 South 88th Street Louisville, CO 80028-6210
Person to Contact	Tom Zanoni, P2 Coordinator Telephone: (303) 673-6074
Product or Service	Computer Peripheral Equipment, Information Storage Devices
Humber of Employees	1.000
Waste Stream Targeted	Freon **113**
Original System	Branson Freon **113** Vapor Degreaser. A 55-gallon Freon vapor degreaser with immersible basket was used to clean small computer parts (to remove oils, dust, debris) in the Assembly Laboratory. Trichlorotrifluoroethane (CFC-113 or Freon-113) is an ozone-depleting chemical. Once in the air, the chlorine atoms react with and destroy the atmospheric ozone which protects the earth fiom harmful UV rays from the sun. Freon 113 is no longer manufactured due to international agreements to protect the ozone layer.
New System (with P2 Modification)	Deionized Water Parts Washer. NC4000 Nova Engineering parts washer (dishwasher) uses deionized water to clean small computer parts for headers, connectors.
Cost Savings	not quantified.
Major Benefits	Reduced CFC emissions in the Laboratory by 100%. Improved business image. Reduced hazardous waste generation, storage, and associated regulatory requirements.
Obstacles	Finding an effective substitute. Required running both processes for a 6-month trial period.
Time Since Implementation	3 vears.
Source/Supplier	Nova Engineering. (D.I. water is produced in-house.)

Company	**StorageTek** 2270 South 88th Street Louisville, CO 80028-6210
Main Reason Implemented	Eliminate use of **CFCs.**
Key to Success for this P2 Modification	Employee Participation.

11/22/95

Pollution Prevention Case Study

Electronics Shops: Switch to a CO, "Snow" Parts Cleaning System.

Company	**StorageTek** **2270** South 88th Street Louisville. CO 80028-6210
Person to Contact	Tom Zanoni. P2 Coordinator Telephone: (303) 673-6074
Product or Service	Computer Peripheral Equipment, Storage Devices
Number of Employees	1,000
Waste Stream Targeted	**CFC emissions**
Original System	**Use of Freon 113 Solvent in Ultrasonic Parts Cleaning Process. A** 1-gallon Branson 3200 ultrasonic cleaner with immersible basket was used with Freon-113 to clean small computer parts such as compliant guides, ceramic buttons (to remove dirt, oils, debris) in the Field Replaceable Unit (FRU) Laboratory. Trichlorotrifluoro-ethane (CFC-113 or Freon-113) is an ozone-depleting compound and is also considered harmful to human health.
New System (with P2 Modification)	**Parts Cleaning with Crystalline CO, , "Snow".** CO_2 snow is used to clean surfaces exposed to contaminants (dirt, oils, etc.) from small computer parts. It generates no hazardous emissions and no hazardous waste. Gaseous CO_2 is drawn from a room-temperature gas cylinder and expanded through a nozzle to produce fine CO_2 particles and CO_2 gas. Cleaning is performed when the snow particles impact a contaminated surface, dislodge adherent contaminated particles, and carry them away in the gas stream. The aerosol can penetrate narrow spaces and no disassembly is required.
Cost Savings Initial Equipment Costs Operating Cost Savings	 Installation of the new CO_2 exhaust system cost ~$750.00. Initial cost of the CO, system was ~$3,000.00 (the system was designed and built in-house). The CO, system replaced one Branson 3200 ultrasonic cleaner which cost ~$2,500. **Not** auantified.

Company	**StorageTek** 2270 South 88th Street Louisville, CO 80028-6210
Major Benefits	**Reduced CFC emissions in the Laboratory by 100%.** **Improved business image.** CO_2 snow crystals are extremely gentle. The process is nonflammable, nontoxic, noncorrosive, and leaves no residue. Reduced worker health and liability concerns. Reduced hazardous waste generation, storage, and associated regulatory requirements.
Obstacles	**A** CO_2 exhaust system had to be installed in the laboratory. Some parts are too big to clean with crystallized CO_2.
Time Since Implementation	6 months
Source/Supplier	None
Main Reason Implemented	Eliminate use of **CFCs.**
Key to Success in Making this P2 Modification	Employee Participation.

11/

Pollution Prevention Case Study

Electronics Shops: Switch from CFC-113 Cleaner to Aqueous Cleaner

Company	**Unisys (Loral) Corporation** 1 William White Blvd. Pueblo, CO 81001
Person to Contact	Gene Willoxson, Safety Engr. Telephone: (719) 585-6026
Product or Service	Manufacture of military computers
Number of Employees	**160**
Waste Stream Targeted	**Chlorofluorocarbons (CFCs)**
Original System	**Trichlorotrifluoroethane (CFC-113 or Freon) Vapor Degreaser,** used as a solvent for cleaning dirt, oils, debris from electronic equipment. Once in the air, the CFC chlorine atoms react with and destroy the upper atmospheric ozone which protects the earth fiom harmful ultraviolet rays fiom the sun. CFCs may also be harmful to human health and must be disposed of as hazardous waste.
New System (with P2 Modification)	**Dupont Axarel-32 Degreaser** replaced CFC-113 in the electronic equipment cleaning processes. A new in-line cleaning system with wash, rinse and dry cycles replaced the vapor degreaser. Axarel-32 is a proprietary hydrocarbon cleaning agent for use in semi-aqueous cleaning processes. It is formulated with a combination of polar and nonpolar components to give the proper balance of selective solvency, high flash point (159°F), and low toxicity.

Company	**Unisys (Loral) Corporation** 1 William White Blvd. Pueblo, CO 81001
Cost Savings Initial Equipment Costs Material Cost savings Payback Period	 A new in-line cleaning system was installed at a cost of ~$200,000.00. Costs to upgrade the exhaust system and piping (PVC) cost ~$10,000.00. Under the original system, Unisys purchased ~8 (55) gal. drums/month of CFC-113 @ $15,000.00/month ($180,000/yr.). Under the new system, 11 *(55)* gal. drums/year of Axarel are purchased @ ~$1,588.00/drum or ~$17,465/year. However, use of IPA as a degreaser (contractual requirements) also increased by 20% or 440 gal./yr or $10,000/yr., a total cost (Axarel/IPA) of ~$27,465/year, a **raw material cost savings of ~$152,500/year.** **Payback is less than 1.5 years.**
Major Benefits .	**Raw material cost savings of ~$152,500/year.** **Eliminated CFCs emissions by 100%.** **Improved business image.** Reduced worker health and liability concerns associated with CFCs. Axarel-32 cleans as well as or better than CFC-113 degreasers.
Obstacles	Axarel-32 can attack plastic piping and cause leaks; therefore a corrosion-resistant PVC piping is used. None of Axarel's components appear on EPA's lists of toxic or hazardous substances, or on the **SARA** 313 Toxic chemicals lists. However, components are listed on the TSCA inventory.
Time Since Implementation	20 months.
Source/Supplier	Van Waters and Rogers 4300 Holly Street Telephone: (303) 388-5651 Denver, CO 80216
Main Reason Implemented	Eliminate use of CFCs and associated costs.
Key to Success in Making this P2 Modification	Employee training on Pollution Prevention.

12/13/95

Pollution Prevention Case Study

Electronics Shops: Equipment/Process Changes to Eliminate Ignitable Wastes in the Solder Coating Process.

Company	Velie Circuits of Colorado, Inc. 555 Alter Street, Unit 19 Broomfield, CO 80020
Person to Contact	Gary Klueckman, Prod. Support Mgr. Telephone: (303) 465-2786
Product or Service	Circuit Boards
Number of Employees	90
Waste Stream Targeted	D001 Ignitable Wastes (isopropanol, flux, fuse oil) in the Solder Coating Process.
Original System	Circuit boards were micro-etched (removes thin layer of copper), triple rinsed with water, dipped into an isopropanol tank (IPA, de-watering device before flux), dipped into a flux tank (HCl reacts with copper, enables solder to bond), and finally, into the solder pot (1000 lb. molten solder dip). A thin layer of fuse oil was then coated over the lead. The IPA and flux tanks had to be dumped once/2 weeks (50 gallon tanks).
New System (with P2 Modification)	On a conveyorized system, circuit boards are micro-etched, triple rinsed, hot air dried (replaces IPA drying), and automatically fluxed with a flux applicator (roller applicator, makes and applies flux), which eliminates flux waste (thin coat applied is used up on the solder). This system eliminated the 45-gallon flux tank change out. A Hot Air Leveler automatically applies the solder with fuse oil, eliminating the fuse oil waste.
Cost Savings Initial Equipment Costs Material Cost savings Waste Disposal Cost Savings Total Cost Savings Payback period	 The new system cost - $150,000.00 (including installation). Under the new system, Velie saves ~**$6600/yr** in material (IPA, flux, fuse oil) costs. Under the old system, 14 barrels/quarter of D001 (blend) waste was disposed of @ $275.00/barrel or $15,400.00/year. This waste was eliminated with the new system at a waste disposal cost savings of **$15,400/year.** Total cost savings of **$22,000/yr** 6.8 yr

Company	**Velie Circuits of Colorado, Inc.** 555 Alter Street, Unit 19 Broomfield, CO 80020
Major Benefits	**Total cost savings of ~$22,000/year.** **Reduced hazardous waste generation and associated regulatory requirements.** **Improved business image.**
Obstacles	High capital costs.
Time Since Implementation	1 month
Source/Supplier	In-house/Landtronic of Germany
Main Reason Implemented	rocess change to increase quality and decrease waste.
Key to Success in Making this P2 Modification	Management support/commitment to spending money on pollution prevention

11/30/95

Pollution Prevention Case Study

Electronics Shops: Process Change to Eliminate Hazardous Wastes Associated with Electroless Copper Plating.

Zompany	Velie Circuits of Colorado, Inc. 555 Alter Street, Unit 19 Broomfield, CO 80020
'erson to Contact	Gary Klueckman, Prod. Support Mgr. Telephone: **(303)** 465-2786
?roduct or Service	Printed Circuit Boards
Qumberof Emplovees	90
Waste Stream Targeted	Hazardous wastes associated with Electroless Copper Process
Original System	Conventional Plated Through Hole (PTH) with Electroless Copper. The copper-clad circuit board is electroless-platedwith copper to provide a conducting layer through the drilled holes for circuit connections between the copper-clad board surfaces. The process involves the catalytic reduction of a metallic ion in an aqueous solution containing a reducing agent, resulting in deposition without the use of external electrical energy. Materials typically used in the process that appear in the waste streams include: abrasive and alkaline cleaning compounds, tin and palladium catalysts, metal wastes, formaldehyde (reducing agent), and chelating agents.
Yew System (with P2 Modification)	The Shadow Process (Graphite Deposit), PTH with Direct Metallization (DM). The process applies a semi-conductive coating of graphite on the fiberglass cores of the circuit board by direct metal plating. After the graphite deposit is dried, the circuit boards are processed through a microetch which undercuts the graphite, removing the colloid from copper surfaces and leaving it intact on the resin and glass. Uniform deposition of the graphite and excellent conductivity promote uniform copper electroplating and eliminate formaldehyde and chelated metals, and other chemicals from electroless copper processes. and reduces water usage.

Company	Velie Circuits of Colorado, Inc. 555 Alter Street, Unit 19 Broomfield, CO 80020
Cost Savings	There is no cost savings associated with this improvement. Material, operating, and waste disposal costs did not change significantly. The savings are in environmental, health, and safety costs, which are difficult to quanti@. Water usage was reduced but could not be quantified.
Major Benefits	Reduces hazardous waste generation. Eliminates use of formaldehyde and other hazardous chemicals associated with electroless copper; reduced worker health and safety and associated liability concerns. Significant reductions in cycle time over electroless copper processes: Electroless Cu - 2.5 hr, Graphite deposit - 10 min. Better PTH reliability and better quality than electroless copper. Significantly reduces water usage. Positive Business Image.
Obstacles	Employee/process adjustment. Trial period (chemical adjustments, etc.) and costs associated with a new process.
Time Since Implementation	1 year.
Source/Supplier	Electrochemicals 5630 Pioneer Creek Drive Maple Plain, MN 55359 Telephone: (612) 479-6454
Main Reason Implemented	Process change to improve quality and decrease hazardous wastes.
Key to Success in Making this P2 Modification	Management suppodcommitment to pollution prevention.

12/07/95

Pollution Prevention Case Study

Electronics Shops: Equipment/Process Changes to Reduce Water Usage.

Company	**Velie Circuits of Colorado, Inc.** 555 Alter Street, Unit 19 Broomfield, CO 80020
Person to Contact	*Gary* Klueckman, Prod. Support Mgr. Telephone: (303) 465-2786
Product or Service	Circuit Board Manufacturing
Number of Employees	90
Waste Stream Targeted	**Water**
Original System	**Once-through Cooling Systems.** Several processes in the manufacturing of circuit boards require water cooling such as the ammonium etcher, plating rectifiers, lamination press, and the shadow process (direct metallization). Cooling water used in these processes passes through the heat exchange coils one time and is discharged into the waste water treatment system.
QewSystem with P2 Modification)	**AMCOT Evaporative Cooling Towers,** Model ST (fiberglass reinforced polyester). Recirculating cooling systems use a cooling tower. Cooling towers are heat exchangers which are used to dissipate large heat loads to the atmosphere. Wet cooling towers rely on the latent heat of water evaporation to exchange heat between the process and the air passing through the cooling tower. After the water passes through the tower to dissipate heat, the water is recvcled back to cool the process again.
Cost Savings Initial Equipment Costs Material Cost savings Pavback period	 AMCOT Cooling Towers, Model ST cost ~$1,300.00 each. Velie purchased 3 of the towers. The new system saves –10,000 gallons of water per day or –3 million gallons per year. At ~$1/1000 gal, this **is** a cost savings of $3,000/yr. Treatment costs would also be reduced, but this was not quantified. <1.3 yr

Company	**Velie Circuits of Colorado, Inc.** 555 Alter Street, Unit 19 Broomfield, CO 80020
Major Benefits	**Saves ~ 3 million gallons of water per year; cost savings of ~$3,000/yr.** **Positive Business Image.** Reduced wastewater treatment costs.
Obstacles	None.
Time Since Implementation of P2 Modification	1 year.
Source/Supplier	AMCOT Cooling Tower Company 14966 Whittram Avenue Fontana, CA 92335 Telephone: 1(800) 444-8693
Main Reason Implemented P2 Modification	Reduce water use and wastewater treatment costs.
Key to Success in Making this P2 Modification	Management support/commitment to pollution prevention

12/07/95

Pollution Prevention Case Study

Electronics Shops: Switch to an Environmentally Safer Alkaline Etchant

Company	**NTI, Colorado Division** 5035 Galley Road Colorado Springs, CO 80915
Person to Contact	Frank Gorman, Tech. Director Telephone: (719) 574-4905
Product or Service	Circuit Boards
Humber of Employees	306
Waste Stream Targeted	Etchants
Original System	**Alkaline Ammonium Chloride Copper Etchant.** Ammoniacal etchants are chelated and generate a chelated rinse water which can be minimized by rinsing the panels with fresh non-copper bearing replenishment etchant prior to the rinsing process. The original concentration of the spent alkaline etchant was 19 oz./gallon of copper. Most high-speed alkaline etchant proprietary formulations also contain Thiourea, a potentially hazardous additive in etchants to improve etching characteristics. Thiourea is listed as a hazardous substance and potential human carcinogen . Spent etchant is shipped off-site for reclamation and recycling.
New System [with P2 Modification)	**Phibro-Guard TFT (Thiourea-Free Technology).** Phibro-Guard TFT is also an ammoniacal alkaline etchant but is free of Thiourea. Phibro-guard TFT does not contain any carcinogens or suspected carcinogenic substances. In addition, the Phibro-Tech recycling process removes trace metallic impurities such as lead, zinc, chromium, and iron that may be a health hazard or detrimental to quality. The recycling process of spent etchant is copper reclamation and metal recovery done by Phibro-Tech using a proprietary method.

Company	**NTI, Colorado Division** **6035** Galley Road Colorado Springs, CO 809 15
Cost Savings	Phibro-Guard TFT costs the same as most alkaline etchants. Other cost savings have not been quantified. Reclamation costs are the same. However, by optimizing the copper concentration within the spent etchant (19 oz./gallon to 20 oz./gallon) a 5% reduction in spent etch volume is generated or a **$6,700/year savings.**
Major Benefits	Cost savings of $6700/yr. Environmentally safer than existing high speed formulations while having performance characteristics equal or superior to commercially available products. Higher speed and copper yield are expected to be obtained. Combines high etching rates, superior line definition, low undercutting, banking, and speed additives. Compatible with metallic and aqueous dry film resists. Reduced worker health and safety, liability concerns.
Obstacles	Designed for use in conventional spray etching equipment using thermostatic temperature control and proper ventilation (protect working environment from ammonia and excessive ammonia loss).
Time Since Implementation	1 month
Source/Supplier	Phibro-Tech, Inc. 204 Sunset Drive Rep: Martin Lieberman, (815) 727-1074 Wilmette, IL 60091-3027
Main Reason Implemented	Improve worker health and safety and improve quality.
Key to Success in Making this P2 Modification	Management commitment/support. Sharing of data and information with production operators to establish responsibility and ownership in P2

12/5/95

Pollution Prevention Case Study

Electronics Shops: Electrowinning Process to Increase Silver Recovery from Spent Fixer

Company	NTI, Colorado Division 6035 Galley Road Colorado Springs, CO 80915
Person to Contact	Frank Gorman, Tech. Director Telephone: (719) 574-4905
Product or Service	Circuit Boards
Number of Employees	306
Waste Stream Targeted	Silver Waste
Original System	Silver Cementation Process using canisters. Limited the amount of silver recovered.
New System (with **P2** Modification)	Installed an electrowinning (electrolytic recovery) unit prior to the silver cementation canisters. Increased silver recovery from spent fixer to 98% efficiency. Electrowinning is the recovery of the silver content from solution using an electroplating process. Cathodes made of thin starter sheets of the metal being recovered, or stainless steel blanks from which the recovered metal can be stripped, are mounted in an open tank. **As** the current passes from the anode to the cathode, the metal deposits on the cathode. With electrowinning added in series prior to canister cementation, NTI experienced a longer effective life for the canisters and improved recovery efficiency.
Cost Savings	With the cost savings on canister usage and 98% silver recovery, savings are ~$2,000/year.
Major Benefits	Minimization of silver discharged. ~$2,000 savings (canister usage and high silver recovery). Improved business image.
Obstacles	none
Time Since Implementation	2 years.

Company	**NTI, Colorado Division** 6035 Galley Road Colorado Springs, CO 80915
Source/Supplier	Silver Recovery, Inc. 604 2nd Street Berthoud, CO 80513
Main Reason Implemented P2 Modification	Silver discharge control and recovery value.
Key to Success in Making this P2 Modification	Management commitment/support. Operator involvement - sharing of data and information with waste treatment operators

3/21/95

COLORADO POLLUTION PREVENTION CASE STUDIES

for

CHEMICAL MANUFACTURING

Pollution Prevention Case Study

Chemicals and Allied Products: Solvent Management Team Formed to Reduce Solvent Wastes/Emissions

Company	**Hauser Chemical Research, Inc.** **5555 Airport** Boulevard Boulder, CO 80301
Person to Contact	Steve Perich, Environmental Affairs Manager Telephone: (303) 443-4662
Product or Service	Natural Source Pharmaceutical and Food Ingredient Manufacturer
Number of Employees	**150**
Waste Stream Targeted	**Solvent wastes, emissions**
Original System	**No Formal Solvent Management Team.** Problem solving started with management and trickled down to employees. Individuals looked at the **specific problem** and not the entire process to minimize waste and reduce solvent emissions. A large quantity of methylene chloride was used **as** a solvent in the product purification processes. Methylene chloride (dichloromethane) is considered a volatile organic compound (VOC) and hazardous air pollutant (HAP) and must be disposed of **as** hazardous waste.
New System (with P2 Modification)	**Formal Solvent Management Team.** Problem solving started from the bench ***(key*** people in the processes) and scaled up to management. **A** team **of** employees reviews the **entire process** to minimize waste and reduce solvent emissions. **A** waste minimization team was formed; solvent wastes/emissions were targeted **for** reduction (primarily methylene chloride) and several changes implemented: **1.** Methylene chloride degrades seals in the process totes. Maintenance **was** performed on all totes, leaks welded, and seals replaced. 2. Use of dedicated containers for specific processes to reduce the need for solvent cleaning. 3. Reviewed and improved sampling procedures to reduce solvent waste. **4.** Improved operating procedures and employee training to reduced solvent emissions/waste. **5.** Improved vapor recovery and recycling systems.

Company	Hauser Chemical Research, Inc. 5555 Airport Boulevard Boulder, CO 80301
Cost Savings	not quantified
Major Benefits	Reduced solvent emissions from **23.7** tonslyear in **1992** to **3.7** tonslyear in **1995.** Reduced methylene chloride hazardous waste from **293** tonslyear in **1992 to 59** tonslyear in **1995.** Recycled **10** million pounds of methylene chloride in **1995.** Recycled **275,000** pounds of isobutyl alcohol in **1995** (other solvents not quantified). Improved business image.
Obstacles	Research and development and testing of new methods/solvent substitutions requires time and money.
Time Since Implementation	**3.5** years.
Source/Supplier	None
Main Reason Implemented	Improve worker health and safety and reduce associated liability concerns. Reduce hazardous waste costs and liabilities.
Key to Success in Making this **P2** Modification	Team work in developing new methods/ideas on pollution prevention. Management support/commitment to pollution prevention.

16/96

Pollution Prevention Case Study

Chemicals and Allied Products: Switch to a Less Hazardous Solvent

Company	BIRKO Corp. 9152 Yosemite Street Henderson. CO 80640
Person to Contact	Terry McAninch, Director R & D Telephone: (303) 289-1090
Product or Service	Produce Industrial Detergents for the Meat Packing Industry
Number of Employees	24
Waste Stream Targeted	Solvent waste, emissions
Original System	Orthodichlorobenzene (ODCB) and Naphthalene-based solvents were used in a detergent product as wetting agents, for penetration of brine, and bacteriostatic characteristics. ODCBs (chlorinated organics) and napthalene-based solvents contain volatile organic compounds (VOCs) and hazardous air pollutants (HAPs).
New System (with P2 Modification)	Replaced solvent-based additives in the detergent blend with plant-extracted Essential Oils. This substitution eliminates the use of hazardous solvents in the detergent blend.
Cost Savings Initial Equipment Costs Material Cost savings	There are no cost savings associated with this improvement. None. Raw material costs increased ~20%; however product prices were increased ~25% to offset these costs.
Major Benefits	Reduced use of ODCB by ~66,000 lb/year and naphthalene-based solvents by 8,300 lb/year. Customers are willing to pay more for a safer product. Reduced health and safety concerns, liability reduction. Improved business image. Reduced potential for hazardous spills, leaks.
Obstacles	Costs more to make the new detergent blend, but these costs can be passed on to the customer. R & D to find less hazardous chemical additives takes time and money.

Company	**BIRKO Corp.** **9152** Yosemite Street Henderson, CO 80640
Time Since Implementation	**1.5** years.
Main Reason Implemented	Improve worker health and safety and reduce associated liability concerns. Business philosophy - it is important to provide a safer uroduct for the customer and emulovees.
Key to Success in Making this P2 Modification	Recognition that P2 must be addressed at the Research & Development phase, considering the entire life cycle of the uroduct.

2/2/96

Pollution Prevention Case Study

Chemicals and Allied Products: Solvent Miser Recycle/Reuse of Solvents in Liquid Chromatography

Company	Geneva Pharmaceuticals, Inc. 2655 W. Midway Blvd. Broomfield, CO 80038-0446
Person to Contact	*Gary* Long, Manager Safety & Environment Telephone: (303) 438-4233
Product or Service	Pharmaceuticals
Number of Employees	850
Waste Stream Targeted	Solvent waste, emissions
Original System	Samples are taken during different cycles of the manufacturing processes and analyzed by liquid chromatography (HPLC) to determine product purity, stability, concentration, etc. Solvents used in the separation process are discarded with the sample material. This process generates a lot of hazardous waste.
New System (with **P2** Modification)	Analtech Solvent Miser is a two-way valve attached to the **HPLC** system to transfer contaminated solvent from the separation process to a hazardous waste container. Uncontaminated solvent material is routed back to the HPLC reservoir for reuse, reducing the amount solvent disposed of as hazardous waste.

Company	Geneva Pharmaceuticals, Inc. 2655 W. Midway Blvd. Broomfield. CO 80038-0446
Cost Savings Initial Equipment Costs Material Cost Savings Waste Disposal Cost Savings Total Cost Savings Payback Period	 1 Solvent Miser Unit costs ~$1,800. Geneva purchased 55 units at a cost of ~$99,000. 1 Solvent Miser unit handles ~65 liters of pure solvent in 3 months; ~50% of this becomes waste. Therefore, ~32 liters is recycled/reused per quarter or 128 liters/year. Analytical grade methanol costs ~$4.00/liter, for a total material cost saving of ~$28,200/year for 55 units. Hazardous waste disposal costs ~$300/55 gal. Geneva disposes of ~14 drums/2 months from the analytical laboratories at a cost of ~$25,200/year. The Solvent Misers allow a 50% savings on hazardous waste disposal or ~$12,600/year (not including hazardous waste materials handling/profile costs). ~$41,000/yr Payback is about 2.4 years.
Major Benefits	Total cost savings of $41,000/year. Reduced hazardous waste generation and liability. Improved business image.
Obstacles	Time and costs associated with equipment modifications, recycling/reuse.
Time Since Implementation	3.5 years.
Source/Supplier	
Main Reason Implemented	Reduce hazardous waste disposal costs and associated liabilities.
Key to Success in Making this P2 Modification	Management support/commitment to pollution prevention.

2/6/96

Pollution Prevention Case Study

Chemicals and Allied Products: Switch to a Water-Based Release Coating.

Company	Central Products Company 1095 South Fourth Avenue Brighton, CO 80601
Person to Contact	Randy Putnam, Environ. Engineer Telephone: **(303)** 654-0500
Product or Service	Pressure Sensitive Tapes
Number of Employees	***260***
Waste Stream Targeted	Solvent waste, emissions
Original System	A solvent-based synthetic rubber/resin release coating is melted, blended, and applied to one side of the hot melt film and chilled. The release coating allows the tape to peel easily. The release coating contains toluene which is a volatile organic compound (VOC) and hazardous air pollutant (HAP) and may be hazardous to human health and the environment.
New System (with P2 Modification)	A nonhazardous water-based release coating replaced the solvent-based coating in the manufacture of hot melt tape. This substitution eliminates the use of toluene in the release coating.
Cost Savings Initial Equipment Costs Material Cost Savings	 None required; however, water-based release dries much slower than solvent-based. In some cases (not in this case), this may require the purchase of drying equipment (expensive) to maintain a similar rate of production. The cost of water-based release is about the same as the solvent-based release coating.
Major Benefits	Reduced total toluene emissions by 10%. Improved business image. Improved worker health and safety, liability reduction.
Obstacles	Water-based release coatings are more difficult to dry.
Time Since Implementation	1 year.

Company	**Central Products Company** 1095 South Fourth Avenue Brighton, CO 80601
Source/Supplier	For information, contact Randy Putnam.
Main Reason Implemented	Reduce hazardous solvent usage, emissions. Customer demand for less hazardous release coating.
Key to Success in Making this P2 Modification	Management support/commitment to pollution prevention.

Pollution Prevention Case Study

Chemicals and Allied Products: Switch to Less Hazardous Cleaning Agents

Company	Fel-Pro Chemical Products L.P. 6120 E. 58th Avenue Commerce City, CO 80022
Person to Contact	Catherine Griffith, Regulatory Affairs Manager Telephone: (303) 289-5651
Product or Service	Manufacturer of sealants, adhesives, lubricants, and epoxies for industrial applications.
Number of Employees	50
Waste Stream Targeted	VOC, HAP emissions
Original System	Methylene Chloride was used in the plant as a cleaning solvent for cleaning mixing tanks and equipment used in the formulation processes. Methylene chloride is considered a Hazardous Air Pollutant (HAP), and wastes/residues must be disposed of as hazardous waste.
New System (with P2 modification)	Thermaclean (095-0057) Graf Compound is used to replace methylene chloride for cleaning mixing tanks and process equipment. Thermaclean contains primarily Ethyl 3-ethoxyproprionate and N-methyl-2-pyrrolidone (NMP) which are not considered hazardous chemicals at this time.
Cost Savings Initial Equipment Costs Operating/Material Cost Savings	 None Saved ~$4,000/year in material costs and $5,000/year in hazardous waste disposal and other environmental costs (such as reduced compliance costs, savings in safety equipment).
Major Benefits	Cost savings of ~$9,000/year Reduced HAP emissions. Reduced hazardous waste generation and associated liabilities. Improved worker health and safety.
Obstacles	Thermaclean dries more slowly. Finding an effective substitute takes time and money.

Company	**Fel-Pro Chemical Products L.P.** 6120 **E.** 58th Avenue Commerce City, CO **80022**
Time Since Implementation	**2** years.
Source/Supplier	Cook Composites and Polymers Company 919 E. 14th Avenue North Kansas City, MO 641**16**
Main Reason Implemented	Reduce worker health and safety concerns.
Key to Success in Making this P2 Modification	Management suppodcommitment to P2 and worker safety.

1/26/96

Pollution Prevention Case Study

Chemicals and Allied Products: Recycle Water, Recapture Product from Wastwater Stream

Company	Sand Creek Chemical L.P. 4150 East 60th Commerce City, CO 80020
Person to Contact	Mark Ebson Telephone: (303) 286-7233
Product or Service	Methanol Production
Number of Employees	24
Waste Stream Targeted	Wastewater
Original System	Natural gas and steam are used in the methanol manufacturing process. A mixture of 85% methanol/15% water is produced and distilled. Wastewater from the process is sent to the POTW (some of the water may contain methanol). Methanol is considered a hazardous air pollutant (HAP) and a listed SARA 313 toxic chemical.
New System (with P2 Modification)	20% of the water from the methanol manufacturing process is reused and pumped back into the steam system. Wastewater is sent to a 20,000 gallon holding tank where it is sampled daily for methanol content before being discharged to the POW. Methanol-contaminated wastewater is reprocessed and methanol removed before final discharge to the POW.
Cost Savings Initial Equipment Costs Operating Cost Savings	 (2) 20,000 gallon storage tanks cost $50,000 installed (one is a backup storage tank). 20% of the water is reused in the process or ~2,000 gallons/day are saved @ ~$3.00/1,000 gallons or ~$2,200/year. Methanol is saved in the monitoring process, but has not been quantified. (This savings does not include the savings from POTW surcharges and discharge fines of greater than $1,000/year).

Company	**Sand Creek Chemical L.P.** **4150** East 60th Commerce City, CO 80020
Major Benefits	**20% of the process water is recycledlreused in the process, saving over $2,000/year.** **Reduced discharges of methanol to the POTW and reduced compliance problems and liabilities.** **Positive business image.**
Obstacles	Capitol costs associated with reclaiming methanol.
Time Since Implementation	1 year.
Main Reason Implemented	Reduce regulatory exposure and reduce costs.
Key to Success in Making this P2 Modification	Management commitment to P2/reducing discharges.

2/2/96

Pollution Prevention Case Study

Chemicals and Allied Products: Equipment Modification to Increase Solvent Recovery and Decrease Solvent Emissions.

Company	**Central Products Company** 1095 South Fourth Avenue Brighton, CO 80601
Person to Contact	Randy Putnam, Environ. Engineer Telephone: (303) 654-0500
Product or Service	Pressure Sensitive Tapes
Number of Employees	260
Waste Stream Targeted	**Solvent waste, emissions**
Original System	Activated carbon beds are a solid sorbent used for capture of organic vapors (VOCs and HAPs) used in the manufacturing processes. The carbon beds were designed with a layer of hardware cloth (expanded metal mesh) layered with gravel and a 10 ton carbon bed. A diffuser spreads the air and distributes the solvent vapors onto the carbon beds. This design allowed channeling (air/solvent escaped through' holes in the bed) and decreased the carbon bed efficiency. **A** steam regeneration system and distillation column are used for solvent recovery from the carbon beds, allowing reuse of the solvent in the manufacturing processes.
New System (with P2 Modification)	The carbon beds are now designed with a titanium fine mesh screen under a 12-13 ton carbon bed (increased carbon bed capacity, larger surface area and higher adsorption capacity) replacing the gravel layer. This design gives more depth, helps prevent channeling, and improves the recovery efficiency of the carbon beds by almost 10%. The same solvent recovery system is used. Forced ventilation drying decreases the cycle time and allows recovery of the solvent with little or no ***HAPs*** generation.
Cost Savings Initial Equipment Costs Operating Costs Savings	 not quantified. **~$39,000/year is saved in material costs (recovered solvent).**

Company	Central Products Company 1095 South Fourth Avenue Brighton, CO 80601
Major Benefits	Increased HAPs recovery efficiency by 10% (capture efficiency is now **99%).** This process change was a primary factor in overall reductions in HAPs emissions by ~90 tons/year, during **a** period when production rates doubled. Material Cost savings of ~$39,000/year (increased solvent recovery). Positive Business Image.
Obstacles	Relatively large capital costs.
Time Since Implementation	***6*** years.
Source/Supplier	None
Main Reason Implemented	Increase solvent recovery and reduce *HAPs* emissions and associated costs.
Key to Success in Making this P2 Modification	Management suppodcommitment to pollution prevention.

/14/96

Pollution Prevention Case Study

Chemicals and Allied Products: Waste Segregation System to Increase Recycling

Company	Central Products Company 1095 South Fourth Avenue Brighton, CO 80601
Person to Contact	Randy Putnam, Environ. Engineer Telephone: (303) 654-0500
Product or Service	Manufacture Pressure Sensitive Tapes.
Number of Employees	260
Waste Stream Targeted	All Wastes Generated from the Manufacturing Processes
Original System	Wastes generated from the manufacturing processes were contained in 55-gallon drums, labeled, and disposed of as hazardous and/or nonhazardous waste.
New System (with P2 Modification)	Wastes generated from the manufacturing processes which can be recycled/reused are placed into separate, color-coded 55-gallon drums. For example, yellow drums contain natural rubber adhesive wastes which are recycled/reused in the process. Yellow/red drums contain release coating which can be recycled/reused in the process. This system reduces the amount of waste disposed of as hazardous waste.
Cost Savings	
Initial Equipment Costs	None.
Operating/Material Cost Savings	~30,000 lb/yr of release coating are recycled/reused at a material cost savings of $5,500/year. ~300,000 lb/yr of adhesive waste are recycled/reused at a material cost savings of ~$130,000/year. Labor and other operating costs are about the same under the new system.
Waste Disposal Cost Savings	Under the new system, hazardous waste disposal is reduced by 8 drums/month, for a waste disposal cost reduction of ~$14,500/year.
Total Cost Savings	~$144,000/yr

Company	**Central Products Company** 1095 South Fourth Avenue Brighton, CO 80601
Major Benefits	**Total cost savings of ~144,000/yr** **Reduced hazardous waste generation by –5300 gal/yr.** **Reduced hazardous waste liability.** **Improved business image.**
Obstacles	None.
Time Since Implementation	6 years.
Source/Supplier	None. Material supply drums are painted in-house and reused.
Main Reason Implemented	Reduce waste generation and associated costs and liabilities.
Key to Success in Making this P2 Modification	Management support/commitment to pollution prevention.

2/14/96

Pollution Prevention Case Study

Chemicals and Allied Products: Recycle Waste Streams Back into the Processes.

Company	KWALHOWELLS Paint and Wall covering 3900 Joliet Street Denver, CO 80239-0119
Person to Contact	Zhristine Les Camela, Tech. Director relephone: (303) 371-5600
Product or Service	Architectural Paints
Number of Employees	70
Waste Stream Tameted	Spent Solvent and Water used to rinse out mixing tanks.
Original System	Mixing tanks (200 - 6,000 gal) used in the paint manufacturing process are rinsed between batches with water or a solvent blend (e.g., mineral spirits/alcohol blend or mineral spirits/xylene blend - depends upon the type of batch). 92% of the products are water-based and can be cleaned with water. The spent water or solvent blend from the cleaning process was disposed of as hazardous waste or nonhazardous waste.
New System (with P2 Modification)	Spent water from the cleaning process is pumped from the mixing tank into a storage tank and reused for cleaning a similar batch. The solvent blend is recovered from distillation and then reused for cleaning a similar batch. For a 3,000 gallon batch, –200 gallons of solvent or water is reused which saves water and solvent and reduces hazardous waste disposal costs. Spent solvent blends or water are disposed of as hazardous and nonhazardous waste.
Cost Savings Initial Equipment Costs Material Cost Savings Waste Disposal Cost Savings Total Cost Savings	 None. Storage tanks, pumps, piping was already in place. –5,000 gal/year is saved in the purchase of the raw material solvent blends. Saves –115,000 gallons/year of water. Recycle/reuse of the solvent blend and water in the processes saves a substantial amount per year in waste disposal costs. Over $200,000/year in total savings.

Company	**KWALHOWELLS Paint and Wall covering** 3900 Joliet Street Denver, CO 80239-0119
Major Benefits	**Total cost savings of over $200,000/yr.** **Reduced hazardous waste generation and associated liabilities.** Improved business image.
Obstacles	Production time is increased because it takes extra time to recycle/reuse the water or solvent.
Time Since Implementation	10 years.
Source/Supplier	None.
Main Reason Implemented	Reduce generation of water and solvent waste and associated costs and liabilities.
Key to Success in Making this P2 Modification	Must schedule paint batches properly for the most efficient use/reuse of the spent water/solvents.

COLORADO POLLUTION PREVENTION CASE STUDIES

for

WOOD PRODUCTS AND FURNITURE MANUFACTURING

Pollution Prevention Case Study

Wood Products and Furniture: Switch to More Efficient Paint Spray Guns

Company	**Phelps-Tointon Millwork** **100**1 Buckingham Street Fort Collins. CO 80524
Person to Contact	Fred Galley, Operations Manager Telephone: (303) 484-9668
Product or Service	Custom Woodworking
Number of Employees	35
Waste Stream Targeted	**Paint-related Waste**
Original System	**Low-Volume High-pressure (Conventional) Spray (LVHP) Guns** use a high velocity air stream to atomize the paint. Pressures typically range from 40 to 70 pounds per square inch (psi). The high air velocity causes paint droplets to dry before reaching the surface and increases paint bounce-back and over spray. This results in excessive over-spray fog and low transfer efficiency (25-30%).
New System (with P2 Modification)	**Air-Assisted Airless Spray Guns** combines compressed air with hydraulic pressure to atomize the coating material. This combination results in finer droplets of coating than produced by airless spray and also allows for a reduction in hydraulic pressure, providing better operator control and higher paint transfer efficiency (50-60%). About 150 to 800 psi of fluid pressure and 5 to 30 psi of air pressure are used to atomize the paint.
Cost Savings Initial Equipment Costs Material Cost Savings Waste Disposal Costs	 $3,360 (includes spray gun, 55-gallon pump with lid and agitator). Material costs are less because of the higher transfer efficiencies, but were not quantified. Waste disposal costs are similar to the original system.

Company	**Phelps-Tointon Millwork** 1001 Buckingham Street Fort Collins, CO 80524
Major Benefits	**Reduced over spray, reduced VOC emissions.** **Material cost savings.** **Positive business image.** The finish is as good or better than with conventional spray guns. Allows **higher production rates** compared to HVLP or LVHP systems due to rapid fluid delivery and high transfer efficiency.
Obstacles	Increased maintenance is required (more mechanical parts). Capitol cost is higher; but in the long run, purchase of the air-assisted airless spray gun will pay off (fine finish, high efficiency rate). Some additional operator training is required. Air-assisted airless technology is not compatible with some high-solids coatings.
Time Since Implementation	3 years.
Source/Supplier	Fluid Air Systems 3020 North Highway 85 Telephone: (303) 814-0208 Castlerock, CO 80104
Main Reason Implemented	Reduce material costs. Need better equipment to handle high-volume custom woodworking.
Key to Success in Making this P2 Modification	Equipment/material information fiom trade journals, suppliers. Employee involvement and training - operator skill is a very important factor in spray efficiency.

1/11/96

Pollution Prevention Case Study

Wood Products and Furniture: Switch to HVLP Spray Gun Equipment for Stains and Sealers.

Company	**Woodleys Fine Furniture** 15 South Bowen Longmont, CO 80501
Person to Contact	Don Brewer, Finishing Dept. Mgr. Telephone: **(303) 443-0716**
Product or Service	Bedroom furniture, entertainment centers
Number of Employees	120
Waste Stream Targeted	**Paint-related Waste**
Original System	**Airless Spray Gun system.** Airless spray technology uses high fluid pressure applied by hydraulic pumps to atomize the coating material, rather than using high pressure air or high volumes of air, as with conventional and HVLP systems. Airless spray application is fast and may be ideal for large surfaces or heavy viscous coatings, but this system generally does not produce a high-quality appearance which is very important in the wood products/furniture industries. Transfer efficiency is **50-60%.**
New System (with P2 Modification)	**High-Volume Low-Pressure (HVLP) Spray Gun system.** HVLP spray guns operate with a high volume of air delivered at 10 psi or less to atomize the coating. Atomization of the coating at low air pressures allows increased transfer efficiency **(65-80%),** reduced over-spray, and therefore, reduced **VOC** emissions. High production rates may not be possible with the HVLP system. However, HVLP is well-suited to small to medium-sized shops such as Woodley's, where high quality is more important than high production.

Company	**Woodleys Fine Furniture** 15 South Bowen Longmont, CO 80501
Cost Savings Initial Equipment Costs Operating Costs Material Cost savings Total Cost Savings Payback Period	 HVLP system *(gun,*cup, hose) cost - $180.00 (inexpensive model). The system uses an existing air compressor. Similar to conventional systems but, the HVLP system **reduced paint booth cleanup costs** (strip, repaint, water wash filter system dump) **by ~$4,000/year** (cleaning reduced from once/month to once/quarter due to reduced overspray). 2,240 gallons of stain/year was used in the conventional airless system @ $26,000/year. With use of the HVLP system, 1,105 gallons of stain is used @ $12,000/year. This is a **cost savings of $14,000/year for stain.** Use of the HVLP system also **saved** (6) 55-gallon drums of **sealer**/year @ $450.00/drum or **$2,700/year.** **Total cost savings of ~$20,700/year.** **Payback is less than 1 month.**
Major Benefits	**Total cost savings of ~$20,700/year.** **Positive business image.** **Improved coating quality.** Reduced VOC and HAP emissions due to less overspray (not quantified). Improved worker health and safety (reduced worker exposure to blowback).
Obstacles	Little employee adjustment/training is required on the HVLP system. However, high production rates may not be possible with HVLP systems. Not all finishes work well with the HVLP system (topcoat lacquer requires a 3-4 ml finish which does not work well in the HVLP equipment).
Time Since Implementation	1 year.
Source/Supplier	Paint & Lacquer Company 3701 S. Santa Fe Drive Englewood, CO 80110 Telephone: (303) 761-0743
Main Reason Implemented	Reduce material costs and over-spray.
Key to Success in Making this P2 Modification	Experience with different spray equipment, coatings

5/96

Pollution Prevention Case Study

Wood Products and Furniture: Switch to Waterborne Topcoat Lacquers

Company	**Shafer Commercial Seating** 4101 East 48th Avenue Denver, CO 80216-3298
Person to Contact	Irwin Suson, Plant Manager Telephone: (303) 322-7792
Product or Service	Chairs and other furniture for hotels and restaurants
Number of Employees	168
Waste Stream Targeted	**Paint-related Waste**
Original System	**Solvent-based Topcoat Lacquers are** used in finishing **wood** furniture. Typical solvent-based lacquers contain 60% to 80% volatile organic compounds **(VOCs),** many of which are also listed as hazardous air pollutants (HAPs).
New System . **(with P2 Modification)**	**Waterborne Topcoat Lacquers.** In waterborne coatings, water, in conjunction with an organic solvent (2 to 30 percent), acts **as** the carrying **medium**. Use of waterborne topcoat lacquers significantly reduces the use of **VOCs** and HAPs. Since waterborne lacquers *dry* more slowly, infrared (IR) drying ovens were added. (Waterborne coatings can also be air-dried, but this will **slow** down production.) With the addition of the drying ovens, production capacity will actually increase significanly.
Cost Savings	
Initial Equipment Costs	(4) IR ovens were purchased and installed for –200,000. A new conveyor system was added for ~$100,000. Stainless steel equipment modifications (new pumps, lines, *guns,* to prevent rust problems) cost ~$30,000.
Operating Costs	The new system will allow them to nearly double their production rate (and sales).
Material Cost savings	Solvent-based topcoat lacquers cost ~$10.50/gallon. Waterbome topcoat lacquers cost ~**$16.00/gallon**. For each coating, 12 chairs can be coated/gallon using solvent-based lacquer. 16-18 chairs can be coatdgallon using waterborne lacquer. Therefore, the cost per chair is **nearly the same:** $.87/chair for solvent-based and $.94/chair for Waterborne. However, water-based topcoat lacquers eliminate the use of solvent-based lacquer **thinners as** a **thinning** agent/cleaner whch will also be a substantial cost savings (not yet quantified).
Payback Period	**Because of the increased production rates** allowed by the new system, the overall payback period will be **about** 3 **years.**

Company	**Shafer Commercial Seating** 4101 East 48th Avenue Denver, CO 80216-3298
Major Benefits	**Reduced VOC emissions from 80 tons/year to 1 ton/year** (HAPs reduction was not quantified). **Reduced fire hazard.** **Improved worker health and safety, liability reduction.** **Positive business image.**
Obstacles	Conventional application processes can be used. However, employee training and adjustment is required. Equipment needs to be corrosion resistant i.e., plastic or stainless steel. Equipment may need to be cleaned immediately after use. **Wood** grain raising can be a problem. Shafer has resolved this problem by sanding the wood surface after applying the first coating followed by application of a second coating. Increased drying times, or significant capital expenditures for drying ovents. (In this case, IR ovens reduced drying times and increased production capacity). Humidity must be controlled (33-35%). Waterborne coatings can be more difficult to repair.
Time Since Implementation	1 month.
Source/Supplier	Colorado Paint Company 4747 N. Holly, Denver, CO Telephone: (303) 388-9265 Diamond Vogel 4500 E. 48th Avenue, Denver, CO Telephone: (303) 333-4499
Main Reason Implemented	Reduce VOC and HAPs emissions and associated regulatory burdens and liability. Improve employee health and safety.
Key to Success in Making this P2 Modification	Management support/commitment to Pollution Prevention. Employee involvement, training in P2 modifications.

Pollution Prevention Case Study

Wood Products and Furniture: Switch to High-solids Varnishes

Company	**Wood Masters** 405 South Link Lane Fort Collins, CO 80524
Person to Contact	Brian Tormev. Owner Telephone: (970) 484-2016
Product or Service	Commercial Cabinetry
Number of Employees	**4**
Waste Stream Tameted	**Paint-related Waste**
Original System	**Low-solids, Solvent-borne Coatings** Conventional coatings consist mainly of resins, coloring agents, extenders, and additives carried in a solvent. Typical coating solvents are volatile organic compounds (VOCs) and hazardous air pollutants (HAPs) such as toluene, xylene, and **MEK.** These coatings contain high molecular weight resins (solids) in the range of 20-30% or lower. Typical VOC content is about ***6.0*** pounds per gallon. Conventional coatings can require addition of up to 50% reducer and a catalyst.
New System (with P2 Modification)	**High-solids, Solvent-borne Coatings** reduce the quantity of volatile organic solvent in the coatings. Wood Masters purchases a M.L. Campbell Duravar Plus (41% solids) and Clearlight Plus **(38%** solids) Catalyzed Varnishes which contain no aromatic or ketone solvents. High-solids finishes contain reduced molecular weight resins to allow high solids concentration while the viscosity remains acceptable for use in conventional application equipment. Solids content for wood product application typically falls in the range of 35%-40% or higher which results in less VOC emissions and solvent waste. VOC content is about 5 pounds per gallon, and the high-solids finish requires addition of **only** 0-5% reducer.

Company	**Wood Masters** **405** South Link Lane Fort Collins, ***CO*** 80524
Cost Savings Initial Equipment Costs Operating Costs Material Cost Savings	 None. The new finishes have reduced labor costs (takes less time to achieve the required film thickness and reduced clean up time), but savings have not been quantified. There may be a small material cost saving associated with this substitution, but it has not been quantified. The new finishes generally cost more per gallon, but require the addition of little or no thinners.
Major Benefits	**Reduced VOC and HAP emissions.** **Improved worker health and safety.** More durable finish. Positive business image. Reduced number of spray applications to achieve a given film thickness.
Obstacles	Employee adjustment to new finishes. Sensitive to temperature and humidity. Difficult to control sagging. Generally require higher cure temperatures.
Time Since Implementation	***6*** months.
Source/Supplier	Paint & Lacquer Company 3701 S. Santa Fe Drive Englewood, CO 80110 Telephone: (303) 761-0743
Main Reason Implemented	Reduce VOC and HAP emissions. Improve worker health and safety, reduce associated liabilities.
Key to Success in Making this P2 Modification	Information from Woodworlung Journals. Employee adjustment to new products.

1/11/96

Pollution Prevention Case Study

Wood Products and Furniture: Product Substitution to Low or No-HAPs Coatings/CoatingSolvents.

Company	**Design Fabricators, Inc.** 555 Aspen Ridge Drive Lafayette, CO 80026
Person to Contact	Bob Coleman, Principal Telephone: (303) 661-9800
Product or Service	Custom Retail Store Fixtures
Number of Employees	115
Waste Stream Targeted	**Coating-related waste, HAPs emissions**
Original System	**Solvent-based Lacquers/Lacquer Thinners.** Typical coatings/coating solvents contain methyl ethyl ketone, methyl isobutyl ketone, toluene, and xylene. Many of these chemicals are considered Volatile Organic Compounds (VOCs) and/or Hazardous Air Pollutants (HAPs).
New System (with P2 Modification)	**Low or No-HAPs Lacquers/Lacquer Thinners,** contain low amounts of or no listed hazardous air pollutants (HAPs). Low-HAPSproducts used in this case: 1. T-6 Lacquer Thinner (Product # 900-0406). 2. Low HAPs Water-White Sealer (# 900-0406-01). 3. Low HAPs Precatalyzed Lacquer (25 Sheen, # 571-0377-25 and 40 Sheen, # 571-0377-40). 4. No HAPs Wipe Reducer (# 590-0156).
Cost Savings Initial Equipment Costs Material Cost savings Waste Disposal Costs	 None. There is little or no cost savings associated with this improvement. Low or no-HAP coatings/coating solvents are, in general, more expensive to purchase than conventional coatings/coating solvents (one is less expensive). Similar quantities are required; therefore costs are slightly higher overall. There is no waste disposal cost savings associated with this improvement.

Company	**Design Fabricators, Inc.** 555 Aspen Ridge Drive Lafayette, CO **80026**
Major Benefits	**Reduced HAP emissions from 21.9 tons/year to 8.7 tons/year, a 60% reduction.** **Improved worker health and safety, reduction in associated liabilities.** **Improved business image.**
Obstacles	Low or No-HAPS Lacquers/Lacquer thinners still contain **VOCS.**
Time Since Implementation	1 year.
Source/Supplier	Guardsman Products **13535** Monster Rd. South Seattle, WA **98178** Telephone: Larry Moore, Rep. **(719) 532-3107**
Main Reason Implemented	Reduce *HAP* emissions. Improve worker health and safety and reduce associated liabilities.
Key to Success in Making this P2 Modification	Working with vendors to find less hazardous products.

Pollution Prevention Case Study

Wood Products and Furniture: Water-based Cleaner for Paint Equipment

Zompany	Mastercraft 3550 Odessa Way Aurora. CO 80011
Person to Contact	Ron Schoenberg, Plant Manager Telephone: (303) 375-8220 Ext. 145
Product or Service	Commercial Wood Products, Cabinetry
Vumber of Employees	-100
Waste Stream Targeted	Lacquer Thinners, VOC Emissions
Original System	Solvent-based Lacquer Thinners are used to clean paint equipment (after use of solvent-based paints) such as spray guns, nozzles, etc. Typical lacquer thinners are organic solvents which contain volatile organic compounds (VOCs) and hazardous air pollutants (HAPs) such as toluene, xylene, and methyl ethyl ketone. Spent lacquer thinner is disposed as hazardous waste.
New System [with **P2** Modification)	A water-based cleaner is used to clean similar paint equipment. Aqueous cleaners are mixtures of water, detergents, and other additives that promote the removal of organic and inorganic contaminants from the paint conveyor and other equipment in the paint line. This product does not contain VOCs. The wastewater is treated and discharged to the POTW.
Cost Savings Initial Equipment Costs Material Cost Savings Waste Disposal Costs	 None. There is a slight increase in material costs associated with this substitution. - 1,250 gallons/month of lacquer thinner were used @ ~$200/55-gallon drum or $4,500/year. -625 gallons/month of the water-based cleaner is used @ ~**$500/55-gallon** drum or $5,700/year. (Increase of $1200/yr) Significant reduction in hazardous waste generation and disposal costs (not auantified).

Company	**Mastercraft** **3550** Odessa Way Aurora, CO 80011
Major Benefits	**Reduced VOC emissions by -40 tons/year.** **Reduced hazardous waste generation, disposal costs and associated liabilities.** **Improved worker health and safety and reduced liabilities.** **Positive Business Image.**
Obstacles	Lacquer thinner is still being used for cleaning paint gun nozzles.
Time Since Implementation	**2** years.
Source/Supplier	Contact Ron Schoenberg.
Main Reason Implemented	Reduce **VOC** emissions. Improve worker health and safety.
Key to Success in Making this P2 Modification	Vendor recommendation.

/15/96

Pollution Prevention Case Study

Wood Products and Fumiture: Switch to Water-based and Hot-Melt Adhesives

Company	**Shafer Commercial Seating** 4101 East 48th Avenue Denver, CO 80216-3298
Person to Contact	Irwin Suson, Plant Manager Telephone: (303) 322-7792
Product or Service	Chairs, tables, and booths for restaurants and hotels
Number of Employees	168
Waste Stream Targeted	**Adhesive-related waste, emissions**
Original System	**Solvent-based liquid adhesives** were used in the manufacture of chairs and booths. These adhesives, used in assembly and edge bonding (bonding foam pads and seat backings onto wood or foam), were sprayed on with an adhesive spray *gun.* Typical synthetic resins and contact or hot melt adhesives contain up to 50% organic solvents such as formaldehyde and 1,1,1-trichloroethane (TCA), which are hazardous air pollutants (HAPs) as well as volatile organic compounds (VOCs).
New System (with P2 Modification)	**Water-based adhesives** and **solventless hot melt adhesives (100% solids)** replaced solvent-based adhesives in the manufacturing processes. The hot melt pellets are melted in a glue pot and warm glue extruded onto material surfaces or applied with an adhesive spray gun (used to bond foam to foam, foam to wood). Water-based liquid contact adhesives are generally applied with a stainless steel adhesive spray gun (used to attach wood backing onto seating materials). In water-based adhesives, water alone or in conjunction with an organic solvent, acts as the carrying **medium,** reducing or eliminating VOCs and/or HAPs in the adhesive material.

Company	**Shafer Commercial Seating** 4101 East 48th Avenue Denver, CO 80216-3298
Cost Savings Initial Equipment Costs	A Binks HVLP BBR Spray gun system for use with hot melt adhesives cost ~$3,000.00. A Slautterdack stainless steel adhesive spray system for use with water-based adhesives cost ~$3,200.00.
Material Cost Savings	(12) 55-gallon **drums** of solvent-based liquid adhesives were used/year at a cost of–$1,200/55-gallon or $14,400/year. Shafer uses ~(4) 55-gallon drums/year of the HP Fuller water-based adhesive at a cost of **$1,200/drum** or $4,800/year. –1,500 lb/year of the Slautterdack hot melt adhesive is used at a cost of ~$2.50/lb. or ~$3,800/year. **Total material cost savings of ~$5,800/year.**
Waste Disposal Cost Savings	Waste disposal costs are similar since very little adhesive waste is generated fiom the processes.
Payback Period	**Payback is about 1 year.**
Major Benefits	**Reduced VOC and *HAP* emissions by ~ 50% (–2,600 lb/yr).** **Material cost savings of ~$5,800/year.** **Positive business image.** Reduced fire hazard. Improved worker health and safety, liability reduction.
Obstacles	Employee adjustment to new products. Equipment for use with water-based adhesives should be corrosion resistant i.e., plastic or stainless steel. Equipment may need to be cleaned immediately after use. Water-based adhesives require slightly increased drying times.
Time Since Implementation	1 year.
Source/Supplier	Slautterdack Company 1663 Catalina St., Sand City, CA (800) 722-0358 HP Fuller Company 200 Sunston Road, Kansas City, **KS** 66115 (800) 255-4210
Main Reason Implemented	Reduce VOC and HAPs **emissions** and reduce regulatory burden and liabilities. Improve employee health and safety and reduce liability.
Key to Success in Making this P2 Modification	Management suppodcommitment to pollution prevention. Working with vendors to find environmentally "friendly" products/materials.

/23/96

Pollution Prevention Case Study

Wood Products and Furniture: Switch to a More Efficient Paint Dispensing System and Purchase Raw Materials in Bulk

Company	Phelps-Tointon Millwork 1001 Buckingham Street Fort Collins, CO 80524
Person to Contact	Fred Galley, Operations Manager Telephone: (303) 484-9668
Product or Service	Custom Woodworking
Number of Employees	35
Waste Stream Targeted	Paint-related Waste
Original System	Coatings/thinners are purchased in 1 or 5-gallon containers for use in a 2-gallon spray paint pot. This process requires manually opening the containers, and manually pouring and mixing the coatingdthinners. Paint pots must be refilled multiple times. This process involves potential for spills and exposure to paint-related waste.
New System (with P2 Modification)	Coatings and thinners used most are purchased in 55-gallon drums and connected to dedicated lines with a drum cover outfit. This system provides direct delivery of the coating material to the spray gun instead of indirect transfer. The drum cover outfit (hose, 55-gallon pump with lid, and agitator) prevents settling of coating formulations and eliminates filling an interim container, transporting the container to the work area, and transferring the coating material from the interim container to the spray gun. The system reduces clean-up between changes and reduces the potential for spills and exposure to paint-related waste. A preheater is placed in the coating drum to maintain Viscosity for smooth flow.

Company	**Phelps-Tointon Millwork** 1001 Buckingham Street Fort Collins, CO 80524
Cost Savings Initial Equipment Costs Operating Costs Material Cost Savings Total Cost Savings Pavback Period	**A** conventional drum cover outfit costs -$1,600 (includes hose, 55-gallon pump with lid, agitator). Phelps-Tointon purchased an air-assisted airless drum cover outfit for ~$2,900 (~$3,300 with the air-assisted airless spray gun). **~$5,000/yr savings in labor costs compared to the original system** (eliminated manual labor in opening cans, transfers, mixing). Under the original system, lacquer/sealer cost ~$12.00/gallon. By purchasing lacquer in 55-gal drums instead of 5-gal containers, the cost is ~$10/gal. 330 gal/month are used for a savings of $7900/yr. Thinner cost ~$5.00/gal if purchased in **5** gal containers vs. $3.50/gal for **55-gal** drums. 110 gal/month of thinner is used, for a cost savings of $2000/yr. **This is a material cost savings of -$10,000/year.** **~$15,000/yr** **Pavback is about 2.3 months.**
Major Benefits	**Total cost savings of ~$15,000/yr.** **Reduced employee exposure to hazardous chemicals.** Reduces clean-up between changes and the amount of thinner needed for cleaning (not quantified). 5-gallon dispensers were disposed **of;** 55-gallon containers are recycled, reducing empty container waste.
Obstacles	Custom colors/mixes are not purchased in **5**5-gallon containers (low volume). 55-gallon containers are more difficult to handle.
Time Since Implementation	3 years.
Source/Supplier	Fluid ***Air*** Systems 3020 North Highway 85 Castlerock, CO 80104 Telephone: (303) 814-0208
Main Reason Implemented	Reduce material and labor costs.
Key to Success in Making this P2 Modification	Equipment/Material information fiom Trade Journals, Suppliers.

1/11/96

Pollution Prevention Case Study

Wood Products and Furniture: Equipment Modification to Reduce Solvent Use

Company	Anonymous Colorado Wood Products Company
Person to Contact	
Number of Employees	~150
Waste Stream Targeted	Solvent-based cleaners, VOC/HAP emissions
Original System	Solvent was poured from a squeeze-type plastic container onto a laminated surface. The surface was then wiped with a cloth wipe to clean ink marks and glue off of the laminated fixtures and edges. Typical solvent cleaners contain volatile organic compounds **(VOCs)** such as methyl isobutyl ketone and methanol which can be harmful to human health and the environment (primary ingredients of smog). This procedure allowed employee exposure to the solvents for an extended period of time.
New System (with P2 Modification)	Cleaning Solvent Cans with Plungers allow the employee to press a spring-loaded cup with the cloth wipe in hand. The 1-gallon metal plunger can dispenses a measured amount of cleaner into the cup and onto the cloth wipe. This procedure allows minimal employee exposure to the solvent cleaners and reduces solvent use.
Cost Savings Initial Equipment Costs Material Cost Savings Payback Period	 ~15 plunger cans were purchased @ ~$37.50 each or $562.50. ~2,145 gallons of solvent are purchased per year. The company saved ~10-15% in solvent materials with the new system. For ~270 gallons/year @ $3.40/gallon, this is a material cost savings of ~$900/year. Payback is about 7 months.

Company	**Anonymous Colorado Wood Products Company**
Major Benefits	**Reduced solvent emissions by ~10-15%.** **Material cost savings of ~$900/year.** Improved worker health and safety (prior to implementation of the new system, employees rotated work stations to reduce solvent exposure and comply with OSHA PELs). Positive Business Image. Reduced fire hazard (metal cans can be grounded during solvent transfers). Product is available in metal or plastic, and 1 gallon, 1/2, and 1/4 gallon sizes.
Obstacles	None
Time Since Implementation	5 months
Source/Supplier	**W.W.** Grainger **453** 1 Innovation Drive Fort Collins, CO 80525 Telephone: (970) **223**-2100
Main Reason Implemented	Reduce solvent emissions. Improve worker health and safety.
Key to Success in Making this P2 Modification	Vendor recommendation. Training of employees in new system.

1/22/96

Pollution Prevention Case Study

Wood Products and Furniture: Equipment Modification to Clean Used Sand Belts

Company	Mastercraft 3550 Odessa Way Aurora, CO 80011
Person to Contact	Ron Schoenberg, Plant Manager Telephone: (303) 375-8220 Ext. 145
Product or Service	Commercial Wood Products, Cabinetry
Number of Employees	–100
Waste Stream Tameted	Solid Waste, Sanding Belts
Original System	Sanding machinery uses a substantial number of sanding belts which were disposed of as solid waste.
New System (with **P2** Modification)	Sanding belts are cleaned by a commercial belt cleaner to extend the life of the belt. Sanding belts roll through the machine as steam and a water-based detergent clean the belt. Cleaning eliminates particle buildup (wood waste) and allows the belts to be reused.
Cost Savings Initial Equipment Costs Material Cost savings	not quantified.
Major Benefits	Reduced generation of solid waste. Material cost savings (not quantified).
Obstacles	Requires initial investment in belt cleaning machine.
Time Since Implementation	
Source/Supplier	
Main Reason Implemented	Reduce material costs. Reduce solid waste generation and disposal costs.
Key to Success in Making this P2 Modification	Management support/commitment to reducing solid wastes.

1/15/96

COLORADO POLLUTION PREVENTION CASE STUDIES

for

AUTO BODY SHOPS

Pollution Prevention Case Study

Automotive Body Shops: Switch to HVLP Spray Equipment

Company	**Colorado Coach Autobody** 4850 Valmont Road, Boulder, CO 80301
Person to Contact	Paul Amara Telephone: **(303)** 449-4153
Product or Service	Autobody Repair
Number of Employees	30
Waste Stream Targeted	**Coatings Material Usage. VOCs** (solvent emissions)
Original System	**Conventional Air Atomized Spray Guns** require compressed air of 35 to 80 psig to atomize coatings. As the compressed air is released from the gun, it expands and propels the coating, then returns to atmospheric pressure. The rapid expansion of spray caused by higher air pressure results in excessive over spray, higher VOC emissions, and a transfer efficiency of 25-30%.
New System (with P2 Modification)	**High Volume Low Pressure Spray Guns (HVLP, Sata N92) with gravity feed paint cups.** Requires **0.1** to 10 psig air pressure for atomization. Generates high volumes of low pressure air which transfers the coating to the substrate with low velocity and prevents the rapid expansion of spray resulting in less over spray, lower VOC emissions, and better transfer efficiency (40-70%) in autobody repair. Mixed paint (primer, base coat, and clear coat use) is fed directly into the spray gun via a gravity flow cup located on top of the paint gun, resulting in little paint loss from the cup into the spray gun (versus siphon paint cups which siphon paint into the gun from below resulting in paint loss from the bottom of the cup).

Company	**Colorado Coach Autobody** 4850 Valmont Road. Boulder. CO 80301
Cost Savings Initial Equipment Costs	Colorado Coach purchased five new HVLP spray guns at ~$435 each (or $2,175 total cost). The new guns were the only initial equipment costs since the old compressed air system and lines were modified to operate with the new HVLP guns.
Material cost savings	Total materials costs (paints, additives, hardeners, primers, reducers, thinners, etc) average ~$20,000 per month. Since implementation of the new HVLP system, there has been a ~ **$5,000/month or $60,000/yr savings in total materials costs or ~ 25%.**
Payback Period	**Payback on the new HVLP equipment purchase of less than 2 weeks!**
Major Benefits	**25% savings in total materials costs or a cost savings of $60,000 per year.** **Reduced VOC emissions by 25%.** Good paint quality. Improves the company's public image by recognition as a "Business Partner for a Clean Environment" by the City/County of Boulder.
Time Since Implementation	6 months
Source/Supplier	Sikkens (Akzo-Nobel Coatings) 4105 Holly Street, Denver, CO 80216 Telephone: (303) 329-6077
Obstacles	Some Employee adjustment. Adjustment to new HVLP equipment took very little time/training. Labor costs have not changed since implementation of the HVLP spray guns. Paint quality has not been a problem.
Main Reason Implemented	Cost savings and reductions in VOC emissions, public recognition.
Key to Success in Making this P2 Modification	P2 Workshop and P2 assistance from Dave Swanson, Boulder County Pollution Prevention Program, (303) 441-1146. Vendors were very helpful in supplying information on spray gun equipment and paint products. Management support for pollution prevention.

10/5/95

Pollution Prevention Case Study

Autobody Repair Shops: Switch to High-Solids Coatings

Company	**Collision Repair Specialists** 1975 31st Street Boulder, Colorado 80301
Person to Contact	David Rouse Telephone: (303) 444-4815
Product or Service	Autobody Repair
Number of Employees	5
Waste Stream Targeted	**Paint Waste, VOC Emissions**
Original System	**Conventional Solvent-based Coatings** Classical organic coating materials are dilute solutions of organic resins, organic or inorganic coloring agents, additives, and extenders dissolved in an organic solvent. The organic solvent gives the coating fluid the necessary viscosity, surface tension, and other properties to allow application of a smooth layer of liquid coating solution. Typical coating solvents, however, are volatile organic compounds (VOC) and hazardous air pollutants (HAPs) such as toluene, xylene, and MEK. Typical solids content falls in the 20-30% range or lower. Typical VOC content is about 3.5 to 6.0 pounds per gallon. Conventional coatings require addition of 50% reducer/thinner (1:1 ratio of paint to reducer).
New System (with P2 Modification)	**High-solids, Solvent-borne Coatings** High-solids coating formulations reduce the amount of organic solvent needed by increasing the concentration of reactive resin in the solvent. Lower molecular weight resins allow high-solids concentration while the viscosity remains acceptable for use in conventional application equipment. Solids content typically falls in the 50 to 70% range, although some formulations are higher. Collision Repair Specialists use a product called Spies Hecker Permacron 2K-Acryl-System (85% solids). Typical VOC content is about 2.3 to 3.5 pounds per gallon or lower. High-solids coatings require addition of only 5-10% reducer/thinner.
Cost Savings	
Initial Equipment Costs	None. High solids coatings use conventional application equipment. Collision Repair Specialists already had HVLP spray gun equipment with gravity feed paint cups prior to use of high-solids coating products.
Material Cost Savings	High solids paint costs on average **$35.00/qt.** ($140/gal) compared to conventional paints at ~$29.00/qt. ($116/gal). Prior to implementation of high-solids paints, the business purchased ~39 gal/month of conventional low solids paints **($4,500/month,** paints only). Currently, **~21** gal./month of high solids paints are purchased per month ($3,000/month, paints only). Less paint is used because of the superior coverage of the high-solids paints. **Paint material cost savings are $1,500/month or $18,000/year.** Less reducer is required for high-solids coatings, so there is also a substantial **savings in thinner material costs.**
Waste Disposal Cost Savings	Less waste paint and solvent waste is generated because less materials are used overall, and because the high-solids paints can be mixed in smaller amounts, resulting in less leftover paints. Prior to implementation of high-solids coatings, 8-(16) gallon containers/year of solvent waste @ $77/16 gal was disposed of and recycled off-site (or $616/year). With use of high solids coatings, only 4-(16) gallon containers/year of solvent waste is generated (or $308/year). This is a **waste disposal cost savings of $308/year or a 50% savings!**
Total Cost Savings	**Total cost savings of $18,300/yr!**

Company	Collision Repair Specialists 1975 31st Street Boulder. Colorado 80301
Major Benefits	Cost savings of $18,300/yr! Reduced VOC and HAP emissions (reduced VOCs by- 1,490 lbs/year or 68%). Positive business image. Improved color, quality, and durability. Reduced worker health and liability concerns associated with solvents. Reduced number of spray applications to achieve a given film thickness.
Obstacles	High-solids coatings generally have a shorter pot life (use time after paint is prepared and exposed to air) which requires more operator skill and attention when using these coatings. High-solids paints also tend to have slightly longer curing times. However, Collision Repair Specialists has not had any problems with curing times or pot life using the Spies Hecker high-solids coatings.
Time Since Implementation	2.5 years.
Source/Supplier	Source: Spies Hecker, Inc. 55 Sea Lane Farmingdale, NY 11735 Telephone: (516) 777-7100 Supplier: H & H Warehouse 5420 Marshall Street Arvada, CO 80002 Telephone: (303) 422-2035
Main Reasons Implemented	Improve quality and lower paint costs.
Key to Success in Making this P2 Modification	Information and assistance from the vendor and supplier.

10/11/95

Pollution Prevention Case Study

Automotive Body Shop: Improved Paint Gun Cleaning

Company	**Colorado Coach Autobody** **4850** Valmont Road, Boulder, CO **80301**
Person to Contact	Paul Amara Telephone: **449-4153**
Product or Service	Auto Body Repair
Number of Employees	**30**
Waste Stream Targeted	**Solvent wastes from paint gun cleaning**
Original System	**Conventional paint gun cleaning system, with little training or monitoring of individual employees.** a) Employees rinsed paint guns and cups with solvent, disposing of waste solvent into a 55-gallon container when it could no longer effectively clean the spray gun equipment. b) No monitoring of solvent waste generation by individual employees.
New System [with P2 Modification)	**Improved 2-stage cleaning system, training of employees, and monitoring of indivual waste generation amounts.** a) Two-stage rinsing of paint cups and paint spray guns. The first stage is an initial cleaning of cups and spray guns to remove the gross contamination. The second stage uses a Safety Kleen gun washing unit, which does the final cleaning, including the gun nozzles. Solvent is sprayed through the guns into a semi-enclosed unit, in which the solvent is collected and recirculated for reuse. The initial cleaning prolongs the life of the solvent in the gun washer. The gun washer reduces solvent usage and air emissions. Overall, the 2-stage system significantly reduces solvent usage. b) Employees are trained in efficient cleaning procedures, and the amount of solvent usage by each employee is then monitored. Each employee is given an empty 5 gallon container to collect lacquer thinner wastes. The waste manager logs the quantity generated monthly by each employee, prior to transfering the waste into a 55 gallon container for off-site disposal.

Company	**Colorado Coach Autobody** 4850 Valmont Road. Boulder. CO 80301
Cost Savings Initial Equipment Costs Material cost savings Waste Disposal Costs Total Cost Savings	 None **A** 55-gallon container of lacquer thinner costs ~$180.00. Before the waste management control system was instituted, employees generated ~95 gallons of waste lacquer thinner per month. Since the system has been in effect, ~50 gallons of waste lacquer thinner is generated per month. This is a **materials cost savings of ~$150 per month ($1,800/year).** The waste hauler will pick up a 55-gallon waste container for $180.00 resulting in a waste disposal cost savings of nearly $150 per month or $1,800 per year. **$3,600 per year.**
Major Benefits	**Cost savings of $3600/yr in material and waste disposal costs.** **Hazardous waste generation is reduced by ~500 gallons per year or ~50%.** **Reduced VOC emissions.** Improve the company's public image by recognition as a "Business Partner for a Clean Environment" by the City/County of Boulder.
Time Since Implementation	***6*** months
Obstacles	Responsibility of the waste manager is increased in maintaining the more disciplined waste inventory control system. Some initial and periodic re-training is required for employees in proper/efficient spray gun cleaning procedures.
Main Reason Implemented	Reduce solvent waste generation and costs.
Key to Success in Making this P2 Modification	P2 Workshop and P2 assistance from Dave Swanson, Boulder County Pollution Prevention Program. (303) 441-1146. Employee participation.

10/5/95

Pollution Prevention Case Study

Automotive Body Shops: Controlled Paint Mixing, Recycle/Reuse of Waste Paints

Company	Colorado Coach Autobody 4850 Valmont Road, Boulder, Colorado
Person to Contact	Paul Amara Telephone: 449-4153
Product or Service	Auto Body Repair
Number of Employees	30
Waste Stream Tameted	Paint Waste
Original System	More than one individual is responsible for paint preparation, which can lead to inventory control problems, more frequent over-mixing of paint, increased potential for spills. Little recycle/reuse of leftover paints.
New System (with P2 Modification)	One individual is responsible for paint preparation. The waste manager alone is responsible for mixing paint for all employees. Care is taken to minimize over-mixing. Recycle/Reuse of Spent Paints. Like colors of leftover paints are combined into a container for recycle/reuse as a foundation paint on other vehicles. The foundation coat is the paint applied over the sealer and under the base coat (actual color of the vehicle). The foundation coat provides good coverage, reducing the total number of color coats required. Previously, new paint was used for the foundation coat rather than leftover paint. The new system reduces the amount **of** paint purchased and the amount of waste paint disposed of.

Company	**Colorado Coach Autobody** **4850** Valmont Road, Boulder, Colorado
Cost Savings Initial Equipment Costs Material Cost savings Waste Disposal Cost Savings Total Cost Savings	 None Average price of a gallon of paint (prices vary by type of paint) **is** ~$32/Liter or ~$120/gal. (Prices are based on the cost of paint alone and not on addition of reducers). On average, 6-7 gallons per month of paint would be disposed of if not recycled/reused at a materials cost of ~$780/month **(~$9,400/year)**. Disposal of the leftover paints costs ~$180/55 gallon or **$250/yr** (based on 6.5gal/mo). **Total cost savings of ~$9,700/year.**
Major Benefits	**Cost savings of ~$9,700 per year.** **80 gal/yr reduction in paint waste.** Improves the company's public image by recognition as a "Business Partner for a Clean Environment" by the City/County of Boulder.
Obstacles	Increased responsibility is required by the waste manager for mixing and recycling/reuse of the paints.
Time since Implementation	6 months
Source/Supplier	
Main Reason Implemented	Reduce paint waste and associated costs.
Key to Success in Making this P2 Modification	Initiative of waste/environmental manager and Boulder County Pollution Prevention Program assistance. Management support for P2.

10/5/95

COLORADO POLLUTION PREVENTION CASE STUDIES

for

AUTO REPAIR SHOPS

Pollution Prevention Case Study

Automotive Repair Shops: Switch to Non-toxic Parts Washer

Company	**All Tune & Lube** 2100 Pearl, Unit B, Boulder, Colorado 80301
Person to Contact	David Rosenblatt Teleohone: 444-8880
Product or Service	Auto Repair
Number of Employees	*6*
Waste Stream Targeted	**Hazardous parts cleaning solvents, solvent wastes**
Original System	**Conventional, Stoddard Solvent Parts Washer.** A sink-type device dispenses solvent from a faucet and collects and recirculates the spent solvent in a drum beneath the sink. A cleaning brush is included as an accessory or as part of the faucet. Stoddard-based solvents (mineral spirits or petroleum naphtha) typically have a flash point of –105 deg. F (highly flammable). The parts-washing solvent is removed and manifested for shipment off-site as hazardous waste, and the parts washer **is** refilled with fresh solvent.
New System (with P2 Modification)	**Profile Plus Parts Washing Detergent is used** in a sink-type unit similar to conventional parts washers. The detergent solution is heated for better cleaning effectiveness, and the solution is collected in a drum beneath the sink and recirculated. The parts cleaner has a filtering unit that removes grease and solids to allow for product reuse. A cleaning brush is included as an accessory. Profile Plus parts washing detergent is a non-alkaline, aqueous, non-toxic, nonflammable cleaner especially designed for use in heated parts cleaners. - 1 quart is added every 4-6 weeks to maintain the solution's cleaning effectiveness. Sludge settles out in the bottom of the container of spent cleaner and must be removed –once per year. The sludge will be analyzed the first time it is removed, to determine if it is a hazardous waste. If not, it can be disposed of with other non-hazardous absorbent material. (This has not been done yet because the sludge **is** still accumulating in the tank.)

Company	**All Tune & Lube** 2100 Pearl, Unit B, Boulder, Colorado 80301
Cost Savings Initial Costs Operating Cost Savings Payback Period	 All Tune & Lube purchased the Water Star parts cleaner for $800.00. *An* initial analysis of the sludge generated will cost ~$200. Requires purchase of 2 gallon ($31.00/gal.) of Profile Plus per year (-$62.00 per year) and (2) 30-lb. bags of Oil Gator for ~$60.00 per year ($122 in total material costs per year). The Safety Kleen Solvent parts washer and solvent replacement service costs -$105.00 every 7-weeks or ~$780.00/year. **Cost savings of ~$660/yr**. **About 1.5 years**
Major Benefits	**Cost savings of ~660/yr.** **Reduced hazardous waste generation** and associated regulatory requirements and liabilities. Reduced worker health and liability concerns associated with parts washer use. Employee satisfaction with the use of a less hazardous, low odor parts cleaning solution.
Obstacles	Initial equipment cost of $800. However, Water Star Inc. offers a time payment plan for equipment purchase. Labor costs did not increase with purchase of the new cleaning system; however, parts cleaning may take slightly longer.
Time Since Implementation	7 months
Source/Supplier	Water Star Inc. Sales Rep: Ted Watrous 3140 K S. Peoria, #257 Telephone: (303) 337-1905 Aurora, *CO* 80014
Main Reason Implemented	Reduce hazardous waste generation and associated costs, imporove worker health and safety.
Key to Success in Making this P2 Modification	Vendor information on new parts washers and parts cleaning products.

10/5/95

Pollution Prevention Case Study

Automotive Repair Shops: Switch to Less Hazardous Parts Washers

Company	Regional Transportation District District Shops Facility 1900 31st Street, Denver, Colorado 80216
Person to Contact	David Genova Telephone: (303) 299-4038
Product or Service	Equipment/Vehicle Maintenance and repair.
Number of Employees	300
Waste Stream Targeted	Hazardous parts cleaning solvent and solvent wastes
Original System	Stoddard-Solvent Parts Washers. A sink-type device dispenses solvent from a faucet and collects and recirculates the spent solvent in a drum beneath the sink. A cleaning brush is included as an accessory or as part of the faucet. Stoddard-based solvents (mineral spirits or petroleum naphtha) typically have a flash point of –105 deg. F (highly flammable). The parts-washing solvent is removed and manifested for shipment off-site as hazardous waste, and the parts washer is refilled with fresh solvent.
New System (with P2 Modification)	Inland Technology "Edge-Tek" parts washers are very similar to conventional parts washers, except for the solvent used and the dual filtration system that continually filters the solvent as it is circulated through the unit. The system uses a petroleum-based solvent called Breakthrough, which is a mixture of straight chain aliphatic hydrocarbons with a flashpoint of –150" F. It is also less toxic than stoddard solvents.

Company	Regional Transportation District District Shops Facility 1900 31st Street, Denver, Colorado 80216
Cost Savings Initial Equipment Costs Operating Costs Total Cost Savings Payback Period	 30 gal. washer complete with filter system is ~$1,240. Initial cost of 30 gal of Breakthrough solvent @ ~$18.83/gal is $565.00. Installation and training is ~$70.00. Total investment/unit is $1,880. Filters (0.1 micron diatomaceous earth) cost $20/filter or $120/yr. Solvent replenishment (6 gal/yr) at $18.83 is $113.00/yr. Sludge/used filters disposal (3 gal. equivalent) is $15.00. Total Operating Cost is ~ $250/unit-year. The original system was a leased Safety Kleen parts washer program which involved a 4-week service interval at ~$85.00 per 30-gal parts washer - $1,020 per year in operating costs. Cost Savings per unit is ~ $770/yr. Payback is ~2.4 years
Major Benefits	Cost savings of ~$770 per year for each parts washer or Total Cost Savings of ~$61,000/yr (79 units). 60 tons/yr reduction in hazardous wastes and associated regulatory requirements and liabilities. Improved worker health and safety, liability reduction.
Obstacles	Employee adjustment - more "elbow grease" is required to clean parts with the new solvent.
Time Since Implementation	Implemented March 1993
Source/Supplier	Inland Technology, Telephone: (206) 922-8932 or (800) 552-3100 2612 Pacific Highway East Tacoma, WA 98424 (Note: Other suppliers are available that offer systems which are eauivalent or similar.)
Main Reason Implemented	Reduce hazardous waste generation and associated costs and liabilities. Improve worker health and safety.
Key to Success in Making this P2 Modification	Management support for P2. Vendor assistance.

10/10/95

Pollution Prevention Case Study

Automotive Repair Shops: Switch to Less Hazardous Parts Washing Solvent.

Company	**Fort Lupton School District** **RE 8 Transportation Center** 6165 Denver Avenue Fort Lupton, CO 80621
Person to Contact	Ed Wilcox, Vehicle Mechanic Telephone: (303) 857-2761
Product or Service	Vehicle Maintenance and Repair
Number of Employees	**30**
Waste Stream Targeted	**Hazardous Parts Washing Solvents**
Original System	**Conventional Parts Cleaning System using Stoddard-Solvent** is used for cleaning dirt, grease, and debris from various bus/vehicle parts. A sink-type device dispenses solvent from a faucet and collects and recirculates the spent solvent in a drum beneath the sink. A cleaning brush is included as an accessory or as part of the faucet. Stoddard-based solvents (mineral spirits or petroleum naphtha) typically have a flash point of –105 deg. F (highly flammable). The parts-washing solvent is removed and manifested for shipment off-site as hazardous waste, and the parts washer is refilled with fresh solvent.
New System **(with P2 Modification)**	**ZEP Parts Cleaning System** is similar to the conventional (Safety Kleen) system, except for the solvent used and the filtration system. An extensive solvent filtration system on the parts washer significantly prolongs solvent life - for –1 to 2 years. The ZEP solvent is a straight-chain aliphatic hydrocarbon with a flashpoint of 143° F and lower toxicity than stoddard solvent. When spent, the solvent does not reauire disposal as hazardous waste.

Company	**Fort Lupton School District** **RE 8 Transportation Center** 6165 Denver Avenue Fort Lupton, CO 80621
Cost Savings Initial Equipment Costs	ZEP **Parts** Cleaning System costs ~$700.00. Total initial investment is ~$865.00 (with 20 gal. of the solvent and the filter system).
Operating/Material Costs	Filter replacement is ~$45.00/year. Every 2 year –10 gallons of ZEP solvent is required to recharge the system @ $10.00/gallon or ~$100.00/2 years. Nonhazardous waste disposal costs ~$30.00/year with the new system. Total annual operating costs of $125/yr. Safety Kleen service costs $88.80/ service (includes hazardous waste disposal), every 12 weeks or 4.3 times/year or ~$380/ year. **Cost savings of $250/yr.**
Payback Period	**Payback is about 3 years.**
Major Benefits	**Estimated cost savings of ~$250/yr.** Reduced hazardous waste generation and associated liabilities. Positive Business Image.
Obstacles	None.
Time Since Implementation	2 vears.
Source/Supplier	ZEP Manufacturing 5500 Joliet Street Denver, CO 80239 Telephone: (303) 373-1371
Main Reason Implemented	Reduce hazardous waste generation and disposal costs.
Key to Success in Making this P2 Modification	Vendor recommendations and information fiom other businesses which have successfully implemented the system.

/16/96

Pollution Prevention Case Study

Automotive Repair Shops: Switch to Thermal Parts Cleaning Units

Company	**Regional Transportation District** District Shops Facility 190031st Street. Denver. CO 80216
Person to Contact	David Genova Telephone: (303) 299-4038
Product or Service	Equipment/Vehicle Maintenance and repair.
Number of Employees	300
Waste Stream Targeted	**Hazardous waste from boil-out tanks**
Original System	**Boil-Out Tanks** using high temperature, high pH (caustic) solution and agitation to clean large engine parts. Five dip tanks may contain as much as 600 gallons each, which may require replacement 1-2 times/year. Waste solutions (high pH and high metals concentrations) are collected for off-site disposal as hazardous waste.
New System (with P2 Modification)	**Thermal Bake-Out Units** replace the boil-out tanks. The thermal system has 3 stages: 1) Thermal Oven - bakes off the oils and grease on the parts, at –400 deg. **F.** 2) Stainless Steel Bead Blaster - removes the ash, debris using the concept of sand blasting with the substitution of stainless steel beads for the sand. Engine parts are not damaged during the blasting process and are clean by the end of the blasting stage. 3) Shaker - parts rotate and turn as high pressure air cools the parts and removes any remaining debris. The process does produce a small amount of solid waste (ash, burnout waste), but the volume and toxicity are greatly reduced compared to the boil-out tanks.

Company	Regional Transportation District District Shops Facility 1900 31st Street. Denver. CO 80216
Cost Savings Initial Equipment Costs	RTD purchased two systems - the larger thermal unit (AMPRO TD 3654, RTD bus-size large engine parts) cost ~$73,000.00. The smaller thermal unit (AMPRO TD 2344, for conventional vehicle-size engine parts) cost ~$48,000.00 (cost includes the 3 stages). There were also installation costs, but these were not quantified.
Waste Disposal Cost Savings	Hazardous waste disposal costs for the new system are reduced by ~$32,000/yr. (Changes in other operating costs were not quanitified.)
Payback Period	Assuming installation costs of –20% of the cost of the equipment, the payback period would be ~ 4.5 years.
Major Benefits	Waste disposal cost savings of ~ $32,000/year. Reduced hazardous waste disposal by ~40,000 lb/year. Reduced hazardous waste liabilities. Improved worker health and safety and reduced liability. Positive Business Image. Reduced potential for spills of hazardous liquids.
Obstacles	Employee training is required in proper use of the thermal units. Parts cleaning man-hours may have increased slightly. The new system requires more labor to load/unload parts, and the cleaning process takes longer. However, a larger number of parts can be run at one time in the thermal units, so the overall throughput of parts is not significantly changed.
Time Since Implementation	10 months
Source/Supplier	AMPRO Machinery Inc. Telephone: (800) 848-0174 Plain City, OH
Main Reason Implemented	Reduce hazardous waste disposal costs and liability. Improve worker health and safety.
Key to Success in Making this P2 Modification	Management support/commitment to P2. Active in-house P2 program to evaluate and implement large projects.

10/10/95

Pollution Prevention Case Study

Automotive Repair Shops: Switch to Less Hazardous Cleaner and Reusable Spray Cans

Company	**Dinstuhl's Fine Garage** 2100 Pearl Street. Unit A Boulder. Colorado 80301
Person to Contact	Pete Dinstuhl, Owner Telephone: 443-9200
Product or Service	Auto Repair for Acura, Honda (general repairs, no bodywork)
Number of Employees	8
Waste Stream Targeted	**Hazardous Aerosol Cleaners**
Original System	**Chlorinated and Hazardous Solvents in Aerosol Cans** are used for cleaning brakes, carburetors, and other uses. Some of the hazardous solvents include methylene chloride, 1,1,1- trichloroethane, toluene, methyl ethyl ketone, xylene, and others. These solvents may be harmful to human health and may not be disposed of in a dumpster unless the aerosol cans are completely empty (all product is used and can no longer hisses when the button is depressed).
New System (with P2 Modification)	**Disposable Aerosol Can Alternative.** Wurth produces a stainless steel, hand held, air-powered aerosol can which can be refilled with cleaning products purchased in bulk. The unit, called a "Sharp Shooter Pressure Sprayer" comes in a variety of sizes (14 oz., 1 quart, 1 gallon). Spray nozzles can be easily changed to meet specific dispensing needs. **Less Hazardous Solvent Cleaner.** Wurth produces a non-hazardous "Brake & Parts Cleaner" for use in the Sharp Shooter. The cleaner is a fast, efficient way to clean and degrease all brake parts (and other parts, including carburetors). Wurth Brake & Parts Cleaner does not contain any solvents which are "listed" under the hazardous waste regulations (such as those listed above).

Company	**Dinstuhl's Fine Garage** 2100 Pearl Street, Unit **A,** Boulder, Colorado 80301
Cost Savings Initial Equipment Costs Material Cost Savings Payback Period	 Dinstuhl's purchased ***(6)*** "Sharp Shooter Pressure Sprayers" for $63.70 each or a total of $382. The cost of the Wurth brake cleaner is $11.50/ gallon. Dinstuhl's uses - 10 gal/month ($115.00/month or $1,400/year). The aerosol brake cleaner used previously costs $96 for a case of 48 cans. Dinstuhl's used - 1.5 cases/mo ($1700/yr). **Cost savings for the non-hazardous bulk brake cleaner is $300/year.** **Payback on the Sharp Shooter Pressure Sprayer system is about 1 year.**
Major Benefits	Cost Savings of - $300/year. Improved worker health and reduced liability concerns. Employee satisfaction with the use of a less hazardous cleaning solution that cleans all parts relatively well (including carburetors). Reduced compliance and liability concerns associated with disposal of empty aerosol cans. Reduced solid waste generation (empty aerosol cans).
Obstacles	Not as convenient as aerosols, propellant qualities are not as good. Employee adjustment required. Spray nozzles clog and require replacement.
Time Since Implementation	1 year
Source/Supplier	Wurth Group of North America, Inc. Telephone: (800) 346-4198 1486 East Cedar Street, Ontario, CA 91761
Main Reason Implemented	Desire to use safer products. Cost savings.
Key to Success in Making this P2 Modification	Management support/commitment to P2. Vendors were helpful in supplying product information.

0/12/95

Pollution Prevention Case Study

Automotive Repair Shops: Inventory Control and Product Evaluation Process

Company	**Regional Transportation District** District Shops Facility 1900 31st Street, Denver, CO **80216**
Person to Contact	David Genova Telephone: (303) 299-4038
Product or Service	Equipment/vehicle maintenance and repair.
Humber of Employees	300
Waste Stream Targeted	**Misc. Hazardous Products**
Original System	**No Formal Inventory Control and Product Evaluation Process.** This system allowed unlimited distribution of vendor samples which often became hazardous wastes. There was no "first-in, fist-out" practice for inventory control. Employees had unlimited access to supplies which led to inefficient use of materials.
New System [with P2 Modification)	**Formal Inventory Control and Product Evaluation Process.** RTD instituted policy and management changes in their inventory control system to ensure that less hazardous materials are purchased and that they are used efficiently. **A** Product Evaluation Committee determines if there is a need for any new products. The safety/environmental division (SSEC) reviews the **MSDS** and other product information to determine if the product meets environmental/safety criteria. If it does, the product can be tested. After testing, all information on the product is submitted to the Product Evaluation Committee for final approval. Only the correct quantity and type of material is ordered, delivered, and used. New supplies cannot be ordered until older products are used up. Storage areas are monitored for improperly stored, labeled, or expired material which can become hazardous waste. Limited access to supplies prompts employees to conserve materials. RTD uses a product exchange program for products no longer used. and waste disposal is used only as a last resort.

Company	**Regional Transportation District** District Shops Facility 1900 3 1st Street. Denver. CO 802 16
Cost Savings	Product control saves money through reduced purchase costs and reduced waste handling/disposal costs. In addition staff time previously spent reviewing/evaluating unnecessary products has been eliminated. Before the new product control system was implemented, there were 40-50 product requests per month, which has now been reduced to 2-3 reauests per month!
Major Benefits	**Reduced material and waste disposal costs.** **Reduced generation of hazardous wastes and reduced liability.** **Improved worker health and safety.** Improved worker productivity (reduction of staff time spent reviewing new products). Reduced number of products used, which simplifies the Materials Safety Data Sheet (MSDS) data base. Positive Business Image.
Obstacles	Employee adjustment to new, less hazardous products, such as aerosol cleaning products, which are sometimes slightly less effective.
Time Since Implementation	6 months
Main Reason Implemented	Improve worker health and safety. Reduce hazardous waste generation. costs. and liabilities.
Key to Success in Making this P2 Modification	Management suppodcommitment to P2.

10/10/95

COLORADO POLLUTION PREVENTION CASE STUDIES

for the

PRINTING INDUSTRY

Pollution Prevention Case Study

Print Shops: Switch to a Low VOC Press Wash

Company	Colt Reproduction 2525 Frontier Road, Boulder, CO 80301
Person to Contact	John Grein, Gen. Manager Telephone: (303) 449-2760 Ext. 109
Product or Service	Commercial Printing
Number of Employees	28
Waste Stream Targeted	Blanket and Roller Wash. VOC emissions
Original System	Varn "Duplicator Wash", a quick-drying wash for small presses. Contains 5.1 lb/gal VOCs. Colt used 10 gal/month as a blanket and roller wash on Ryobi 3302M two-color press and AB Dick Series 9800 one-color press.
New System (with P2 Modification)	Varn "Airo-clean WM", low VOC, water-miscible blanket and roller wash for use on the same presses. Contains only 4.1 lb/gal VOCs, and is mixed with 50% water, which reduces the solvent usage by ~50% and solvent VOC emissions by ~60%.
Cost Savings Initial Equipment Costs Material Costs Total Cost savings	 None Duplicator Wash costs $75.85/5-gallon container. At 10 gal/month the material cost is $1800/yr. Airo-clean WM costs $12.45/gal. For 5 gal/month (since it is mixed with 50% water only half as much is used) the cost would be $750/year. ~$1050/yr
Major Benefits	Cost savings of $1050/yr. Lowers VOCs from solvents by ~370 lb/yr or ~60%. Improved quality - water miscible solvents remove gum and paper glaze simultaneously with ink. Prolongs roller and blanket life. Improved public image by recognition as a "Business Partner for a Clean Environment" by the City/County of Boulder. Improved worker health and safety.

Company	**Colt Reproduction** **2525** Frontier Road, Boulder, CO 80301
Obstacles	Airo-clean WM is not yet available in 5-gallon containers, which is inconvenient because 1-gallon containers do not allow the solvent to be pumped directly to the equipment. The new solvent dries more slowly. However, the cleaning process takes less time overall because the new solvent cleans more thoroughly.
Time Since Implementation	2 years.
Source/Supplier	**Varn** Products Company, Inc. 14000 Westfair East Drive Houston, Texas 77041 Rep: Ron Robb (303) 692-9199 Dixon Paper Company Telephone: (303) 371-7510 3900 Lima Denver. CO 80239
Main Reason Implemented	Improve worker health and safety, public recognition by City of Boulder.
Key to Success in Making this P2 Modification	Management support for P2 and employee involvement.

10/31/95

Pollution Prevention Case Study

Print Shops: Lower VOC Blanket and Roller Wash

Company	**D** & K Printing 2930 Pearl Street, Boulder, CO 80301
Person to Contact	Jim Kinkead, Manager Telephone: (303) 444-1123
Product or Service	Commercial Printing
Number of Employees	46
Waste Stream Targeted	VOC emissions from blanket and roller washes
Original System	Prisco Powerklene UK Blanket and Roller Wash for use with Heidelberg Speed-Master 4-color, 40 inch and 5-color, 28 inch presses. Powerklene has a VOC content of 6.67 lb/gallon.
New System (with P2 Modification)	Prisco Environmental Series (PES), VOC Reduction Program for reducing the VOCs in blanket and roller washes used with the Heidelberg Speed-Master presses. D & **K** Printing is using Step 1 of the PES Program (PES 153 Blanket/Roller Wash.). Step 1 reduces the VOC content of the current blanket and roller wash by -20% (PES 153 contains 5.3 lb/gal VOCs). Subsequent steps (product changes) would further reduce VOCs in the blanket/roller wash.
Cost Savings Initial Equipment Costs Operating Costs	None D&K used - 1-55 gal drum of Powerklene/month @$327.25/55-gallon or ~$3,900/year. D&K uses a similar quantity of PES 153 @ $360.25/55-gallon or ~$4,300/year, so costs have increased slightly. However, they believe less PES 153 will be used when they have fully adjusted to the new product (since it evaporates more slowly), which may result in a slight overall cost savings.

Company	**D & K Printing** 2930 Pearl Street, Boulder, CO 80301
Major Benefits	**PES 153 reduces VOC emissions from blanketholler washes by -20%.** **Improved business image by recognition as a "Business Partner for a Clean Environment" by the City/County of Boulder.** Improved worker health and safety, liability reduction - reduces problems with skin irritation from traditional washes.
Obstacles	Takes slightly longer to dry.
Time Since Implementation	6 months
Source/Supplier	Prisco Merchandising Telephone: 1(800) 338-2241 DBA Printers' Service 6741 Exchange Drive Mansfield, TX 76063
Main Reason Implemented	Improve worker health and safety and reduce VOC emissions. To be recognized as a ''Business Partner" by the City/County of Boulder.
Key to Success in Making this P2 Modification	Assistance and information from the vendor.

10/31/95

Pollution Prevention Case Study

Printing Shops: Switch to Low VOC Blanket/Roller Wash

Company	**Rocky Mountain News** 5090 N. Washington Denver. ***CO*** 80216
Person to Contact	Michael Galusha, Pressroom Mgr. Telephone: (303) 892-2024
Product or Service	Rocky Mountain Newspaper Printing/Binding/Advertising
Humber of Employees	600
Waste Stream Targeted	**Blanket/Roller Wash - VOC emissions**
Original System	**VWM Met Blanket/Roller Wash** for Metro presses. This product is an oil-based solvent blend with a VOC content of **7.2** lb/ gal. VWM Metwash was used with Goss Color-liner, 4-high configuration cold-Webb Offset Presses (non-heat set). Employees dispersed the cleaner from a 55-gallon drum into pint buckets without lids and the product was applied with cloth wipes to clean the blankets and rollers.
New System (with P2 Modification)	**Vam Bio-News Concentrate Biodegradable Blanket/Roller Wash** is a water-based detergent blanket wash for water-based newspaper inks. Contains less than 5% of the VOC content of standard washes 0.32 lb/gal. Bio-News is pumped from a 350-gallon covered, reusable tote into 5-(30) gallon stainless steel tubs on wheels. Bio-News is pumped from these containers into an empty tub with cloth wipes for cleaning.
Cost Savings Initial Equipment Costs Material Cost Savings	 None 350 gallons of Varn Bio-News is used every 9 weeks @ $4.50/gallon or ~$9,100/year. Bio-News is diluted with water 6:1 while VWM is used as a concentrated solution. 350 gallon of VWM Wash was used every 4 weeks at a cost of $3.50/gallon or ~$15,900/year. This is a **cost savings of ~$6.800/vear!**

Company	**Rocky Mountain News** 5090 N. Washington Denver. CO 80216
Major Benefits	**Cost savings of ~$6,800 per year!** **Reduced VOC emissions from blanketholler washes by –31,000 lb/yr or ~95%!** **Positive business image.** Improved worker health and safety. Employee satisfaction with the use of a less hazardous, low odor blanket/roller wash. Cleans better - new product removes solvent soluble and water soluble glaze. Reduced potential for accidents, spills fiom product transport.
Obstacles	Stronger solvent such as VWM is still required to clean some parts such as ink pans. Cleaning with Bio-News requires slightly more time.
Time Since Implementation	2 years
Source/Supplier	Varn Products Company, Inc. 14000 Westfair East Drive Houston, TX 77041 Rep: Ron Robb (303) 692-9199
Main Reason Implemented P2 Modification	Improve worker health and safety. Reduce costs.
Key to Success in Making this P2 Modification	Management suppodcommitment to P2 and efforts of Rocky Mountain News Safety Committee. Information and assistance fiom vendor.

11/10/95

Pollution Prevention Case Study

Print Shops: Switch to Low VOC, Soy-based Inks

Company	D & K Printing 2930 Pearl Street, Boulder, CO 80301
Person to Contact	Jim Kincaid, Manager Telephone: (303) 444-1123
Product or Service	Commercial Printing
Number of Employees	46
Waste Stream Targeted	VOC emissions from inks
Original System	Sun Chemical Oil-based Inks. Conventional sheet-fed oil-based inks for use with Heidelberg Speedmaster 4-color, 40 inch and 5-color, 28 inch presses. The inks contain an average of 35% VOCs.
New System (with P2 Modification)	Sun Chemical Natural Lith Soy-based Inks. Petroleum-based oils in conventional inks are replaced with soy oils. The soy-based inks contain ~10% VOCs.
Cost Savings Initial Equipment Costs Material Cost Savings	None. (No equipment modifications are necessary.) D & K used ~5,000 lb/year of inks. Oil-based inks cost an average of $5.33/lb or $26,600/year. Soy-based inks cost an average of $4.88/lb or $24,400/year. This is a total cost savings of **~$2200/yr.**
Other Benefits	Reduced VOC emissions from inks by ***~25%.*** Colors are cleaner and brighter than with oil-based inks. Soy-based inks make it easier to use less alcohol in the fountain solutions because they are more compatible with water. Improved worker health and safety, liability reduction. Positive Business Image.
Obstacles	Some slight adjustments in operating conditions are required with switch to new inks. (However, D & K has not found any difference in drying time between oil and soy-based inks.)
Time Since Implementation	6 months.

Company	D & K Printing 2930 Pearl Street, Boulder, CO 80301
Source/Supplier	Sun Chemical Telephone: (303) 373-2655 11925 East 49th Denver, CO 80239
Main Reason Implemented	Reduce VOC emissions and improve worker health and safety. To become a "Business Partner" recognized by the City/County of Boulder.
Key to Success in Making this P2 Modification	Management suppodcommitment to P2 and improving worker health and safety.

Pollution Prevention Case Study

Print Shops: Switch to Alcohol-Free Fountain Solution

Company	**Johnson Printing** 1880 South 57th Court Boulder, CO 80301
Person to Contact	Allen Andrews, Project Manager Telephone: (303) 443-1576
Product or Service	Commercial Printing
Number of Employees	122
Waste Stream Targeted	**Alcohol emissions (VOCs) from fountain solutions**
Original System	**Fountain Solution with 20% Isopropyl Alcohol (IPA)** for sheet-fed and non heat-set web lithographic printing. Alcohol is used as a wetting agent in the fountain solution to decrease the surface tension of the solution. This allows the printer to use less water on the plate for better ink control. VOC content of IPA is 6.5 lb/gallon.
New System (with P2 Modification)	**Alcohol-free Fountain Solution** is used for sheet-fed and non heat-set web lithographic printing. 10% Rycoline 9-289 Alcohol Replacement is used in combination with 187-A Fountain Solution Etch. This formulation results in a 60% reduction in VOCs from the fountain solution.
Cost Savings Initial Equipment Costs Operating Cost Savings	None. (No equipment modifications are necessary.) There are no cost savings associated with this improvement. (Total operating costs remain about the same.) Labor costs are slightly higher due to more precise (labor- intensive) operating conditions required without alcohol. The new fountain solution is more expensive, but substantially less is reauired. so material costs remain about the same.

Company	**Johnson Printing** 1880 South 57th Court Boulder. CO 80301
Major Benefits	**VOC emissions from fountain solutions are reduced by ~60% (–8,000 lb/year).** **Improved business image with customers and the community.** Improved worker health and safety, liability reduction. Company and employee satisfaction and pride in reducing Dollution and benefiting the environment.
Obstacles	Lost production time and labor required to experiment with new fountain solutions and operating conditions. The new formulation doesn't work as well with metallic inks; more difficult jobs may require the use of IPA.
Time Since Implementation	**4** years
Source/Supplier	H & S Supply Telephone: (303) 298-8555 5961 Marion Drive Denver, CO 80216
Main Reason Implemented	Reduce VOC emissions. Improve business image.
Key to Success in Making this P2 Modification	Vendor assistance and information.

1/16/96

Pollution Prevention Case Study

Printing Shops: Reuse of Leftover Ink

Company	**Signal Graphics** 8368 N. Sheridan Blvd., Westminster, CO 80003
Person to Contact	Rick Garcia Telephone: (303) 426-5522
Product or Service	Printing
Number of Employees	4
Waste Stream Targeted	**Waste Inks**
Original System	**Disposal of Leftover Inks** Spent/leftover inks fiom two-AI3 Dick 9800 series offset presses are placed in designated waste containers and picked **up** by a waste hauler for off-site treatment/disposal. Little recycle/reuse of leftover inks.
New System (with P2 Modification)	**Recycle/reuse of Leftover Inks** **Ink** trays are filled with only enough ink for each run or shift, and unemulsified inks are returned to their containers. Leftover inks are segregated according to color and type of **ink** and are combined into containers for reuse. Crisco (shortening) is used to thin the ink as needed for reuse. Fibers and debris can be found in recycled/reused **ink;** therefore, the ink is reused on print jobs such as bond runs where high quality is not as important.
Cost Savings Initial Equipment Costs Material Cost Savings Waste Disposal Costs Total Cost Savings	 None Signal Graphics purchases ~60 lbs. of inks (colored, black, and white) every 3 months at a cost of $500.00 or ~$2,000/year. They save >**5%** (**~$100/yr**) on the purchase of new ink since they are able to reuse ~ **3** lbs. of spent inks per month. Reduces waste disposal by –3 lb/month. At $300/55-gallon drum, this is a cost savings of ~**$200/yr**. **~$300/vr**
Major Benefits	**Cost savings of ~300/yr.** Reduced ink waste generation by –40 gal/yr, and reduced associated liabilities.

Company	**Signal Graphics** 8368 N. Sheridan Blvd., Westminster, CO 80003
Obstacles	Cannot use recycled ink on all jobs due to contamination with fibers and debris which can cause marks.
Time Since Implementation	**2** years
Source/Supplier	
Main Reason Implemented	Reduce operating costs. Reduce waste disposal costs and liabilities. ·
Key to Success in Making this P2 Modification	Management commitment to P2/waste minimization efforts.

Pollution Prevention Case Study

Print Shops: Equipment Modification to Reduce Wastes

Company	Jefferson County Public School Printing Department 809 Quail Street, Bldg. #1, Lakewood, CO 80215
Person to Contact	Rick Rowe Telephone: (303) 982-2273
Product or Service	Low volume printing services for Jefferson Co. Public Schools - 90-95% black inks.
Number of Employees	7
Waste Stream Targeted	**Ink,** Solvent emissions and waste
Original System	Conventional Small Offset Presses are used: an Itek 975 **PFA** Press and a Multi-Graphics 1250 (one-color). These presses run 5,000 impressions per hour one-sided (Multi-Graphics) to 8,000 impressions per hour double-sided (Itek), and reauire the use of oil or rubber-based inks.
New System (with P2 Modification)	Duplicators are used in place of the offset presses. Two new duplicators were purchased: a Risograph GR 3750 Duplicator and a Gestetner Duplicator 5380. These are used for low to medium-range one-sided, primarily one-color printing. These units take an original document, digitally scan the image, and transfer it to a master via a thermal imaging process. The master is biodegradable. Water-based ink is microprocessor-controlled and vacuum drawn from a cartridge, eliminating ink waste. Use of hazardous solvents for clean-up is also eliminated. The print drum can be quickly changed for color printing. Prints 8,000 impressions/hr. Can run 5,000 - 10,000 impressions/plate.
Cost Savings Initial Equipment Costs Material Costs Waste Disposal Cost Savings	 Risograph GR 3750 Duplicator - ~$16,000 (manuf. suggested retail). Gestetner 5380 Duplicator - ~$15,000. Total material costs for both duplicators: ~$10,000/yr, vs. ~$24,000/yr for offset presses, a material cost savings of **~$14,000/yr.** Waste disposal cost savings have not been quantified. However, JeffCo predicts a 90-95% reduction in generation of ink and solvent wastes.

Company	**Jefferson County Public School Printing Department** 809 Quail Street, Bldg. #1, Lakewood. CO 80215
Major Benefits	**Savings of ~$14,000/yr in material costs.** **Maintenance costs are significantly reduced** (but have not been quantified). **Use of hazardous inks/solvents is eliminated,** thereby reducing VOC and HAP emissions, worker health and liability concerns, hazardous waste generation, and associated regulatory requirements. **Positive business image.** Very little initial training is required; the duplicators are easy to operate, much like a copy machine.
Obstacles	Itek 975 and Multi-1250 offset presses are better for long runs (> 10,000 impressions) and multi-color one pass printing. A print drum must be changed in the duplicators to change colors, requiring multiple passes for multi-color jobs.
Time Since Implementation	60 days
Source/Supplier	Gestetner, 445 Union Blvd., Suite 112 Lakewood, CO 80228 Rep: Jeffrey Lopez (303) 989-4499 RISO (Frontier Business Products), 13800 E. 39th Aurora, CO 80011 Rep: Glen Roberts (303) 373-2900
Main Reason Implemented	Looking for alternatives for Multi-1250 presses due to increased costs to repair/rebuild older machines. Reduce hazardous waste generation.
Key to Success in Making this P2 Modification	Vendor recommendations on state-of-the-art products/equipment.

1/2/95

COLORADO POLLUTION PREVENTION CASE STUDIES

for

DRYCLEANING SHOPS

Pollution Prevention Case Study

Dry Cleaners: Switch to Wet Cleaning Process

Company	**Morrison Suede & Leather/Avenue Cleaners** 401 East 17th Avenue Denver, CO 80203
Person to Contact	Jim Orlin, CEO Telephone: (303) 894-9911 or (800) 982-6746
Product or Service	Laundering/Dry Cleaning Leathers and Suedes, Textile Garments.
Number of Employees	19
Waste Stream Targeted	**Perchloroethylene (Perc) Emissions**
Original System	**Dry-to-Dry Dry Cleaning System using perchloroethylene [perc).** (Western Automation Vibramatic 150 with distillation unit and sniffer). Perc is a hazardous air pollutant (HAP) and potential human carcinogen. Waste such as filters must be disposed of as hazardous waste. Perc dissolves grease and oil from clothing without wetting the fibres (without using water). In the old system perc was used for 98% of their cleaning (leathers, suedes, textiles, etc.).
New System [with P2 Modification)	**85% of Leather and Suedes and 25% of Textiles are cleaned by a Wet Cleaning process.** Wet Cleaning is a water-based alternative to *dry* cleaning that includes high-tech washing, drying, and finishing equipment, and biodegradable detergents that leave water recyclable. Clothes are protected from shrinkage and wrinkling through precisely controlled water temperatures, mechanical action (agitation), chemical injection, and washing and drying times.
Cost Savings	
Initial Equipment Costs	Aqua Clean System (Wascomat wet cleaning washer/dryer) - ~$39,000. Veit 8315 Pressing Machine - ~$16,000.
Material Costs	~80% less perc is used under the new system, at a **cost savings** of **$5,500/yr**. Costs of the chemicals designed for wet cleaning and spotting have not yet been quantified. Water usage/costs have increased, but have not been quantified. Energy requirements have not changed significantly.
Waste Disposal Cost Savings	Waste Qsposable costs associated with Perc, includmg filters, have **decreased by ~80%**; however, actual cost savings have not been quantified.

Company	**Morrison Suede & Leather/Avenue Cleaners** 401 East 17th Avenue Denver, CO 80203
Major Benefits	**Reduced Perchloroethylene(HAPs) emissions by 80%.** **Reduced hazardous waste disposal by 80%.** **Positive Business Image.** Improved worker health and safety and reduced liability. Reduced potential for spills and leaks of perc and the associated liability. **Wet cleaning is superior to dry cleaning in quality and performance in a wide variety of garments.** Colors won't fade with wet cleaning and there is no "chemical smell".
Obstacles	Successful wet cleaning takes skill and experience, and a learning curve is involved in the process change. Special finishing (pressing) equipment is required (wet cleaned garments are more difficult/time consuming to press without special equipment). Some garments will still need solvent-cleaning. Morrison will maintain the Perc Dry-to-Dry machine for these garments. Their goal is to eventually do wet cleaning on 60% - 80% of textile garments.
Time Since Implementation of P2 Modification	3 years - wet cleaning with leathers/suedes. 6 months - wet cleaning textiles.
Source/Supplier	Aqua Clean Systems, Inc. 469 Doughty Blvd. **,P.OBox** 960338 Inwood, NY 11096-0338 Telephone: (516) 371-4513 or (800) 645-2204 Note: Other Wet Cleaning Equipment/Suppliers are available. Morrison chose Aqua Clean because they seemed to provide the most advanced technology in wet cleaning available at the time.
Main Reason Implemented P2 Modification	Improved quality and performance of professional wet cleaning. Reduce costs and liability associated with use of perchloroethylene.
Key to Success in Making this P2 Modification	Management suppodcommitment to quality products and Dollution prevention.

2/28/95

Pollution Prevention Case Study

Dry cleaners: Alternative Drycleaning Solvent

Company	La Nouvelle Fine Cleaners and Launderers 4025 East Dickenson Place Denver, CO 80222
Person to Contact	Rick Bugdanowitz, Owner Telephone: (303) 691-0123
Product or Service	Laundering/Dry cleaning - Fine Garments
Number of Employees	18
Waste Stream Targeted	Perchloroethylene (Perc) emissions, waste
Original System	Multimatic Mercury Dry-to-Dry dry cleaning system, using perchloroethylene, a hazardous air pollutant (HAP), and potential human carcinogen. Wastes such as filters must be disposed of as hazardous waste.
New System (with P2 Modification)	Omega PDFS-45 Dry-to-Dry dry cleaning system, using a new solvent: Fluid-2000 (DF-2000), a high purity, aliphatic hydrocarbon solvent with a flash point of 147°F (made by Exxon). The system is a closed-loop, refrigerated petroleum cleaning system (similar to machines made for use with Stoddard solvent) with built-in nitrogen generating system (injects nitrogen into the drum, lowering the oxygen content, minimizing combustion potential). Cleaning ability of DF-2000 is comparable to PERC or Stoddard solvents. Waste products need not be disposed of as hazardous waste - spent solvent can be disposed of as used oil; and sludge and filters, when dry, may be disposed of in the dumpster.

Company	**La Nouvelle Fine Cleaners and Launderers** 4025 East Dickenson Place Denver, CO 80222
Cost Savings Initial Equipment Costs Material Cost Savings Waste Disposal Cost Savings Total Cost Savings	 Omega PDFS-45 *dry* cleaning unit cost ~$50,000 + installation (about the same cost as a Perc ***dry*** cleaning machme). The previous system used ~30 gallordmonth of Perc @ ~$6.00/gallon or ~$2160/year. A **similar** quantity of DF-2000 is used @ ~$3.50/gallon or ~$850/year, **a material cost savings of ~$1300/year.** Detergent **costs** are similar to those of a Perc *dry* cleaning machine. The original system generated ~30 gallon/month of waste sludge and 13 spent filters/month for a total hazardous waste disposal cost **of** ~$4,300/year. With the new system, a similar quantity of waste sludge and filters may be generated but can be disposed of as nonhazardous solid waste at a cost of ~$300/yr, for a **waste disposal cost savings of ~$4,000/year!** **~$5,300/yr**
Major Benefits	**Total Cost Savings of ~$5,300/year.** **Eliminates Hazardous Air Pollutants (HAPs).** **Very mild on sensitive fabrics, trims, etc, and greatly reduces dye fading compared to PERC.** Improved worker health and safety, reduced liability concerns. Odor level is dramatically lower than with Perc or Stoddard solvent. Positive business image.
Obstacles	No building modifications were required, but approval fiom the Fire Marshal was required prior to start-up. DF 2000 is not intended for use in machines originally designed for Perc • equipment modifications are necessary for safe use.
Time Since Implementation	2 months.
Source/Supplier	Exxon Chemical Company P.O. Box 3272 Houston, TX 77253-3272 Omega Cleaning Systems P.O. Box 1539 St. Albans, Vermont 05478 1 **(800)** 724-5976
Main Reason Implemented	Reduce costs and liabilities associated with the use of perc. Improve worker health and safety.
Key to Success in Making this P2 Modification	Management support/commitment to pollution prevention.

2/13/95

Pollution Prevention Case Study

Dry Cleaners: Technology Modifications to Reduce HAP Emissions and Hazardous Waste.

Company	**Country Clean Dry Cleaners** **Sheldon Cleaners** 116 East Foothills Parkway 2560 Baseline Road Fort Collins, CO ***80526*** Boulder, CO 80303
Person to Contact	Bill Burger, Owner of Country Clean (970) 226-5964 Paul Fischer, Owner of Sheldon Cleaners (303) 499-7030
Product or Service	Dry cleaning, laundering
Number of Employees	**5**-7
Waste Stream Targeted	**Perchloroethylene (Perc) emissions, waste**
Original System	**Conventional Dry-to-Dry dry cleaning machine using perc** Some of the features of conventional machines which generate emissions and wastes: 1. Vents to the outside to allow perc removal from clothes during *dry* cycle. 2. Carbon core filter cartridges had to be replaced once every 2-3 months and stored for disposal as hazardous waste. 3. Manual still cleaning. Perc **is** removed from the still to allow cleaning. The still is then cleaned manually with a bucket and cloth wipes. 4. Manual waste sludge removal system from still (by raking out the sludge).
New System (with P2 Modification)	**Country Clean and Sheldon have purchased similar "new technology" Dry-to-Dry dry cleaning machines** with the following P2 features: 1. Closed-loop technology, hermetically sealed during the entire processing sequence, resulting in virtually no solvent emissions to atmosphere. Advanced refrigeration system reduces vapor losses and eliminates the need for sniffers and venting ducts. 2. Powderless ECO filters with automatic filter maintenance program prolongs filter life. Filter replacement is required once every 2-5 years. 3. Perc is automatically pumped into *dry* cleaning wheel for still cleaning. 4. Emission-free still rake out system. Residue is first pumped **through** a closed circuit. Steam is added to remove remaining solvent. The sludge is then automatically pumped emission-free into a sealed waste drum. 5. Emission and spill-free machine filling system (pumps perc from sealed 55-gal. container directly into machine). *6.* Computer controls regulate routine operating/maintenance functions to minimize emissions.

Company	**Country** Clean **Dry** Cleaners Sheldon Cleaners 116 East Foothills Parkway 2560 Baseline Road Fort Collins, CO 80526 Boulder, CO 80303
Cost Savings Initial Equipment Costs Material Cost Savings Disposal Cost Savings Total Cost Savings	 ~$65,000 for new machme equipped with computer control, ECO-filter, refrigerated condenser system, emission-free still rake-out system, etc. Reduced water usage by **-80%** (specific cost savings not quantified). Original system system used 20 gal. of Perc/month @ ~**$5.50/gal**. or $110/month ($1,300/yr). The new system reduces perc usage by **90%**, to –2 gal/mo. at a cost of **$130/yr**, for a cost savings of ~$1,200/yr. Hazardous waste generation (still residue sludge/spent filter waste) is reduced by 60% for a cost savings of ~$500/yr. **~$1700/vr**
Major Benefits	Total cost savings **m** materials and waste disposal of over $1,700/yr. Reduces HAP emissions by ~90%. Improved worker health, safety and liability concerns associated with Perchloroethylene. Improved business image. Reduced potential for exposure, accidents, spills **from** raw material and waste material handling. Verv little solvent residue/odor **left** on clothes.
Obstacles	Closed-loop system takes more time *(5* min./load) to *dry* than vented system. More expensive (–30% more) **than** conventional perc *dry* cleaning machines.
Time Since Implementation	1 year.
Source/Supplier	BÖWE PASSAT Dry Cleaning and **Laundry** Machinery Corp. 2700 Commerce Street Wichita Falls, TX 76303 Telephone: 1(817) 723-1065
Main Reason Implemented	Improve worker health and safety, reduce hazardous waste generation and HAPs emissions.
Key to Success in Making this P2 Modification	Owner **support/commitment** to Pollution Prevention.

1/29/95

Pollution Prevention Case Study

Dry Cleaners: Reusable Garment Bags

Company	Country Clean **Dry** Cleaners and Laundries 116 East Foothills Parkway Fort Collins, CO 80526
Person to Contact	Bill Burger, Owner Telephone: (970) 226-5964
Product or Service	Dry cleaning, laundering
Number of Employees	5
Waste Stream Targeted	Plastic garment bag waste.
Original System	Plastic garment bags were used on each garment. Some bags are returned for recycling, but most are disuosed of.
New System (with P2 Modification)	"We Care" Bags. Country Clean customers can purchase a "We Care" nylon bag. The bag is reused by the customer, and Country Clean also cleans the nylon bags as needed.
Cost Savings Initial Equipment Costs	None. The cost savings to Country Clean from reduced purchases of plastic bags has not been quantified. Cost to the customer: $12.00 for the 1st bag, the 2nd bag is $6.00 or 2 bags for $18.00. (Country Clean also gives discount coupons/coffee mugs as incentives for bag purchase and use).
Major Benefits	Positive business image - attracts environmentally conscious customers. Reduces purchases of plastic bags. Reduces generation of solid waste by customers.
Obstacles	Requires willingness of customers to participate.
Time Since Implementation	1 year.
Source/Supplier	Safety-Kleen **(303)** 761-8614
Main Reason Implemented P2 Modification	Reduce plastic garment bag waste. Customer satisfaction.
Key to Success in Making this P2 Modification	Owner support/commitment to Pollution Prevention.

11/29/95

APPENDIX I

MAIN REASONS FOR IMPLEMENTING POLLUTION PREVENTION

Main Reasons for Implementing Pollution Prevention

What are the main factors which motivate businesses to implement pollution prevention improvements? For each of the P2 case studies in this compendium, the business was asked this question. The responses were included in each case study and are summarized and discussed in this section. For many of the case studies, the business gave more than two main reasons for implementing the P2 project. To be consistent and to avoid weighing some case studies more heavily than others, only the two most important reasons were taken from each case study for this summary. The responses are shown in the following table and in the attached bar chart.

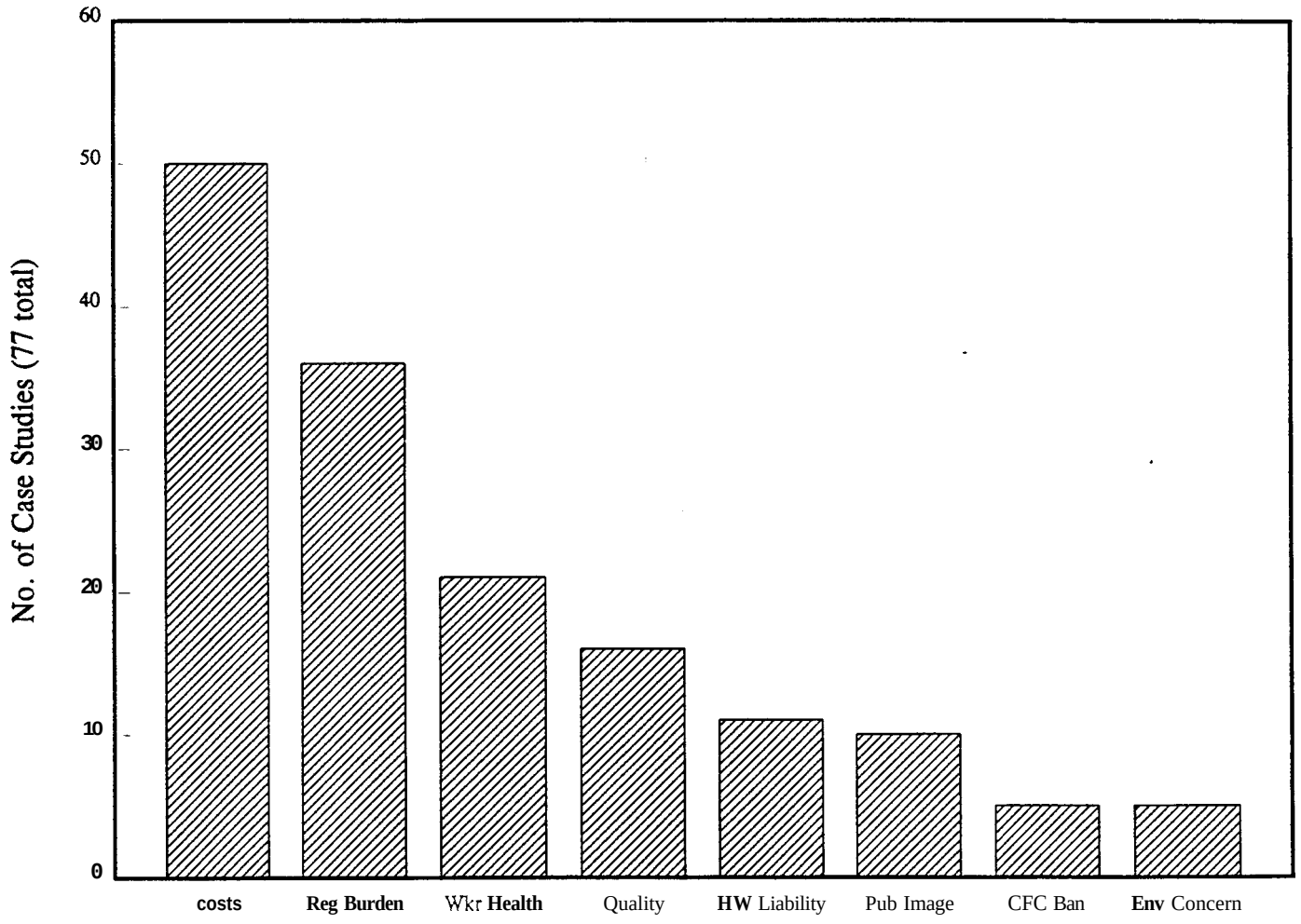
Reasons for Implementing P2	**Number of case studies motivated**	**Percentage** (of the 77 total case studies)[1]
Reduce costs	50	65%
Reduce regulatory burden or exposure to potential penalties. Specific regulations involved:		
- Hazardous waste regulations	12	
- Water regulations	9	
- Air regulations	7	
- Both hazardous waste and air regulations	8	
Total:	36	47%
Improve worker health and safety	21	127%
Improve quality or increase production	16	21%
Reduce liability for spills or hazardous waste liability	11	14%
Improve public image	10	13%
Production ban for TCA and Freon 113	5	6%
Reduce impacts on the environment	5	6%

Conclusions. It is not surprising that for most of the case studies (~65%), the desire to reduce costs was a main factor. On the other hand, it might be somewhat surprising that for approximately one-third of the case studies the desire to reduce costs was **not** one of the two main reasons. Other than the desire to reduce costs, the most important factor appears to be concerns about compliance with environmental regulations and the desire to reduce the compliance burden.

---

[1] Two main reasons were allowed for each case study, so the percentages add up to 200% (199% because of rounding).

Main Reasons for Implementing P2



Obstacles to Pollution Prevention

For each case study the business was also asked whether it encountered any obstacles or difficulties in implementing the P2 project. In addition to the brief response included in each case study, the responses are summarized and discussed in this section. All of the obstacles were overcome; none of them prevented the P2 project from being successfully implemented.

As for the "main reasons" discussed above, up to two types of obstacles were included in this summary for each case study. Most businesses mentioned only one obstacle, and for 16 of the 77 case studies, no obstacles were mentioned.

Type of Obstacle	Number of Case Studies	Percentage (of the 77 total case studies)
Technical difficulties in getting the new system to perform as well as the old system, or disadvantages such as slightly longer drying time	30	39%
Employee adjustment or training required	18	23%
Involved **significant staff time** to implement the change	16	21%
Required relatively **large capital investment**	11	14%
Bureaucratic or regulatory obstacles	2	3%
No obstacles experienced	16	21%

Regulatory or bureaucratic obstacles. Although this type of obstacle was reported for only two case studies, several companies discussed obstacles of this type in relation to implementing other P2 projects. The hazardous waste regulations include several requirements which make recycling and reuse of hazardous wastes difficult. For example, the regulations make it impractical to recover and reuse waste solvents from filters or other residues if the solvents are "listed wastes", such as toluene. The regulations would still consider the residue from the recovery process such as the filters to be hazardous waste, despite the low concentration of solvent remaining in the residue. The hazardous waste regulations also make it very difficult for a business to send its waste to another business that could potentially reuse the waste, unless the waste can be reused as it is - without any type of prior treatment or processing.

Note: If your business is experiencing any obstacles to pollution prevention related to environmental regulations, please contact the CDPHE P2 Program ((303) 692-3009). We will advocate appropriate regulatory changes to remove these obstacles, if possible.

Shafer Commercial Seating experienced difficulty in obtaining the approval of the City of Denver, Building Permits Department, for its new drying ovens because the ovens were so new and innovative that they had not yet been UL - listed. For pharmaceutical companies including Syntex Chemical, Hauser Chemical, and Geneva Pharmaceutical, FDA regulations make it very difficult to make changes to processes already approved and implemented. Inflexible military specifications make it difficult for AMI, of which the Department of Defense is a significant customer, to make P2 improvements to some of their processes.

APPENDIX II

COLORADO GOVERNOR'S POLLUTION PREVENTION CHALLENGE PROGRAM -

LIST OF PARTICIPANTS AND CONTACTS

Colorado Governor's Pollution Prevention Challenge Program

The Governor's P2 Challenge Program is a voluntary program designed to provide an additional incentive for larger companies to improve their pollution prevention efforts. The program began in January, 1995. Participants were required to set measurable goals for their pollution prevention programs, and must report their progress toward meeting these goals to the CDPHE P2 Program. The participants were given a plaque by the Governor for their P2 commitments, and will receive further recognition as the program progresses and they achieve their goals.

In addition the participants in the Governor's Challenge Program have agreed to share their P2 successes and expertise with other businesses in Colorado. Some of these successes have been included in the P2 case studies in this compendium, but many others were not. We encourage Colorado businesses to contact the companies listed below for assistance with any technical problems or challenges with implementing new pollution prevention methods.

❒Governor's P2 Challenge Participants❒

Asarco Inc.	Denver	Nicole Mathis, Env. Engineer 296-5900
Ball Corp.	Broomfield	Joette Bailey, Env. Services 469-5511
Battle Mountain Resources	San Luis	Sally Kaiser (719)672-3362
Central Products Co.	Brighton	DC. Di Dia, Director of Manuf. 654-0500
Conoco Denver Refinery	Commerce City	Tom Meyers, Env. Director, 286-2025
Coors Brewing Co.	Golden	Sandra Woods, Chief Env. Officer 277-2171
CF&I Steel	Pueblo	Mel Lager, Mgr. Plant Services (719)561-7386
Eastman Kodak	Windsor	Karla Fossoy, (970)686-4509
Gates Rubber	Denver	Patrick McFadden 744-4820
Hauser Chemical Research	Boulder	Steven Perich, Mgr. Env. Affairs 443-4662
IBM Corp.	Boulder	Chuenarun Dischner 924-6300, x4993
Lexmark International	Boulder	Dan Roberts, Haz. Waste Tech. 581-5176
Lockheed-Martin	Denver	George Larsen, Env. Mgr. 977-4556
Lucent Technologies (formerly AT&T)	Westminster	Ron Stow, Senior Env. Eng. 290-5255
Mastercraft	Aurora	Ron Schoenberg, Plant Mgr. 375-8220
Merix Corp.	Loveland	Bob Ashley, (970) 203-6557
NTI, Inc.	Colorado Springs	Frank Gorman, Tech. Director (719)574-4900
Public Service Co.	Denver	Mindy Trautman, Mgr. Env. Serv. 294-2826
Samsonite Corp.	Denver	Kermit Hodge, Env., H&S Director 373-7251
Schlage Lock Co.	Security	Dorinda Mancini (719)390-5071,x452
Shafer Commercial Seating	Denver	Erwin Suson, Plant Mgr. 322-7792
StorageTek	Louisville	Tom Zanoni 673-6074
Symbios Logic	Fort Collins	Jill Farver, Mgr. Env., H&S (970)226-9246
Syntex Chemicals	Boulder	Jonathan Lind, 938-6445
Unisys Corp.	Pueblo	Ray Luna (719)585-6026,x6381

APPENDIX III

SOURCES OF ADDITIONAL POLLUTION PREVENTION INFORMATION AND ASSISTANCE

Colorado Department of Public Health and Environment

POLLUTION PREVENTION TECHNICAL ASSISTANCE RESOURCES

POLLUTION PREVENTION ASSISTANCE

COLORADO DEPARTMENT OF PUBLIC HEALTH AND ENVIRONMENT (CDPHE) POLLUTION PREVENTION PROGRAM

-UPCOMING WORKSHOPS, TECHNICAL ASSISTANCE, REFERRALS, CASE STUDIES, LIBRARY RESOURCES

CDPHE
OE-B2-PPU
4300 CHERRY CREEK DRIVE SOUTH
DENVER. CO 80222-1530

- PARRY BURNAP (303)692-3009
- NEIL KOLWEY (303)692-3309
- TAMERA VAN HORN (303)692-3017

COLORADO STATE UNIVERSITY WASTE MINIMIZATION ASSESSMENT CENTER

COLORADO STATE UNIVERSITY
DEPARTMENT OF MECHANICAL ENGINEERING
WASTE MINIMIZATION ASSESSMENT CENTER
FORT COLLINS, CO 80523

- DR, HARRY EDWARDS (970)49 1-5317
- MIKE KOSTRZEWA (970)491-7709

EPA ENVIRO$ENSE

-A FREE, PUBLIC, INTEGRATED ENVIRONMENTAL INFORMATION SYSTEM

BULLETIN BOARD SYSTEM: (703)908-2092

USE A PERSONAL COMPUTER WITH A MODEM AND COMMUNICATIONS SOFTWARE SET TO THE FOLLOWING SPECIFICATIONS:

BAUD RATE:	2400 TO 14,400
DATA BITS:	8
PARITY:	NONE
STOP BITS:	I
EMULATION:	ANSI OR VT-100

VIA THE WORLD WIDE WEB (INTERNET): HTTP://WASTENOT.INEL.GOV/ENVIROSENSE

EPA POLLUTION PREVENTION INFORMATION CENTER (PPIS)

-TECHNICAL DOCUMENTS. CASE STUDIES

ENMIRONMENTAL PROTECTION AGENCY
401 M. ST., SW (3404)
WASHINGTON, D.C. 20460 (202)260-1023

POLLUTION PREVENTION PARTNERSHIP

-THE POLLUTION PREVENTION PARTNERSHIP IS A COLORADO PRIVATE/PUBLIC NON-PROFIT CORPORATION WHICH IS WORKING TO REDUCE POLLUTION IN THE STATE. ITS MEMBERSHIP INCLUDES PROMINENT COLORADO COMPANIES, GOVERNMENT AGENCIES, AND PUBUC INTEREST GROUPS. THEY HAVE FOUND THAT PREVENTION PAYS BY REDUCING COSTS AND LIABILITY. THEY WANT TO SHARE THEIR SUCCESSES WITH OTHER BUSINESSES THROUGHOUT THE STATE.

POLLUTION PREVENTION PARTNERSHIP
1099 18TH ST., SUITE 2100
DENVER, CO 80202

- PAUL FERRARO. PARTNERSHIP SECRETARY (303)294-1200

LOCAL HEALTH DEPARTMENT POLLUTION PREVENTION PROGRAMS

-THE FOLLOWING LOCAL HEALTH DEPARTMENTS HAVE STAFF DEDICATED TO PROVIDING POLLUTION PREVENTION ASSISTANCE:

ADAMS COUNTY

TRI-COUNTY HEALTH DEPARTMENT
4301 E. 77ND AVE
COMMERCE CITY. CO 80022-1488

- MIKE MORELAND (303)288-6816

BOULDER COUNTY

BOULDER COUNTY HEALTH DEPARTMENT
3450 BROADWAY
BOULDER, CO 80304

- DAVE SWANSON (303)441-1146

LARIMER COUNTY

LARIMER COUNTY DEPARTMENT OF HEALTH AND ENVIRONMENT
1525 BLUE SPRUCE DRIVE
FORT COWNS, CO 80524-2004

- JUDY HEIDERSCHEIDT (970)498-6792

JEFFERSON COUNTY

JEFFERSON COUNTY HEALTH AND ENVIRONMENT
260 S. KIPLING
LAKEWOOD. CO 80226

- PAUL SAUNDERS (303)239-7066

MESA COUNTY

MESA COUNTY HEALTH DEPARTMENT
515 PATTERSON ROAD
GRAND JUNCTION, CO 81506

- SUSAN KISER (970)248-6937

PUEBLO COUNTY

PUEBLO CITY-COUNTY HEALTH DEPARTMENT
151 CENTRAL MAINSTREET
PUEBLO, CO 81003

- DAN OTOUPALIK (719)583-4341

TRADE ASSOCIATIONS

AMERICAN ELECTROPLATERS AND SURFACE FINISHERS SOCIETY

3525 N. CASCADE AVE.
COLORADO SPRINGS. CO 80907

- BILL THOMAS (719)687-7244

AUTOMOTIVE SERVICE ASSOCIATION OF COLORADO
6301 W. 44TH AVE., SUITE 2D
WHEATRIDGE, CO 80033
●JOE SUMAN, EXECUTIVE DIRECTOR (303)431-9357

PROFESSIONAL CLEANERS AND LAUNDRY ASSOCIATION
P.O. Box 202251
DENVER. CO 80220
●CECILIA PARTRIDGE, EXECUTIVE DIRECTOR (3031355-1878

ROCKY MOUNTAIN FABRICARE ASSOCIATION
2150W. 29TH AVENUE, SUITE 200
DENVER, CO 80211
●GARY LEEPER. EXECUTIVE DIRECTOR (303)433-4446

PRINTING & IMAGING ASSOCIATION, MOUNTAIN STATES
5031 S. ULSTER ST., #350
DENVER, CO 80237
●JIM FREY, EXECUTIVE DIRECTOR (303)771-1578

ENERGY CONSERVATION

OFFICE OF ENERGY CONSERVATION
1675 BROADWAY, SUITE 1300
DENVER, CO 80202
●ANNE EUINS, PROGRAM MANAGER (303)620-4292

ENERGY ANALYSIS AND DIAGNOSTIC CENTER
-THE ENERGY ANALYSIS AND DIAGNOSTIC CENTER LOCATED AT COLORADO STATE UNIVERSITY WILL CONDUCT FREE ENERGY AUDITS FOR SMALL MANUFACTURING FACILITIES WITH STANDARD INDUSTRIAL CODES 20 THROUGH 39.
COLORADO STATE UNIVERSITY (970149I-7709

WATER CONSERVATION

OFFICE OF WATER CONSERVATION
DEPARTMENT OF NATURAL RESOURCES
OFFICE OF WATER CONSERVATION
1313 SHERMAN ST.
DENVER, CO 80203
●CHRIS BRIDGES, PROGRAM MANAGER (303)866-3441

SOLID WASTE REDUCTION

OFFICE OF ENERGY CONSERVATION
OFFICE OF ENERGY CONSERVATION
1675 BROADWAY, SUITE 1300
DENVER, CO 80202
●KELLY ROBERTS, RECYCUNG COORDINATOR (303)620-4292

INDEX OF POLLUTION PREVENTION CASE STUDIES BY COMPANY

Index of Case Studies by Company

Mobile Tool International, Inc.	Westminster	11, 17, 23
Morrison Suede & Leather/Avenue Cleaners	Denver	146
NTI, Colorado Division	Colorado Springs	7, 71, 73
Phelps-Tointon MillWork	Fort Collins	93,107
RBM Precision Metal Products, Inc.	Colorado Springs	48
Rocky Mountain News	Denver	136
Rocky Mountain Metal Finishers	Colorado Springs	57
RTD, District Shops Facility	Denver	9,122,130
Samsonite Corp.	Denver	36, 38
Sand Creek Chemical LP.	Commerce City	85
Schlage lock Co.	Security	42
Shafer Commercial Seating	Denver	97,105
Sheldon Cleaners	Boulder	150
Signal Graphics	Westminster	142
Storage Tek	Louisville	59, 61
Sundstrand Aerospace	Denver	30, 34
Unisys Corp.	Pueblo	63
Velie Circuits of Colorado, Inc.	Broomfield	65, 67, 69
Western Forge	Colorado Springs	55
Wood Masters	Fort Collins	99
Woodleys Fine Furniture	Longmont	95

Colorado Department of Public Health and Environment
Pollution Prevention Program
4300 Cherry Creek Drive South OE-B2
Denver, CO 80222-1530
(303) 692-3309

Colorado Department
of Public Health
and Environment