Pollution Prevention is the Answer

Five Navistar plants prove pollution prevention builds profits

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Current end-of-pipe control methods are approaching the point of diminishing returns.

For the environment, the last three decades of the 20th century will be like no other. These decades saw the creation of the U. S. Environmental Protection Agency and the passage of several very tough environmental laws and regulations that spawned a whole new industry involving regulators, consultants, remediation experts, lawyers, mediators, and criminal investigators. Over 100 countries gathered in Rio to set global environmental policies. Industry environmental awareness also increased, triggered in some cases by civil and criminal penalties imposed on companies for serious environmental crimes. Finally, these decades saw the strength of "consumer-power" — consumers demand that industry produce "green" products, conserve raw materials, recycle used commodities, and prevent pollution creation.

Conservative estimates rank environmental protection in the United States as a $120 billion per year industry in 1990, projected to hit $240 billion by 2005.[1] The Clean Air Act Amendments of 1990 alone, at full implementation, will cost U. S. industry about $25 billion per year. With the increasing costs of removing pollutants from smoke stacks and from waste water discharge pipelines, and of disposing hazardous and non-hazardous wastes, government and industry finally realized that the current end-of-pipe control methods are approaching the point of diminishing returns. To remove the last one percent of pollution could require a capital expenditure almost equal to the total cost of the original control equipment.

In the late 1980's two words consistently found their way into environmental documents — pollution prevention. Pollution prevention has evolved from terms like "waste minimization," as used in the Resource Conservation and Recovery Act, focusing on regulated hazardous wastes, and "waste reduction" which involves a direct measure to prevent waste discharges to air, water, or land. Pollution prevention broadens the concept to include products and processes.

The U. S. Congress passed the Pollution Prevention Act of 1990 which clearly stated that pollution prevention is a national policy. An important part of the act is a requirement that all generators who are required to file an annual toxic chemical release form under Section 313 of the Superfund Amendments and Reauthorization Act of 1986 (SARA) must include in that filing a "toxic chemical source reduction and recycling report for the preceding calendar year." The Clean Air Act Amendments of 1990 likewise had as one of its primary goals "to encourage or otherwise promote reasonable federal, state, and local government actions, consistent with the provisions of this act,

for pollution prevention."

As early as 1975, 3M created a program called 3P — Pollution Prevention Pays. 3M reports that in 12 years, the 3P program prevented or reduced pollutant generation by almost half a million tons, representing an estimated savings of about $420 million.[2] Since then several other companies have adopted pollution prevention programs — Dow Chemical Company's WRAP (Waste Reduction Always Pays); Chevron's SMART (Save Money and Reduce Toxins); General Electric's POWER (Pollution, Waste and Emissions Reduction); Monsanto's Pledge (eliminate 90 percent of toxic releases in 1992, 100 percent ultimately); and AT&T's goal to totally eliminate chlorofluorocarbon (CFC) use by 1994.

The Navistar International Transportation Corp.

Navistar has instituted the GREEN (Get Reductions of Environmental Emissions at Navistar) pollution prevention program. Goals to reduce the hazardous and nonhazardous waste and toxic releases were set for the corporation. Progress toward these goals are measured on an annual basis. Like most other corporate pollution prevention programs, Navistar's GREEN program is driven by the need to comply with the requirements of the corporation's Environmental Protection Policy and Management Program.

Navistar's Environmental Protection Policy and Management Program

In 1991, Navistar revised its existing environmental policy and issued a comprehensive environmental protection policy to convey and demonstrate to its many publics (employees, shareholders, customers, neighbors, suppliers, regulators, etc.) that "Navistar is committed to adhering to high standards of environmental quality and to providing a workplace that protects the health and safety of our employees and the communities surrounding our facilities."

The environmental management program was created together with the policy to ensure that the requirements of the policy are known, understood, and complied with by each of the company's operating units. One of the major elements of this management program is pollution prevention — "Navistar is committed to minimizing the volume and toxicity of wastes generated in our facilities. We will work with suppliers to obtain environmentally acceptable raw materials and will investigate and pursue process modifications that prevent pollution and result in waste reduction. We will implement internal recycling programs. We will vigorously pursue opportunities to recycle or reuse potential waste before considering other waste management practices. We will dispose of all wastes safely and responsibly."

It was with this very strong corporate commitment to environmental protection that the GREEN pollution prevention program at Navistar was developed, implemented, measured, and continuously improved.

Waste Management Hierarchy

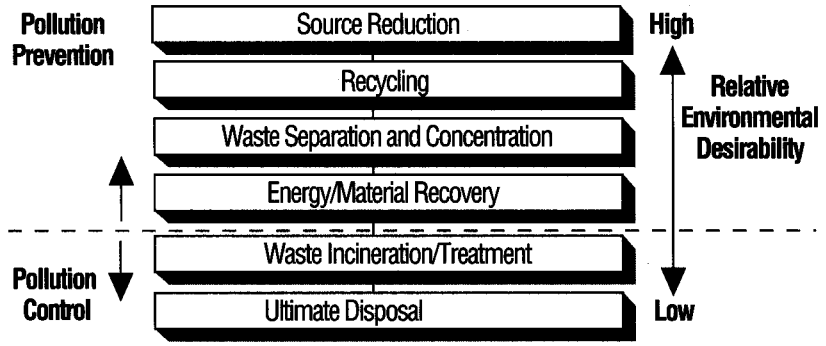

Figure 1. *Source: EPA Manual for Waste Minimization Opportunity Assessments, April 1988.*

What is Pollution Prevention?

Pollution prevention is generally defined as any practice that reduces or eliminates the amount and/or toxicity of generated wastes released to the air, land, or water prior to the application of management practices, treatment, or disposal. U. S. EPA recognizes source reduction, recycling, waste separation and concentration, and energy/material recovery as pollution prevention, in the order of decreasing relative environmental desirability (see Figure 1).

Pollution prevention includes the design of products and processes that will lead to lower waste product volume. As a total manufacturing plant philosophy, a pollution prevention program examines and implements methods to reduce hazardous, nonhazardous, and other wastes and releases.

Pollution Prevention Benefits

The principal benefit of a pollution prevention program is cost savings. In addition, the working environment will become safer for employees as a result of source reduction, in-process recycling, and waste stream toxicity reduction. Other very important benefits include protection of the environment, meeting compliance requirements, reducing liability, and promoting better community relations.

Pollution Prevention Terminology

Defining terms and measurements is crucial to a successful pollution prevention program because misun-

End-of-Pipe Controls and P2 Activities

End-of-Pipe Control Technologies	Alternative Pollution Prevention Strategies
Incineration of solvent fumes	Utilization of lower volatile organic compounds (VOC) coatings and higher transfer efficiency paint application
Sanitary waste water treatment	Water saver toilets and showers
Cardboard box recycling	Investment in returnable containers
Catalytic converter for vehicle emissions	Clean-burn design and alternative fuels (such as natural gas)

Figure 2.

derstanding may result in misplaced efforts.

- Industrial pollution is a material purchased by a business which it did not sell at a profit.
- Solvent evaporation resulting from a parts washer must be replaced with more solvents. Scrap paint is incinerated as a hazardous waste instead of being applied to a part.
- Heat from boilers cannot be fully reclaimed and is lost to wastewater discharges while energy is expended to produce more heat.
- Dunnage from suppliers' packaging is landfilled after one use even though it was purchased by the supplier first and ultimately by the end-customer.

Therefore, pollution can be measured in economic terms as well as environmental terms.

The EPA holds a narrow view of pollution prevention — "the use of materials, processes, or practices that reduce or eliminate the creation of pollutants or wastes at the source. It includes practices that reduce the use of hazardous materials, energy, water, or other resources and practices that protect natural resources through conservation or more efficient use"[3] The abbreviation for pollution prevention, "P2" will be used throughout the remainder of this article.

The converse of P2 is end-of-pipe control which typically consumes energy, costs money, and eventually results in some form of pollution. Off-site recycling is not included in the EPA definition of P2. Rather, recycling is considered a form of end-of-pipe treatment which is typically energy intensive and often results in degradation of the product being recycled.[4] Recycling may be more desirable than some other forms of treatment such as incineration or landfilling, but it does not prevent the creation of the waste at the source and may only postpone the ultimate disposal of the material.

Many terms similar to P2 can be found in the literature and regulations. These include terms like waste minimization, source reduction, clean technology, and green manufacturing. Waste minimization was previously advocated by the EPA and is specifically mandated in the 1984 amendments to RCRA. Waste minimization, unlike P2, included recycling in addition to source reduction activities. Each uniform hazardous waste manifest includes a certification that the generator has a waste minimization program to reduce the volume and toxicity of wastes generated. Figure 2 shows examples of end-of-pipe controls and P2 activities.

The terms of measurement are important in defining goals and monitoring improvement. EPA recognized that year-to-year comparisons of Toxic Release Inventory (TRI) releases mandated by SARA should be based on some normalized value rather than total pounds. Normalizing data using a production ratio or an activity index other than production volume allows a company to compare year-to-year gains in efficiency.

Accounting for the Environment

Businesses are faced with a multitude of competing interests for money to fund special projects. Product research, marketing, employee development, and safety all require funding. Accounting methods, therefore, are a key aspect of a successful P2 program. Inappropriate methods of evaluating costs and benefits may result in a decision to delay or deny the implementation of a project.

Many suggestions have been made about the kinds of accounting methods that consider environmental costs. Life cycle analysis includes the cost of ultimate disposition of a product in its purchase price.[5] Such a method would permit the consumer to make an economic decision without regard to "green" advertising claims. Germany has taken a first step in this direction by requiring producers of products to be responsible for disposal. As a result, automobile manufacturers, for example, must accept the return of a junk vehicle and arrange for the recycling or disposal of its various components. In addition to the manufacturing and operating costs associated with a component, the cost to recycle or dispose of the materials would be valuable information in determining which raw materials and designs to use. However, there are currently no standardized techniques for gathering and interpreting environmental data in life cycle analyses, so many of the results being touted by industry councils are debatable.[6]

Another accounting method promoted previously in quality circles and gaining acceptance in the environ-

mental realm is cost accounting. Cost accounting within a business unit allocates costs to products and processes responsible for producing those costs rather than lumping costs into general accounts. For example, environmental budgets may contain a line item for waste disposal from a facility that has many different products or processes. Cost accounting suggests that knowing how much of the cost is related to each process or product would result in more appropriate decision-making when costs are considered. Traditional accounting has the effect of failing to identify the products or processes most responsible for environmental costs and failing to target P2 investments to the products and processes with the greatest environmental costs because the information is incomplete.

A significant advantage to the cost accounting method is to raise awareness of the cost of waste at the point of generation. Once departmental budgets are affected by rising costs associated with waste, the goal of waste reduction ceases to be just the environmental department's concern.

Whatever accounting method is utilized, companies should attempt to identify total costs and benefits in a P2 project. Too often, opportunities are measured only in terms of reduced disposal costs. However, a P2 project evaluation should consider benefits and costs in many other areas such as material purchases; liabilities related to spills, fires, and accidents; energy usage; employee health claims related to chemical exposures, handling of raw materials and waste; manufacturing or warehouse space for storage of material and waste; production rate changes; paperwork associated with purchasing and disposing of materials, regulatory exposure and increased public relations/marketing value. It may be difficult to assign a dollar value to some of these categories, but the additional discussion of unquantifiable benefits and reduced risks may be enough to ensure approval of P2 projects that appear marginal using only quantifiable "real" dollars.

Accountability for environmental protection at Navistar starts with the chairman of the board, who reports to the board of directors. In addition to the members of the environmental organization, managerial employees have environmental accountability as part of their performance reviews. Besides employee performance reviews with their group vice presidents, plant managers submit annual environmental status reports and environmental audit action plans to the corporate officer responsible for environmental protection. An appropriate disciplinary program for environmental infractions is the ultimate factor in employee accountability at Navistar.

Five Manufacturing Environmental Success Stories

P2 projects may be intuitive or serendipitous, large or small, capital intensive or capital avoiding.

Painting truck cabs, chassis, and components is the primary source of pollution at the Springfield, OH Assembly Plant. Painting operations generated wastewater, hazardous and nonhazardous wastes, and air pollution. Solvents, the primary pollutants in paints, are referred to as VOCs (volatile organic compounds). Past programs to reduce VOCs resulted in shutting down five paint booths when a new state-of-the-art paint facility was constructed in 1987. The new finishing lines utilized lower VOCs containing coatings on two lines and a VOC fume incinerator on two other lines. Since 1987 Navistar has made other improvements to reduce air pollution and waste generation from the finishing plant.

The primary use of solvents at the paint facility is to clean the robotic paint guns between color change cycles. In the past, Navistar has used as much as 2000 gallons per day of solvent. The waste solvent is recycled off-site and returned to Navistar for reuse. Waste paint purged from the lines during color changes — as well as any paint left in the container after the job is finished — is flushed into the waste solvent. Two significant initiatives have targeted waste paint and solvent reductions from these lines.

Colored basecoat has always been applied in two coats to provide the optimum film build and finish quality. The two applications are made in two consecutive paint booths using four robots in each booth. Changing paint colors required the purging of all eight distribution lines from the common paint container to each robot. The paint process was refined in a manner which permitted the same paint to be applied in just one coat. Paint transfer efficiency increased, resulting in less oversprayed paint. In the four months since the one-coat formulas were implemented, Navistar has reduced purge solvent usage nearly 50 percent. Because of increased transfer efficiencies and reduced paint lost in a color-change cycle, the plant purchases 35 percent less paint.

One-coat Basecoat Summary (December 1992 to March 1993)

	Before	After
Purge solvent usage (gallons/day)	784	415
Paint usage (gallons/day)	883	557
Material handling (minutes/day)	16	8
Paperwork for shipping (minutes/day)	30	15
Four-month savings		$0.5 million
Annualized savings		$2.7 million

Figure 3.

During this four-month start-up period, the program has reduced costs by $500,000 (see Figure 3). Small reductions in paint sludge and air pollution are also anticipated.

Approximately 0.9 gallons of paint per special color container has been purchased as a safety factor since the suction line does not draw off the bottom. The bottom fill urns, however, draw paint from the very bottom of the urn. As a result, less paint is wasted and less paint is purchased. Although this program is just starting, the projected costs and benefits are impressive:

Modification of urns	Cost $46,000
Benefits:	
Reduced paint purchases and waste	16,900 gallons
Projected savings by October 1993	$250,000
Reduced paint purchases and wastes	0.7 million

Replacement of Chlorinated Solvents at Springfield, OH Assembly Plant

The Springfield Assembly Plant utilized two chlorinated solvents, methyl chloroform (1,1, 1-trichloroethane) and methylene chloride. Chlorinated solvents have been industry favorites for many years because of desirable properties such as low flammability and excellent cleaning properties. However, chlorinated solvents have also been implicated in groundwater contamination, health problems, and ozone depletion. Methylene chloride, for example, is a toxic solvent under review by OSHA for a more stringent employee exposure limit. Methyl chloroform may contribute to the destruction of the earth's protective ozone layer so EPA is requiring that its use be phased out. Navistar wanted to completely eliminate both solvents from the assembly plant.

Methyl chloroform was used to smooth a sealer bead applied to metal surfaces. After a change in the sealer formulation, employees discovered solvent was not really needed. This discovery reduced air emissions of methyl chloroform by 56,000 pounds per year and hazardous waste generation by 9000 pounds per year. In addition, the company saved $30,000 annually.

Methylene chloride was the primary component of a powerful paint gun cleaner. Methylene chloride is a suspected human carcinogen and is on several of EPA's lists of regulated toxic chemicals. The two remaining ingredients of the paint gun cleaner, acetone and xylene, were also on the EPA list of hazardous air pollutants (HAPs). Navistar worked with the solvent supplier to create a new mixture that had no chlorinated solvents or solvents listed on the HAP list, had a high flash point, a low vapor pressure, and provided good cleaning of paint equipment. The new blend met with resistance by employees unaccustomed to the odor. However, it was communicated to these employees that the newer solvent was safer to work with, despite its unpleasant odor. Although the total air emissions from clean-up operations are not expected to change, the formula conversion resulted in a reduction of 49,000 pounds per year of HAP emissions. The net benefit of switching to the new solvent formulas has been $20,000.

In addition to the benefits already described, methylene chloride and methyl chloroform were the only hazardous wastes generated at the facility which carried the F002 designation(hazardous waste category containing spent halogenated solvents). By eliminating the use of these two solvents, the toxicity of the waste stream has been reduced and the F002 waste code has been dropped.

West Chicago, IL Parts Distribution Center Reduces Solid Wastes

The Parts Distribution Centers (PDCs) are responsible for providing service parts to dealerships throughout North America. As a result, PDCs often receive parts in bulk and repackage them for distribution. The primary wastes generated at PDCs are packaging materials such as corrugated paper, damaged pallets, and shrink wrap.

In 1989, the West Chicago PDC sent 7976 yards of compacted solid waste to the local landfill. Initial P2 efforts in 1990 began with the easiest waste stream — corrugated paper. A bailer was rented and corrugated materials were segregated from the waste stream for recycling. After some investigation, a contractor was located who makes use of wood wastes, so the damaged pallets could be diverted from the disposal stream. Now shrink wrap is re-used to pack materials for export shipments.

As a result of the recycling efforts, Navistar landfilled only 1592 cubic yards of solid waste in 1992, an 80 percent reduction compared to 1989. In addition, while landfill costs have continued to rise, West Chicago

Pallet Facts

Wooden pallet production has increased almost 250 percent in the last 20 years, from 155 million manufactured in 1972 to 540 million manufactured in 1991. Revenues totaled $4.4 billion in 1991. Over half of wooden pallets manufactured are the one-way, expendable (disposable) design. The wood pallet industry is the largest user of hardwood lumber in the U.S., on a volume basis, consuming almost 42 percent (four times more than the next highest industry). Lumber use by the wood pallet industry increased 81 percent between 1977 and 1990; usage by the wood pallet industry increased 7.3 percent between 1987 and 1990; it fell slightly in 1991 (due to an economic slowdown).

Pallet manufacturers primarily are small companies with under 20 employees. Thirty-three pallet manufacturers are listed in the *Cincinnati Bell Workbook Yellow Pages*, and is probably not a full listing of pallet makers in the Cincinnati metropolitan area. There are no listings for "Pallet Repair" or "Pallet Recycling."

Pallets are proposed to be banned from disposal in construction and demolition debris landfills (possible 1993 state legislation). Wood wastes are estimated to be between seven percent and 37 percent of all solid wastes, with pallets and construction and demolition wood the bulk of these volumes. (No estimate of pallet waste contribution is available for Hamilton County); pallets may make up five to ten percent of the district's solid waste stream.

Over 25 percent of the total non-expendable pallet production was purchased by the grocery and related products industry in 1985 (with similar trends to date). The grocery industry has a universally acknowledged failed pallet exchange program for their food and dry good products. A grocery committee has spent the last four years developing guidelines to create a structure that would provide a successful pallet exchange program and prevent the annual $500 million in damaged goods (excluding labor, injuries, loss of sales, etc.). *Courtesy of Ken Stern, The Institute of Advanced Manufacturing, Cincinnati, OH.*

paid only $41,063 for disposal and recycling in 1992 compared to $72,436 in 1989.

West Chicago PDC did not stop evaluating P2 projects after implementing the recycling projects. Outside packagers shipping to the PDC are now instructed to first use supplier cartons, then Navistar-supplied corrugated cartons. Shipments from West Chicago are sent on returnable wood or plastic pallets so that many shipments can be made with a single pallet. Wood pallets account for 42 percent of all hardwood consumption in the United States each year, over half of this for non-returnable pallets which are landfilled or burned after a single use, according to the Institute of Advanced Manufacturing Sciences, Inc.

Machine Coolant Projects at Melrose Park, IL Engine Plant

Diethanolamine (DEA), a rust preventative aid in the facility's coolants, was the only chemical on the plant's SARA 313 Report to EPA in 1989. Releases that year totaled 16,600 pounds. DEA is considered toxic and was therefore a good candidate for elimination from the process. With the help of the Source Reduction Committee, the facility's environmental manager called in the coolant manufacturers and requested the facility's coolants be reformulated with a nonhazardous and nontoxic replacement for DEA.

The coolant manufacturers helped the Melrose Park Plant find a coolant that met the facility's specifications and completely eliminated DEA. The new coolant was phased in whenever a machine sump required pumping out, keeping replacement costs to a minimum and avoiding unnecessary disposal of good coolants. The facility was not required to file a SARA 313 report for 1991 because DEA usage was below the threshold reporting limit of 10,000 pounds. In 1992 the DEA was entirely eliminated from the facility; a potential health problem had been eliminated too, with no capital investment by the Source Reduction Committee and no increase in material costs.

Even more impressive than the toxicity reduction, the usage of machine coolants has dropped 65 percent at Melrose Park since 1989. A polishing system cleans the coolant by removing tramp oil and bacteria. As a result, the coolant is reused right at the facility. The polishing system is saving Navistar $80,000 per year.

Solvent Reductions at Columbus Plastics Operation

The Columbus Plastics Operation, located in Columbus, OH is the manufacturing facility for Navistar's medium and heavy duty fiberglass body part. Some parts require the use of numerous internal supports, clips, stiffeners, etc. which must be bonded to the sheet molded compound (SMC) sheet in order to provide necessary support to the outer structure. Parts were prepared for bonding by first priming the contact areas with a methylene chloride-based solvent. The two-part urethane-based adhesive was mixed by in-line static mixers connected in series then applied to the primed parts. After every cycle, on each of eight stations, the rubbing and mixers were purged and flushed.

The Columbus Plastics Operation has incorporated P2 into its continuous improvement process. Teams have been commissioned and tasked with the responsibility of assessing specific areas of operation by map-

ping all sub-processes and their relationship to Navistar's goals (one of which is an aggressive approach to P2), identifying opportunities for improvement and measuring success. This is a continuous loop process with each iteration bringing the operation markedly closer to actualization of the highest levels of efficiency and profitability. A high priority has been assigned to the source reduction of SARA 313 reportable chemicals.

The senior process engineer led his team through a waste minimization opportunity assessment. Immediately, two waste minimization projects were launched to reduce the usage of methylene chloride, one of the SARA 313 reportable toxic chemicals at Columbus. The first project centered on redesigning the mixer and application tip. The mixer and tip have been combined in the form of a disposable spiral "Apple Core" mixer, consisting of a series of left and right hand spiral elements.

Each element is designed so that both leading and trailing edges are razor sharp, thus minimizing the possibility of material accumulation which can cause plugging and associated problems. Operators were able to make a smooth transition to the new disposable tips with little or no resistance. The most serious impediment was that the tips were difficult to remove and replace. With minimal training we were able to address this concern and make the new tips as easy for the operators to replace as possible. The previous mixer had to be used up to twelve in a series, each costing $1.00. The new tips/mixers cost just under $1.00 each, replacing twelve in-line mixers.

The primary P2 success comes from the elimination of the need to flush lines. Over 47,000 pounds per year of waste solvent generation was avoided by eliminating the solvent flush. Methylene chloride was the primary component of the flush solvent. Because much of the waste solvent was recycled in-house, almost 22,000 pounds of distillation still bottoms per year were also avoided.

The second project required the cooperative effort of Navistar and its supplier. Navistar and its primary supplier of adhesives, Ashland Chemical, participated in the development of a replacement adhesive that would eliminate the use of solvent primers. Navistar is in the final stages of testing, with confidence that it will be successful in eliminating the primer from both ambient and heat-cured bonding systems. More than 25,000 pounds of waste solvent will be avoided by utilizing a primer-less replacement for the current adhesive. Success in this area will decrease the use of methylene chloride by 80 percent from 1989 levels. The two source reductions have annual savings projections of more than $170,000, with negligible capital investment.

Sand Reclamation at Indianapolis Castings Corporation

Navistar is also the manufacturer of INTERNATIONAL® medium and heavy duty diesel engines for the world market. Each year Navistar produces castings for more than 104,000 diesel engines at its wholly owned subsidiary, the Indianapolis Castings Corporation (ICC). The castings are machined into engines at the adjacent engine plant.

ICC evaluated P2 opportunities at the foundry and, while it was not economically feasible to reduce the use of sand, reuse of spent sand showed promise. Environmental benefits ranged from reducing landfill needs by 51,000 cubic yards per year to reduced demand for new sand resources and reduced long-term liability associated with landfills.

For ages, sand has been used in foundries to facilitate the casting of complex shapes. Sand, with chemical or clay binders, is used in molds and core assemblies to cast three dimensional objects with internal tunnels and partial voids. During casting, the molten metal burns out the binders leaving a residue on the sand grains. Once the part is formed and the metal cools, the sand cannot be reused in core or mold making until the residue has been removed. In the past, the waste sand was landfilled, creating liability issues.

Most of the sand reclaimers in use today are gas fired. Indiana Power and Light (IPL) has been working with the Electric Power Research Institute (EPRI) Center for Materials Production (CMP) since 1988 to develop an electrical process. When CMP discovered that infrared heating could be used to heat sand to the high temperatures required for reclaiming, they turned to BGK Industries to develop the first infrared reclaimer using high intensity infrared heating together with fluidized bed technology.

The heart of the reclaimer system is the fluid bed calciner where the sand is heated by infrared emitters; the emitters are housed in protective quartz tubes and immersed in the fluid sand bed. Operating at 4000 degrees Fahrenheit, the emitters radiate heat to the individual sand particles. Fluidizing action distributes the heat uniformly throughout the sand bed. The sand

is quickly brought to operating temperatures in excess of 1500 degrees Fahrenheit which calcines the clay on the sand grains and destroys any chemical binders.

The reclaimer has two waste heat recovery loops, which result in significant energy savings. In the first loop, cold counter-flowing fluidizing air pre-cools hot sand entering the cooling chamber. The air is heated and continues upward to preheat spent sand entering the calciner. The second loop passes exhaust air from the hot fluid bed through a heat exchanger to preheat incoming air.

From the cooling chamber, sand is discharged into the fluid bed cooler where sand temperatures are reduced to 100 degrees. After cooling, secondary mechanical scrubbing removes residual calcined particles. The sand is then stored in a 1000 cubic foot hopper until ready for use.

ICC disposes of over 300 tons of spent sand every day. With increasing sand costs and landfill tipping fees, along with new pending environmental restrictions on solid waste disposal, ICC sought IPL's help to find a way to minimize sand disposal. In 1991, IPL formed a coalition of partners, including EPRI, CMP, BGK Industries, and ICC, and with assistance from EPRI's Tailored Collaboration Program, the coalition funded a research project to install the BGK prototype commercial infrared foundry sand reclaimer at ICC. The reclaimer required only 200 kWH/ton green sand.

The reclaimer can process 1 1/2 tons per hour of spent sand with 98 percent yield. Based on a 288-day operating period, the unit will process 10,370 tons of spent sand annually. The initial capital expenditure for the reclaimer is around $500,000 with an annual operating cost of $83,000. When the total annual costs without reclaimer ($425,170) are compared to total annualized cost with reclaimer ($91,447), ICC will realize annual savings of $333,723. With an assumed discount rate of 10 percent, this project will show a payback in one and a half years.

ICC generates more than 18 tons of spent sand per hour at the foundry. When plans for expanded capacity come to fruition, ICC can anticipate a savings of more than $3 million annually with a one-year return on investment. By reclaiming all of ICC's spent sand, IPL could realize additional revenue of $500,000/year with an energy savings equivalent to 38,500 barrels of oil; CO^2 emissions will be reduced by 15,600 tons. If sand reclamation were utilized throughout the industry's 3200 foundries, 5.8 million tons of nonhazardous foundry sand would be available for beneficial reuse.

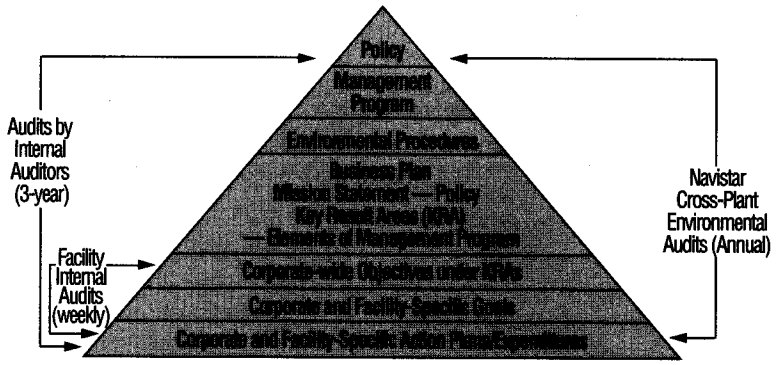

Figure 4. *Every three years, outside environmental consultants are invited to review and evaluate the company's auditing process.*

Navistar's Environmental Business Plan and Green Initiative

In 1991, Navistar issued a revised comprehensive Environmental Protection Policy and Management Program. The policy stated in part the company's commitment to "exercise innovation in our manufacturing processes and our end products to minimize or prevent the generation of waste and the discharge of contaminants into the environment." The policy constitutes the mission of the company with regard to environmental matters. The purpose of the Environmental Management Program is to ensure that the requirements of the policy and all environmental laws are complied with by every operating unit. One of seven Key Result Areas (KRAs) of the Management Program is Pollution Prevention (P2). (See Figure 4.) Navistar has a three-year business plan which defines corporate objectives for each KRA. Facility specific goals and action plans are developed to implement these objectives. The primary objective under the P2 KRA is a 25 percent reduction of waste and SARA 313 reportable toxic releases by 1993 and a 50 percent reduction by the year 2000, based upon a 1989 baseline. The deployment of the Environmental Policy and Management Program are depicted in Figure 4.

Since P2 is critical to the long-term survival of Navistar in terms of financial opportunities and environmental compliance, a P2 Process Team was established to Get Reduction of Environmental Emissions at Navistar (GREEN). The team was formed with the approval of the board of directors' policy committee and reports to the director of environmental affairs, with each facility environmental coordinator serving on the team. The purpose of the team is to coordinate the exchange of information

among facilities, track progress, and provide feedback to the director of environmental affairs.

In order to track P2 activity throughout the corporation, a newsletter, *The G.R.E.E.N. Report*, is published. The newsletter tracks progress at each facility and increases the flow of information of on projects considered, whether implemented or not.

Conclusion

Navistar has made pollution prevention one of its highest priorities and has benefited from the establishment of P2 teams at its facilities. The company saved about $2 million in 1992 in raw material expenditures, operating costs and disposal costs. Three million dollars' incremental savings are projected for 1993. Less air pollution, wastewater, hazardous waste, and nonhazardous wastes are being generated. The liability from future superfund sites has been reduced. Finally, Navistar's image has improved before our customers, stockholders, neighbors, regulators, and ourselves. The lesson of preventing pollution instead of controlling it was a lesson well learned. Preventing pollution saves money and Navistar wants other businesses to share in the benefits it has experienced.

Many businesses still focus on pollution *control* instead of pollution *prevention*. Pollution control often resulted in conflicting practices — air pollution control devices creating water pollution, wastewater treatment plants creating landfill problems, and landfills creating groundwater problems. As pollution control laws became more restrictive, landfills started filling up and business faced increased global competition, cost reduction became the new driving force in pollution. Pioneers such as 3M, Dow, and AT&T recognized that there is more money to be saved by preventing pollution than by controlling it.

This new focus has resulted in exceedingly rapid progress in reducing emissions and costs by many companies. Millions of dollars can be saved by increasing manufacturing efficiency, changing formulas, and reducing waste. If for no other reason, begin a P2 program today for the purely selfish reason to add to your company's bottom line. In the meantime, current and future generations will benefit from the improvements to the environment.

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For a comprehensive P2 review read "Industrial Pollution Prevention: A Critical Review", Harry Freeman, et al., *Journal of the Air and Waste Management Association*, May 1992.