HBI-94-018-01, Pub. 4/29/95

EPIC

Environmental Pollution Prevention Project

CASE STUDY

Pollution Prevention Assessment for an Offset Printer

Executive Summary

A pollution prevention diagnostic assessment was done at a printing facility. The objective of this assessment was to identify pollution prevention options that would reduce the quantity of toxics, raw materials, and energy used in the manufacturing process; demonstrate the environmental and economic value of a comprehensive pollution assessment; and improve manufacturing competitiveness and product quality. The assessment was performed by an EP3 team comprised of an expert in the printing process and a pollution prevention specialist.

Ten pollution prevention options were identified which could reduce the impact of the plant's operations on the environment. These changes would reduce operating costs by US$4,500 per year for a one-time investment of $1,400.

Of these, eight are no/low-cost changes which can eliminate exposure of workers to lead and solvents, reduce the quantity of waste ink sent to the landfill by 250 kilograms per year, recycle an additional 40 tons of paper per year, and eliminate the discharge of used oil to the sewer. These changes will reduce operating costs by $2,900 per year.

Two capital-intensive changes were identified which can reduce solvent use, solvent releases to the landfill, and significantly reduce worker exposure to solvents. An investment of $1,400 will reduce operating costs by $1,900 per year. The pollution prevention options identified at this facility can be readily transferred to other small printing facilities.

Facility Background

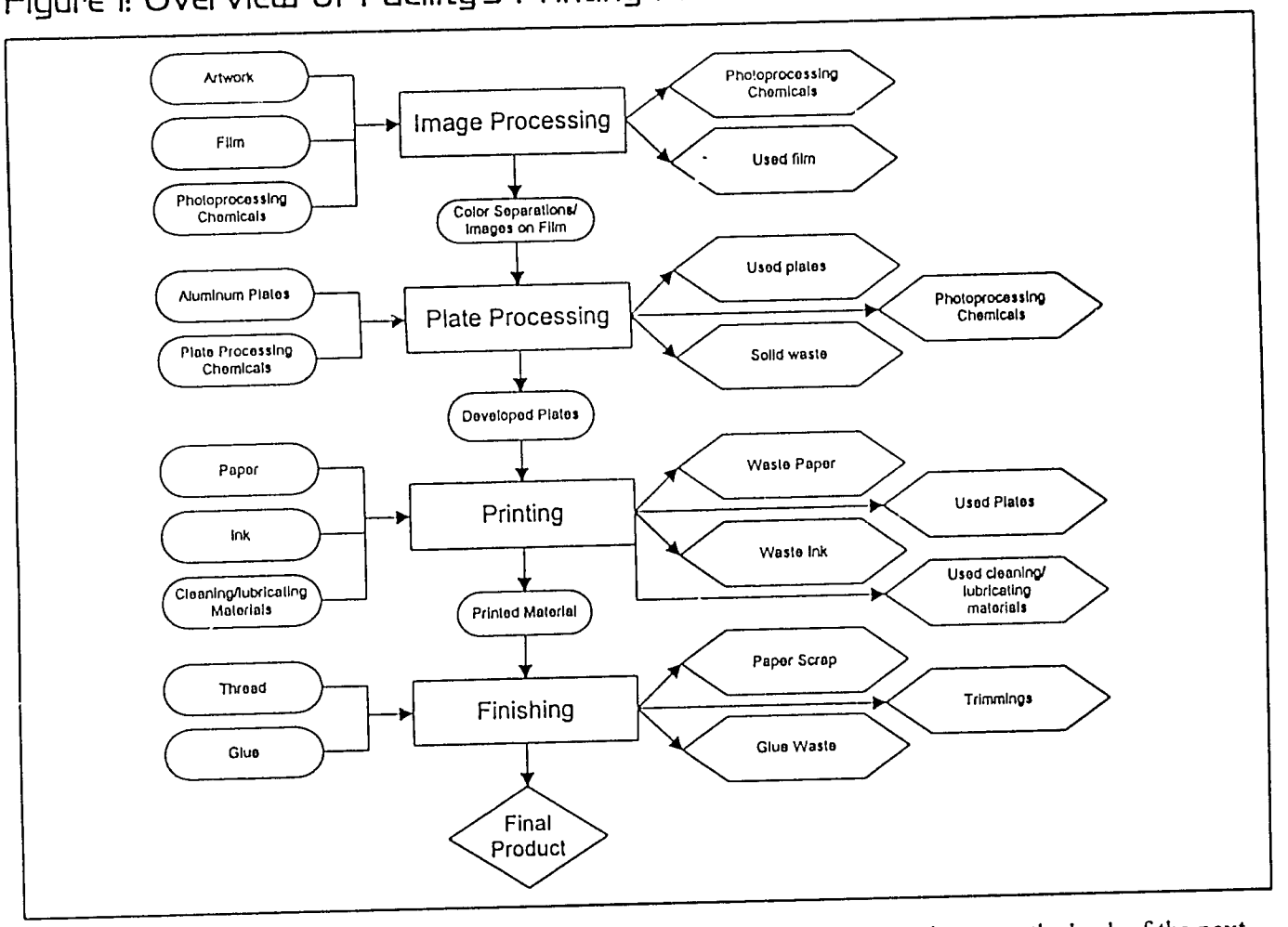
The facility is an offset printer that prints business forms and a type of daily agendas. It operates five presses: 3 two-color, sheet-fed presses and 2 one-color sheet-fed presses. One hundred and seventy production workers and eighty support staff work three shifts, 6 days per week. In 1994, the facility expects to use 960 metric tons of paper and 10 tons of ink.

Plant and Process Description

The plant has four main unit operations: image processing, plate processing, printing, and finishing. Images that customers want printed on paper are delivered in the form of illustrations or sketches. These images are photographed and the negative is used to transfer an image to a photosensitive, thin aluminum sheet called a plate. If a multi-color image is to be printed, the image is transferred to two, three or four plastic photosensitive sheets called color separations. These color separations are used to create separate plates for each color stage on the press. Plate development creates a surface which is attractive to ink (oleophilic) where there is to be an image and repellent to ink, but attractive to water (hydrophilic), where there is to be no image. The plates are then mounted on a roller on the press.

The plate is first rotated through a fountain solution which contains a solution of chemicals such as gum arabic, zinc or magnesium nitrate and phosphoric acid salts which accentuate the wetability of the hydrophilic areas of the plate. The fountain solution application

Figure I: Overview of Facility's Printing Process



system is called the dampening system because it dampens the plate with water.

The plate is next rotated against the ink roller system. Ink is transferred to the areas of the plate which were not wetted by the fountain solution. In the final portion of the rotation of the plate roller, the plate comes into contact with a roller onto which a rubber mat (called a blanket) has been mounted. The inked portion of the plate transfers ink to the blanket. The plate roller continues to rotate to be re-dampened with fountain solution. The blanket roller, holding the inked image on its surface, rotates until it contacts the paper which is pressed against the blanket roller by a roller called the impression cylinder. After the inked image is transferred to paper, the blanket continues to rotate until it again is inked by the plate, and the process repeats. The blanket must be kept free of extraneous ink, lint and paper fibers which could mar the image to be printed. The blanket is cleaned often during a press run. Blanket cleaning consumes a significant amount of solvent.

The inks used in sheet-fed presses dry by polymerization or air oxidation. While the sheets are drying, the wet ink may transfer an image to the back of the next sheet. To prevent image transfer, sheets are sprayed with kaolin or other inert powders as they come from the press.

After printing, the impressions are finished according to the specifications of the customer. Finishing operations include trimming to size, cutting, folding and binding with thread, staples or glue.

Environmental Problems

The key environmental problems associated with this printing facility include: 1) developer and rinse water streams are sewered directly without treatment, likely exceeding sewer pH standards; 2) chemical containers are discarded, sold, or used for solvent delivery in the print shop; 3) rubber printing blankets are discarded as solid waste; 4) liquid solvent, rags contaminated with ink and solvent, and ink containers are all sent to an un-lined landfill; 5) wet rollers are cleaned with a detergent/leaded gasoline/water mixture which is sewered; 6) deionizer regeneration acids and bases are sent directly to the sewer system; 7) fountain solution

Table I: Summary of Recommended Pollution Prevention Opportunities

Operation	Pollution Prevention Action	Environmental Benefit	Implementation Cost	Financial Benefit	Payback Period
Printing	Launder press rags and recover solvent	Reduce solvent releases to the landfill by 6,000 l/year; reduce worker exposure to solvents	$700	$900/year	Immediate
Blanket Washing	Collect and reuse solvent and rags	Reduce solvent use by 1,400 l/year	$700	$1,000/year	8 months
Wet Roller Cleaning	Eliminate use of gasoline	Eliminate exposure of workers to lead; reduce discharge of 600 l/year of gasoline to sewer	$60/year	none	not applicable
Ink Storage	Use anti-skinning spray	Reduce ink loss to landfill by 250 kg/year	none	$1,600/year	Immediate
Printing	Segregate solid wastes	Reduce paper to landfill by 43 tons/year	none	$1,300/year	Immediate
Photomechanical	Change from methanol to isopropyl alcohol	Eliminate worker exposure to methanol	none	none	Immediate
Photomechanical	Rinse plates with deionized water	Reduced plate and paper waste	none	not quantifiable	Immediate
Solvent Use	Increase use of solvent-resistant gloves	Reduced worker exposure to solvents	$180/year	non quantifiable	Immediate
Used Oil	Move oil drum; recycle oil	Eliminate discharge of oil to sewer	none	not quantifiable	Immediate
Fountain Solution	Change to low emission fountain solution	Reduce emissions by 3,400 kg/year	not quantifiable	none	not quantified
TOTAL			$1,400 initial cost; $240/year	at least $4,800/year	

ingredients evaporate creating air emissions; 8) waste ink is not recycled; and 9) waste oil is not recycled. This facility is currently recycling some of its wastes. Film trimmings, used film and thirty liters of spent fixer are all sold to silver recyclers every two months; scrap plates are sold to recyclers; and most scrap paper is recycled.

Pollution Prevention Opportunties

The assessment identified ten pollution prevention opportunties that address the problems identified above with significant environmental and economic benefits. **Table 1** lists the opportunties recommended for the facility and presents the environmental benefits and the financial costs and benefits for each.

Change to Laundered Rags and Recycle Solvent: Press ink rollers, plates and blankets are cleaned with solvents and cotton wipers. This facility could use rags for all press-cleaning applications in place of cotton wipers. After use, the solvent can be recovered from the rags, and the rags can be laundered and reused. Recovering solvent and ink from rags and laundering rags will eliminate the disposal of approximately 6,000 liters of solvent, reduce exposure of the material handlers to solvent vapors, and reduce the disposal of cotton wipers.

Solvents can be removed from the rags using a centrifuge; however, the volume of solvent recovered and rags processed at this facility is too small to justify the expense of purchasing and installing a centrifuge ($22,000). The facility should locate a laundry capable

of supplying these services. The facility will save $2,800/year in wiper purchases, and while laundering fees will cost $1,920/year, the overall savings to the facility are $900/year.

Recover Blanket Washing Solvent and Rags: Blanket washing with solvent removes a small amount of ink. Using a hand-wringer, the solvent can be removed from the rags and reused several times before it must be re-distilled. This will reduce solvent use by 1,400 liter/year. The rags can also be reused, thereby reducing laundering costs. The cost of installing a wringer is $700. The total avoided cost is $1,000 per year; the payback period is 8 months.

Eliminate Use of Leaded Gasoline for Wet Roller Cleaning: The wet rollers are cleaned in a motorized roller cleaning machine located in a sink connected to the sewer system. The cleaning solution is made up of leaded gasoline, water and a small amount of powdered laundry detergent. All liquids from this cleaning process (including about 600 l/year of leaded gasoline) go to the sewer. The rollers can be cleaned using detergents which will cost $300/year while the savings in reduced gasoline purchases will be $240/year. The net cost is $60/year.

Reducing Losses of Ink During Storage: About 25% of all containers of ink are being stored without lids. All inks used at the plant are of the air-oxidizing or polymerizing type, and exposure to air quickly forms a dried film of ink which must be discarded. All ink being stored after opening should be sprayed with an anti-skinning spray and lids be replaced on the ink cans when not in use. The net savings in ink total $1,600 per year, and less ink will be discarded to the landfill.

Change Solid Waste Collection at Presses: There is one trash barrel located at each press, and all waste is discarded into this drum. All scrap paper coming off the press is placed in the drum, becoming contaminated with solvent and ink wastes. Three separate drums should be located at each press: one for rags, one for paper, and a third for all other trash to facilitate recycling. Currently, waste paper in the plant is collected by an outside contractor in exchange for collection and some cleaning services. The value of all possible recycled paper is $1,300/year. Whether or not these savings can be realized is dependent upon evaluation of the contract the facility has with the paper recycling company.

Other Recommendations:

• *Change to Less Toxic Photoprocessing Chemical:* Isopropyl alcohol, a less toxic cleaning solvent, could be substituted for methanol. This will reduce worker exposure to methanol vapors.

• *Change to Deionized Water Final Rinse of Plates:* Deionized water could be used to rinse the plates because tap water in the area is very high in dissolved solids (especially magnesium sulfate). The residue of the salts blurs the image on the plate and can cause corrosion of the plate surface. The creation of scrap from corrosion of plates has been noted but not quantified. The cost of the change to deionized water will be negligible, but the cost of scrap is high and effects the efficiency of the facility.

• *Increase the Use of Gloves*: All workers using solvents for cleaning should wear solvent resistant gloves while cleaning to reduce worker exposure to solvents and ink ingredients. Ninety pairs of gloves will be needed each year at a cost of $180. The payback cannot be determined because the present value of worker illness due to solvent exposure is not known.

• *Recycle Used Oil and Reduce Oil Leaks*: Used oil should be recycled. The collection drum should be moved because it is currently leaking into the sewer. These measures would eliminate the discharge of oil to the sewer system.

• *Investigate Alternative Fountain Solutions:* To decrease paper drying-time and possibly increase production rates, the press foreman wants to use refrigerated isopropyl alcohol-containing fountain solutions for several of the presses. Changing to such solutions would result in increasing the emissions of organic compounds to the air by about 4,000 kg per year. The facility should investigate the replacements that have recently come to market to solve the paper distortion problem on water-based fountain solution presses without greatly increasing emissions. The higher purchase cost of substitutes is offset by a reduced loss rate.