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Environmental Pollution Prevention Project

CASE STUDY

Pollution Prevention Assessment for Paint Production

Executive Summary

This assessment evaluated a paint manufacturing facility. The objective of the 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; improve manufacturing competitiveness and product quality. The assessment team was comprised of two experts in the paint manufacturing process, and two local pollution prevention consultants.

The assessment identified seven pollution prevention recommendations, one of which has two options. Depending on the option chosen, the implementation cost ranges from US$17,050 to $30,850; annual savings range from $19,838 to $37,380.

There are extensive opportunities for saving water through recycling and equipment changes at this site. Most of the wastewater produced at this plant results from a non-contact cooling process and washing latex paint holding tanks. Recycling the water would reduce water use by more than half, and the plant would no longer need to purchase water from the local utility. The cost for these systems is $30,000, with annual savings of $32,000/year.

Other pollution prevention opportunities at this faciltiy would reduce wastewater discharges with high pH and BOD/COD, reduce the amount of VOC emissions, and eliminate the use and discharge of heavy metals. Total savings from these options are $5,060/year with a one-time cost of $850.

Facility Background

The facility produces paints and other coatings for architectural coatings companies. It operates one shift per day, five days per week. There are 170 full-time employees. During the summer, temporary help is hired to meet peak-season demand. Currently, paint production is at 6,44,000 liters/year and is planned to increase to 11,400,000 liters/year through expansion of the latex production facilities. Presently, alkyd paints represent 60% of production and latex paint represents 40%.

Manufacturing Process

The commercial product of this facility is paint. However, in addition to paint production, the facility also processes raw materials into components that are used in paint production. The processes that were examined are fish oil refining, alkyd resin production, and solvent distillation.

Fish oil refining requires neutralizing the oil with caustic soda. This process uses water, caustic soda, and sodium chloride. Three products result from the neutralization: 1) partially refined fish oil; 2) soap stock of neutralized fatty acids; and 3) water. The neutralized fish oil is blended with absorbative clay to remove the chromaphores and undesirable waxes in the partially refined oil. The mixture is pressed through a filter and is ready to be used in alkyd production.

In the alkyd resin manufacture, fish or soybean oil is co-reacted with polyhydric alcohol to extract the remaining water. After "cooking," the completed alkyd is transferred to a thin-down tank, where it is

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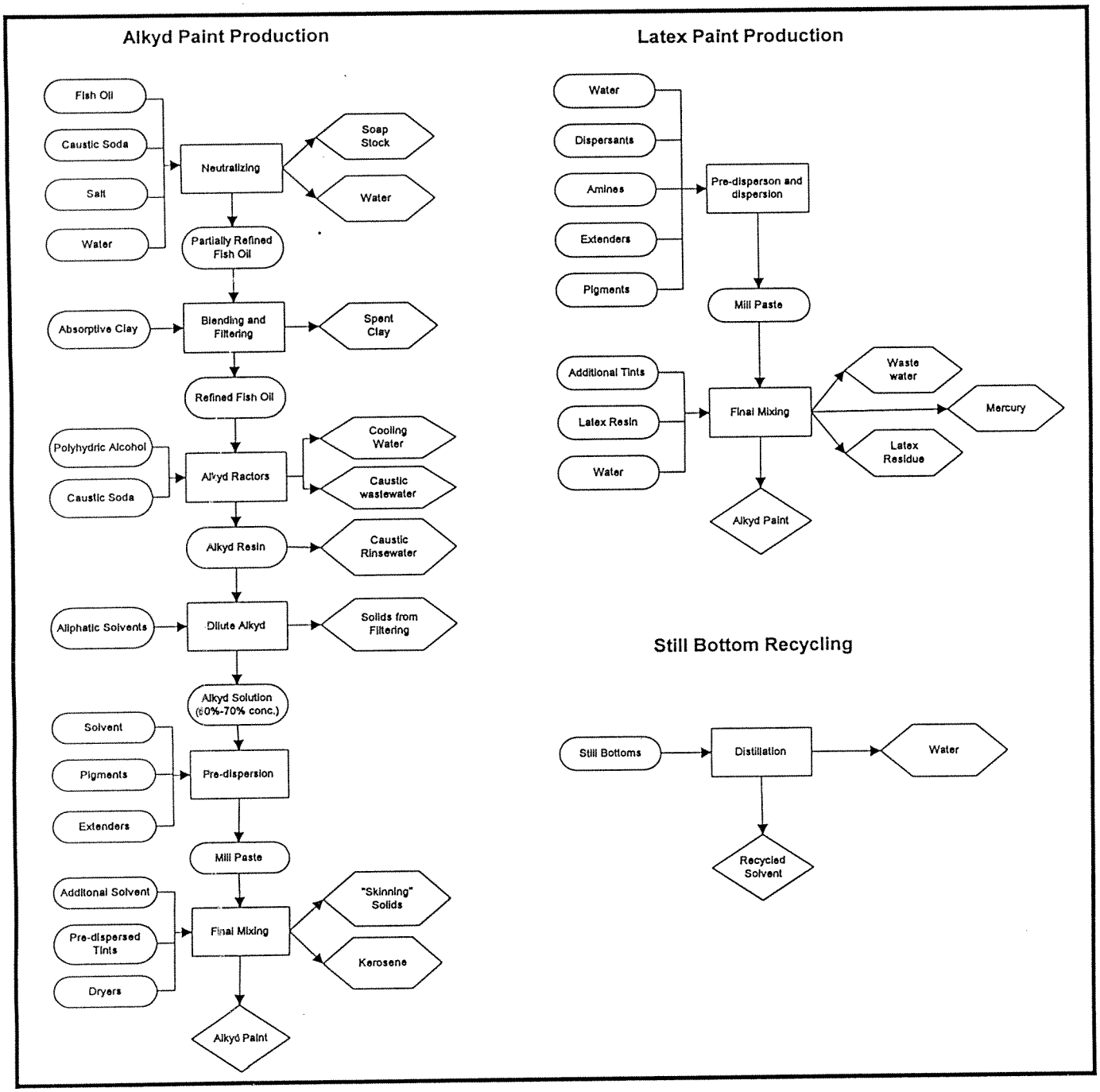
Figure I: Overview of Facility's Paint Production Process



mixed with aliphatic solvents.

Waste solvents are steam-distilled for solvent recovery. The recovery rate is 75% from the still. All still bottoms are recycled into corrosion resistant solvent-based primer. This produces 1,512 liters/month of still bottoms and 7,182 liters/month of recycled solvents.

There are two types of paints produced at this plant: alkyd resin and latex. Alkyd paint production consists of three steps. The first is pre-dispersion, which takes place in an open tank. Alkyd, solvent, pigment, and extenders are blended together into a high viscosity mill paste, using high-speed agitators known as COWLES dispersers. The resulting paste accumulates in open tanks for final mixing. Additional alkyd resin, tint, and dryers are added in open-top blend tanks that hold the paint until final consumer packaging.

To produce latex paint, water, dispersant, amines (a stabilizer), extenders, and pigments are combined to form mill paste. Depending on the size of the paint batch, pre-dispersion and dispersion can be combined into one operation; additional ingredients are either added to the original tank or mixed with the mill paste that was transferred to let-down tanks. Finished batches are held in the open tanks until they are put into consumer packaging.

Table I: Summary of Recommended Pollution Prevention Opportuntities

Operation	Pollution Prevention Action	Environmental Benefit	Implementation Cost	Potential Savings	Payback Period
Alkyd Reactors	Recycle Cooling Water	Reduce Water Usage by 108,720 m3	$15,000	$16,320/yr.	11 months
Alkyd Reactors	Eliminate one caustic rinse	Reduce discharge of 576 m3 of high pH wastewater to sewer	$500	$420/yr.	14 months
Alkyd Paint	Cover paint tanks	Reduce solvent losses by 34,000 l/yr and reduce VOCs emissions	$350	$3,060-4,640/yr.	2 months
Raw Materials Changes	Substitute non-metal bearing pigments for lead and chrome pigments	Elimination of heavy metals in product; avoid future liability	6-8 fold increase in material costs	none	not applicable
Paint Production	Substitute organic biocide for mercury	Eliminate use of mercury; avoid future liability	none	not quantified (approximately 20% savings per kilogram)	not quantified
Latex Paint - Option 1	Use high pressure spray nozzles and recirculate washwater	Reduce wash water generation by 80% (396 m3)	$1,200	$38/yr.	31.5 years
Latex Paint - Option 2	Install closed-loop recycling system	Recover and reuse 100% of the wastewater	$15,000	$16,000	11 months
Solid Waste	Develop program to reduce solid wastes	Reduce generation of solid wastes	not quantified	not quantified	not quantified
TOTAL:			**$17,050 - $30,850**	**$19,838 - 37,380/yr.**	

Environmental Problems

Key environmental problems associated with this facility are: 1) discharge of untreated water directly to sewer; 2) use of flammable and toxic metals that affect worker safety and health; 3) escape of VOCs; 4) use of heavy metals; 5) use of mercury; and 6) solid waste.

Pollution Prevention Opportunities

The assessment identified nine pollution prevention opportunities. **Table 1** lists the recommendations and presents the environmental benefits and financial cost for each.

Recycling of Non-Contact Cooling Water: Installation of a recycling system for the cooling water has an estimated cost of $15,000. This system would completely eliminate the need to buy water from the water utility. At current water use costs, payback would be reached in eleven months, with a yearly savings of $16,320.

Caustic Cleaning for Alkyd Reactor: The number of cleanings done with caustic cleaners should be reduced. The reactor vessels does not need to be cleaned when switching from soybean oil to fish oil processes. Cleanings can also be reduce by dedicating reactors to specific types of oils. In addition, the caustic cleaner solution can be re-used until it becomes ineffective for cleaning. This will result in smaller amounts of caustic materials being discharged.

Alkyd Paint Production: The mixing, blending, and manufacture of the solvent based paints takes place in uncovered tanks. These tanks should be covered to reduce fugitive emissions. Covering the tanks would also prevent product loss due the formation of a layer of dried paint on the surface. Approximately 30 tank covers are needed; estimated cost is $350. Routine use of covers on all open tanks would result in an estimated savings of $3,060 to $4,640 per year.

Raw Material Substitution: To reduce health and safety hazards in the manufacture of solvent based paints, non-metal bearing pigments should be substituted for lead and chrome pigments. Metal-free pigments are 6-8 times more expensive than heavy metal bearing pigments and will increase raw material costs by $0.53 to $1.59 per liter of finished paint in those colors affected.

Substitution of Organic Biocide for Mercury: Isothiazoline, an organic biocide, is currently being used in a small portion of paint production. Organic biocides use should be increased to the maximum possible. There are other organic alternatives that may be suitable and should be explored. The cost of the isothiazoline is approximately US$1.00/kg lower than mercury. It is used at approximately the same concentration.

Latex Paint Production: There are two options for reducing the amount of washwater generated during paint production.

Use Spray Nozzles and Recirculate Water: The amount of washwater generated in the latex tank washing procedure can be substantially reduced through the use of high pressure spray nozzles and recirculate the washwater. Installation of a recirculation tank during expansion of the plant's latex production facility is recommended. Estimated reductions in initial wash water generation are 80% which would be further reduced through recirculation. At current water costs of $0.15/m^3, this would result in a yearly cost savings of $38/year. The cost of system is estimated to be $1,200.

Implement On-Site Retention of Latex Washwater: A closed loop system for recycling of all latex washwater can be implemented. This can be achieved by installing a three-phase concrete or lined latex washwater settling pond on-site. Latex paint residue could be used in subsequent paint production and the supernatant water should be suitable for reuse in subsequent latex paint production. It is expected that a settling pond system would cost $15,000, resulting in savings of approximately $16,000 per year.

Other Recommendations:

Solid Wastes Production and Disposal: Develop a program to make employees more aware of the types and amounts of wastes generated in order to identify reduction opportunities.

Establish Spill Control Policy: Management should establish policy prohibiting spills, leaks, or other waste discharges to the ground. A cleanup procedure should be established in the event of accidental spills or leaks and workers trained in its use.

Implementation:

Since the assessment was done, the facility has implemented or is actively evaluating all recommendations. The following have been implemented:

1. A system to recirculate the cooling water from the alkyd reactors was installed to reduce water use.

2. While caustic soda is still being used to clean the reactors, the time between cleanings has increased from about 10 day to every 80-90 days, significantly reducing the amount of high pH wastewater being discharged. In addition, washings between the production of different resins were eliminated.

3. A closed-loop recycling system with settling ponds for the cleaning water in latex production was installed. This has eliminated discharges contaminated with mercuric biocides and latex paint.

In addition, the facility is conducting a financial analysis for the purchase or internal fabrication of tank covers to reduce fugitive emissions and is investigating the substitution of organic biocides for mercuric biocides.

For Further Information

For futher information on this assessment or other activities sponsored by EP3, call the EP3 Clearinghouse at (703) 351-4004, send a fax to (703) 351-6166, or on Internet: ep3clear@habaco.com