MULTI MEDIA ENVIRONMENTAL CONCERNS IN WARP SIZING

LOW TECH APPROACHES TO

WASTE REDUCTION

by

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ABSTRACT

Environmental compliance is no longer considered an acceptable approach to dealing with industrial pollutants. Industry must take a proactive approach, a waste reduction approach, to waste and pollution. They must go beyond compliance in every environmental arena. Avenues to achieving such a program in a textile operation and case studies are described.

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INTRODUCTION

Environmental issues of the textile industry, once limited to effluent discharge requirements, have expanded to include pretreatment specifications, aquatic toxicity, air emissions, solid waste, water usage, and hazardous waste management. Textile managers can no longer be solely concerned with plant operations. With the increased environmental savvy of the public, a manager must be ever aware and involved with public relations and company image.

The once popular notion of "dilution is the solution to pollution" has slowly been put to death with the ever increasing cost of potable, process-quality water and wastewater treatment. The realization that there is often a direct relationship between pollution/waste and profits forces plant managers to implement proactive environmental programs. Simple compliance is no longer good enough in today's "green" world.

METHODS

Taking a "fresh look" at a facility, its operating procedures, the ingredients used in processing and the waste produced can reveal available opportunities for waste reduction. A "fresh look" at a facility can only be accomplished by someone without preconceived ideas--someone without fear of repercussions or ridicule. A plant walk through survey or audit, as outlined in the next section, will pinpoint areas of concern. This survey, in combination with a detailed review of material safety data sheets (MSDSs), inventory QA/QC, and operational practices and procedures can lead to explanations for aquatic toxicity, BOD, COD and other environmental problems.

WASTE AUDIT

As is the case with most manufacturing facilities, waste in textile or warp sizing operations is found in four basic arenas--waterborne, airborne, hazardous, solid. Although each waste comes with its own individual management approaches, the initial steps taken toward dealing with them should be the same--elimination and reduction. The best first step in proper waste management is a waste audit.(1)

In addition to identifying and quantifying individual waste streams, a waste audit can pin point practices, procedures and processes which result in waste generation. Further, it allows for the collection and evaluation of technical and economic data necessary to select appropriate waste reduction and management techniques.(2) Using six basic steps beginning with 1) developing a written corporate waste reduction policy and progressing through, 2) audit team selection, to 3) gathering of available background material, to 4) developing a plant flow diagram and conducting an in-plant survey, and finally to 6) the technical and economic evaluation of waste reduction alternatives, the waste audit can become a simple tool used to help construct the waste reduction plan.(3)

As is apparent by the first step in the audit, any waste management plan must begin with true and real corporate commitment. A written corporate policy is required. A policy which can be easily identified and understood by the employees. Employees will rise or fall to whatever level is expected of them, it is therefore essential that commitment to waste reduction be made apparent and the goals be set at an achievable level. Employee work practices and ethics are the first line of defense against waste reduction; therefore they are the key ingredient in a waste reduction plan. Properly educating employees as to what a waste is, where it comes from, the effect it has on the environment, the effect it has on profitability and ultimately their job stability, can help assure that the waste reduction alternatives and work ethics adopted in step six will be properly implemented and maintained.

THE LOW TECH APPROACH

Traditionally textile mills have had simple concerns when addressing wastewater treatment such as BOD, COD, TSS and oils. Until now they have not been forced to be concerned with air emissions, solid waste disposal or storm water runoff. With the enactment of the Clean Air Act, storm water monitoring requirements, increased tipping fees at landfills, pretreatment requirements and additional effluent monitoring parameters, textile plant managers also find themselves in the role of environmental manager.

Ingredient Analysis

The best approach to dealing with these wastes starts by performing a waste audit as outlined in the previous section. Learning the origin and destination of waste, provides the opportunity for elimination or reduction and not merely transfer of the waste from one media to another. By examining and evaluating all products used in the facility and establishing acceptable or unacceptable levels of pollutants in these products, an initial grasp of the waste problem can be achieved. This is a simple step and requires the review of all MSDSs and working closely with vendors to assure that essential data on BOD, COD, metals, etc. be provided. Without this kind of information, educated decisions on appropriate chemical substitutions can not be made. Additionally, prescreening of all products used in the facility and testing of incoming ingredients and fibers can provide valuable information on pollutants which may be introduced indirectly.(4)

Analysis of ingredients should begin with incoming water. Impurities such as trace quantities of metal ions are of particular interest due to the effect they can have on soaps and bleaching operations. Seasonal differences in water should also be accounted for.

All incoming substrates, fibers, fabrics should be analyzed as well. Analysis should include but may not be limited to type and percent of size; levels of oils, fats and waxes; trace metals in the fibers; trace metals on the fibers from anti-static or mildew finishes; BOD and COD levels.

It should not be taken for granted that the quality of chemical products is always the same. Although this assumption may be valid the majority of the time, a single instance where the quality deviates can result in both environmental and economic problems. Upon receipt, every chemical should be analyzed to determine the concentration of active ingredients; and where possible, pollutants.

As a final note on incoming ingredients and vendors, it is a good business to get to know vendors and set ingredient acceptance guidelines before a problem arises. If a vendor is hesitant about working within the specified guidelines or is not forthcoming with necessary information, then another vendor should be sought. Vendors are aware of the environmental complexities and limitations facing the industry; therefor they should be a willing partner in helping to promote a proactive approach to environmental issues/problems.

Chemical Conservation/Inventory Control

Chemical conservation/inventory control go hand-in-hand and begins with the proper disposal of ingredients which are out of date or no longer used. Proper disposal is not defined as "dump down the drain" or "send to the landfill." There are numerous companies which deal with such chemicals.

All recipes should be evaluated to assure that they have as few ingredients as possible. Often times recipes for dye baths, finishes, sizing have excess additives. These ingredients were added to counteract a problem with processing. Instead of an analysis of the problem to determine if there is an appropriate substitute, a counteracting ingredient was added. An example might be a defoamer. This band aide approach can result in excess chemical usage and cost.

Conduct an analysis of all ingredients to determine if they can perform more than one function. If a single ingredient can be used for a variety of functions this could reduce inventory control, result in bulk purchasing opportunities and reduce the possibility of formulation errors.

Purchase only the amount of ingredient needed. Keep as few chemicals, in as small quantities as possible, in stock. This applies not only to process chemicals, but to laboratory chemicals as well. Purchasing large quantities of chemicals for a favorable price may end up costing more than the purchase price if they go out of date or must be disposed of later. This is a case where a little is better.

Chemical Handling and Storage

Provide equipment for precise measurement of all chemicals and additives. Even though some additives are relatively inexpensive and excess usage will not have a large economic effect, it may have a major environmental effect. This translates to eliminating the scoop method of ingredient addition. If a scoop must be used then employees should be made aware that a level scoop, not an overflowing scoop is required. Transporting of scooped ingredients across a work area can result in spillage; therefor is may be useful to provide an oversized container for ingredient transfer.

This can also be applied to liquid ingredients including water. When filling equipment with water, whether for processing or for cleaning, there should be a method of determining the amount of water to be used. Directions should be very specific, given in pounds/ounces or gallons. For larger equipment a metering pump, a depth stick or a visible mark for water addition should be provided.

Storage of chemicals and ingredients is also critical. Storage should be away from floor drains and hoses and, where possible, in as dry an atmosphere as possible. Additionally, ingredients should be stored off the floor and out of traffic patterns. This will prevent bagged ingredients from becoming wet and reduce accidental puncture/breakage.

Employee Training

The major pollutants associated with warp sizing include the large volumes of wastewater generated and the BOD of that wastewater. These pollutants can be attributed to the sizing operation itself as well as other factors including poor housekeeping, untrained workers, poor maintenance, and other chemicals used in processing.

To correct the problems of excess water usage, dumping of size mixes, hosing ingredients down the drain, formulating large size batches, employee training will be required. Employees do not think of ingredients used in their work as waste. They do not realize that their work performance can have a direct affect on the quantity of waste produced and therefor on the environment. Once employees realize that they can have a positive affect on the environment by practicing conservative work ethics they become enthusiastic participants in the program. If however, there is an employee who is unwilling to be an active participant in a program it may be necessary to implement some disciplinary action. This will quickly get the message across that management is serious about waste reduction.

Before taking any drastic actions, such as disciplinary approaches, make sure that the employee has the necessary tools to get the job done. Are instructions precise? Is equipment available to allow the job to be performed without wasteful practices? Does the employee really know how to do their job correctly? If the "susie teaches sally" method of training is employed, the older employee may be passing along all those wasteful habits to the new employee.

Employees should therefor be trained as to:
-what a waste is
-where it comes from
-what affect it has on the environment
-what affect it has on profitability and ultimately their job
-how to properly perform their jobs
-how to spot wasteful activities
-make suggestions about ways to reduce waste

Nobody knows the process better than the line operators. They are aware of the areas that generate the most waste and result in excess water usage. With this wealth of knowledge it

might be beneficial to ask them for their ideas. Involving the employees in the program, whether through employee suggestion /reward programs, team competition, or shift competitions is vital to the success of the program. When a suggestion is made, consider it, no matter how outlandish or simple it might first appear. Remember they are on the floor day in and day out.

Housekeeping and Maintenance

Housekeeping and maintenance are two other area that require employee involvement; but more importantly corporate commitment. Broken pipes, dripping pumps, running hoses when reported must be immediately addressed. If employees report a housekeeping or maintenance problem and it goes unattended, the perceived message is that corporate commitment is lacking. If corporate officials do not care then why should the individual employee care?

The initial stages of a waste reduction program may result in extra duties for the maintenance and housekeeping crews. Repair of broken or malfunctioning equipment may be time consuming at first, but once a routine maintenance plan is established, will in fact be minimized.

Even though textile processing is a wet industry there is no need to allow excess water usage. For this reason all hoses should be equipped with high pressure, low volume, automatic turn off nozzles. Small losses add up and cost the plant as incoming potable water and outgoing wastewater. Small losses are constant and mount up. A one quart per minute leak (or combination of leaks), a stream about 1/2 the diameter of a lead pencil, will cost approximately $350 per year at a rate of $2.50 per 1,000 gallons. This leak could therefor be translated into a worker sitting in the break room for several days, taking a paid mini vacation.(5) This could add up rather quickly in those plants that are not recycling cooling water.

Housekeeping and maintenance crews should work together to establish a routine approach to cleaning and repair of equipment. If these items are allowed to go unattended for extended periods, harsher cleaning chemicals may be required or permanent damage may be done. The old cliche "an once of prevention is worth a pound of cure" is applicable here.

Solid Waste

Disposal of solid waste has basically been a low or no cost items for most textile mills. Landfill tipping fees have traditionally been so low that it was not economically feasible to sort the waste for resale. With the mandated landfill disposal reductions, the expense of new lined landfills, and the fact that the majority of landfills in operation are rapidly approaching their capacity, tipping fees are increasing

enormously. What might not have been economically feasible 2 years ago may very well be feasible today. Additionally, through waste exchanges and state waste reduction programs, markets for almost every type of waste have been established.

Once again however the approach should be from the front end, if you don't create it you don't have to dispose of it. To this end it is best to demand that vendors provide chemicals and commodities in returnable drums or totes. Skid mounted polypropylene bulk buying of size can drastically reduce the amount of solid waste being generated. Explore the markets for the solid waste that is currently generated at your facility. If markets do not exist then demand that vendors provide their products in returnable or recyclable packaging.

SPECIFIC AREAS OF CONCERN

The following information is presented in an attempt to provide some solutions to specific problems frequently encountered by textile mills.

Metals

Whether dyeing, finishing, or washing prior to cut and sew operations, meeting metals limits in effluent or pretreatment permits can be difficult for textile mills. When attempting to isolate and reduce metals loadings in textile effluent, all aspects of plant operation must be examined because metals sources can be found from incoming water to maintenance chemicals.

Water supplies, in particular well water, can contain varying amounts of metals ions. City water systems often add metals as corrosion inhibitors. It is not uncommon to find significant levels (>1 ppm) of zinc, copper, and iron in public water supplies.(6) Additionally, seasonal water treatment can result in changes in the incoming water supplies. It is therefor imperative that incoming water be tested periodically.

Incoming fibers often contain metals, both naturally occurring and added. Natural fibers such as cotton, absorb metals from the environment during growth. Man-made fibers often use metal containing polymerization catalyst. The addition of antistatic and antifungal treatments often result in fibers arriving with elevated metals loading. Other sources of metals on fibers include machine oils and needle oils.(6)

Oxidation and reduction agents have traditionally contained metals. Although the use of dichromate oxidizers have basically be replaced with periodate, bromate and peroxide, they are still used in many laboratory functions. If the use of metal

containing solutions is to continue in the laboratory, the and alternate way of disposal should be examined.

Reducing agents should be examined to identify metal-bearing solutions which can be replaced by non-metal bearing solution. An example would be the use of sodium hydrosulfite in lieu of zinc stabilized sulfoxylate. The replacement of copper sulfate with resinous fixatives is being used for direct dyes. In this case the elimination of the dye is a trade off with increased BOD and nitrogen loadings. But, using epsom salts as an antimigrant until application of a fixative from a continuous resin finish formulation can reduce metals, BOD, and nitrogen loadings.

Certain dye classes can be expected to contain metals. This data has been published by the American Dyestuff Manufacturers Institute.(4) Most of these dyes are green and blue and usually occur in the 74000 series of chemical constitutions which are phthalocyanine dyes and pigments.(6) The most obvious approach is the replacement of metalized dyes with non-metalized dyes. A second approach is a mixture of metalized and non-metalized dyes in an attempt to reduce the metals. A final approach is to assure complete exhaustion of the dye onto the fabric by adjusting time, pH, temperature, salt concentration, fixatives and other parameters.

Water repellant, flame retardant, antifungal and antiodor finishes can contain tin, antimony and zinc. Formulation of only the amount needed for such treatments will eliminate end of batch dumps.

Repair procedures may utilize stripping ingredients such as zinc sulfoxylate-formaldehyde, permangenate or dichromate. The need of these operations should be carefully considered.

Miscellaneous sources of metal contamination include biocides used in air washer systems or cooling towers; photographic processing processes; herbicides; pesticides; maintenance chemicals; boiler additive; lubricating oils; and, needle oils. A review of MSDSs should provide insight to metals contained in each product

An often overlooked but very real contributor to metals loading could be plumbing. Copper plumbing with lead solder joints or galvanized equipment can be contributing to metals loadings in the effluent.

Aquatic Toxicity

With aquatic toxicity limits being established for both direct and indirect dischargers, the textile industry has an entirely new environmental problem to face. Determining the cause of an aquatically toxic effluent can be both time consuming

and expensive. The cause of the toxic condition can be difficult to pinpoint as it can result from an individual ingredient, a combination of ingredients or other existing conditions in the receiving waters. To further complicate matters, an aquatically toxic condition can appear and disappear for no apparent reason.

Compliance with effluent metals limits have lulled many textile firms into a false sense of security. Compliance with metals limits does not necessarily translate into compliance with metals limits. For that reason the elimination of as many metalized ingredients as possible is recommended.

Testing for aquatic toxicity is conducted with fresh water organisms therefor it is to be expected that salt would result in an aquatically toxic effluent. However, more often than not, the removal of salt will not resolve the toxicity problem. This statement is not intended to downplay the seriousness of salt overuse in textile mills or the problems being faced by mills trying to reach the 230 mg/l or less effluent limit.

Surfactants, detergents, emulsifiers and dispersants are frequently contributing agents in aquatic toxicity. Since the function of a surfactant is to lower interfacial boundaries of water and other materials at phase boundaries, it by nature is toxic to aquatic life.(6)

There is ongoing research into the toxicity of surfactant and many references are available outlining there relative toxicities. Since there is a large variance in the toxicities of similar types of surfactants there are a few rules of thumb to remember:

- -the more linear the molecule, the more degradable the molecule
- -Branched hydrophobes are less degradable than linear and aromatic are the least degradable
- -BOD:COD ratios in a textile mill usually range from 2.5:1 to 5:1. A very high ratio, >5:1 indicates poor biodegradability.(6)

Quaternary amine compounds, "quats" have a variety of uses in a textile mill, ranging from disinfection to softening. A review of MSDSs may reveal many sources of these compounds which can be a major cause of aquatic toxicity. If used as a softener, the separate piping should be installed to prevent its introduction into the wastewater.

Solvents emulsions are used for scouring or dye carriers for synthetic fibers. Although these generally exhaust into the fibers and are driven off as airborne waste during drying they can become a part of the wastewater through leaks, spills, drum washing activities, poor housekeeping and batch dumps.

Chlorinated materials used in scouring should be replaced with non-chlorinated materials as chlorinated ingredients can result in an aquatically toxic effluent.

Extreme variances in pH can also result in aquatically toxic effluents as can chemicals used in wastewater treatment. Flocculent, polymers and chlorine used in wastewater treatment should be considered as possible causative agents.

CASE SUMMARIES

The following case summaries are intended to demonstrate the waste reduction - pollution prevention approach to resolving environmental problems.

Process Modification

In an attempt to control algae growth in the air washer, the J.P. Stevens, Lincolnton, NC plant added biocides to the system. Discharge from periodic cleaning and the basic "blow down" from the system was discharged into a small stream. Analysis showed the discharge to be aquatically toxic; therefor the NC Division of Environmental Management revoked the discharge permit. When the city refused to allow the discharge of this waste stream into the sewer, J.P. Stevens had explore alternative technologies for algae control. Since this particular plant engaged in carding, spinning and winding operations, discontinuation of the air washer system was not a feasible alternative.

After a review of available options, the decision was made to install an ultraviolet disinfection system on the air washer system. The closed-loop system offered two very positive points. It would allow for the elimination of the use of biocides and it would eliminate the discharge altogether.

The system installed was provided by Hydro Systems, Inc. and is capable of disinfecting 100 gpm of air washer water. As can be seen below, the payback period was less than 2 years, after which the company can show an annual cost savings of $2,578.(7)

Capital Cost.....$4,560
Annual Operating Cost.....$ 872
Annual Biocide Cost.....$3,450
Difference in Annual Cost.....$2,578

Pay Back Period = 1.77 years

Chemical Substitution

Faced with reducing effluent phosphorus loading from 7.7 mg/l to 1 mg/l, United Piece Dye Works located in Edenton, NC had a choice between constructing an expensive treatment system or chemical substitution. They chose the later. Through a detailed analysis of production processes and chemistry and a review of all chemicals used in the facility, major and minor sources of phosphorous were identifies.

Chemical substitutions and nonmechanical process modifications were made to allow the use of non-phosphate chemicals. Examples included the reduction in used of hexametaphosphorous and the elimination od phosphoric acid. The results were environmental compliance with no capital expenditures.(8)

Inventory Control

West Point Pepperell in Robeson County, NC undertook a program to evaluate all chemicals, dyes and commodities used within their facility. An employee committee was formed and charge with the task of evaluating each chemical based on fire hazard, safety, and environmental hazard. Areas such as biodegradability, metal content and toxicity were considered. By evaluating all chemicals and simplifying all recipes to eliminate unnecessary chemicals and finding substitutes for hazardous chemicals, West Point Pepperell has greatly reduced their waste management costs and chemical costs. Additionally it has involved the employees in decision making and the environmental arena. Some substitutes that were made include a water-based cleaner for an organic solvent, the rejection of dichlorobenzene dyes due to health problems associated with benzine, and the rejection of a chloride catalyst for resins due to its association with bis-(cholormethyl)ether.

The committee continues its work by evaluating all chemicals proposed for use in the facility and by working with vendors to assure that chemicals specified are environmentally safe.(8)

SUMMARY

The basic premise of low tech waste reduction is common sense. If managers and employees respect and treat their work place in the same way that they do their home, then water usage and waste generation can be greatly reduce. By asking "why this or why not that" answers to waste problems can be discovered. The key is to have an open mind and dismiss those simplistic ideas or off the wall ideas. These are often the very ideas that will result insubstantial waste reduction and cost savings. The final point is to get back to basics or keep it simple. There is

a lot of truth in the old cliche' that the more complicated something is, the more there is to go wrong. Waste reduction can be very simple so just do it!

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