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Waste Minimization in Textile Industry

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Abstract: *There has been ever-increasing efforts to somehow arrange manufacturing processes in such a way that they cause minimal damage to the environment.Waste minimization is the application of a systematic approach to reducing the generation of waste at source. In other words, waste minimization prevents the waste from occurring in the first place, rather than treating it once it has been produced by end-of-pipe treatment methods.Here the main focus point is the general waste minimization suggestions for reducing water, chemical and energy consumption; reducing solid waste; and minimizing the emission of toxic substances*.

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I. Introduction

The application of a systematic approach to reducing the generation of waste at source is called waste minimization. Waste minimization applies to hazardous materials, non-hazardous materials, water, energy, raw materials, all waste emissions, and other resources. It is NOT a one-off activity, but an ON-GOING program. That is, it is a technique that can be applied to all inputs to and outputs from, a process.This review paper contains detailed descriptions of the various waste minimization options that are available for the textile industry.General waste management for reducing water consumption includes attention to minor leakages and faulty valves problems to reducing number of process steps and reusing water for auxiliary processes. For reducing chemical consumption; control over dosing, chemical recovery and reuse and improving scheduling are highlighted.

II. Reducing Water Consumption

Water is used extensively throughout textile processing operations. Almost all dyes, specialty chemicals, and finishing chemicals are applied to textile substrates from water baths. In addition, most fabric preparation steps, including desizing, scouring, bleaching, and mercerizing, use aqueous systems. The amount of water used varies widely in the industry, depending on the specific processes operated at the mill, the equipment used, and the prevailing management philosophy concerning water use. Reducing water consumption in textile processing is important for furthering pollution prevention efforts, in part because excess water use dilutes pollutants and adds to the effluent load. A reduction in water use of 10 to 30 percent can be accomplished by taking fairly simple measures.Water consumption in a textile factory can be reduced by implementing various changes ranging from simple procedures such as fixing leaks, to morecomplex options such as optimizing water use and reducing the number of process steps. Some guidelines are outlined here-

- Repair Leaks, Faulty Valves, etc.

A simple method of determining if leaks exist is to take incoming water meter readings before and after a shut-down period when no water is being used. A difference in the readings could indicate a leak.

- Turn off Running Taps and Hoses

Encourage workers to turn off taps, hoses & water valves when water is not required. The fixingof hand triggers to hoses also reduces water consumption.

- Turn off Water when Machines are not running.

Encourage workers to turn off machines and water during breaks and at the end ofthe day. Avoid circulating cooling water when machines are not in use.

- Reduce the Number of Process Steps.

This involves a study of all the processes and determining where changes can bemade. For example, fewer rinsing steps may be required if a dye with highexhaustion is used.

- Optimize Process Water Use.

Examples include using batch or stepwise rinsing rather than overflow rinsing, introducing counter-current washing in continuous ranges, and installing automaticshut-off valves.

- Recycle Cooling Water

Cooling water is relatively uncontaminated and can be reused as make-up or rinsewater. This will also save energy as this water will not require as much heating.

- Re-use Process Water

This requires a study of the various processes and determining where water of lowerquality can be used. For example, final rinse water from one process can be used forthe first rinse of another process.

- Using Water Efficient Processes and Equipment

Although replacing outdated equipment with modern machines which operate atlower liquor ratios and are more water efficient requires capital investment, thesavings that can be made ensure a relatively short pay-back period.

- Sweeping Floors

Instead of washing the floors of the dyehouse and kitchens, rather sweep up anyspillages and wash down only when essential. Not only will this reduce water use,but also the concentration of contaminants to drain as the waste is disposed of assolids.

- Reusing Water from Auxiliary Processes

The water used in the rinsing of ion-exchange columns and sand filters can bereused elsewhere in the factory.
The main environmental concern in the textile industry is about the amount of water discharged and the chemical load it carries. We can reduce the amount of water consumption, if these mentioned guidelines are followed.

III. Reducing Chemical Consumption

The majority of chemicals applied to the fabric are washed off and sent to drain. Therefore, reducing chemical consumption can lead to a reduction in effluentstrength and therefore lower treatment costs, as well as overall savings in chemicalcosts. Various options for reducing chemical use are listed below :

- Recipe Optimization

Recipes are generally fail-safe designed which results in the over-use of chemicals. Optimizing the quantity of chemicals required will lead to more efficient chemical useand lower costs. Continual updating of recipes should be carried out when newdyestuffs enter the market as, in general, less of these chemicals are required.

- Dosing Control

Overdosing and spillages can be reduced by mixing chemicals centrally andpumping them to the machines. Check that manual measuring and mixing is carriedout efficiently and automatic dispensers are properly calibrated.

- Pre-screen Chemicals and Raw Materials

Avoid dyestuffs containing heavy metals, solvent-based products and carrierscontaining chlorinated aromatics. Safety data sheets should be obtained from thechemical manufactures to obtain information such as toxicity, BOD and COD.Check that raw materials do not contain toxic substances. Check that companieswill accept expired raw materials for disposal.

- Chemical Substitution

Review chemicals used in the factory and replace those hazardous to theenvironment with those that have less of an impact. Use dyes that have highexhaustion rates and require less salt.
Specifically:
*replace metal-containing dyes
*use bi-reactive dyes in place of mono-reactive

- Correct Storage and Handling

More effective control of the storage and handling of chemicals will results in lessspillages reaching the drains.

- Chemical Recovery and Reuse

Chemical use may be reduced through recovery and reuse. For example, sodiumhydroxide from mercerising can be recovered through evaporation. Dye baths may bereused and size can be recovered for reuse.

- Process Changes

Investigate the feasibility of changing to cold-pad batch dyeing. This results in lesschemicals being used (and in particular, salt) and reduces water consumptionsignificantly.

- Improve Scheduling

Review the scheduling of continuous processes such as sizing, desizing, paddingetc. to ensure that the same chemical bath is used as many times as possible, thusreducing the number of dumps to drain per day.

This has been clarified that by following these point the chemical consumption can be reduced.

IV. Energy Conservation

As with water conservation, reductions in energy use can result in substantial savings and lower emissions from boilers or generating plants. They include optimizing compressed air generation, installing compressor control systems, and general housekeeping .Reduce cooling loads,decrease condensing temperature (as a guideline, reducing condensing temperature by 1oC will yield savings of between 2% and 4% of annual refrigeration cost); Increase evaporating temperature (as a guideline, increasing evaporator temperature by 1oC will yield savings of between 2% and 4% of annual refrigeration cost); Compressor control, incorrect control of compressors can increase costs by 20%, or more; Boiler blow down, economizers, insulation, flash steam recovery, good housekeeping, installing heat exchangers, optimizing plant environmental conditions, shutting off of lighting, air-conditioning, etc.

V. 5.Reducing Solid Waste

In terms of volume, solid waste is the second largest waste stream in the textile industry next to liquid effluent. There are a number of waste minimization options available to reduce solid waste, and these include:
i) Reducing the amount of packaging material by improved purchasing practices such as ordering raw materials in bulk or returnable intermediate bulk containers (IBCs). This reduces spillages, handling costs, exposure of workers to chemicals and the amount of storage space required. ii)Purchasing chemicals in returnable drums. Enquire if vendors will accept unwashed drums as this will reduce the waste water generated in the factory. If possible, ordering chemicals in IBCs rather than bags as these are easily broken, causing spillages.
iii) Purchasing yarn on reusable plastic cones rather than cardboard cones.
iv) Reducing seam waste through effective training programs.
v) Selling waste fibers, sweeps, rags, yarn and cloth scraps.

VI. Reducing Toxicity

Compounds that contribute to the aquatic toxicity of textile effluent include salt,metals, surfactants, toxic organic chemicals, biocides and toxic anions. Some
methods of reducing the use of these compounds are to :
* Reduce metal content through careful pre-screening of chemicals and dyes formetal content and using alternatives where possible.
* Reduce the amount of salt in the effluent by optimizing recipes, using low-salt
dyes, reusing dye baths and optimizing dyeing temperatures.
* Use biodegradable surfactants such as linear alcohol ethoxylates.
* Replace chlorinated solvents with un chlorinated alternatives
*Carefully pre-screen chemicals for their toxic nature using MSDS.

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VII. Results And Discussion

The measures discussed in this paper for water, chemical and waste minimization for textile industries have potential to save:

v Raw Materials 01 to 05 %
v Packaging 10 to 90 %
v Ancillary materials 05 to 20 %
v Electricity 05 to 20 %
v Water 20 to 80 %
v Effluent 20 to 80 %

v Solid Waste 10 to 50 %

This paper guides the Textile industry in:

-The way to reduce the consumption of water & chemical.
_ Identifying areas of waste
_ Constructing mass and energy balances

VIII. Conclusion

The textile industry emits a wide variety of pollutants from all stages in the processing of fibers and fabrics. These include liquid effluent, solid waste, hazardous waste, emissions to air and noise pollution. Waste minimization is important because it: reduces operating costs; reduces risk of liability; reduces end-of-pipe treatment; improves process efficiency; enhances public image; protects health and environment; and improves employee moral. It is important to investigate all aspects of reducing wastes and emissions from the textile industry, as not only will it result in improved environmental performance, but also substantial savings for the individual companies.

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