

“Recycling Of Textile Waste Is The Best Way To Protect Environment”

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Textile recycling-

Textile industry is among the most essential consumer goods industry. We all need garments and other textile products such as footwear and bags etc. However, textile industry is also accused of being one of the most polluting industries. Not only production but consumption of textiles also produces waste. To counter the problem, textile industry has taken many measures for reducing its negative contribution towards environment. One of such measures is textile recycling- the reuse as well as reproduction of fibers from textile waste.

Recovery and recycling provide both environmental and economic benefits Textile recovery:

- Reduces the need for landfill space. Textiles present particular problems in landfill as synthetic (man-made fibers) products will not decompose, while woolen garments do decompose and produce methane, which contributes to global warming.
- Reduces pressure on virgin resources.
- Aids the balance of payments as we import fewer materials for our needs.
- Results in less pollution and energy savings, as fibers do not have to be transported from abroad.

Reclaiming fiber avoids many of the polluting and energy intensive processes needed to make textiles from virgin materials, including: -

- Savings on energy consumption when processing, as items do not need to be re-dyed or scoured.
- Less effluent, as unlike raw wool, it does not have to be thoroughly washed using large volumes of water.
- Reduction of demand for dyes and fixing agents and the problems caused by their use and manufacture.

Sources of textile waste-

Mainly textile waste comes from household sources. Average lifetime of any clothing is deemed to be for about 3 years, after which, they are thrown away as old clothes. Sometimes even 'not so worn garments' are also discarded as they become unfashionable, or undesirable. These are post-consumer waste that goes to jumble sales and charitable organizations. Most recovered household textiles coming to these organizations are sold or donated. The remaining ones go to either a textile recovery facility or the landfill. Textile wastes also arise during yarns and fabric manufacturing, apparel-making processes and from the retail industry. They are the post-industrial waste. Apart from these textile wastes other wastes such as PET bottles etc. are also used for recycling polyester fiber.

Why textile recycling?

Textile recycling is good for both, environmental and economic benefits. It avoids many polluting and energy intensive processes that are used to make textiles from fresh materials.

- The requirement of landfill space is reduced. Textiles lead to many problems in landfill. Synthetic fiber doesn't decompose. Woolen garments do decompose but also produce methane, which contributes to global warming.
- Pressure on fresh resources too is reduced.
- Leads to balance of payments as we buy fewer materials for our requirements.
- As fibers get locally available, they don't have to be transported from abroad thus reducing pollution and saving energy.
- Lesser energy is consumed while processing, as items don't need to be re-dyed or scoured.
- Waste water reduces as it does not have to be thoroughly washed with large volumes of water as it is done for, say, raw wool.
- Demand is reduced for textile chemical like dyes and fixing agents.

Textile recycling industries-the figures

More than 500 textile recycling companies are engaged in operating the stream of used textiles in the United States. The textile recycling industry employs approximately 10,000 semi-skilled workers at the primary processing level and creates an additional 7,000 jobs at the final processing stage. Primary and secondary processors account for annual gross sales of \$400 million and \$300 million, respectively.

- An estimated 11.9 million tons of textiles were generated in 2007. It equates to 4.7 % of total municipal solid waste (MSW) generation.
- As per the Council for Textile Recycling, textile recycling industry prevents 2.5 billion pounds of post consumer textile product waste from going into the solid waste stream annually.
- These 2.5 billion pounds of post consumer textile waste represents 10 pounds per person in the United States.
- About 500 million pounds of textiles collected are used by the collecting agency. The balance is sold to textile recyclers, including used clothing dealers and exporters, wiping rag graders, and fiber recyclers.
- Most textile recycling firms are small, family-owned businesses. Majority of them employ around 35 to 50 workers, many of whom are semi-skilled or marginally employable workers.

➤ **The Challenge**

The UK textile industry is currently facing significant challenges, associated mainly with environmental legislation and overseas competition.

Environment-related issues of current importance include:

The rising costs of effluent treatment/disposal as water companies respond to EC Directives to reduce the pollution levels of sewage works outfalls.

More stringent legislation relating to effluent quality, e.g. toxicity, colour (some water companies have already introduced colour charges, and this trend could increase).

Rising water supply costs as water companies invest in improved distribution systems to reduce leakage, new treatment plants to improve water quality and new water supplies to meet increased demand.

Historically, water supply and effluent disposal costs have been an insignificant component of total operating costs, and managers have, rightly, focused on other priorities. This situation is now changing. Water is becoming a scarce resource in relation to demand, and water supply and effluent disposal costs have risen and will continue to rise. Environmental protection is now a reality.

The Purpose And Structure Of This Guide

The Environmental Technology Best Practice Programme has produced guide to show how all textile companies can address these issues and save money, without the need for large-scale investment.

This introduces the concept of material balances in the various processes by helping companies to understand how and where water and chemicals are used in their processes.

Identifies 'good housekeeping' opportunities for reducing water and chemical use.

Outlines water, chemical and effluent management action programme.

Considers alternative technical options for reducing water, chemical and effluent disposal costs.

Highlights specific case studies that demonstrate the savings achieved by UK and overseas textile companies.

The focus is on the following three specific sectors of the textile industry all of which process cotton, wool and synthetic fibers:

Woven fabric finishing

Woven fabric finishing includes preparation of the cloth (desizing, scouring, bleaching and mercerising), dyeing, printing and finishing (resin treatment, water-proofing or flame-proofing and special finishes).

Knit fabric finishing

The knit fabric finishing sector produces knit fabric goods and hosiery outerwear and underwear. Processes include bleaching, dyeing, printing and special treatments. Desizing and mercerizing operations are not required.

Stock and yarn dyeing and finishing

The stock and yarn dyeing and finishing sector produces sewing thread and textile and carpet yarn. Processes include scouring, bleaching, mercerising, dyeing and special finishes.

This Guide does not cover dry processing, carpet manufacture or wool scouring, although many of the opportunities identified here are applicable to the wet processing operations in these sectors.

Other Good Practice Guides produced by the Environmental Technology Best Practice Programme include:

- Saving Money Through Waste Minimisation: Raw Material Use;
- Saving Money Through Waste Minimisation: Reducing Water Use;
- Saving Money Through Waste Minimisation: Teams and Champions;
- Cost-effective Water-saving Devices and Practices.

Identify All Opportunities For Reducing Water And Chemicals Consumption

Cost savings through improved process efficiency, waste minimisation and reduced water and chemical use can all be achieved by the better control of resources. Once the audit has been completed, there should be a good idea of the quantities of water and chemicals used, where and how they are used, and the effects of their use in terms of effluent flows and costs. The company is therefore in a position to consider whether it is possible to reduce usage and save money.

Options For Reducing Water Use

This Section outlines a range of options for reducing water use. However, because of the complex nature of the textile industry, not all of these options will be applicable to every textile company. The examples given illustrate the actions that have been taken to reduce water use by various companies in the UK and abroad. They show that, where water conservation has not been considered before, it is not unusual to achieve reductions of 20 - 50%.

➤ **Simple water-reducing options**

- **Repair leaks, faulty valves etc**

Establish maintenance checklists and set priorities for repair, depending on the severity of the fault. Remember that small, constant leaks may look insignificant but the associated water loss can be substantial, especially if multiplied over a whole site. Remember, too, that leaks continue for 24 hours/day, seven days/week.

- **Turn off running taps and hoses**

This simple procedure can result in substantial savings. People are often unaware of the cost of leaving taps and hoses running. They are more likely to turn off running taps and hoses if they are made aware of the annual cost of waste. Meanwhile, fixing hand triggers to hoses is a simple way of reducing water use and saving money.

- **Turn off water when machines are not operating**

Make sure operators turn off machines during breaks and periods when production is low, and also at the end of the day. Avoid circulating cooling water when machines are not operating. This will save both water and energy. Employees at a small hat-dyeing company often left hoses running after hats had been cooled as part of the manufacturing process. By attaching hand triggers to the hoses, water and effluent costs have been reduced by around £2 000/year.

Dye-house employees have been known to leave a tap running in summer to keep drinks cool.

A half-inch diameter pipe running for ten hours a day at full bore could cost £2 500 a year in water and effluent charges. It would be much cheaper to buy a refrigerator!

➤ **Advanced water-reducing options**

- **Reduce the number of process steps**

With the continual improvements in chemical performance, processes should be regularly reviewed to ensure every stage is still necessary. Many firms have dramatically reduced rinse water by reducing the number of process steps involved.

- **Reduce process water use**

Washing and rinsing are both important for reducing impurity levels in the fabric to predetermined levels. Because water and effluent disposal costs have been low, there has been a tendency to overuse water. Now that prices are increasing, the optimisation of water use could pay dividends. One possible option is to reduce rinse water use for lighter shades. Table 4 gives examples of successful water reduction projects in batch and continuous operations.

- **Dyeing operations**

Winch dyeing

By dropping the dye batch and avoiding overflow rinsing, water consumption was reduced by 25%.

High and low

By replacing the overflow with pressure-jet dyeing batchwise rinsing, water consumption was cut by approximately 50%.

Beam dyeing

Preventing overflow during soaking and rinsing can reduce water consumption by about 60%. Automatic controls proved to be economical, with a payback period of about four months.

Jig dyeing

Reductions in water consumption ranging from 15% to 79% were possible by switching from overflow to stepwise rinsing. Rinsing using a spray technique, which was tried on a laboratory scale, was also effective.

Cheese dyeing

A reduction in water consumption of around 70% proved possible with intermittent rinsing.

Continuous dyeing

A 20 - 30% saving was realized by introducing automatic water stops. An effective method of washing is to use a countercurrent system. Horizontal washing equipment delivered double the performance of vertical washing machines, using the same amount of water.

- **Examples of process water reduction**

Instead of softening as the final rinse, a Leicester-based dyer softens its cloth outside the batch process by pad applications. This reduces the number of process steps, saves on water and reduces process time by one hour. Apart from the saving in water, chemicals, energy and effluent, more fabric can be processed in a shift. A medical textile company in Lancashire has cut two wash cycles from its bleaching process, reducing effluent costs by £1 700. There have been associated savings in water, chemicals, energy and time.

Recycle cooling water

Many cooling water systems are operated on a once-through basis. The resulting hot water is generally uncontaminated and can be re-used in the process as make-up or rinse water.

Re-use process water

It is sometimes possible to re-use certain waste streams, eg dilute washwater, in other parts of the process:

- Process water in other textile operations, with or without the addition of chemicals.
- Rinse water for another process in which low-grade rinse water is acceptable.
- Rinse water for direct use in a continuous countercurrent washing system where diluterinses are re-used in successively dirtier washing bowls.

Other options for process water re-use include:

- Using scouring rinse waters for desizing or machine cleaning (this option requires additional tank storage, but such storage may be available where there is unused equipment).
- Using mercerising water to prepare baths for scouring, bleaching and wetting fabric (in this option the caustic content of the liquor must be continuously measured).

- As water and effluent costs continue to rise, new technologies for treating and recycling water for process use are more likely to become viable.

Countercurrent washing/rinsing

Countercurrent washing/rinsing is an established technique common on continuous ranges. This system of operation can significantly reduce water use.

➤ **Options For Reducing Chemical Use**

Most of the chemicals used in textile processing are not retained on the fibre but are washed off.

Effluent strength - and therefore treatment costs - can be reduced by:

Controlling the quantity of each chemical used;

Replacing more-polluting chemicals with less-polluting substances.

The options chosen will vary from company to company.

✓ Simple options for chemical reduction

Recipe optimisation

The chemical recipes used in wet processing are often fail-safe under the most extreme conditions.

This results in the overuse of chemicals and increased effluent strength. Check whether the recipes are mixed to specification and whether the chemical is vital to the process.

Dosing control

If recipes are mixed manually, check how operators measure and control dosing. If automatic dosing systems are used, check whether they are properly calibrated. Overuse will result in a higher strength effluent and will increase effluent disposal costs. Unnecessary chemical use also increases chemical costs.

✓ **Identifying Opportunities For Reducing Chemical Use**

In some cases it is possible to achieve a 20 - 50% chemical reduction by reviewing recipes and chemical use. This can correspondingly reduce effluent BOD by 30 - 50% and cut the costs of effluent disposal.

Instrumentation

Most textile processes take place under high temperature (90°C+) and/or pressure conditions over a considerable period of time. Check that these conditions are optimised for each batch or product run. In many cases, instruments can be installed to ensure uniformity of conditions. If instruments of this type are installed, make sure that they are calibrated and show the true conditions.

Pre-screen chemicals

Chemical data relating to the strength (BOD, COD) and toxicity (metals content, etc) of chemicals are available from manufacturers and suppliers in the form of Material Safety Data Sheets (MSDS).

These should contain chemical, ecotoxicological and environmental information and will help to pre-screen chemicals and select those with the least effect on effluent strength and toxicity. Chemicals such as alkyl phenol ethoxylates (APEs) may be present in detergents and are of continuing concern because of their oestrogenic effect on fish.

Pre-screen raw materials

Raw textile fibres can contain a number of toxic substances, which end up in the effluent after processing. Where possible, select raw materials from countries that have banned the use of toxic chemicals. The International Wool Secretariat (IWS) has recently carried out an investigation for wool processors and stock yarn dyers for the carpet industry. Now, by purchasing their wool fleece from carefully selected locations, processors have reduced toxic substances in their effluent.

Production scheduling

The need for machine cleaning between dye and print runs can be dramatically reduced by careful production scheduling. By progressing from lighter shades of dye to darker shades (and back again) some companies have eliminated many of the cleaning cycles, cut down on dye losses and reduced effluent quantities.

✓ **Advanced options for chemical reduction**

- Product Fibre Dye Machine
- Knit fabric Polyester Disperse Jet
- Cotton Reactive or direct Beck
- Poly/cotton Disperse/reactive or direct Beck
- Yarn package Polyester Disperse Package
- Poly/cotton Disperse/reactive or direct Package
- Hosiery Nylon/Spandex® Acid Paddle
- Hosiery Nylon/Spandex® Disperse/acid Rotary drum
- Carpet Nylon Disperse/acid Beck
- Polyester Disperse Beck
- Woven fabric Aramid® Basic Jet
- Skein/hank Acrylic Basic Skein/hank

➤ **Examples of dye bath re-use**

Improved dye fixation

Considerable attention has been given to maximising the fixation of dyes to yarn and fabric, and new techniques are continually being developed. Better fixation contributes to lower chemical use and lower effluent contamination. Textile managers should regularly monitor specific dye consumption to ensure that optimum performance is maintained.

Effluent treatment

Some companies have to correct the pH of their final effluent to sewer by dosing with acid or alkali. Examine the range of waste streams available and consider neutralising one stream with another, thereby eliminating the need for additional chemicals.

Specific benefits of new printing equipment include:

Reduced cleaning loss - In rotary screen printing, up to 8.5 kg of colour or print paste can be present in the pipe between the dye tank and squeegee blade. This will be 'lost' when the pipe is cleaned out at changeover. Reduced-diameter pipework and reverse compressed air injection have reduced this loss to just 1.5 kg.

Screen printing squeegee wash – Washwater use for squeegee cleaning can be reduced from 100 litres to 20 litres per squeegee by replacing manual washing with automatic high pressure water cleaning.

Conveyor belt washwater recycling - Older machines use substantial quantities of water to remove lint and dye from the print machine conveyor in a blanket wash at the end of the line. New equipment uses staged rinsing with countercurrent rinse water flow, significantly reducing water use and effluent generation.

Other technological developments include:

A new system of package dyeing has been developed for dyeing very soft yarn packages, eg delicate wool, polyamide carpet yarns, acrylic and wool yarns. The system can replace hank dyeing of these fibres. Cost savings are achieved by reduced fibre wastage, omitting handling operations, shorter cycle times and reduced water use.

Cleaner technology

- Single-stage desizing-scouring-bleaching processes for processing cellulose and their blends with synthetics.
- Solvent-aided scouring and bleaching processes.
- Activated peroxide bleaching taking chemically-treated goods straight into a peroxide bath through the washing machine.
- Dyeing-sizing of warp yarns for denim-style products.
- Hot mercerisation in place of conventional cold mercerisation, often enabling the elimination of separate scouring treatment.

- Combined disperse and reactive/direct colour-dyeing of blended fabrics containing low percentages of cellulose.
- Use of padding method in place of exhaust methods for dyeing, wherever possible.
- Use of bicarbonate in a peroxide bath for vat oxidation to convert caustic alkalinity into carbonate alkalinity for its easier removal. Alkalinity requires a plentiful supply of water.
- Electrolytic process for the dyeing of vat colours and reduction-clearing of disperse colour printed synthetic fabrics.
- Dry-heat fixation techniques for the development of Rapidogen prints in place of the conventional acid-steaming method.
- Direct finishing of pigment-printed goods and direct carbonising of disperse-printed goods without intermediate washing.

Conclusions

Low water and effluent disposal costs have resulted in overuse and wasteful practices throughout industry. Now that effluent disposal (and chemical) costs are rising, many companies are, almost literally, throwing money down the drain.

It is not necessarily true that to save money you first need to spend money. Your first step towards saving money by reducing water use and effluent strength is to understand and review water and chemical use throughout your site. You can then draw up a list of potential actions, giving priority to those that are easy to implement and likely to be the most cost-effective. Implementing those actions will achieve savings. Constant monitoring will ensure that you maintain and increase those savings.

The key to successfully reducing water and chemical use is to begin looking. Question operating procedures, ask why things are done the way they are, talk to colleagues and involve as many people as possible to help save the company money and remain competitive. You may be surprised by what you can achieve.

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