



ENVIRONMENTAL
TECHNOLOGY
BEST PRACTICE
PROGRAMME

GG62
GUIDE

WATER AND CHEMICAL USE IN THE TEXTILE DYEING AND FINISHING INDUSTRY



GOOD PRACTICE: Proven technology and techniques for profitable environmental improvement

WATER AND CHEMICAL USE IN THE TEXTILE DYEING AND FINISHING INDUSTRY

This Good Practice Guide was produced by the
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SUMMARY

The textile dyeing and finishing sector uses large volumes of water and substantial quantities of complex chemicals. Companies operating in this sector are facing significant challenges, many associated with the acquisition and disposal of these essential raw materials. In particular, the charges incurred for mains water supply and effluent disposal are increasing, and companies need to address these issues to save money and remain competitive.

This Good Practice Guide shows that it is possible for companies to reduce their water and effluent costs, often by as much as 20% or more, by implementing no-cost and low-cost changes. Furthermore, overall savings can be doubled or trebled when the associated saving in raw materials is taken into account.

The first step for any company, whatever its size, is to undertake a site audit and investigation to determine:

- how much water is used on site and where;
- the different types of chemical used on site and the quantities involved;
- the volume, quality and source of all effluent streams.

The audit needs to be effective in its own right and stimulate an appropriate response. Each company should establish a waste management team with the resources to plan, implement and manage a complete water, chemicals and effluent management programme.

An effective audit will highlight potential areas for improvement and facilitate assessment of the various options for reducing water and chemical use. These options range from simple tasks such as repairing water leaks and optimising the chemical recipes used, to more advanced initiatives such as recycling process and cooling water, and replacing potentially polluting chemicals with others that have less impact on effluent quality. The projects that are easiest to implement and are the most cost-effective (often low cost) should be put in hand first.

A management programme of this type will only be effective in the longer term if the initial savings are sustained over time and, preferably, increased. It is therefore essential to monitor every aspect of the programme and to report the progress made and the savings achieved to all staff. This will help to maintain the enthusiasm of everyone involved. It is also important to give individuals particular responsibilities for investigating water and chemical use and for taking appropriate action to achieve improvements.

The case studies given in this Guide clearly show that companies that have spent time and effort reviewing their water and chemical use and investigating and implementing options for a reduction are making significant savings. The wider adoption of this management approach will allow the textile sector to become more competitive and more able to respond effectively, not only to current environmental challenges, but also to the wider challenges posed by the competitive environment in which the industry operates.

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1.1 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, eg 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.**

In addition to these environmental concerns, the textile industry is having to respond to rapidly changing market requirements, as dictated by fashion, seasonality and customer expectations.

A number of companies have already responded to these challenges. They have reviewed the way in which they operate and have turned various 'pressures' into opportunities. As a result, they have become more profitable and competitive.

1.2 THE PURPOSE AND STRUCTURE OF THIS GUIDE

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

This Guide:

- 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 a 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 fibres:

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 mercerising 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. For more information on these other sectors please contact the Environmental Helpline (0800 585794).

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

(GG25) *Saving Money Through Waste Minimisation: Raw Material Use;*

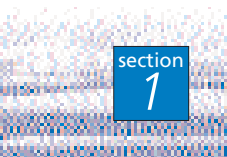
(GG26) *Saving Money Through Waste Minimisation: Reducing Water Use;*

(GG27) *Saving Money Through Waste Minimisation: Teams and Champions;*

(GG67) *Cost-effective Water-saving Devices and Practices.*

Although these Guides are not specific to the textile industry, they include case studies and savings for a wide range of UK industries that have adopted a similar approach to the one outlined in this Guide.

Further advice and information on environmental issues affecting the textile industry, eg legislation, effluent treatment, are available from the Environmental Helpline on 0800 585794.



Waste minimisation strategies already implemented by some companies have demonstrated that substantial cost savings can be made with zero investment by improving operating practice. In every case, the key to achieving these savings has been for companies to understand the material flows through the process and to establish the true financial cost of all waste products. Section 5 of this Guide describes the basic methodology to be used if this understanding and knowledge is to be acquired. In summary, a company must:

- measure;
- monitor;
- target;
- control.

Waste minimisation projects have shown that many companies perceive their waste to be less than 1% of turnover **but** actual waste costs can be as much as 10% of turnover.

One Leicester-based dyer paid an estimated £50 000/year for effluent disposal. When the company carried out an audit as part of a regional waste minimisation initiative, and took waste dyestuffs and water into account, the full waste cost was found to be more than £150 000/year.

Although not all the waste could be eliminated, the audit helped to focus the company's attention on priority areas, and it went on to reduce water, waste and effluent disposal costs by 19%.

2.1 PROCESS FLOWS

All processes can be represented by a simple flow diagram (Fig 1). Raw materials and other inputs are converted by the process into the finished product plus waste. Any items that do not form part of the finished product should be regarded as waste.

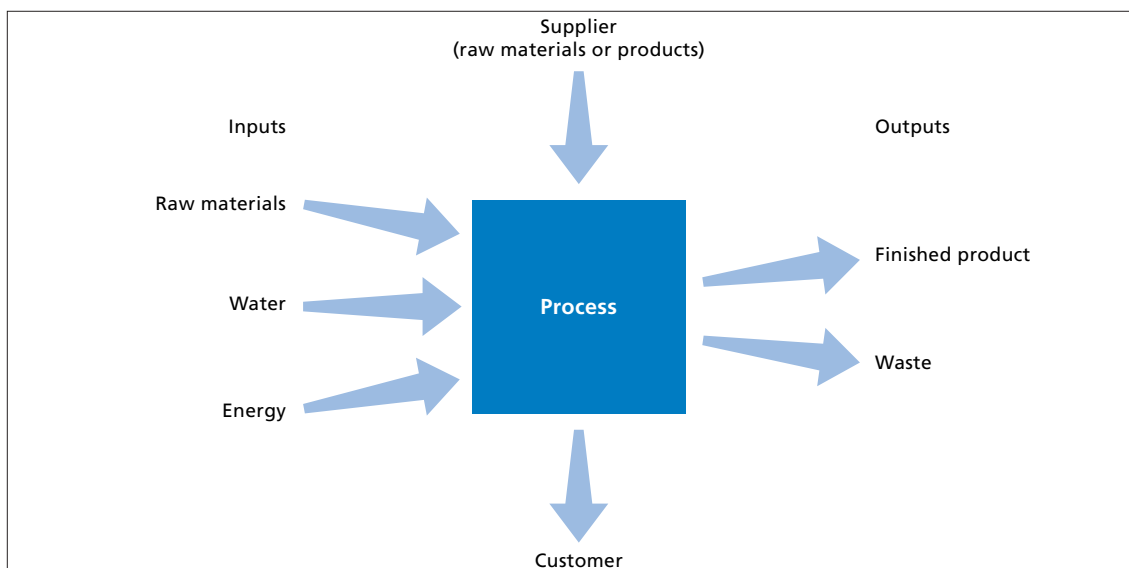


Fig 1 General process flow diagram

The process flow diagrams for woven fabric finishing, knit fabric finishing and stock and yarn dyeing and finishing are shown in Figs 2 - 4. Once measured, the values obtained for raw material and energy use can be compared with published figures and with relevant supplier and equipment information.

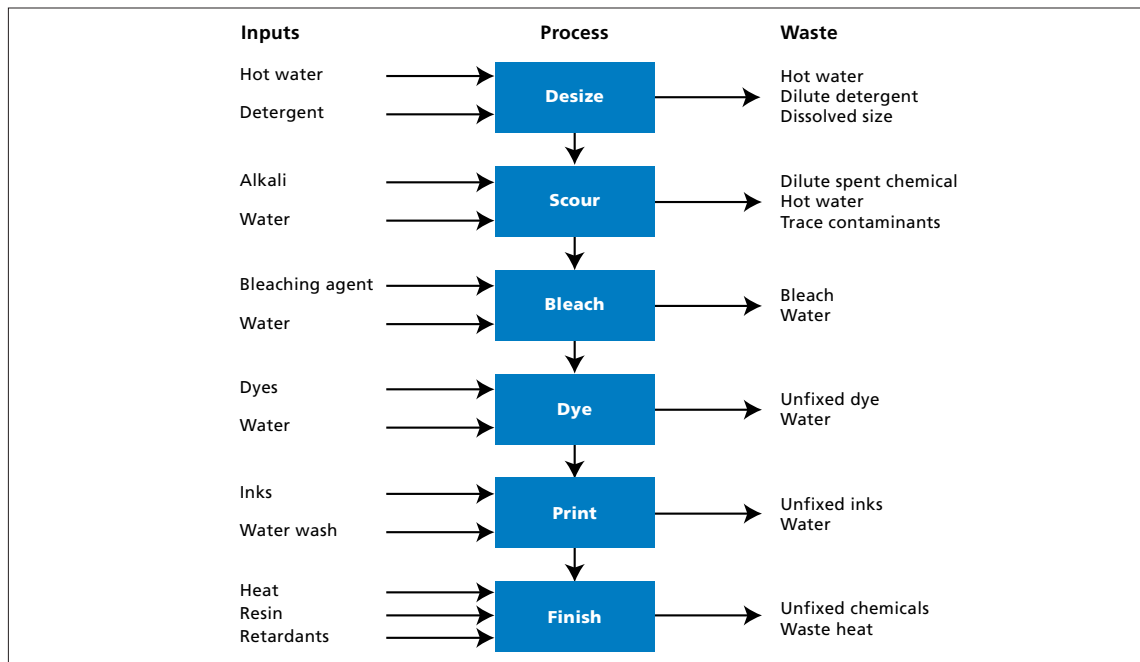


Fig 2 Woven fabric finishing

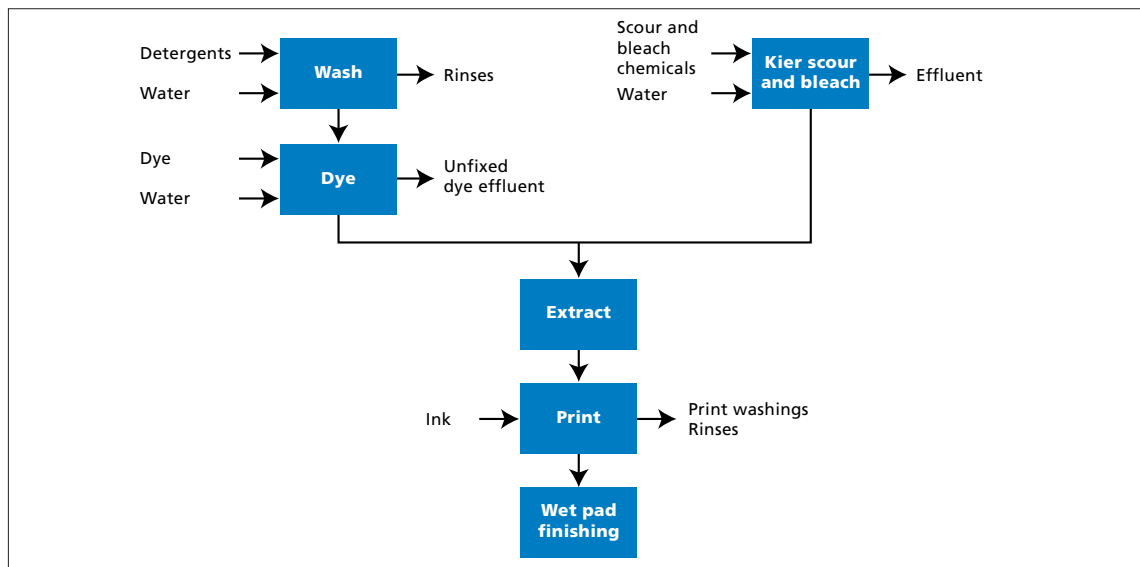


Fig 3 Knit fabric finishing

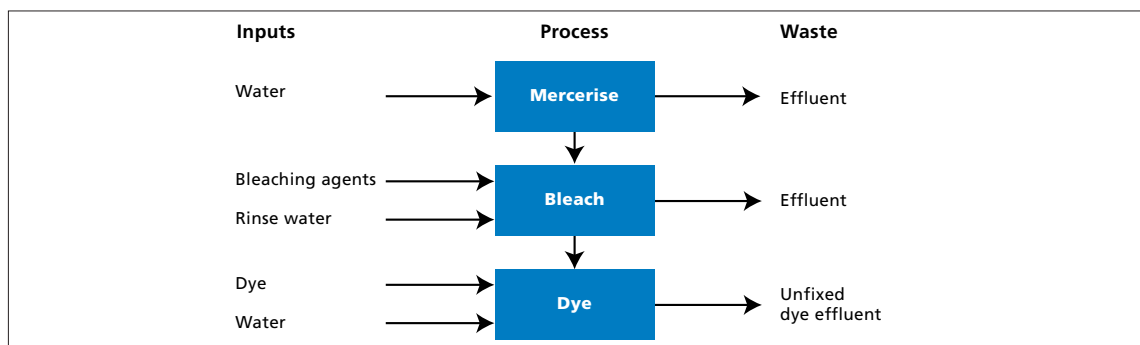


Fig 4 Stock and yarn dyeing and finishing

Textile companies can have hundreds of different material inputs. The majority of these are not retained in the end-product but are discharged in wastewater. Any examination of the material balance needs to consider all the inputs to the process and all the outputs from it. Differences between the two can often indicate opportunities for substantial cost savings.

2.2 PROCESS INPUTS - MATERIALS USED

The input materials used in textile dyeing and finishing can include: water, the fibre, yarn or cloth, eg wool, cotton, polyester, and a range of process chemicals including:

- acids, eg acetic, formic;
- alkalis, eg sodium hydroxide, potassium hydroxide, sodium carbonate;
- bleach, eg hydrogen peroxide, sodium hypochlorite, sodium chlorite;
- dyes, eg direct, disperse, pigment, vat;
- salts, eg sodium chloride;
- size, eg starch, PVA;
- stabilisers, eg sodium silicate, sodium nitrate, organic stabilisers;
- surfactants;
- auxiliary finishes, eg fire retardant, softeners (or handle modifiers).

Any assessment of material inputs should also include auxiliary and cleaning materials. These are seldom subject to the same degree of control as dyestuffs, and limited investigation can often yield easy savings.

2.2.1 Dye inputs

Not all the dye is fixed to the fibre during the dyeing process. Table 1 shows the percentage of unfixed dyes for various textiles. The reactive dyes used for cotton have the poorest fixation rate, and since 52% of the textile-fibre market is cotton, most coloured effluent problems arise from dyeing cotton with reactive dyes. Heavy metals are associated with the effluents from wool dyeing.

Fibre	Dye type	Unfixed dye %
Wool and nylon	Acid dyes/reactive dyes for wool	7 - 20
	Pre-metallised dyes	2 - 7
	After chromes	1 - 2
Cotton and viscose	Azoic dyes	5 - 10
	Reactive dyes	20 - 50
	Direct dyes	5 - 20
	Pigment	1
	Vat dyes	5 - 20
	Sulphur dyes	30 - 40
Polyester	Disperse	8 - 20
Acrylic	Modified basic	2 - 3
Polypropylene	Spun dyed	N/A

Table 1 Percentage of unfixed dye for different dye types and applications

2.3 PROCESS OUTPUTS - PRODUCT AND WASTE EFFLUENT

The quantity and composition of textile industry effluent varies with the type of fibre, the process involved and the way that process is operated.

Effluent quality is determined by:

- the level of impurities in the raw fibre prior to processing;
- the type and configuration of the wash ranges, eg batch or continuous;
- the types of chemicals used and their concentration;
- the amount of water used and the washwater flow rate.

Other factors affecting effluent characteristics include fashion requirements and changing seasons, ie colours and shade. Table 2 summarises the published data for combined effluent from the processing of cotton and synthetic blends.

Determinand	Woven fabric finishing	Knit fabric finishing	Stock and yarn dyeing and finishing
BOD ¹ (mg/litre)	550 - 650	250 - 350	200 - 250
Suspended solids (mg/litre)	185 - 300	300	50 - 75
COD ² (mg/litre)	850 - 1 200	850 - 1 000	524 - 800
Sulphide (mg/litre)	3	0.2	0 - 0.09
Colour (ADMI ³ units)	325	400	600
pH	7 - 11	6 - 9	7 - 12

¹ Biological oxygen demand

² Chemical oxygen demand

³ American Dye Manufacturers Institute

Table 2 Typical effluent characteristics

Water companies use the Mogden formula (see below) to calculate the cost, in pence/m³, of treating effluent. Costs vary between the different water companies around the country.

The Mogden formula is expressed as:

$$C = R + V + Ot.B/Os + Bv + St.S/Ss$$

Where

- C = Cost (pence/m³)
- R = Reception and conveyance
- V = Primary treatment
- Ot = COD of effluent after one hour quiescent at pH 7
- B = BOD of settled sewage
- Os = COD of crude sewage after one hour quiescent settlement
- Bv = Additional volume charge if there is biological treatment
- St = Total suspended solids of effluent at pH 7 (mg/litre)
- S = Treatment and disposal costs of primary sludge/m³
- Ss = Total suspended solids (mg/litre) of crude sewage

Charges for B/Os and S/Ss are usually expressed in pence/m³ relative to standard strength (concentration: usually expressed in mg/litre). Standard strengths vary from water company to water company.

The basic principles of the Mogden formula are that effluent disposal costs depend on

VOLUME and STRENGTH

A reduction in effluent volume and an improvement in effluent quality will reduce effluent costs. In addition, there will be savings related to water and chemical use.

Fig 5, which plots the change in average trade effluent charges for the ten water and sewerage companies, shows the substantial increase in real terms year-on-year since 1989.

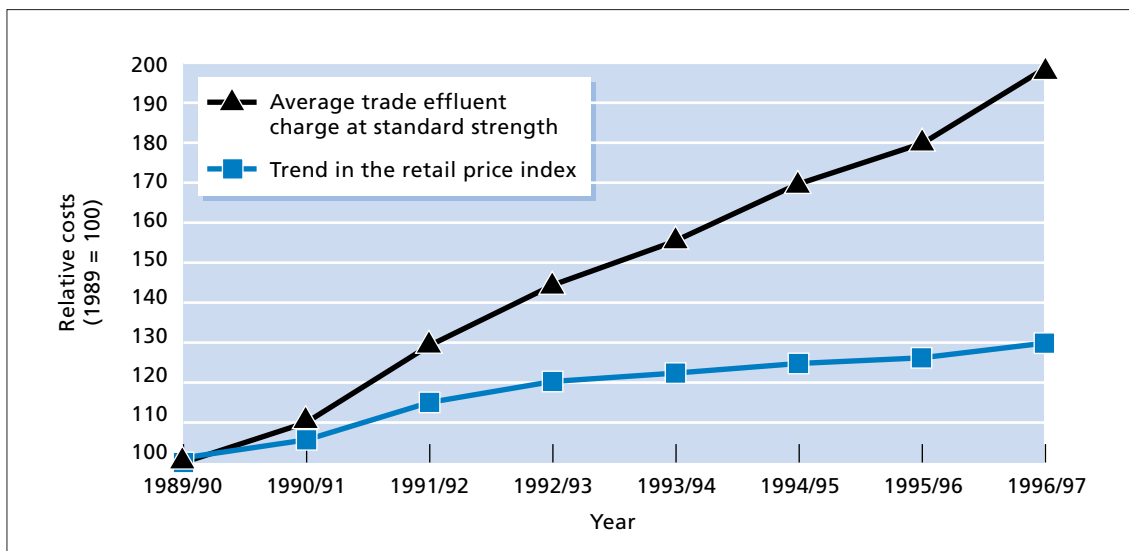


Fig 5 Trend in trade effluent charges

Effluent costs can be reduced in three ways:

- by using water more efficiently to reduce the effluent volume;
- by using chemicals more efficiently to reduce effluent strength;
- by using alternative chemicals which reduce effluent strength and are less detrimental to the environment.

However, before a company can decide on the most effective ways of achieving these savings, it will need to carry out a site audit and investigation to determine:

- how much water is used on site and where;
- the different types of chemicals used on site and the quantities involved;
- the volume, quality and origin (department or machine) of all effluent streams.

Quantifying the materials entering and leaving the site allows a material balance (see Section 2.1) to be prepared. The values obtained can be compared with published figures and with relevant supplier and equipment information.

3.1 WHAT YOU NEED TO KNOW ABOUT WATER USE

3.1.1 Overall water use and effluent levels

The first step is to establish how much water was used by a site during the past year. This information can usually be obtained from recent water bills (from on-site meter readings in the case of a borehole supply).

Secondly, find out how much effluent leaves the site (again from old bills or effluent meter readings).

The two sets of figures should be roughly comparable. However, it will be necessary to account for:

- evaporation losses (variable, depending on site, drying operations, cooling requirements etc);
- product losses (generally low, as little water is incorporated into the fibre);
- rainwater additions (see below).

If water bills or historic meter readings are not available, water use can be determined by taking daily readings from the site's main water meters. This should be carried out over a period of at least one month. When the data are extrapolated to establish annual water consumption figures, full account should be taken of any seasonal change in production that may affect water use.

A similar exercise can be carried out for effluent production by monitoring the flow from the main discharge pipe.

Establish whether or not rainfall is discharged with the trade effluent. If it is, unnecessary disposal costs are being incurred. A rainfall of 1 m/year draining from a 10 000 m² site would add 10 000 m³ to the effluent volume. Uncontaminated rainfall should therefore be routed to surface water with the agreement of the Environment Agency (in England and Wales), the Scottish Environment Protection Agency or the Environment and Heritage Service (in Northern Ireland).

3.1.2 Allocating water use to individual processes

There are three key areas of water use in textile processing:

- fabric or yarn pre-cleaning and rinsing prior to dyeing or printing;
- the dyeing or printing operation, soaping and after-treatment;
- rinsing.

Plus others, eg ion exchange, boiler, cooling water, steam drying, cleaning.

Allocate consumption between these key areas, giving proper consideration to the smaller ancillary water users as well as to the large process consumers (Table 3).

Process water users	Ancillary water users
Scouring processes	Evaporation - usually small unless the cooling load is large
Finishing processes	Domestic/toilets (typically 50 litres/person/day)
Bleaching processes	Boilers - can be excessive if condensate is not returned
Dye house	Factory washing - may be high if hose pipes are used
Process cooling	Air conditioning
Process rinsing/washing	Utility cooling - can be easily recycled

Table 3 Key areas of water use

Allocating consumption to the different water users on site can be achieved using: flow-monitoring devices; machine meters; equipment specifications; direct observation, eg disconnecting a water pipe and timing how long it takes to fill a known volume; calculation; and estimates. The exercise can be simplified by concentrating initially on processes that are known to be significant water users.

It should be possible to account for more than 90% of the water coming into the site and to identify the main water users. If less than 80% of the incoming water is accounted for, there could be an error in the calculation, excessive process or ancillary water use, or a leak. Check meter readings for the correct units as a first step.

The results of this site audit, with its material balance and allocation of water use, should provide enough information to focus attention on potential areas for improvement. They will also allow assessment of the various options for reducing water use.

3.2 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%.

3.2.1 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.

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!

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.

3.2.2 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.

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.

Reduce process water use

Washing and rinsing are both important for reducing impurity levels in the fabric to pre-determined levels. Because water and effluent disposal costs have been low, there has been a tendency to over use 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 realised 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.

Table 4 Examples of process water reduction

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.

A medical textile company in Lancashire recycles cooling and condenser water, saving almost 11 000 m³ of borehole water. Savings on effluent disposal alone amount to £3 000/year. Water pumping, treatment and energy savings are also achieved by recycling this water.

A Scottish cloth finisher saves approximately £5 000/year by recycling cooling water from its solvent-scouring plant for use in wet processing. Apart from reducing water and effluent costs, recycling also achieves energy savings as a result of the pre-heated water and the reduced demand on borehole pumps.

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Re-use process water

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

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

A medical textile company in Lancashire saves almost 7 000 m³ of borehole water by recycling the last rinse water from beam-and-winch bleaching operations. This accounts for savings in effluent disposal of £2 700. Savings will be higher when pumping and water treatment costs are taken into account.

A Wigan-based dyer and finisher has halved its water consumption by using the effluent from the bleaching process in the scouring wash, saving £10 300/year in effluent disposal and water costs. Total water and energy savings of approximately £36 000/year have been achieved as a result of waste minimisation initiatives.

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 (see Section 6).

Countercurrent washing/rinsing

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

4.1 WHAT YOU NEED TO KNOW ABOUT CHEMICAL USE

The first task is to identify the different types of chemical used and the overall quantities involved in each case. These material inputs should be ranked as an inventory by cost and by the quantity consumed over a representative period (typically 3 - 12 months) depending on the seasonality of production. Efforts to reduce chemical use should first be directed at those materials accounting for the top 20% of costs.

Once the chemical use inventory has been drawn up, establish **where** each of the chemicals is used and in what quantities. Talk to colleagues about chemical use and observe how chemicals are measured, transferred, mixed, added to processes etc.

Gather as much technical data as possible from suppliers to establish the biological oxygen demand (BOD), chemical oxygen demand (COD), metals content and toxicity of each chemical. This information can be used to assess the type of effluent produced by each process and to identify areas for further investigation.

The chemical use inventory can be used as a benchmark for comparison with subsequent improvements. It is important to relate this information to production output.

4.2 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.

4.2.1 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.

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.

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.

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.

Investigation of chemical constituents has been known to show unnecessary duplication of the same chemical in different proprietary materials.

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

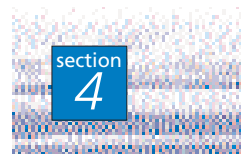
The need for machine cleaning between dye and print runs can be dramatically reduced by careful production scheduling. By progressing from lighter shades of dye to darker shades (and back again) some companies have eliminated many of the cleaning cycles, cut down on dye losses and reduced effluent quantities.

4.2.2 Advanced options for chemical reduction

Chemical substitution

The objective of chemical substitution is to replace those process chemicals with a high pollutant strength or toxic properties with others that have less impact on effluent quality. Table 5 illustrates some of the changes that textile companies have made to reduce BOD and improve effluent quality. Information about the BOD for textile chemicals can be found in Appendix 1.

A Scottish cloth-finishing company has reduced the COD of its effluent from an average of 2 460 mg/litre to 700 mg/litre by changing from soap scouring to the use of anionic/non-ionic detergents and by carrying out trials to keep detergent use to a minimum. This reduction in COD represents a saving in effluent disposal costs of approximately £20 000/year.



Application	Current material	Substitute material
Sizing	Starch	PVA/acrylates
Acid desizing	Enzymatic	Mineral acids
Washing	Soaps (140% BOD)	Synthetic detergents (0 - 2.2% BOD)
Neutralising scoured goods	Soda ash	Sodium acetate (converts mineral acidity into organic acidity)
pH adjustment in disperse dyeing and pigment printing	Acetic acid	Ammonium sulphate (although salt concentration increases, the ammonium serves as a nutrient in the biological treatment process)
Textile printing	Gum-thickening	Emulsion thickening (full or partial)
Oxidation of vat dyestuffs	Acetic acid	Sodium bicarbonate in conjunction with peroxide or perborate
Finishing	Temporary starch-based finishes	Durable resin finishes
Dyeing of blended varieties in pale shades	Two-stage dyeing using two different classes (eg polyester using disperse, and cellulose using vats, reactives)	Single class dyestuffs like Indigosol, pigments
Polyester dyeing	Other carriers	Monochlorobenzene
Dye bath acid	Acetic acid (0.64 kg BOD/kg)	Formic acid (0.12 kg BOD/kg)
	Carding oils and anti-static lubricants	Non-ionic emulsifiers

Table 5 Reducing BOD at source: a checklist of possible chemical substitutions

Chemical recovery and re-use

The recovery and re-use of chemicals have been applied successfully in three main areas:

- the re-use of dye solutions from the dye bath;
- the recovery of caustic after the mercerising process;
- the recovery of size in cotton processing (in practice this is limited to integrated operations which apply and remove size).

For example, with conventional dyeing, usually only the dye and a few speciality chemicals are totally consumed during the process. Most of the chemicals remain in the dye bath and are discarded with it. The feasibility of dye bath re-use depends on dye, colour, shade and whether dyeing is carried out in a batch or a continuous process. In some cases, dye baths can be re-used at least 5 - 10 times (in other cases up to 25 times) until the build-up of impurities limits further re-use. Processes where dye bath re-use has been successfully applied are shown in Table 6.

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

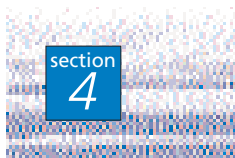
Table 6 Examples of dye bath re-use

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 (see Section 6.1). 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.



HOW TO PUT A WATER, CHEMICALS AND EFFLUENT MANAGEMENT PROGRAMME INTO ACTION

Not all the opportunities outlined in Sections 3 and 4 will apply to every company. The most effective way of achieving improvements is to consider them within the context of the business as a whole. This is more effective than implementing individual projects on an ad hoc basis. Improvements should be prioritised, for example, there is no point spending a lot of time improving the control of a dyeing machine if it is to be replaced next year.

The systematic programme of work outlined in this Section can be applied to **any** company or process. This approach should ensure that only the most cost-effective measures are put into practice.

5.1 ESTABLISH A WASTE MANAGEMENT TEAM

The first step is to establish a waste management team with the responsibility, commitment and resources for implementing a water, chemicals and effluent management programme. This team should include as a minimum:

- a senior management representative;
- the dye-house/technical manager;
- the quality/environmental manager;
- a site services representative;
- shift supervisors/operators.

Depending on the nature and size of operation there may be considerable overlap between these roles.

In the case of larger companies, other members of staff should be involved in the management programme to provide assistance when necessary.

Ultimately, all employees should be involved in the programme at some stage. It is the operators who know about the plant and how they carry out their tasks, and it is their behaviour and working practices that may need to be altered. For more information see Good Practice Guide (GG27) *Saving Money Through Waste Minimisation: Teams and Champions*.

In many companies resources are already stretched to the limit. If this is the case, consider how those resources could be expanded. For example, approach the local Training and Enterprise Council, which can provide a range of services targeted at manufacturing industries. Local universities and colleges may also be able to offer temporary placement students.

Another option is to combine a water and chemical management programme with the development of an environmental management system. Government funding is available to help companies establish such a system. The Small Company Environmental and Energy Management Assistance Scheme (SCEEMAS) provides companies with up to 50% of the cost of hiring experts to help establish an environmental management system and register under the EC Eco-Management and Audit Scheme. Grant assistance is available to companies with an annual turnover of less than £32 million. For more information, contact the SCEEMAS office on 0345 023423.

5.2 PLAN THE PROGRAMME

Once the team has been selected, a clearly defined plan should be devised and agreed. This should outline:

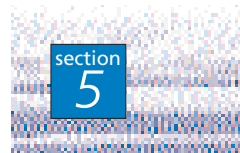
- the scope of the programme (what they are going to do and why);
- programme aims and targets (what they hope to achieve);
- techniques and methodology (how they are going to do it);
- responsibilities (who is going to do what);
- timetable (expected completion date of programme, dates of meetings).

It is also important at this stage to agree resource requirements and availability, eg days available per person to perform agreed tasks. Regular meetings should be held to review progress and generate ideas.

5.3 CARRY OUT A SITE AUDIT

Once the team is in place and the plan agreed, the next task is to gather as much data as possible about the site and the operations carried out. This is done by conducting a systematic audit of the site, reviewing existing information, eg accounts and production data, understanding material flows through each process, some monitoring and, most importantly, talking to colleagues and operators.

The aim of the audit, described in more detail in Sections 3.1 and 4.1, is to quantify water and chemical consumption and effluent production for each process, and to achieve a balance of purchased inputs (materials, water and energy) against process outputs (finished product and waste streams). Where sites are large, or resources limited, it makes sense to divide the site into separate, measurable units and to audit one unit at a time.



5.4 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. The options presented in Sections 3.2 and 4.2 should help to identify specific opportunities.

The best way to proceed is to set up a meeting of colleagues who are familiar with the processes and ask why water and chemicals are used in the way they are. By using the meeting as a brainstorming session it should be possible to identify ways of reducing water and chemical use. If the findings of the audit were surprising, see what this session brings up!

Try using simple problem-solving techniques to generate ideas. The cause and effect (or fishbone) diagram (Fig 6) is one example of this type of technique.

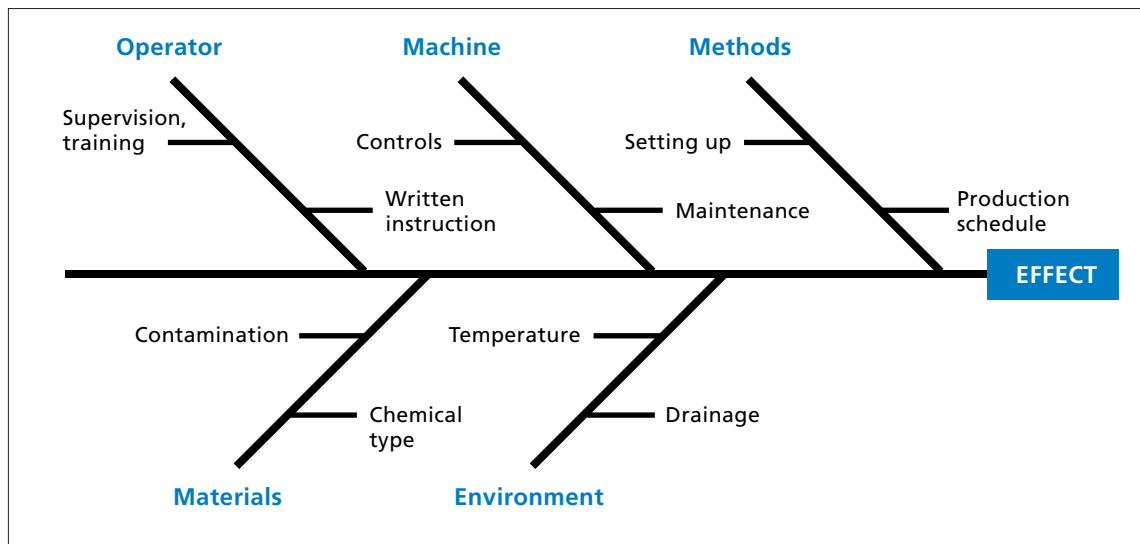


Fig 6 Cause and effect diagram

The cause and effect diagram can be used to examine all the reasons for a particular effect or variability in output. This effect may be high water use, high effluent strength, etc. To reduce the effects, it is first necessary to understand the causes. These may be associated with:

- operator actions;
- type and condition of machinery;
- methods and operational procedures;
- material type and purity;
- working environment.

Brainstorming should attempt to identify all the contributing factors for each 'leg' on the diagram. Only when all the factors have been identified should the process begin to assess the contribution that each one makes to the effect. This is essentially a management task and, to benefit fully, a systematic approach should be adopted. This will allow potential savings to be maximised from the various options identified during the audit.

5.5 ASSESS THE FEASIBILITY OF OPTIONS AND DEVELOP AN ACTION PLAN

The next step is to assess each option in terms of its technical and economic feasibility. This will allow the drawing up of an agreed priority list of all the options in a 'league table' showing the costs and benefits of each project. At the top of the list should be the most cost-effective projects and those that are easiest to implement. These projects should be put in hand at the earliest opportunity.

Develop options that involve process or procedural modifications and capital expenditure. These can be implemented at a future date.

5.6 MONITOR IMPLEMENTED OPTIONS AND ACHIEVEMENTS

Once chosen options have been implemented, monitor them to make sure that the benefits predicted are not only achieved but also sustained and improved. While measurement is fundamental to achieving control of the process, it is not sufficient on its own. Compare the findings with targets already set and carry out further investigations if these targets are not met. Responsibility for this should be allocated to specific individuals.

5.7 REPORT PROGRESS AND SAVINGS TO THE WORKFORCE

Effective water, chemicals and effluent management is an ongoing process. It requires consistent commitment from management, and it may involve rewriting procedures or introducing improved recording systems to sustain the improvements. It is, therefore, important to encourage and motivate the workforce by letting them know what has already been achieved. This can take the form of team briefings, newsletters or notice-board posters.

SUMMARY

The stages for implementing a water, chemicals and effluent management programme are:

- ✓ establish a management team;
- ✓ plan the programme (resources, targets and timescales);
- ✓ carry out an audit to establish water and chemicals use and effluent production;
- ✓ identify all opportunities for reducing the consumption of water and chemicals;
- ✓ assess the feasibility of the various options;
- ✓ implement solutions;
- ✓ monitor the implemented options;
- ✓ report progress and cost savings to the workforce;
- ✓ manage the initiative to sustain and increase savings.

section
5

Implementing a water, chemicals and effluent management programme requires you to:

- | | |
|-----------|---|
| ■ Measure | Renew or recalibrate measuring devices. |
| ■ Monitor | Record the consumption of materials and water on a regular basis, together with production figures. |
| ■ Target | Set standards of key material use per unit of production, for example, and compare measured results with these targets. |
| ■ Control | Give individuals particular responsibility for investigating and for taking action to achieve improvements. |

Fig 7, which is based on United Nations Environment Programme Technical Report No. 16, summarises the essential steps.

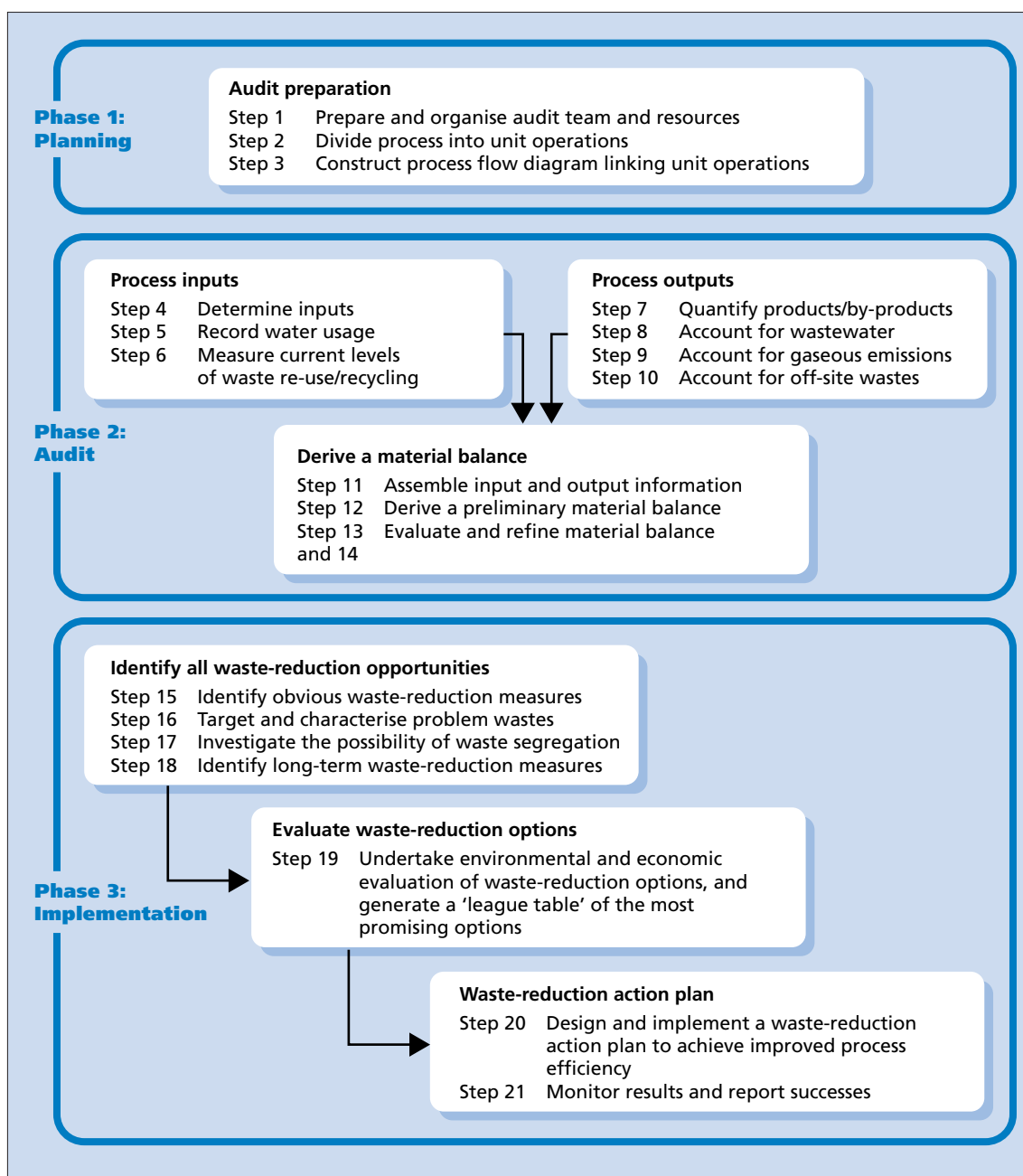


Fig 7 Step-by-step waste audit guide

So far, this Guide has concentrated on improved operation, maintenance and procedures - in other words on good management. Good management techniques frequently achieve savings for little or no capital cost by making the best use of existing machines and materials. However, further savings may be achieved by using more technical options such as switching to newer dyestuffs and considering the water and chemical efficiencies of new equipment prior to its purchase.

6.1 DYESTUFFS

Dye manufacturers recognise the vital importance of the environmental impact of using dyes. This has led to the development of new dyes with a lower toxicity, improved levelling and exhaust characteristics, and narrow quality tolerances. Specific dye improvements include:

- fibre-reactive dyes for cellulose, with stable fixation rates regardless of variations in dyeing conditions, ie in liquor ratio, salt or alkali quantities, temperature and time;
- direct dyes with high fixation rates irrespective of variations in liquor ratio, salt or alkali quantities, temperature and time;
- pale and medium-to-dark shade polyester dyes with high exhaust properties, fastness and reproducibility;
- metal-free reactive dyes with high fixation rates and minimum salt consumption;
- metal-free direct dyes;
- metal-free, pre-metallised and chrome dyes;
- low-sulphide/sulphide-free dyes.

Further improvements include:

- granular dyestuff formulations which are easy to dissolve and handle and which reduce dust generation;
- the withdrawal and replacement of potentially carcinogenic azo-dyestuffs;
- dyestuffs with biodegradable formulating agents.

Although these dyes may be slightly more expensive, it is worth considering the potential longer-term savings arising from more efficient dye use and reduced effluent costs.

6.2 FIBRES

A number of new, man-made fibres are currently under test throughout the textile industry. These new fibres could have a greater affinity for dyestuffs and may help to improve exhaust dyeing and reduce the problem of coloured effluent. New fibres include:

- lyocell cellulosic fibres (similar to viscose);
- polyester and polyamide microfibres;
- new polyester fibres that can be dyed with disperse dyestuffs at low temperatures (up to 100°C);
- exhaust dyeable polypropylene fibres that can be dyed with disperse dyestuffs.

Although it may take time for some of these new fibres to gain wide acceptance, it is worth keeping a check on the latest developments via trade associations and journals. Microfibres in particular may be more difficult to dye deeper shades, and some optimisation, involving consultation with suppliers, may be needed.

6.3 NEW EQUIPMENT AND CLEANER PRODUCTION

Textile equipment manufacturers are also aware of environmental pressures and are developing new, more efficient machines with low liquor/cloth ratios and lower energy consumption. A list of equipment manufacturers and suppliers is given in Appendix 2. Table 7 shows the variations in water use between different types of dyeing machine and dyeing technique.

	Water usage (litres/kg)				
	Vat	Direct	Disperse	Reactive	All dyes
Jig	10.1	7.1		16.0	13.7
Beck		18.4	22.2	37.9	36.0
Beam			19.5		19.5
Continuous	4.1				4.1

Table 7 Comparison of water usage by different dyeing machines

However, machine water use is only part of the picture. Post-dye rinsing operations use far more water, and care must be taken to ensure that savings achieved at the machine are not counteracted by extra rinsing and washing requirements. In other words, new equipment must be considered within the context of the whole production process and not investigated in isolation. Reducing overall cycle times may be worth more than water and chemical savings.

Table 8 provides examples of cleaner technology practices in the industry. Many of these offer benefits in terms of reduced water and chemical use, and also reduced cycle times. Each should be assessed for its relevance and benefit to site operations.

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.
- Fuzzy logic technology for the control of key dyeing parameters such as pH values has been developed. These systems are particularly suitable for polyamide and wool dyeing.

Cleaner technology

Single-stage desizing-scouring-bleaching processes for processing cellulosics 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 cellulosics.

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.

Source: United Nations Environment Programme Technical Report No. 16

Table 8 Examples of cleaner production process modifications

- The pre-treatment of cellulosic fibres with cationic compounds increases the degree of fixation for reactive dyestuffs.
- The alkaline dyeing process for polyester fibres offers shorter dyeing cycles by avoiding pH changes, and improved quality by reducing oligomer problems.
- Computer systems are available to control the dyeing process and optimise recipes. Programs are available that take account of varying liquor ratios and calculate the optimum pH, salt, alkali and other chemical levels. Other factors such as fibre, temperature, time and dye-house structure can also be accommodated in these programs.

The above improvements suggest that dyeing is becoming a more modernised and controlled procedure. As understanding of the dyeing process improves, further advances are expected in both processes and recipe optimisation.

However, it is unlikely that technological advances will eliminate the production of effluent completely. There is, therefore, considerable scope for textile effluent treatment and re-use, and there is extensive research and development in these areas.

6.3.1 Effluent treatment and re-use

Effluent treatment and re-use is being actively explored by equipment manufacturers. For some dye processes, it should be feasible to recycle 80 - 90% of process water. Current equipment can already achieve recycling levels of up to 70%. One of the main issues is the salts that are used in

the dye process. These can build up and affect the evenness of dyeing. However, some salts (as well as the water) can be recycled, giving additional material savings.

Options for effluent treatment include:

- biological/biosorption techniques;
- ultrafiltration;
- ion exchange;
- reverse osmosis;
- adsorption;
- coagulation/flocculation;
- chemical oxidation;
- photocatalytic oxidation;
- electrolysis.

For more information on these treatments see also Good Practice Guide (GG37) *Cost-effective Separation Technologies for Minimising Wastes and Effluents* available free of charge through the Environmental Helpline 0800 585794.

By reading this Guide you have taken the first step in reducing your consumption of water and chemicals.

The following action plan summarises how you can achieve cost-effective savings.

ACTION PLAN

- ✓ Appoint a team leader and team members (see Good Practice Guide (GG27) *Saving Money Through Waste Minimisation: Teams and Champions*).
- ✓ Allocate water and chemical use to each process on your site (see Sections 3 and 4).
- ✓ Draw up a plan with milestone activities (see Section 5).
- ✓ Determine the true costs of water and chemical use for each process.
- ✓ Focus on high-cost areas first.
 - ✓ Use brainstorming techniques to identify the causes of waste.
- ✓ Prioritise options for improvement based on the likely cost saving and ease of implementation.
- ✓ Implement the most promising options.
- ✓ Monitor the benefits and report successes to all employees.
- ✓ Incorporate monitoring into your existing management system.

If necessary, obtain help.

The Environmental Helpline (0800 585794) can:

- send you copies of relevant Environmental Technology Best Practice Programme publications;
- suggest other sources of information;
- arrange for a specialist to contact your company if you employ fewer than 250 people.

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.

This Guide also highlights actions that have been taken by specific textile companies to reduce water, effluent and chemical costs. Although these will not be applicable to all situations, the management approach outlined in this Guide can be used by any organisation, regardless of its size, process or location.

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.

Appendix 1

5-DAY BOD FOR SOME TEXTILE CHEMICALS

Name	Composition	Use	BOD percent
Acetic acid, 56%	CH ₃ COOH	dyeing, scouring	33,36
B-2 Gum	starch dextrans	printing ink, size	61
Dyes			
Alizarine cyanine		acid dye	Near 0**
Byaform blue 2B		direct dye (formaldehyde after treatment)	Near 0**
Calcogene black (GXCF conc.)		sulphur dye	10
Celliton fast (Blue AF100%)		acetate colour	3
Erie brilliant (Black 5150%)		direct dye	8
Fast red salt 3GL	insoluble azo compound		2
Khaki carbanthrene (2G)		vat dye	0
Naphthol AS-BR		prepare	10
Ethanol	C ₂ H ₅ OH	solvent	93*, 125
Ethyl acetate	C ₂ H ₅ CO ₂ CH ₃	solvent	66*
Formic acid 85%	HCOOH	scouring	2
Gelatin	gelatin	size	100
Glue	glue	size	66
70% Hydroxyacetic acid	HOCH ₂ COOH		7
Hydroxy ammonium sulphate	NH ₂ OH ₂ SO ₄		4
Monochlorobenzene	C ₆ H ₅ Cl	swelling agent in dyeing of Dacron (dyeing assistant)	3
Oxalic acid	H ₂ C ₂ O ₄ ·2H ₂ O	rust removal	14
Phenol	C ₆ H ₅ OH	dyeing	200
Picking oil		sizes, spinning, carding oils	13
Red oil	sulphonated castor oil	soap making, carding	68+
Salicylic acid	C ₆ H ₄ (OH)COOH	dyeing	141
Soap nonpareil	fatty acid soap	scouring, fulling, washing	140
Sodium alginate	size	thickening agent	36
Sodium hydrosulphite	Na ₂ S ₂ O ₄	reducing, stripping	22
Special textile flake	sodium salt of fatty acid	detergent	112
Surfactant DN-40		scouring	15
Sulphonated castor oil	castor oil		52
Sulphuric acid	H ₂ SO ₄	dyeing	0
Tall oil soap		soap	147
Tallow	tallow	soap making	152
Tergitol 4	C ₄ H ₉ CH(C ₂ H ₅) C ₂ H ₄ CH(SO ₂ Na) CH ₂ CH(CH ₃) ₂		0
Triethanolamine	(HOCH ₂ CH ₂) ₃ N	emulsifier, dispersing agent	10
Wheat starch	starch	printing, inks, size	55
Wool oil	(mineral oil + base)	spinning	3

Table A1 5-day BOD for some textile chemicals

* Calculated from the theoretical BOD and the published percent of theoretical.

** Interfered with the dye colour during determination.

Source: United Nations Environment Programme - Technical Report No.16

Appendix 2

USEFUL CONTACTS

The following lists include representatives of two types of organisation:

- companies involved in the manufacture and supply of textile machinery or textile chemicals;
- UK textile trade associations.

A list of products and services is given below. The list is not exhaustive and has been compiled from information currently available to the Environmental Technology Best Practice Programme. The listing of an organisation should not be regarded as an endorsement of its services or products by the Programme. Similarly, the Programme makes no claim for the competence or otherwise of any organisation not listed.

MANUFACTURERS AND SUPPLIERS

Company	Service	Tel. No.
BASF	Dye manufacturer	0161 485 6222
Border Textiles	Supplier of a wide range of finishing and dyeing equipment	01274 851616
Boucher (Textile Engineering) Ltd	Manufacturer of dye vats	01562 822237
Ciba-Geigy Dyes and Chemicals	Dye manufacturer	01625 618585
DyStar UK Ltd	Dye manufacturer	01422 377000
DyStar Textilfarben GmbH (Germany)	Customer services/dye technology information	(00 49) 214 303 1445
Hall and Boyden Ltd	Manufacturer and supplier of a wide range of dyeing equipment	01706 525611
Longclose Ltd	Manufacturer and supplier of a wide range of dyeing and finishing equipment	0113 270 9831
Magna Colours Ltd	Manufacturer and supplier of dye mixing equipment	01226 731751
Samuel Bradley	Supplier of a wide range of dyeing and finishing equipment	0161 477 0909
T Bibby and Co Ltd	Supplier of a wide range of dyeing and finishing equipment	01422 366331

UK TEXTILE TRADE ASSOCIATIONS

British Apparel and Textile Confederation

Tel: 0171 636 7788

British Carpet Manufacturers Association

Tel: 0171 580 7155

British Interior Textiles Association

Tel: 0161 832 8684

British Textile Fibres Association

Tel: 0161 624 3611

British Textile Machinery Association

Tel: 0161 834 2991

British Textile Technology Group

Tel: 0113 259 1999

Tel: 0161 445 8141

Confederation of British Wool Textiles Ltd

Tel: 01274 652207

International Wool Secretariat

Tel: 0171 499 1555

Tel: 01943 601555

Knitting Industries Federation

Tel: 0116 254 1608

Local Action for Textiles and Clothing

Tel: 01484 450146

Needle Loom Felt Manufacturers Association

Tel: 0161 764 5401

North East Lancashire Textile Manufacturers Association

Tel: 01254 580248

Northern Ireland Textiles and Apparel Association

Tel: 01846 689999

Northern Ireland Wool Users Association

Tel: 01762 334433

Scottish Textile Association

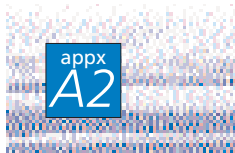
Tel: 0141 226 3262

Textile Finishers Association

Tel: 0161 832 9279

Textile Statistics Bureau

Tel: 0161 834 7871



The Environmental Technology Best Practice Programme is a joint Department of Trade and Industry and Department of the Environment initiative. It is managed by AEA Technology plc through ETSU and the National Environmental Technology Centre.

The Programme offers free advice and information for UK businesses and promotes environmental practices that:

- **increase profits for UK industry and commerce;**
- **reduce waste and pollution at source.**

To find out more about the Programme please call the Environmental Helpline on freephone 0800 585794. As well as giving information about the Programme, the Helpline has access to a wide range of environmental information. It offers free advice to UK businesses on technical matters, environmental legislation, conferences and promotional seminars. For smaller companies, a free counselling service may be offered at the discretion of the Helpline Manager.

FOR FURTHER INFORMATION, PLEASE CONTACT THE ENVIRONMENTAL HELPLINE

0800 585794

e-mail address: etbppenvhelp@aeat.co.uk

World wide web: <http://www.etsu.com/ETBPP/>

