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**ENVIRONMENTAL GUIDELINES FOR THE
TEXTILE DYEING AND FINISHING INDUSTRY**

Environment Protection Authority
State Government of Victoria

June 1998

ENVIRONMENTAL GUIDELINES FOR THE TEXTILE DYEING AND FINISHING INDUSTRY

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Cover photograph: Dyed fabric being unloaded from a jet dyeing machine.
Photograph courtesy of Bradmill Undare Group

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FOREWORD

For a number of years, EPA has been identifying and promoting alternatives to regulatory approaches for the protection of the environment and the health of the community – both now and for future generations.

These methods rely largely on the ability and willingness of industry and the community to take more responsibility for environmental performance.

Like many other industries, the textile dyeing and finishing industry has been through a period of adjustment and accommodation to environmental requirements and regulations. The industry is now more responsive to environmental issues and community concerns and committed to producing positive environmental outcomes.

One of the mechanisms for achieving these outcomes and maximising environmental performance is for industries to define and adopt Best Practice Environmental Management (BPEM) guidelines. This publication sets out BPEM guidelines for the textile dyeing and finishing industry. The guidelines were developed in consultation with the industry and have been endorsed by it.

These guidelines will be reviewed regularly and updated as necessary on the basis of operating experience and the development of national standards. Users are encouraged to evaluate their usefulness and provide comment to assist in this review process.

I commend these guidelines to the textile dyeing and finishing industry and urge their adoption and implementation in the interests of improved environmental performance.

BRIAN ROBINSON
CHAIRMAN

Acknowledgment:

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1 INTRODUCTION

Australia's textile manufacturing industry comprises a group of highly interrelated industries. In 1992/93 the textile manufacturing industry in Australia employed more than 24,000 people. Victoria is the major textile-producing state, with nearly half of the industry's total employment.

Every process and almost every operation within a textile dyeing and finishing plant has an environmental aspect that should be considered and for which the environmental performance can potentially be improved.

The future development of the industry will depend on several factors, including the adoption of Best Practice Environmental Management (BPEM). BPEM encompasses the identification and implementation of policies that are environmentally beneficial while being consistent with business practices and commercial practicalities.

BPEM is synonymous with Best Practice Business Management. Both aim to maximise the efficiency of raw material usage, while minimising the consumption of energy, water and auxiliary chemicals and the discharge of environmentally damaging materials.

BPEM is driven not by compliance, but by the recognition that efficient resource usage results in increased productivity as well as reduced environmental impact.

1.1 OBJECTIVES OF THE GUIDELINES

These guidelines will help members of the textile dyeing and finishing industry develop programs, systems and practices to improve their environmental performance to best practice levels, in an affordable, sustainable and efficient way.

The guidelines identify the major environmental aspects of the textile dyeing and finishing industry and describe ways industry can assess and minimise potential and actual environmental impacts. Emphasis is given to the development of a managed approach to continual environmental

improvement through the adoption of an environmental management system (EMS).

1.2 SCOPE OF THE GUIDELINES

This document is intended as a guideline for industry participants seeking to adopt BPEM.

It contains information on:

- textile wet processing and finishing operations, and wastes generated
- Government's environmental policies and the regulatory environment
- opportunities for technology and process improvement
- strategies for setting environmental goals
- achieving environmental goals via an EMS, waste minimisation and cleaner production programs.

The guidelines can be used by all manufacturers and participants in the supply chain, government agencies and industry organisations. While the guidelines have been written specifically for Victoria, the principles and practices apply equally across Australia. The guidelines do not disadvantage Victorian operations over those in other States.

1.3 BEST PRACTICE ENVIRONMENTAL MANAGEMENT

Best Practice Environmental Management (BPEM) means managing an organisation or activity to achieve a high level of environmental performance which is sustainable, continuously improves and is consistent with business or economic objectives. Thus, BPEM needs to be integrated with overall management philosophy and practice.

The BPEM publication series comprises guidelines and codes of practice for industry sectors or activities, which outline what is needed to achieve optimum environmental outcomes, consistent with the industry's economic viability.

BPEM may encompass site selection, process design, technology choice, key operating parameters and procedures, contingency arrangements, and monitoring and auditing aspects.

BPPEM publications outline key environmental objectives relevant to the industry or activity and provide suggested measures to achieve these objectives. Satisfactory implementation of the suggested measures will result in meeting the objectives. However, operators are able to consider alternative ways to meet the objectives and to apply the best site-specific solution with an outcome equivalent to, or better than, the suggested measure. Thus, innovation is not stifled and flexibility is provided, while those seeking greater direction or certainty can simply apply the suggested measures.

The underlying philosophy of BPPEM guidelines and codes is to provide a forward looking approach rather than simply reflect the current norm. Where problems or issues occur within the industry, a direction or solution to these will be included.

A comprehensive EMS – preferably in accordance with the principles outlined in the International Organisation for Standardisation (ISO) 14000 series – is an integral part of BPPEM. These principles include the determination of all environmental aspects associated with the company's activities, and a process of continual improvement in environmental performance.

BPPEM provides the opportunity to harness the following benefits:

- reduction in unit costs
- opportunities for eco-marketing
- potential reduction in EPA licence fees
- possible preferred supplier status
- potential reduction in resource consumption
- sustainable improvements in environmental performance
- improved community perceptions and relations
- increased compliance with regulatory requirements
- reduced exposure to risk (occupational safety and health as well as environmental)

A BPPEM guideline or code is not of itself mandatory, but the potential exists to refer to such a document in approvals, licences or permits. Regulatory authorities generally expect forward-looking manufacturers who are committed to continuous improvement through a

total quality management approach, to voluntarily adopt BPPEM guidelines and codes.

BPPEM represents a commitment by management to adopt improved practices within the company. Appendix 1 summarises the new paradigm.

1.4 USING THE GUIDELINES

These guidelines focus on key issues and areas for investigation, and identify relevant information and source materials. The guidelines suggest feasible improvement measures specific to the textile dyeing and finishing industry, as well as methodology and tools. The guidelines do not aim to provide detailed technical solutions.

The guidelines identify the main environmental issues, related environmental objectives, and suggested methods by which the objectives can be met.

A checklist is provided in Appendix 2 to assist plant management carry out a thorough evaluation of the relevant environmental issues and identify all possible areas where action can be taken or improvements can be made.

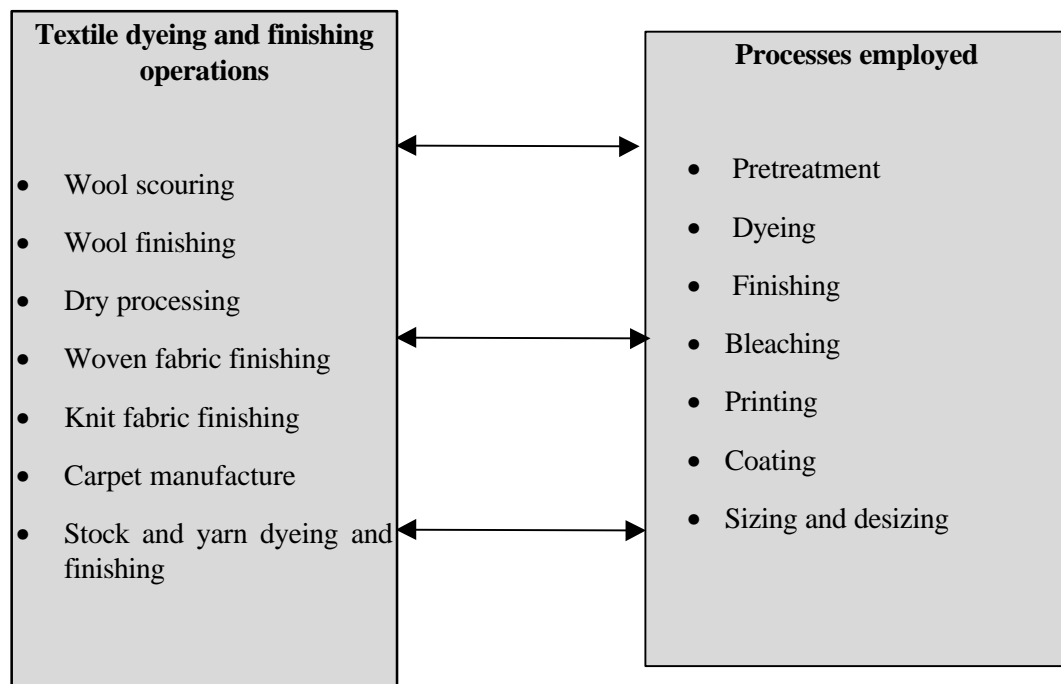
2 TEXTILE DYEING AND FINISHING

The textile dyeing and finishing industry has traditionally generated large volumes of waste and been a large consumer of energy.

As it may take 200 litres of water to produce, dye and finish one kilogram of finished textile, the industry has a high demand for water and serious effluent management issues to address. Textile finishing also requires the input of a wide range of chemicals which, if not contained in the final product, become waste treatment and disposal problems.

A large proportion of the environmental issues affecting the industry are related to the use and discharge of water. Washings from dyeing and rinsing operations may produce hot, alkaline, highly saline, odorous and highly coloured effluent.

Other environmental issues requiring consideration are energy, chemical usage, stormwater, solid wastes, emissions to atmosphere, contaminated land, noise, hazardous materials, groundwater and other environmental issues particular to the location of a facility.



3 STATUTORY REQUIREMENTS

Fundamental principles which guide Victorian Government policy and legislation on the environment include:

- pollution prevention (eg through waste avoidance and risk reduction)
- the precautionary principle (to enable prudent action to be taken in the absence of complete scientific certainty)
- sustainable development
- the “polluter pays” principle.

LEGISLATION

Current Acts, policies and Regulations administered by EPA are listed in Appendix 3 *References and Information Sources*.

The *Environment Protection Act 1970*

The *Environment Protection Act 1970* provides for the control of water, air and land pollution, industrial waste and the emission of noise. The Act is administered by EPA.

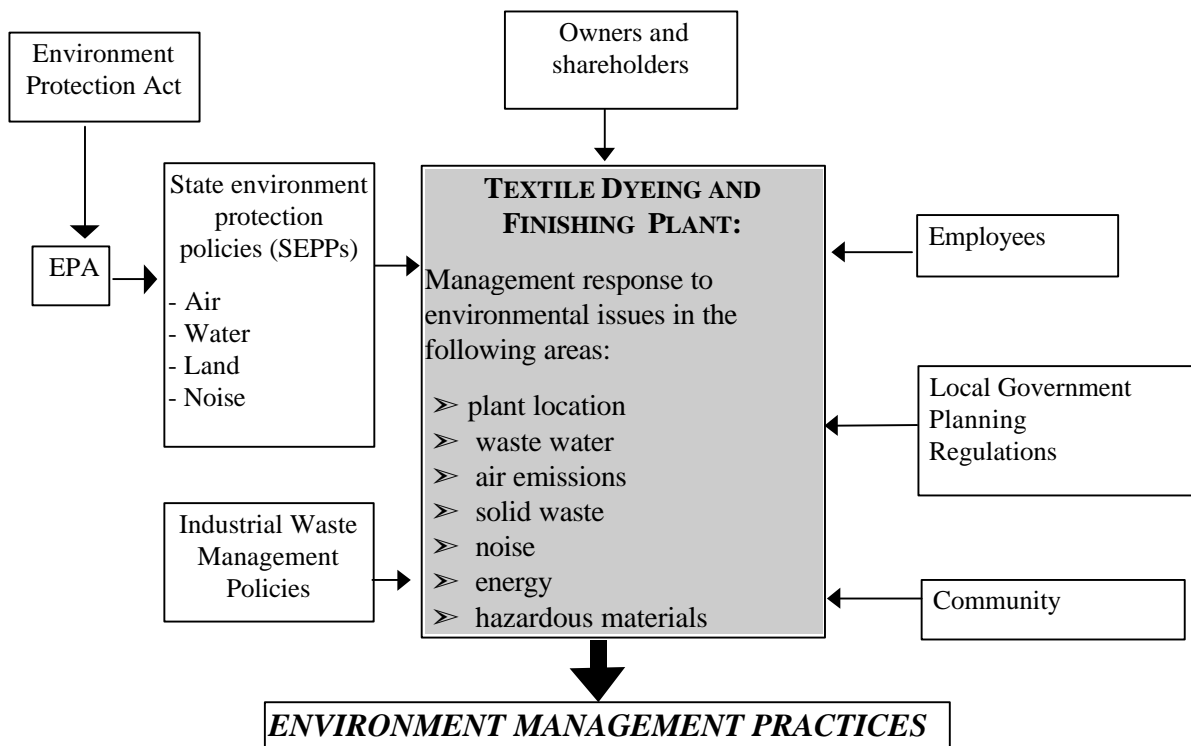
Under the Act, discharges of wastes into the environment must accord with State environment protection policies (SEPPs), which identify beneficial uses for particular segments of the environment, and establish ambient objectives and discharge limits.

Policies

The *Environment Protection Act 1970* provides for the formulation and adoption of SEPPs and Industrial Waste Management Policies (IWMPs) by the Government.

SEPPs provide a framework for environmental protection in Victoria by identifying “beneficial uses” of the environment to be protected, environmental objectives appropriate to those uses, and plans and programs for the attainment of those objectives.

IWMPs define and give effect to strategic plans for the management of industrial waste, including waste minimisation initiatives, and the regulation of waste treatment and disposal facilities.



The *State Environment Protection Policy (The Air Environment)*, (the Air Policy) specifies both emission limits and acceptable ground level concentrations for pollutants that may be emitted by industrial and other premises.

Emissions from industrial facilities must comply with the Air Policy.

Some design ground level air emission concentrations [SEPP (The Air Environment), Schedule C]		
	ppm	mg/m3
Ammonia	0.8000	0.60000
Acetic acid	0.0420	0.50000
Cotton dust (raw)		0.00670
Hydrogen chloride	0.2000	0.20000
Hydrogen sulphide	0.0001	0.00014
Odour	1 odour unit	

The Air Policy also requires the control of odorous substances and particles.

Schedules in the Policy set out the control requirements for specific industries.

Schedule F-4 describes requirements to control discharges of waste to air from the textile dyeing and finishing industry.

Under the Policy, EPA has discretion to exempt operations from compliance with Schedule F in certain circumstances. These include situations where compliance would preclude innovative control or energy saving technologies, and are discussed at 5.2.

Similarly, the *State Environment Protection Policy (Waters of Victoria)* and other SEPPs related to surface waters prescribe quality limits for wastewaters discharged to various receiving environments and water quality objectives for those water bodies. Requirements for wastewaters vary for different water bodies, where different beneficial uses may apply.

These may be defined in SEPPs for different catchments – for example, *Waters of the Yarra River and Tributaries (SEPP No W-29)* and *The*

Waters of Far East Gippsland (SEPP No W-21).

Some industries are undertaking direct application of wastewater to land for irrigation under EPA licence conditions. This accords with SEPPs for surface waters, which require that wastewater be directed to sustainable land disposal instead of being discharged to surface waters, wherever this is achievable.

Many wastewater discharges are to reticulated sewerage systems operated by water authorities or water businesses – in which case the discharge requirements are usually governed by the operator of the sewerage system and are not subject to direct EPA controls.

The *State Environment Protection Policy (Control of Noise from Commerce, Industry and Trade) No. N-1 1989*, specifies permissible noise limits in noise sensitive areas – such as residential buildings, hospitals and motels. The acceptable noise levels which are specified are related to the type of development in the surrounding area. Noise limits are set by adjusting background noise levels for day, evening and night conditions. If adequate buffer distances have been provided and maintained, noise requirements can more easily be met.

TYPICAL NOISE LIMITS: dB(A)			
	Day	Evening	Night
Residential	50-54	44-48	39-43
Commercial district	59-63	52-57	47-52
Predominantly industry	63-68	57-61	52-56

The SEPP applies only to the Melbourne metropolitan area. In country areas, EPA may set noise targets based on the SEPP and may use discretion in each particular case.

The *Industrial Waste Management Policy (Waste Minimisation) 1980* (Waste Minimisation Policy) specifies objectives for minimising industrial waste through avoidance and reduction, in preference to recycling and reclamation. Thus, this policy shifts the emphasis from regulatory approaches and “end of pipe” pollution control to “cradle-to-grave” controls. The *Industrial Waste Strategy* established

systems and controls for hazardous wastes, as well as fostering industry agreements for waste reduction and industry codes of practice.

Among other things, the Waste Minimisation Policy requires all new development subject to works approval under the Act to develop a waste management plan, with emphasis on waste minimisation.

Some processes generate wastes with a high potential to cause environmental harm. These “priority wastes” have to be specially managed and treated to minimise the risk of pollution. All new premises and modifications to existing processes generating “priority wastes” are required to use best available technology.

Regulations

The Environment Protection (Scheduled Premises and Exemptions) Regulations 1996 describe premises which are scheduled, and thus required to comply with the licensing and works approval provisions of the *Environment Protection Act 1970*. Specific discharges which are exempt from the licensing provisions are also listed.

Textile dyeing and finishing works are scheduled, and hence subject to works approval and licensing. This classification includes plants carrying out carpet manufacturing, wool scouring, and textile bleaching, dyeing and finishing.

However, sites which do not carry out both dyeing and finishing are exempt from licensing for discharges to air, although they still require works approval for the installation of new plant or modifications to existing plant.

As well as being required for the installation of new plant, works approval must precede alterations to existing scheduled premises, which will increase or change waste discharges. Works approval is also needed to relocate plant or waste discharge points. Refer to section 19A(1) of the *Environment Protection Act 1970* for a complete description of works approval obligations.

The *Environment Protection (Prescribed Waste) Regulations 1998* classify certain industrial and domestic wastes as prescribed waste. Prescribed waste can only be removed from a site by an approved waste transporter. Some of the solid wastes generated by the dyeing and finishing industry are prescribed (see Section 5.5).

The *Environment Protection (Prescribed Waste) Regulations 1998* also contain details of the transport certificate system for the movement of prescribed industrial waste and define the responsibilities of the waste producer, accredited agent, waste transporter and waste processor.

4 WASTE MINIMISATION

Waste minimisation is an important part of BPEM. By focussing on waste avoidance and reduction through use of cleaner production processes and practices, pollution control and waste disposal costs can be lowered.



Preference should be given to waste avoidance or reduction, ahead of recycling and reuse. If these type of actions are not possible then, and only then, should treatment be considered, followed by the least preferred alternative of waste disposal.

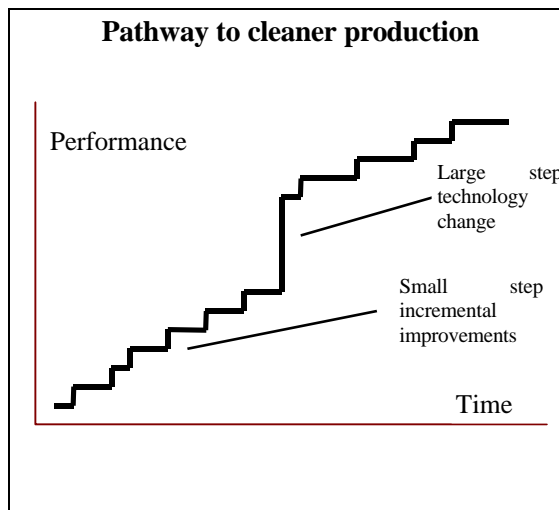
4.1 INTRODUCTION TO WASTE MINIMISATION

Waste minimisation includes good housekeeping practices and changes to staff attitudes, as well as technical factors. Improvements as simple as ensuring water is turned off when equipment is not working or arranging production to minimise the amount of cleaning required may collectively add up to significant gains. The potential impact of such non-technological or “low-tech” measures should not be underestimated.

Some of the smaller incremental improvements are easy to gain, but difficult to maintain. Teamwork and commitment from production staff, supported by strong management and effective management systems, should enable sustainable and continuous performance improvement.

Another essential part of waste minimisation is understanding what wastes are being produced and the processes which generate them. As well as establishing a baseline against which

improvements can be assessed, this data will allow waste reduction options to be evaluated.



4.2 IMPLEMENTING WASTE MINIMISATION

A useful approach to waste minimisation involves the preparation of a Waste Management Plan (WMP) The starting point for a WMP is a waste audit. This should:

- identify all gaseous, liquid and solid waste streams
- quantify and characterise the waste streams
- establish the methods of waste stream generation.

Having done the waste audit, a waste assessment is then carried out. This involves an investigation of production processes and raw material purchases, and an assessment of all waste streams.

A technical and economic feasibility analysis is then conducted to determine which waste minimisation opportunities identified should be adopted.

The WMP contains an implementation timetable and a description of the method of implementation, the anticipated cost and environmental benefits.

The waste minimisation program should not be a one-off activity, but should be periodically reviewed to ensure that the WMP is being adhered to, and to identify any new waste minimisation opportunities.

The waste minimisation program should also be an integral part of the company's approach to environmental management. Thus, it should be a key element when an EMS is established.

Specific waste minimisation measures are described in sections 5.2, 5.3 and 5.4

Potential waste minimisation outcomes
<ul style="list-style-type: none">• Less water inputs and wastes generated.• Less chemical usage.• Less energy input.• Faster dyeing cycles.• Improved economic performance.

Further information can be found in EPA publications *Guidelines for Preparing Waste Assessments – A Practical Guide Towards Cleaner Production* (Publication 277), *Guidelines for Preparation of Waste Management Plans* (Publication 383) and *Waste Minimisation, Assessments and Opportunities for Industry* (Publication 351).

Waste minimisation
<p>Objective</p> <p><i>To minimise waste generation and maximise economic benefits.</i></p>
<p>Suggested measures</p> <ul style="list-style-type: none">• Establish a management policy in support of waste minimisation.• Establish a waste management team which includes operators and technical staff.• Conduct a waste audit.• Assess viable waste minimisation projects.• Prepare a Waste Management Plan.• Increase staff awareness of waste minimisation principles and practices.• Increase operator understanding of performance factors.• Motivate operators to improve performance.

5 ENVIRONMENTAL ELEMENTS

Environmental elements relating to the industry are set out in the following sections. One of the main potential impacts of this industry is on water quality. Air quality, site selection, noise impacts and other important issues are also addressed.

5.1 SITING FACILITIES AND MODIFYING EXISTING PLANT

Environmental factors are one of the most important considerations in siting a new facility or upgrading an existing plant. Careful site selection can reduce the risk of environmental problems during the operational life of the plant. Important environmental factors to be considered in siting textile plants are:

- proximity to residential areas (buffer distance requirements)
- future land use
- site hydrology
- weather and prevailing wind conditions in relation to sensitive land uses
- geology and ground permeability
- site contamination
- proposed nature of wastes and treatment systems
- water supply and availability of waste-water treatment and disposal facilities
- presence of incompatible industrial neighbours.

These issues should be considered at greenfield sites and when relocating or modifying existing plant.

Requirements for planning new industrial developments are prescribed under the *Planning and Environment Act 1987*. Planning approval may be required for the establishment of a textile plant.

Buffer distances

In order to provide a basic level of protection from odour, dust and noise, a textile dyeing and finishing plant should not be located inappropriately with regard to designated residential areas or other sensitive land uses.

This is to protect the amenity of the area by anticipating possible unintended or accidental emissions that may occasionally arise from

causes such as equipment failure, accidents and abnormal weather conditions. The buffer distance is usually measured from the nearest textile activity capable of emitting odour.

Buffer distances should not be regarded as an alternative to good source control, as discussed in 5.2. Air modelling studies may be necessary at the design stage for large operations to assist in assessing the possible risk of adverse impact on local amenity.

Siting should also take into account the need to protect sensitive natural water resources. Thus a textile plant should not be sited within 100 metres of surface waters, nor be located on a flood plain or in declared special water supply catchment areas, unless adequate protection of surface and groundwaters can be demonstrated by the proponent.

Buffer distances between textile plant processing operations and sensitive areas should be determined with reference to *Recommended Buffer Distances for Residual Air Emissions* (EPA Publication AQ 2/86).

Where a new or modified facility is proposed within a recommended buffer, a risk assessment should be carried out to assess the potential for adverse effects on sensitive uses. If a risk assessment shows unacceptable risks, alternative siting or technology need to be considered.

Buffer distances usually are considered for new or green field sites or for additional work on existing sites. If there is to be substantial development on existing sites with potentially inadequate buffers, the site developers usually need to show that the introduced technology will reduce any risk of adverse impacts.

A buffer may be occupied by compatible non-sensitive land uses. Buffer zones can also be provided within a site by wise use of available land. Some typical buffer distances for textile industries taken from *Recommended Buffer Distances for Residual Air Emissions* (EPA Publication AQ 2/86) are provided below.

Industry	Classification	Recommended buffer distance (m)
Dyeing or finishing of cotton, linen and woollen yarns and textiles		300
Carpet backing with latex		300
Production of artificial fibres and textiles	(a) cellulose nitrate or viscose fibre	1,000
	(b) other synthetic fibres and textile	500
Treatment or production of textiles	(a) using carbon disulphide	500
	(b) using other substances	Determined by EPA on site-specific basis
Rope, cordage and twine		100
Wool scouring		200

Siting
<p>Objective</p> <p><i>To minimise environmental impacts by appropriate site selection.</i></p> <p>Suggested measures</p> <ul style="list-style-type: none"> • Site new plants in accordance with buffer distance recommendations <i>Recommended Buffer Distances for Residual Air Emissions</i> (EPA Publication AQ 2/86). • Site at least 100 metres from surface waters. • Site so that prevailing winds will not transport pollutants and noise towards sensitive land uses. • Consider the current and future proximity of sensitive developments.

5.2 AIR QUALITY

Types of emissions

The main emissions to atmosphere from textile dyeing and finishing processes are odours and particles. These emissions arise from drying, bleaching, heat setting, stentering and other finishing processes. Their control represents a major challenge to the industry.

The *SEPP (The Air Environment)* contains specific requirements for stationary sources and specifies emission limits for various pollutants.

As previously noted, Schedule F4 of the *State Environment Protection Policy (The Air Environment)* sets out emission controls for textile dyeing and finishing plants.

However, the Policy allows EPA to exempt sites from compliance with Schedule F, subject to ambient objectives being met. The policy identifies the following matters as being relevant:

- compliance with policy would increase or create waste disposal problems
- compliance would preclude the use of energy saving technology or innovative controls
- compliance cannot be achieved by using reasonably available technology

- maximum ground level concentrations will not be exceeded and the discharge will not adversely affect any beneficial use of the environment.

In considering an exemption, EPA will look at how effectively the proposed alternative technology will control emissions compared with the controls set out in Schedule F4.

In accordance with the SEPP, EPA licences impose specific requirements for emission controls for a production facility. Emissions can often be estimated from a knowledge of products used and volatiles likely to be emitted, but usually need to be determined by testing. Ground level concentrations can then be determined at the peak operating conditions through the use of plume dispersion modelling.

Common air emissions in textile dyeing and finishing	
<i>Emission</i>	<i>Sources</i>
Water and steam	Drying, stentering and heating operations
Carbon Dioxide	Boilers, forklifts, engines and transport
Oils and mists	Finishing, stentering, proofing
Solvents, VOCs	Stentering, drycleaning and washing processes
Ammonia	Dyeing and printing
Formaldehyde	Coating, crosslink finishing
Carriers	Dyeing
Organic finishes	Coating and finishing

BPEM involves investigation of these emissions, identification of ways to avoid or minimise them, and formulation of controls on residual emissions to reduce any negative impacts on the environment. This process should consider emissions during both normal and abnormal operating conditions – such as plant and process start-up, commissioning of new plant, power and equipment failure, and fires.

The introduction of new products such as dye carriers and lubricating and finishing oils should

be preceded by screening for their potential to generate odour and smoke emissions

Waste minimisation

Waste minimisation is an integral part of BPEM. Each facility should initially investigate opportunities for waste reduction through process, material or product changes which may result in elimination of emissions or reductions in their quantities or toxicity.

For example, emissions will be minimised for a particular heat setting or stentering process if the coating used on the fibre is applied at the optimal level. Non-optimal coating layers will result in correspondingly greater emissions and the facility will lose money in wasted inputs as well as the increased requirement to treat wastes.

In recent years, the use of toxic moth proofing agents that do not biodegrade readily – such as pentachlorophenol – by the textile finishing industry has ceased. Alternatives to formaldehyde based resins are also available to reduce the environmental risk of this biocide.

Quantification of the processes which generate emissions will lead to better understanding of waste generation and hopefully the identification of both simple and more complex opportunities to reduce emissions.

Drying operations

There are several different technologies available to textile finishing facilities for drying. Each of the drying processes – mechanical drying, steam heating, hot air, or RF drying systems – should be examined from the point of environmental outcomes as well as efficiencies, energy consumption and cost. Monitoring intermediate and final product moisture levels and using this information to optimise drying processes is sound practice.

Stenters

Stenters may be major emission sources of particle emissions. As well as applying waste minimisation practices – such as using optimum coating levels and applying less volatile coatings – the following steps should be considered:

- examining opportunities to use less volatile finishes, less toxic and odorous chemicals in dyeing
- turning off power to machine when not in use (this may be automated)
- optimising oven performance (measure it first)
- splitting the oven exhaust wastes and recycling the clean streams (most of the volatiles are emitted in the first oven)
- warming up incoming gases using heat exchange with out-going hot emissions (equipment has been specifically designed for this application)
- using moisture meters to minimise the amount of exhaust gases required for the process by motor control
- using a mist eliminator to reduce particle emissions.

gases from an afterburner could be used to preheat incoming waste stenter gases.

Control systems

Emissions of waste gases can be controlled using stack gas treatment systems.

The following emission control systems should be investigated as part of BPEM:

- diversion of stack emissions to neutralise alkaline effluent (CO_2 to $\text{CO}_3\text{H}_2\text{CO}_3$)
- diversion of stack emissions through the boiler, to reduce VOC and odour emissions
- cooling and filtration (heat recovery possible)
- gas scrubbing (water pollution and operating cost high)
- electrostatic filtering (removal of particles requires energy).

The applicability of the above approaches will depend on individual circumstances.

Some of these systems are very efficient in contaminant removal, but do not necessarily eliminate wastes. For example, stack gas scrubbing to remove volatile organic components does not destroy these contaminants, but condenses them into a liquid. This has to be discharged as effluent or as a sludge requiring specialised disposal. This reinforces the desirability of waste minimisation.

It is possible to save energy by using hot emissions to heat up incoming gases. For instance, exhaust

Air emissions

Objective

To reduce air emissions and conserve energy resources, to ensure there is no health risk or loss of amenity.

Suggested measures

- Review and analyse emissions and monitor and analyse consumption of inputs which generate these emissions.
- Assess opportunities to replace volatile with non-volatile components and toxic with lower toxicity components.
- Assess each material for its toxicity and environmental hazards:
 - is it a priority waste, listed in Schedule A of the *Waste Minimisation Policy*?
 - does it contain toxic components?
 - is it reactive with other materials?
 - will it photodecompose?
 - is it particularly odorous?
- Review all coating materials for volatility and odour potential.
- Reduce coating concentrations where practical.
- Run fans and ventilation equipment more efficiently:
 - use speed variation to reduce emissions
 - switch off equipment when processes are not running.
- Reuse exhaust gases in other parts of the plant or off-site.
- Automate the operation of machinery to switch off when not in use.
- Monitor and control fugitive emissions.
- Capture emissions from heat setting machines and duct to a chimney.
- Use pressure dyeing machines where practical.
- No heat setting of goods with excess volatiles (more than 0.3% w/w).
- Ensure atmospheric batch dyeing machines are vented and fugitive emissions controlled.
- During dye carrier and/or sulphur operations for atmospheric batch dyeing, machines should be completely enclosed with any venting ducted to a chimney.

5.3 WATER QUALITY

The most difficult environmental issue for the textile dyeing and finishing industry is the generation of wastewaters. Effluent quality limits can be difficult for companies to meet and are likely to become more stringent, requiring textile dyeing and finishing operations to employ waste minimisation, to avoid resorting to expensive on-site treatment.

Environmental issues associated with textile industry effluents include:

- residual dyestuffs – toxicity, colour, biodegradability
- halogenated organic compounds (AOXs)
- heavy metal contamination (Cr, Cu, Zn)
- surfactants and synergistic relationship with toxicants
- salts in effluent which is to be reused for land application
- auxiliary agents for dyeing – toxicity and biodegradability
- finishes – toxicity and biodegradability
- elevated temperatures
- high levels of total oxidised sulphur (TOS)
- high BOD levels.

Policy requirements

The first priority for wastewater management is the implementation of waste avoidance and reduction.

Where reticulated sewer is available, wastewater should be directed to the sewer, with the approval of the system’s operator. Pretreatment may be required.

Where sewer is unavailable, the preferred method of managing wastewater is to use it for land irrigation, in accordance with the *SEPP (Waters of Victoria)*. Irrigation schemes should be designed in accordance with *Guidelines for Wastewater Irrigation* (EPA Publication 168), to be sustainable and avoid contaminating land or groundwater.

Disposal to surface waters should only be considered if a combination of waste minimisation, recycling and land irrigation cannot avoid a wastewater discharge to surface water.

If discharge to surface waters is being considered, the requirements of the relevant SEPPs must be observed. Key parameters for policy compliance include toxicity, colour and total dissolved solids (TDS). Discharges should not display acute or chronic toxicity; discharges should not cause objectionable colours in receiving waters; and TDS levels in receiving waters should not be increased unacceptably.

To ensure policy compliance, wastewater quality should be comparable with that of the receiving waters. This would be likely to require a treatment regime combining processes such as sedimentation, chemical dosing, dissolved air flotation, biological oxidation and filtration. The capital and operating costs of such complex treatment processes may be significant. These processes also generate sludge, which requires an environmentally sound disposal route.

An assessment of potential TDS impacts would have to consider the characteristic high TDS levels of textile industry wastewater and the large natural TDS variation in Victorian waters (from tens of mg/L to thousands of mg/L). Thus, such an assessment should be site-specific and may have to consider treatment processes such as reverse osmosis.

Minimising wastewater generation

As for emissions to atmosphere, the general approach to wastewater minimisation is to:

- audit all wastewater streams
- assess options for minimising each individual stream
- prepare a plan for implementing the selected options.

A good starting point is to ensure that formulations do not use excessive amounts of chemicals or water. This may involve a program of trials and monitoring. Once the optimum formulations have been determined, operating procedures should be put in place to ensure they are adhered to. A number of Victorian plants have successfully used this approach.

When assessing options to minimise wastewater streams, consider the following methods:

- minimise machine cleaning through better maintenance and production planning

- optimise production to reduce liquor ratios
- optimise and reduce the number of rinses
- optimise cycle times and job turn-around
- use lower liquor ratio machinery
- reduce reprocessing through better quality controls
- combine rinses with scours
- scours may be done in dyebath
- recycle steam condensate back to boilers
- recycle cooling waste to use as hot/ mixed hot-cold fill
- recycle rinses as feeds for dyebaths and scour baths
- recycle “clean rinses”.

A key factor in water usage in dyeing, scouring, bleaching and other textile finishing processes is the “liquor ratio” – the volume of liquor required in the process per kilogram of fibre. Dyeing plants have been developed which operates with progressively lower liquor ratios to reduce water usage. Care should be taken to investigate the overall environmental impact of some of these processes before a decision is made to adopt them.

Liquor ratios for various dyeing processes	
<i>Process litres/kg</i>	
Dyeing winches	20-30 : 1
Hank machines	30 : 1
Jet dyeing	7-10 : 1
Package dyeing	5-8 : 1
Pad batch	5 : 1
ULLR dyeing	5 : 1

Exhaust dyeing can achieve high levels of dye fixation to the fibre and may produce significantly lower levels of dye waste.

Simple effluent volume reduction may result in reduced effluent disposal charges, but the effect of volume reduction may simply be to concentrate contaminants. This could require contaminant minimisation or treatment to meet

trade waste acceptance standards or to reduce environmental impacts in cases of discharges to surface waters.

Dyebaths

Dyebaths generally have high levels of BOD/COD, colour, toxicity, surfactants, fibres and turbidity, and may contain heavy metals. They generally constitute a small fraction of total liquid effluent volumes, but may contribute a high proportion of total contaminants.

Dyes naturally tend to generate highly visible colour problems. The reduction of colour in the spent dyebaths will help reduce the final effluent colour.

Methods to reduce dyebath contamination levels include:

- choose biodegradable surfactants
- reduce salt usage in dyebaths – high levels of salts make reuse of the spent liquors difficult and expensive
- ensure dye fixing is maximised
- recycle light shade dyebaths into darker shades
- flocculate or otherwise remove dyes from dyebaths before dropping them to effluent, or for recycling.

Both dyes and application technologies are being continually improved. Each facility should balance the cost of dyes and processes against the environmental cost of cheap materials and wasteful processes. In particular, plant management should examine:

- use of low salt dyes
- dye toxicity and carcinogenicity, and heavy metal content
- pad batch, spray and other low volume application techniques
- use of CO₂ for neutralisation instead of mineral acids
- use of low temperature dyeing techniques
- use of dyes with high levels of exhaustion
- use of dyes that fix well onto the fibre and require less rinsing
- replacement of reactive dyes with direct dyes – especially with heavier shades – to save

water in fixing and washing off (soaping and rinsing)

- improving repeatability of shades – hence reducing the need to correct shades – by maintaining more accurate records and better dye delivery systems.

Suggestions for bleaching
<ul style="list-style-type: none">• Avoid chlorinated bleaches where possible (hydrogen peroxide may be used to avoid pollution).• Recycle unspent bleaching liquors.• Avoid the need for bleaching by minimising reprocessing.• Reduce machine cleaning requirements with more timely maintenance and by planning production to follow light shades with dark.• Post-bleaching of peroxide stable shades bleach in boil-off bath of dyeing.

Treatment of dyebath wastewater

Technologies are available to purify almost any waste stream from a textile facility. However, the cost of many of the treatment options makes waste reduction an attractive alternative.

The following techniques may be used individually or in combination:

- electrolysis
- adsorption (should be reversible)
- ultra-filtration, and reverse osmosis
- activated sludge digestion
- dissolved air flotation
- bacterial treatment (aerobic and anaerobic)
- ozone treatment
- oxidation/reduction (may lead to more pollution)
- flocculation – alum and ferric (again may lead to more pollution).

The removal of dyes and other contaminants may simply transfer the waste problem from one phase to another. Many of these treatments will end up with a toxic byproduct that may have to be disposed of at a secure landfill.

The BPEM solution to the problem of residual dyes and auxiliaries in effluent is to maximise the fixation of the dyes on the fibre and to consider recycling the spent dyebath, after treatment if necessary.

Salt in dyeing effluent

Salts are an important issue for the textile dyeing industry. Common salts are required in a number of dyeing systems – particularly for cotton dyeing where reactive dyes are used.

The low value of salts makes them a poor target for recovery and the small nature of the ions comprising salts makes them difficult to remove by standard effluent treatment methods. They are not removed by biological treatments and require physical or chemical separation techniques (reverse osmosis, evaporation, electrolysis).

Salts may affect the application of effluent to land for irrigation purposes. It may be possible to examine the use of different salts, which improve effluent sodium adsorption ratio (SAR) and hence improve reuse options.

BPEM is to use low salt dyeing techniques and to examine opportunities for dyebath recycling.

Finishing applications

Finishing can lead to high levels of pollutants in wastes. The moth proofing agents most commonly used – pyrethrins – have a high degree of insect toxicity. If this material is over applied, does not adhere well to the fibre, or washes off in post-treatments, the resulting wastes can be highly contaminated with pyrethrins.

Heavy metals in finishing treatments and other contaminants such as fluorides used for flame-proofing can also lead to contamination of wastewater that is difficult to treat.

Finishing treatments should also be examined in terms of the end use of the products. The “cradle-to-grave” approach to environmental management will include consideration of the recyclability or reusability of the textiles after the products have finished their natural life. If a product is likely to be incinerated there may be environmental problems if it contains heavy metals or resins that may break down to form toxic gases.

Once options for material substitution have been examined, the next step to reduce contamination of the effluent from finishing materials is to monitor and improve the level of fixation to the fibre. If padding or spraying is used as an application method, can the over spray and remaining baths be kept and reused? If these options are exhausted it may be possible to separate and treat these waste streams before they are discharged.

Wastewater
<p>Objective</p> <p><i>To reduce water consumption and wastewater loads.</i></p>
<p>Suggested Measures</p> <ul style="list-style-type: none"> ● Audit the wastewater streams to determine the processes causing high volumes of water use and those generating contaminated effluent. ● Optimise formulations, to reduce chemical and water usage. ● Examine opportunities to replace toxic and non-biodegradable chemicals and dyes with alternatives that have a low toxicity and are readily biodegradable. ● Consider processes that use less water and chemicals. ● Improve quality procedures to reduce reprocessing. ● Use preventative maintenance to reduce breakdowns and associated wastes. ● Confirm reduction targets and associated savings. ● Identify possible reduction opportunities throughout processes. ● Examine automated control technologies ● Establish reduction and recycling strategies for high volume waste processes and contaminated waste streams.

5.4 CHEMICAL AND WASTE STORAGE AND HANDLING

Although it is necessary to store chemicals and wastes at textile industry sites, this inevitably creates an environmental risk. Spills can severely pollute land, surface waters and groundwater. A spill of even a low toxicity, biodegradable material to a waterway can lead to severe oxygen depletion and the death of aquatic life. Although spillage may be accidental, the responsible organisation may be liable for any environmental damage which occurs.

Staff training is particularly important, as many spills are the result of human error. Management must ensure that staff are trained and prepared to prevent spills and know how to take corrective action to contain spill material or prevent its release into the environment. This type of training must be continuous.

Staff must have access to adequate information about the nature of materials used in the work place, the hazards associated with their use and safe handling and spill control measures. A comprehensive and up to date set of material safety data sheets must be available, along with emergency procedure guides and safe handling notices in storage areas.

Clearly, a program to reduce the environmental risks associated with spills should be carried out. It should include the following elements.

- Firstly, audit current chemical and waste storage facilities, and identify potential risks.
- Implement a program to reduce risks, based on the results of the audit. The program should consider:
 - reducing inventories
 - replacing below ground with above ground tanks
 - replacing hazardous materials with less hazardous/non-hazardous materials (for example, replace mineral acids with acetic or formic acid)
 - using automatic dispensing systems
 - bunding.
- Provide contingency plans to deal with any spills which occur. Plans should consider issues such as:

- isolating and recovering spilled materials *before* they enter the environment or sewerage systems
- containing and cleaning up spills which have entered waterways
- disposal or reuse of recovered residues
- contacting key company and government agency personnel to advise them of the emergency.
- Provide *continuous* staff training.

Chemical and waste storage and handling

Objective
To reduce the risk of spillage or other losses which cause environmental damage.

Suggested measures

- Audit chemical and waste storage and handling, and evaluate the associated environmental risks.
- Determine protective strategies and prioritise these in a plan, which may include the following:
 - reducing inventories and using less hazardous materials
 - storing liquids in above ground storage tanks
 - using automatic dispensing systems
 - installing bunding in accordance with *Bunding Guidelines* (EPA Publication 347) and *Australian Standard AS1940*
 - installing spillage and fire water containment systems.
- Establish an inspection, maintenance and monitoring program.
- Establish a staff awareness and training program.
- Develop, and keep up to date, emergency plans and manifests.
- Confirm that the storage and handling of chemicals complies with the *Dangerous Goods Act 1985* and applicable *Dangerous Goods Regulations*.

5.5 SOLID WASTE AND PRESCRIBED WASTE

Solid wastes do not generally present major environmental problems in textile dyeing and finishing. Most of the solid waste is generated by salt bags, dyestuff and chemical containers and packaging. Other solid waste includes waste fibre and sludges from water purification and effluent treatment facilities.

Waste fibre

Waste fibre can be recycled as a feedstock for other operations, including:

- cleaning
- dye adsorption
- boiler feed
- external uses
- quilting
- fibre pilling
- insulation
- geotextiles
- low grade products
- respinning and weaving
- non-wovens.

Packaging waste

Chemical containers present a disposal problem, even when empty. A number of regulations apply to reuse and transport of empty chemical containers. Production facilities should investigate bulk chemical delivery rather than supply in small containers to avoid disposal problems.

Packaging waste

Objective

To reduce all forms of packaging going to landfill.

Suggested measures

- Accept goods in bulk wherever practical.
- Use returnable containment systems (collapsible minibulk containers).
- Use recyclable containers.
- Seek to return all non-recyclable containers to suppliers.
- Segregate containers into recycling areas (plastics, paper and cardboard, steel).
- Reuse non-hazardous containers.

Solid waste disposal

Solid wastes from a dyehouse and finishing plant have traditionally gone directly to municipal tips. Under the *Environment Protection Act 1970* the waste generator has a responsibility to ensure that wastes are properly disposed of. Some solid wastes generated by the textile finishing and dyeing industry are classified as prescribed wastes and must be transported in accordance with the *Environment Protection (Prescribed Waste) Regulations 1998* to a suitably licensed landfill.

These include:

- boiler blowdown sludge
- filter cake sludges and residues
- dyes
- chromium compounds
- oxidising and reducing agents
- peroxides
- surfactants
- pesticides.

For a complete listing, refer to the *Environment Protection (Prescribed Waste) Regulations 1998*.

Solid waste reduction

Objective

To minimise the production of all forms of solid waste.

Suggested measures

- Audit solid wastes generation and evaluate disposal systems and costs.
- Identify opportunities to avoid or reduce solid wastes:
 - reduce packaging waste
 - seek to have suppliers accept returns of left over materials
 - seek greater process efficiencies and less reprocessing
 - introduce processes that generate less solid wastes.
- Examine opportunities to reuse solid wastes currently going to landfill, for example:
 - composting of putrescible solid wastes
 - food wastes as animal feeds
 - recycling fibre wastes
- Establish quantification and monitoring systems for prescribed wastes.
- Wherever practical, minimise generation of prescribed wastes.
- Establish systems to ensure that prescribed wastes are managed in accordance with the relevant Regulations.

5.6 NOISE

Noise coming from a textile production plant may have a significant impact on the local environment. Textile plants in the Melbourne metropolitan area must comply with the *State Environment Protection Policy (Control of Noise from Commerce, Industry and Trade) No. N-1*.

Impacts are greater where, as is the case for many sites, textile plants are close to residential areas. Because of the high potential for noise to affect amenity, management should give high priority to liaising with the local community so that it can be aware of, and effectively resolve, noise issues. Potential noise impacts should be considered at greenfield sites and when existing plant is being modified or relocated.

Noise abatement can often be achieved by simple non-technical measures such as closing doors and shutter windows, controlling delivery hours and restricting fork lift movement on open roads. Telephones and loudspeakers can affect residential areas and should be considered. Simple measures such as ensuring loudspeakers are directed away from residential areas may be effective.

Where noise abatement requires more detailed analysis and control, an acoustic consultant should be used.

Noise in textile processing equipment	
<i>Source</i>	<i>typical levels dB(A)</i>
Steam injection systems	
Ventilation fans	55-69
Hooter/siren	57-70
Air compressors	46-69
Brushing machines	
Hydro extractors	
Forklift	50-60

Noise
<p>Objective</p> <p><i>To ensure no noise nuisance results from the facility.</i></p>
<p>Suggested measures</p> <ul style="list-style-type: none"> ● Locate unloading and transport operations away from residential and other noise sensitive areas. ● Ensure “hooters” are used for emergencies only. ● Avoid use of paging systems. ● Eliminate water hammer. ● Maintain steam and air hoses. ● Isolate equipment with vibration absorbent pads. ● Consider using acoustic louvres and double glazing to reduce noise. ● Liaise with the local community to identify noise issues.

5.7 ENERGY CONSUMPTION

Energy efficiency and waste minimisation are often closely linked. Measures that avoid or reduce wastes often save energy and vice versa. Many of the energy savings that may be made in any facility relate to staff awareness of the need to conserve energy and their attention to small measures that can collectively make a big difference. Heating and lighting energy requirements can be reduced through sensible conservation measures.

Textile dyeing and finishing facilities use significant quantities of energy for steam, power for motors, direct heat for drying, air compressors, air conditioning and cooling. Each facility should consider and quantify the energy usage of its processes and its overall energy costs. The main opportunities for energy savings will reside in the largest energy-using processes and products. Derivation of energy consumption benchmarks (for example, kJ/kg of production) is a good starting point if the various production processes can be so characterised.

Comparisons of the energy costs of drying methods usually present good opportunities for energy and cost savings. Steam, gas and RF drying comparisons have shown that it is important to look at the efficiency of heat production and then the efficiency with which this heat is transferred to the fibre.

Options to reduce energy consumption which should be considered are outlined below.

Heat recovery

- Recover cooling water and use it as heated input water.
- Return steam condensate to boilers.
- Reuse different process waters.
- Examine the efficiencies of existing heat exchangers.

Lighting

- Look for opportunities to delamp by better use of natural light, upgrading lamp efficiencies, or adjusting areas which are overly bright.
- Use of motion sensor switches (smart lighting).

- Use of daylight compensation dimmers.

Compressed air

- Reduce operating pressure where possible.
- Eliminate all leaks – even small leaks can be costly.
- Shut down compressors on main air lines during idle periods.
- Size the compressors to the application.
- Size main lines correctly.

Operation of stenters/drying chambers

- Do not over dry (temperature and time).
- Use heat exchangers between inlet and outlet air.
- Aim for a maximum exhaust moisture of 150 g/kg when drying (less air = less energy).
- Use auto pilots.
- Investigate low pick-up techniques and technologies.
- Minimise energy use during stand-by periods.

General

- Examine and use low temperature technologies.
- Exchange heat from hot effluent to incoming waters for boilers or hot baths.
- Recover heat from boiler stacks and hot waste streams.
- Install frequency inverters on electric motors to reduce electricity usage.
- Provide cut off systems to save energy during start up and shut down, and stagger equipment start ups.
- Insulate dyeing vessels, dryers and boilers.
- Insulate dryers.
- Use more efficient pumping systems (displacement pumps rather than pressure pumps).
- Recycle cooling waters as heated input waters for rinses or dyebaths.
- Upgrade to high efficiency pumps and electric motors.
- Match the pump size to the application.
- Measure boiler output in kilojoules and calculate the energy yield.

- Review dyeing programs and reduce temperatures and time settings where possible.
- Use of combustible wastes as fuel.
- Consider regulating air or water flows in air conditioning with variable speed drives or motors.

Energy saving plan

The saving of energy requires a monitoring program, the setting of goals and targets, and concrete plans to implement changes. A review of program outcomes and the accounting of energy consumption to individual processes and products is important for making decisions on the energy and environmental costs of products and processes.

Any reduction in energy usage has the additional benefit of reducing greenhouse gas emissions, as well as reducing operating costs.

Energy
<p><i>Objective</i></p> <p><i>To improve the efficiency of energy usage and reduce consumption of energy per unit of production on a continuous improvement basis.</i></p>
<p><i>Suggested measures</i></p> <ul style="list-style-type: none">● Conduct an energy audit to determine the major areas of energy use, and define and value each waste energy stream.● Determine and monitor the efficiency of major energy using processes.● Examine opportunities for energy use reduction.● Compare systems for efficiency in terms of cost and actual energy use.● Prepare a program of improvements in efficiencies.● Recognise and reward contributions from staff.

6 ENVIRONMENTAL MANAGEMENT

EPA encourages the responsible self-management of environmental issues by industry through environmental management plans and environmental management systems (EMSs). EPA's ability to recognise good environmental management has been enhanced through the introduction of the accredited licensee system. These initiatives should be incorporated in the BPEM program.

6.1 BENEFITS OF SOUND ENVIRONMENTAL MANAGEMENT

With commitment from management and staff, a company can gain continuing advances in environmental performance through the implementation of an EMS.

Establishment of an EMS within a company enables the integration of environmental policies and programs into management policy and business operations. The EMS includes:

- the adoption of environmental policies and objectives
- the formulation of environmental plans and programs
- the setting of performance targets
- the establishment of a system of regular monitoring and review of environmental performance.

A key feature is that it involves personnel at all levels of the organisation in the achievement of environmental objectives.

An EMS is a highly desirable component of the total management program for a textile dyeing and finishing operation. Environmental management needs to be pro-active and deal with the full range of environmental issues – both routine and unexpected. Reducing wastewater loads needs as much attention as controlling chemical spills.

Environmental management is an ongoing process, not a one-off exercise or a single management plan. A fundamental principle of EMS is continuous improvement.

An EMS itself does not guarantee that all of a company's environmental problems will be

solved promptly and efficiently. However, it provides a framework within which the organisation's skills and resources can be used effectively in tackling the opportunities for environmental improvement, starting with the highest priority projects – those that involve compliance and issues of due diligence for management and those that can make a significant positive impact on environment and economic performance.

The EMS should not exist as an independent element in a management program. It should be integrated with other management structures – such as those for production, planning, quality management, and occupational health and safety. An integrated approach will yield the maximum benefits because the fundamental elements of these management systems are related and incorporate commitment, policy, targets and programs, monitoring, and review to achieve continuous improvement.

In summary, the benefits of sound environmental management include:

- improved performance (environmental and economic) and reduced risk
- due diligence (regulatory, compliance and more)
- enhanced community relations and perceptions
- potential for eco-marketing
- sustainable operations (that do not create resource or waste problems)
- performance measurement for better production management
- improved corporate image.

6.2 KEY ELEMENTS OF AN EMS

Commitment

Management needs to be fully committed to environmental improvement to provide the sustained impetus to introduce and implement an EMS, and to win the commitment and support of staff at all levels in the organisation. The person or people with principal responsibility for EMS implementation must be

in a position to make or influence decisions on planning and resource allocation.

Staff commitment is also critical to the successful implementation of an EMS. Many of the functions performed to generate improvements are at an operational level. Housekeeping and other basic operational functions that save resources and reduce environmental problems cannot work unless staff are involved in, and supportive of, the environmental improvement process.

Initial performance review

This may be called an environmental audit and should include:

- assessment of impacts of wastes and emissions, raw material supply and consumption, and energy consumption
- review of compliance with environmental law
- evaluation of environmental implications of all company operations
- environmental risk assessment
- review of management and monitoring systems
- review history of environmental performance.

At this point it may be suitable to compile a register of environmental regulations and compliance issues, and a list of environmental aspects for consideration.

Management should then be in a position to identify the major priorities for environmental improvements, and what resources are required to run the EMS.

Environmental policy

This sets the vision for the organisation in terms of its environmental performance. With knowledge of the current position and opportunities for improvement, management can set the basis for improvements.

The policy needs to establish a strong direction for the organisation if the EMS is to succeed. It is much better to establish policy objectives that the organisation can reasonably achieve, and for which realistic actions can be formulated.

Suggested features of environmental policy

The policy should:

- be appropriate to the nature of the company's operations and impacts
- include a commitment to continuous improvement and cleaner production
- require compliance with all legislation and regulation
- provide a framework to set and review the objectives and targets
- be documented and communicated to all staff
- be available to the public
- have authority from the highest level in the organisation.

Objectives, targets and the program

Once a policy is in place, strategic objectives can be set that are reasonable and achievable. The objectives should cover all of the priority areas for environmental performance improvement.

Objectives must have a measurable outcome and a timeline for achievement. From the objectives, a series of targets can be set to ensure that the objectives are met in a timely fashion. An example is given below.

Objective

Overall waste levels shall be reduce by 15% per year, measured as a fraction of total production.

Targets

1. Dye rinses shall be monitored and reduced by 15% in year 1.
2. Water purification system shall recycle all backwashes in 6 months
3. Chemical wastage shall be monitored and reduced by 5% in the first year

Objectives and targets should include control measures that will extend preparedness for emergencies and excursions from normal operations.

The program established to meet objectives and targets should use the strategies of cleaner production and waste reduction.

Implementation and operation

The EMS should be an integral part of overall management. If ISO 9000 for quality control is in operation, the EMS should pick up the document control procedures in use, and environmental objectives can be added to the management reporting system.

It is essential that the responsibilities and actions within an EMS are structured so that the people responsible can *make things happen*, and that reporting to the highest level of management from each department is mandatory. This will ensure that the EMS is not relegated to the background when other pressures are placed on the organisation.

Training, awareness and competence is critical to ensure effective operations and implementation of an EMS. The training should include all personnel whose work may create a significant impact upon the environment. Employees must be made aware of all significant impacts their activities could cause, and be aware of emergency preparedness and response requirements.

The EMS, including key procedures, should be documented and periodically reviewed and revised.

Reviews and corrective action

Continuous monitoring and regularly programmed reviews of all components of the EMS are necessary to ensure that:

- performance is optimised
- changes in market, business and regulatory environments are taken into account
- achievement of objectives and targets is in line with policies.

It makes sense to review the EMS when other management systems are reviewed.

Audits and compliance

Auditing can be conducted using internal or external auditors. It is wise to get independent people to carry out this role. If the organisation wants to gain certification for its EMS it must use external auditors accredited by the appropriate bodies (JASANZ for ISO 14001 in Australia and New Zealand).

Management needs to demonstrate due diligence in its management of the environment as well as compliance with all relevant environmental legislation, agreements and codes of practice. Audits should be used to confirm progress toward these goals.

ISO 14001

An EMS can be part of a wider quality management system. The EMS and (if applicable) the quality management system may use ISO 14001 and ISO 9001 as guides to sound management systems.

6.3 EPA'S ACCREDITED LICENSEE SYSTEM

The accredited licensee system is described in sections 26A–26E of the *Environment Protection Act 1970*, introduced through the *Environment Protection (General Amendment) Act 1994*.

The system is designed to provide companies which have the necessary management, technical and legal skills, and a commitment to good environmental performance, with a degree of freedom from the prescriptive approach to works approval and licensing, as well as a reduction in licence fees.

To gain accredited licensee status, the company must hold a current waste discharge licence, have demonstrated a high level of environmental performance, and have an on-going capacity to maintain and improve this performance.

The following prerequisites are used in the assessment of accredited licensee status.

- An EMS certified by a person approved by EPA.
- An environmental audit program, with the participation of an independent environmental auditor approved by EPA.

Regular auditing of environmental performance is an essential part of best practice. It establishes current environmental performance, indicates how well environmental management is functioning and identifies new issues as they arise. The use of external environmental auditors ensures independence and objectivity.

- An environment improvement plan, developed in consultation with EPA and the local community.


A well managed facility should have an open attitude to the community, and establish mechanisms and procedures to liaise with the community on a continuing basis. The scale of this liaison should reflect the impact of the site, the proximity of sensitive land uses and the level of community interest. Community liaison is most productive if it is incorporated in an environment improvement plan (EIP). EIPs set out targets for environmental improvement which are endorsed by the company, the community and EPA. More information is available in Environment Improvement Plans (EPA Publication 394).

Benefits for accredited licensees include:

- the ability to manage affairs without detailed regulatory prescription
- a single system for the site
- works approvals are not required – except where there will be substantial changes to a process, or a major change to a discharge or emission
- a reduction in licence fees
- improved liaison and consultation with the local community
- confidence that the plant’s environmental effects are being properly managed.

Additional information on the accredited licensee system can be obtained from *Accredited Licensee – Guidelines for Applicants* (EPA Publication 424).

Environmental management
<p>Objective</p> <p><i>To achieve a consistently high level of environmental performance by good management of the operation.</i></p> <p>Suggested measures</p> <ul style="list-style-type: none"> • Obtain a commitment to sound environmental management from senior company staff. • Have an EMS. • Carry out regular environmental audits which extend to all activities at the site. • Establish mechanisms for continuing liaison with the community. • Consider the potential for EPA to grant the site accredited licensee status.

ACCREDITED LICENCE	
Requirements	Benefits
<ul style="list-style-type: none"> • Environmental Management System • Demonstrated good environmental performance • Environmental audit program • Environment Improvement Program 	<div style="text-align: center;">  </div> <ul style="list-style-type: none"> Reduced licence fees Reduced regulatory prescription Less stringent licence and works approval controls Improved community relations

GLOSSARY OF TERMS

In these guidelines the following definitions apply.

ANZECC

Australian and New Zealand Environment and Conservation Council.

Best practice

The practice of seeking out, emulating and measuring performance against the best standard identifiable.

Biochemical oxygen demand (BOD)

A measure of the oxygen demanding substances in wastewater (indicates the level of pollution present). It is expressed as the number of milligrams of oxygen which is consumed in a litre of the water over five days.

Cleaner production

Cleaner production involves process modification to achieve:

- reduced material consumption
- lower environmental impact
- reduced resource depletion.

Dye carrier

A compound used to increase the rate of dye uptake and diffusion at a given temperature.

Effluent

The liquid discharged from a treatment unit or system. It is qualified according to the type of treatment received (for example, sand filter effluent or treatment plant effluent).

EIP

Environment improvement plan.

EIS

Environmental impact statement.

EMS

Environmental management system.

Environmental management plan

A plan covering the operation of the production facility to manage the environmental impacts.

EPA

Environment Protection Authority (Victoria).

Excess volatiles

Defined as more than 0.3% (w/w) of volatile material in the textile goods, excluding water. The reference temperature for volatility is the maximum process temperature to which the goods will be subjected.

Finishing agent

A compound added to textiles after dyeing or bleaching to modify a physical or chemical characteristic of the textile.

GLC

Ground level concentration.

Groundwater

Water located beneath the land surface.

ISO

Signifies an International Standard issued by the International Organisation for Standardisation.

JASANZ

Joint Accreditation System of Australia and New Zealand

Nutrients

Substances that stimulate and enhance growth. Generally refers to nitrogen and phosphorus in waters.

Odour level

The odour level measured in accordance with the EPA's Standard Analytical Procedure B2 (1985). Odour level is expressed in odour units ("ou") and is analogous to concentration.

Odour emission rate

The arithmetic product of the odour level of the wastes to be discharged and the column rate of discharge (in wet cubic metres per minute referred to a temperature of zero degrees Celsius and a pressure of 101.3 kilopascals) and is expressed in odour unit volumes per minute ("ouv/min").

Reclaimed water

Water that has been reclaimed from wastewater and treated to a standard which is satisfactory for its intended use.

Reuse

The application of appropriately treated wastewater for a specific purpose.

Scheduled premises

Premises scheduled under the *Environment Protection (Scheduled Premises and Exemptions) Regulations 1996*, which establishes the premises subject to EPA works approval and licensing.

SEPP

State environment protection policy developed and proclaimed under section 16 of the *Environment Protection Act 1970*.

Sodium adsorption ratio (SAR)

A measure of the amount of sodium, relative to calcium and magnesium, to indicate the effect on soil structure and reduced rate at which water moves through the soil.

Suspended solids (SS)

The non-filterable residual solids which are suspended in effluent. It is expressed in milligram/litre (MG/L).

Surface waters

As defined in *State Environment Protection Policy (Waters of Victoria)*.

Treated effluent

Effluent that has been treated to secondary standard by biological oxidation and clarification but not disinfected.

Total organic compounds

The sum of all compounds of carbon which contain at least one carbon-to-carbon bond plus methane and its derivatives.

VOCs

Volatile organic compounds.

Waste minimisation

The optimisation of processes and operations to reduce waste, including recycling and reuse of waste and waste reduction.

APPENDIX 1 BPBM: THE NEW PARADIGM

“7 – S element	Indicators	Old	New
<i>Superordinate goals</i>	<ul style="list-style-type: none"> Guiding concepts of organisation Set of values, aspirations Broad notions of future directions 	<i>Efficiency</i>	<i>Best Practice</i>
<i>Style</i>	<ul style="list-style-type: none"> Management actions rather than words Allocation of time by senior management to issues Symbolic behaviour – genuine commitment of consistent resources, appointment of skilled people etc 	<i>Formal</i> <ul style="list-style-type: none"> Command and Control Environment low priority for CEO 	<i>Committed</i> <ul style="list-style-type: none"> CEO vision, personal commitment & leadership Demonstrated priority for senior management
<i>Structure</i>	<ul style="list-style-type: none"> Formal organisational structure Emphasis given to particular tasks, co-ordination of work 	<i>Rigid</i> <ul style="list-style-type: none"> Steeply hierarchical Weak or no links between OH&S, environment and production management 	<i>Flexible</i> <ul style="list-style-type: none"> Involvement of all staff Flatter, team oriented Integration of OH&S, environmental and production management
<i>Strategy</i>	<ul style="list-style-type: none"> The way a company aims to improve its competitiveness The response a company plans in anticipation of or in response to, changes in its external environment 	<i>Reactive</i> <ul style="list-style-type: none"> Meet regulations, focus on end-of -pipe No specific environment policy Closed door to community 	<i>Pro-active</i> <ul style="list-style-type: none"> Link between environmental excellence and competitiveness Emphasis on continuous improvement Community responsive strategy
<i>Systems</i>	<ul style="list-style-type: none"> All procedures, formal and informal, that make the organisation function Includes budgeting, training, production systems etc and informal systems such as meetings 	<i>Environmentally exclusive</i> <ul style="list-style-type: none"> Minimum required to meet regulations 	<i>Environmentally inclusive</i> <ul style="list-style-type: none"> Environmental Management Plan Environmental system integrated with business processes
<i>Staff</i>	<ul style="list-style-type: none"> Appraisal systems, formal training programs, morale, attitude, motivation etc 	<i>Directed</i> <ul style="list-style-type: none"> Performance measured by cost No sense of ownership 	<i>Empowered</i> <ul style="list-style-type: none"> Responsibility and accountability with staff Environmental criteria in performance appraisal Pride in activities of the firm
<i>Skills</i>	<ul style="list-style-type: none"> Skills, attributes or capabilities which dominate in the organisation 	<i>Functional</i> <ul style="list-style-type: none"> Production and waste control focus 	<i>Problem – solving</i> <ul style="list-style-type: none"> Integrated approach to improvement Innovation, problem solving skills highly regarded

Based on: *Structure is not Organisation* (Waterman, Peters & Phillips) and developed in *The Environmental Challenge: Best Practice Environmental Management* (Australian Manufacturing Council, 1992).

APPENDIX 2 QUICK REFERENCE AND SELF ASSESSMENT CHECKLIST FOR TEXTILE DYEING AND FINISHING FACILITIES

Setting environmental objectives

Environmental objectives must be addressed in the context of the operation of the facility and its underlying organisational policies and objectives. If an environmental objective conflicts with the business interests of a facility it will generally not be achieved. It is possible to achieve environmental performance improvement in business with environmental and business growth objectives working in unison.

Environmental improvement is one area that demonstrates the viability of an organisation in the long term. Unattended environmental problems can lead to clean up costs, waste disposal charges and fines for pollution, which are only going to rise in the future, making non-compliance an increasingly costly risk.

Prioritising opportunities for improvement

Every organisation has to operate within a regulated environment – compliance with laws, regulations and agreements is necessary for long term viability. At the same time, economic sustainability is crucial, so improvements must sit within the framework of economics and regulations.

Once an evaluation of current operations has been carried out and a list of environmental improvements compiled, these can be prioritised in order of importance to the facility. The priorities should be ordered by considering:

1. legal compliance
2. opportunity for environmental improvement
3. net financial impact.

Evaluation of environmental priorities

The checklist on the next page should be completed for each facility, to establish priorities. Numerical ratings are determined for each item on the checklist, to establish the order for improvements. Ratings are calculated for each of the following three headings, then summed. Examples are also provide, as shown on the diagram.

Compliance

Any non compliance issues should be addressed as a matter of urgency. Assign a rating of 5 to any non-compliance.

Opportunity for environmental improvement

Rate each item on the checklist from:

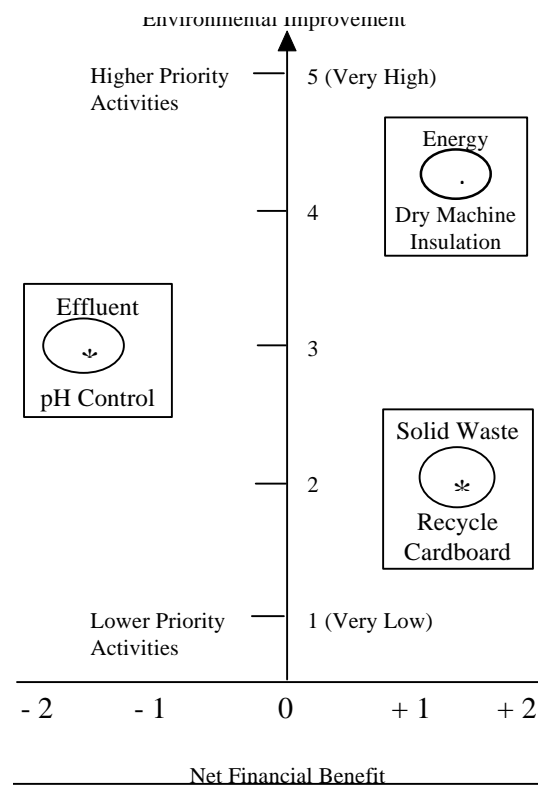
- 1 – very low opportunity to improve to
- 5 – very high opportunity to improve.

Net financial benefit

Assess the net financial impact to the facility through adoption of best practice for each item:

- -2 – substantial negative financial impact
- +2 – substantial positive financial impact.

Summing the ratings for each of the above headings determines the priority order for improvements, with the proviso that correcting non-compliances always have first priority.



QUICK REFERENCE AND SELF ASSESSMENT CHECKLIST FOR TEXTILE DYEING AND FINISHING FACILITIES

Environmental Element	A		B					C					A+B+C Priority Rating	
	Compliance		Opportunity for Environmental Improvement					Net Financial Benefit						
	Yes	No	1	2	3	4	5	-2	-1	0	+1	+2		
			←					→	←					→
			(very low)			(very high)		strong -			strong +			
Siting - buffer zones														
Waste Minimisation - energy - gas - power - water - raw materials - process chemicals														
Wastewater Management of: - Salts TDS) - temperature - pH - Total oxidised sulphur (TOS) - Metals - Halogens - SS - BOD - nitrogen - oil / grease - contaminated surfactants - nutrients - Colour and biodegradability														
Solid Wastes - waste minimisation - recycling / reuse - prescribed waste - packaging waste - other														
Noise														
Soil and Groundwater - stormwater - groundwater - soil														
Air Emissions - odour - CO/ NOX - VOC - particles - Specific Pollutants														
Dangerous Goods - storage and handling - transport - disposal														

Environmental Element	A		B					C					A+B+C Priority Rating
	Compliance		Opportunity for Environmental Improvement					Net Financial Benefit					
	Yes	No	1	2	3	4	5	-2	-1	0	+1	+2	
			← →					← →					
		(very low) (very high)					strong - strong +						
Examples													
1 Effluent pH	No = 5			3			-2						=6
2 Recycled cardboard packaging	Yes = 0		2								+2		= 4
3 Power saving through machine insulation	Yes = 0				4					+1			= 5

The above assessment indicates that the priority order for improvements would be:

1. effluent pH: correcting a non-compliance
2. power saving through machine insulation
3. recycling cardboard packaging.

APPENDIX 3 REFERENCES AND INFORMATION SOURCES

LEGAL AND GOVERNMENT

(Available from EPA, Information Victoria or the Commonwealth Government Book Shop)

Acts

Contaminated Land Act 1991.

Local Government (Planning and Environment) Act 1990.

Environment Protection Act 1970.

Water Industry Act 1995.

Soil Conservation Act 1958.

Pollution of Waters by Oil and Noxious Substances Act 1986.

Dangerous Goods Act 1985 (plus amendments).

Dangerous Goods Handling and Storage Regulations 1989 (plus amendments).

Occupational Health and Safety Act 1985.

Renewable Energy Authority Victoria Act 1990.

Planning and Environment Act 1987.

Litter Act 1987.

State environment protection policies

State Environment Protection Policy (The Air Environment).

State Environment Protection Policy (Control of Noise from Commerce, Industry and Trade).

State Environment Protection Policy (Groundwaters of Victoria).

State Environment Protection Policy (The Waters of Victoria).

State Environment Protection Policy (The Waters of East Gippsland).

State Environment Protection Policy (The Waters of Lake Burrumbeet and Catchment).

State Environment Protection Policy (The Waters of Lake Colac and Catchment).

State Environment Protection Policy (The Waters of Port Phillip Bay).

State Environment Protection Policy (The Waters of the Dandenong Valley).

State Environment Protection Policy (The Waters of the Latrobe River and Catchment).

State Environment Protection Policy (The Waters of the Western District Lakes).

State Environment Protection Policy (The Waters of the Wimmera River and Catchment).

State Environment Protection Policy (The Waters of the Yarra River and Tributaries).

State Environment Protection Policy (The Waters of Westernport Bay and Catchment).

Other

Industrial Waste Management Policy (Waste Minimisation) 1990.

National Environment Protection Measures, National Environment Protection Council, 1996.

Zeroing in on Waste – Pathways to Cleaner Production for Victorian Industries, EPA Publication 537, 1997

Standards

BS7750 – *British Standard for Environmental Management System.*

EMAS – *European Standard for Environment.*

ISO 14000 – *International Standards Organisation Standard for Environment Management System.*

ISO 14001 – *Specification for EMS.*

ISO 14004 – *Guidelines to Implementing an EMS.*

ISO 14010 – *Auditing Principles, Procedures.*

ISO 14020 – *Labelling and Testing Procedures.*

ISO 14030 – *Performance Evaluation.*

ISO 14040 – *Life Cycle Analysis Assessment.*

ISO 14050 – *Glossary of Terms.*

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Cleaner Production of Wool, CSIRO Textile News 24 (May), 1 Pub. Year: 1994.

CPAS – The Clean Process Advisory System, National Centre For Industrial Treatment Technologies, Michigan Technological University, Houghton, Mi. 49931, USA.

Design Manual for Textile Bleaching and Dyeing Industry, Hong Kong Government Industry Department (May 1995), Hong Kong Productivity Council.

Dyeing as a New Environmental Challenge, C. Horstmann – Journal Of The Society Of Dyers And Colourists: Vol. 111, pg. 185, 1995.

Energy Efficiency in the Textile Industry, Howard Rudd – International Dyer pg. 25 – 28, October 1993.

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Environmental Choice New Zealand, Wool Pile Carpets – Requirements Specification EC – 23 – 94.

Environmental Pollution Prevention Project (EP3), Internet: <http://es.inel.gov/ep3/ep3-cs3.ht>.

National Cleaner Production Database, Internet – http://www.erin.gov.au/portfolio/ep..et/ncpd/auscase_studies/ausdye.ht.

Neutralising Effluent by Flue Gases, Dipl. – Ing. Alfred Schwarzmuller – International Textile Bulletin Vol. 2, pg. 60, 1993.

Oslo and Paris Conventions for the Prevention of Marine Pollution, PARCOM Recommendation Concerning Effluent discharges From Wet Processes In The Textile Processing Industry, (The Hague – November 1994).

PARCOM Recommendations 94/95 Concerning Best Available Techniques and Best Environment Practice for Wet Processes in the Textile Processing Industry, (Karkskrona June 1994).

Possibilities and Tendencies in Exhaust Air Purification of Textile Finishing Machines, Dipl. – Ing. H. Frieberg – International Textile Bulletin Vol. 2, pg. 5 – 20, 1993.

Purification of Exhaust Air with Concentration of Liquor Residues and Effluent by Evaporation in a Cyclone Scrubber, Dipl. – Ing. K. -H. Gottschalk – International Textile Bulletin Vol. 1, pg. 5 – 10, 1991.

Removing Colour from Dyehouse Waste Waters – A Critical Review Of The Technology Available, P. Cooper – Journal of the Society Of Dyers And Colourists: Vol. 109, pg. 97 – 100, March 1993.

Salt Requirements put Pressure on Wet Processing Plants, Fred L. Cook – Textile World pg. 83 – 86, August 1994.

SWAMI – Strategic Waste Minimisation Initiative, US EPA – Office of Research And Development, Washington DC 20460.

Textile Industry and the Environment, United Nations Environment Programme, Technical Report No. 16 (November 1994).

Management systems

Cleaner Production Case Studies, EPA, Canberra, 1996.

Guidelines for Preparation of Waste Management Plans, EPA Publication 383, August 1993.

Industrial Waste Minimisation Procedures for Waste Assessment, EPA Publications 358, February 1993.

Industrial Waste Strategy Review, EPA Publication 501, May 1996.

Principles of Environmental Management, Business Council of Australia.

The Environmental Challenge: Best Practice Environmental Management, Australian Manufacturing Council, March 1992.

The Environmental Challenge: Sustainable Businesses in the 1990s, Australian Manufacturing Council, July 1991.

The Environmental Challenge: Best Practice Environmental Regulations, Australian Manufacturing Council, June 1993.

Guidelines for Preparing Waste Assessments – A Practical Guide Towards Cleaner Production, EPA Publication 277, 1994.

Industrial Waste Management Policy – Waste Minimisation, EPA Publication S 52, 1990.

Accredited Licensee Guidelines For Applications, EPA Publication 424, 1996.

Waste Minimisation: Assessment and Opportunities for Industry, EPA Publication 351, July 1993.

Cleaner Production Waste Studies EPA Publication 536, July 1997.



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