

Aiming for Sustainable Product Development

Textiles

Contents:

- Drivers for change
- Life cycle environmental impacts
- Design strategies
- Relevant publications
- Web sites



This brochure aims to provide summary information and guidelines that can assist designers, specifiers and the textiles industry in its transition to higher levels of environmental performance and Sustainable Product Development (SPD).

Drivers for change

Environmental improvements in the textile industry are driven by both economic and environmental objectives, including:

- opportunities to reduce production costs
- water and waste water disposal costs and regulation
- energy costs
- need to reduce greenhouse gas emissions
- consumer demand for environmentally sensitive textiles
- environmental demands in the international marketplace.

Textiles generally undergo many separate processing steps, usually carried out by different companies, with each step affecting the environmental impacts, and product performance, of the next. For example, the choice of fabric type will determine the types of dye and dye processes to be used. The dye quality will affect the useful life of the garment.

This picture is further complicated by the demands of fashion and the consumer, which may have unintended environmental consequences, such as a demand for colours that require more chemicals when being fixed. The aim in EcoReDesign is not necessarily to choose the best fashion or material, but to reduce the environmental impacts of all products while maintaining their function and market viability.

Life cycle environmental impacts

Environmental impacts occur at every stage of the life cycle of textiles. The textile industry generates large volumes of waste and consumes large amounts of energy and water. It can take up to 200 litres of water to produce, dye and finish one kilogram of textiles. (United States Environmental Protection Agency Best Management Practices for Pollution Prevention in the Textile Industry, 1996.)

The degree of environmental impact varies between the different stages of production, fibres and uses. Cotton has a large environmental impact during its growth while, for synthetic or manufactured textiles, the amount of energy used during production is a major impact. Because clothes need to be laundered, the environmental impact associated with clothing is greatest during the 'use' phase, while, for furniture and interior textiles, the greatest impact tends to be in the 'production' phase.

The following tables outline the environmental impacts of the different stages of the life cycle of natural and manufactured fibres.

Environmental impact of natural fibres

Fibre Growth

- displaces land for crops
- leaches nutrients from soil

- contaminates soil and water through use of chemicals such as pesticides, biocides and herbicides
- weakens crop strain
- uses energy and water, which are finite resources

Harvesting

- chemicals such as defoliants, are borne by the air. They are a human health hazard on contact and/or by breathing
- significant use of chemical defoliants and fuel-powered machinery

Production Cleaning

- use of strong chemicals
- waste to landfill
- water pollution by detergents, soaps, bleaches
- by-product: lanolin from wool scouring
- chemicals and fuel emissions
- noise and dust

Spinning

- dust and noise
- loose fibres can be breathed in
- noxious fumes
- solid waste: cones and pallets

Fabric Production

- uses finite resources
- dust and noise
- noise
- releases fumes from chemicals
- uses energy and water, which are finite resources

Finishes

- toxic by-products and fumes from chemicals, metals, dyes, resins
- VOCs emanate from fabric and garment
- handling health hazards
- storage of waste – used dye
- uses energy and water, which are finite resources

Garment Production

- waste from off-cuts
- dust
- health hazard through handling of fabric and other processed products
- chemical residues from the application of finishes
- dry cleaning uses chemicals
- solid waste: packaging, inks, plastics, hangers

Distribution

- air pollution
- use of fuel, which is a finite resource, for distribution

Consumer Use and Disposal

- solid waste: packaging
- excess consumption because of frequently changing fashions
- emissions from waste incineration and/or dumps
- care of products, by washing, ironing, dry cleaning: water pollution, energy and chemical use

Environmental impact of synthetic fibres

Fibre

- consumes finite resources such as petroleum, coal and oil
- toxic by-products are unable to be eliminated
- by-products require treatment and landfill
- air, water and land pollution by toxic chemicals
- requires long-term safe storage
- effects health through contact and breathing (foul odour)

Spinning

- use of chemicals for all finishes (including delustering, anti-static), size resins and dyeing
- toxic by-products: fumes and volatile fumes emanating from fabrics and garments
- heat and energy required
- water used
- handling is a health hazard
- storage for waste

Fabric Production

- solid wastes: textile off-cuts
- fumes stirred up in the handling of textiles are a health hazard
- use of finite resources

Finishes

- toxic by-products and fumes from chemicals, metals, dyes, resins
- VOCs emanate from fabric and garment
- handling health hazards
- storage of waste – used dye
- air pollution and use of finite resources – water, fuel, energy

Garment Production

- solid waste: packaging, inks, cut-offs, plastics, hangers
- chemical residues from the application of finishes
- dry cleaning uses chemicals

Distribution

- transportation uses finite fuel and causes air pollution

Consumer Use and Disposal

- solid waste: packaging
- recycling limitations
- toxic emissions from waste incineration and/or dumps
- excess consumption through frequently changing fashions
- solid waste: non-bio-degradable textiles; finishes leach into soil and water
- use and care of products – washing, ironing, dry cleaning – cause water pollution and use energy

(Based on tables from: Andrews, K., Masters thesis, University of Technology, Sydney, 1995).

Design strategies

Water usage and waste water disposal

The textile industry is one of the largest producers of waste water. It is chemical-intensive in preparation, dyeing, finishing and slashing. Generally, the Australian industry has developed and implemented waste water treatments although there are many dyeing and finishing facilities that still find it difficult to meet existing limits. These requirements will become more stringent with the growing awareness of the environmental problems associated with the use of chemicals and heavy metals, of problems associated with salts and the suitability of biodegradable surfactants in waste water.

Some of the strategies which are being employed to reduce the waste water are:

- selecting fabric and dye combinations which maximise dye effectiveness;
- separating different waste water streams, to allow selected reuse
- counter-current rinsing
- using enzymes rather than chemical agents, where possible, to improve waste water quality (possibly for reuse), which reduces chemical costs.

Strategies for reducing energy consumption

In the design stage:

- select materials with a lower energy content
- alter components of product design to reduce energy use
- increase product life.

In the production stage:

- exchange heat from hot wastes to incoming streams
- insulate hot vessels (dyeing machines, boilers, steam pipes, hot water storage)
- investigate cold-temperature dyeing and finishing
- use microwave energy for dyeing
- match energy forms to use.

In general:

- compare systems in terms of cost and energy efficiency
- prepare a program of continuous improvements to eliminate inefficiencies
- conduct an energy audit
- determine and monitor the efficiency of major energy-using processes.

Textiles and energy

Energy consumption is evident throughout the total life cycle of textiles, from use of farm machinery, to transport to processing plants (for the Australian industry, this may be as far away as in Europe), to manufacture (including finishing and dyeing), distribution, sales and disposal.

Solid wastes

In Sydney, in 1993, the clothing and textiles industries accounted for about 5 per cent of the industrial waste stream, totalling 22,000 tonnes per year. The composition of this waste was mainly fabric (14,000 tonnes), with some paper, cardboard and wood. (Dick, K., *The Composition and Origin of Solid Waste in Sydney*, Waste Services NSW, 1993) The majority of these fabrics were synthetics as the non-synthetic materials were generally recovered and used to produce absorbent rag material for the automotive repair industry. In Melbourne, in 1993, rags and textiles accounted for 10 per cent of the commercial and industrial waste destined for landfill. (Maunsell Report, *Waste Traffic and Composition Surveys Report for the Melbourne Metropolitan area*, 1993) In the domestic waste stream, disposal of fabric is generally through hard waste collections and self-hauled waste to landfill.

In summary

Traditionally, the environmental impacts associated with the textile industry are spread throughout the life cycle of fabrics and there are different issues at every stage of production, use and disposal. Therefore, it can not be said that a single fibre is more environmentally benign than another. Manufacturers and designers should try to

specify a textile which:

- is manufactured from renewable or recycled resources
- produces little or no waste throughout its life cycle
- is not reliant on polluting or toxic chemicals throughout its lifetime
- is long-lasting and durable, requiring little or no care
- uses minimal energy and resources from growth to manufacture
- uses minimal water consumption during its life cycle
- is reusable, recyclable or biodegradable.

Increasingly there is considerable discussion about product-service strategies and how the total volume of manufactured products might be reduced through dematerialisation and maximising materials efficiency. It's therefore important to carefully understand the functional aspects of conventional products and explore the potential for designing new, sustainable services as opposed to simply redesigning existing products.

Relevant publications

- Gertsakis, J., Lewis, H. & Ryan, C., *A Guide to EcoReDesign:™ Improving the environmental performance of manufactured products*, Centre for Design at RMIT with Environment Australia, Melbourne, 1997 (manual and video).
- Gertsakis, J., Lewis, H. & Ryan, C., *An Introduction to EcoReDesign:™ Improving the environmental performance of manufactured products*, Centre for Design at RMIT with Environment Australia, Melbourne, Reprinted 1998
- *EPA Manual, Best Management Practices for Pollution Prevention in the Textile Industry, RPA/625/R-96/004*, United States Environment Protection Authority, Office of Research and Development, Washington, DC, September 1996.
- Paakkunainen, R., *Textiles and the Environment*, the European Design Centre, Netherlands. 1995.
- EcoSpecifier: A Guide to Environmentally Preferable Materials, Centre for Design at RMIT in association with the SRD, Melbourne 1999.

Web Sites

Textile Environment Network, UK —
<http://www.zen.co.uk/cim.inst/research/environment/ten/intro.html>

The Centre for Sustainable Design, UK —
<http://www.cfsd.org.uk>

FabricLink —
<http://www.fabriclink.com>

EcoSpecifier: A Guide to Eco Materials —
<http://ecospecifier.rmit.edu.au>

EcoRecycle Victoria
<http://www.ecorecycle.vic.gov.au>

Centre for Design at RMIT University
<http://www.cfd.rmit.edu.au>

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