Understanding the impacts of wet processing: Dyeing

This document highlights the key environmental impacts of common dye techniques for cellulosics, denim and synthetics, as well as lower impact options.

It has been developed as part of the Sustainable Clothing Action Plan (SCAP). SCAP is a collaborative agreement to improve the environmental impact of clothing. See **wrap.org.uk/scap2020**

Why is wet processing so impactful?

Wet processing refers to any process that uses liquid to pre-treat, dye, print or finish a product. This stage of the product lifecycle has a notable environmental impact using vast amounts of water, energy and often hazardous chemicals.

Dyeing can take place at multiple stages within the supply chain, from dyeing fibres and yarns through to fabrics and garments. The environmental impact of dyeing is related to the type of dye, type of material being dyed, application method used, stage applied and overall desired effect. In general dyeing requires significant amounts of water and energy due to the use of heated dye baths and rinsing baths. Many of the chemicals used in dyeing also present a concern.

Cellulosic fibres

Conventional

Direct Dyes

Commonly used for creating light or pastel shade products. During this dyeing process, chemical compounds called azo amines can be created. Some azo amines are carcinogenic and are currently restricted by REACH. Many direct dyes also contain azo compounds, which are amongst the groups targeted by Greenpeace for elimination as part of its Detox campaign. Commonly used on: cotton, viscose & silk.

Reactive Dyes Reactive dyeing requires vast amounts of salt, water and energy. The process is quite inefficient, leading to low fixation rates (approx. 75%). This means that repeated rinses are needed to remove the unfixed dye, increasing both water and energy use as rinse water is often heated. Waste water produced from reactive dyeing contains high levels of both salt and dye, which is difficult to treat. Commonly used on: cotton, viscose, polyamide, wool & silk.

Less impactful

High Fixation Reactive Dyes (HFRD)

HFRD have been altered to have a greater affinity for fibres, creating higher fixation rates (85–90%). HFRD reportedly uses less than half amount of salt compared to conventional reactive dyes.

By increasing the fixation rates, the water usage decreases as fewer rinses are required. This also leads to energy and time savings.

Denim

Conventional

Synthetic Indigo (Powder)

Indigo is a highly inefficient dyestuff and requires, in the case of denim, the yarn to be repeatedly dipped into a series dye baths in order to take on the indigo colour. A powdered form of indigo is most commonly used within the industry. However this can lead to operational health & safety issues with workers needing to mix the indigo powder with chemicals such as sodium hydrosulphites.

Commonly used on: cotton.

Sulphur Dyes

Sulphur dyes are insoluble in water, therefore in order for the fibre to take on the dye, a range of auxiliary chemicals must also be added. As a result of this process, wastewater is heavily contaminated with e.g. salts and sulphides. Commonly used on: cotton & viscose.

Less impactful

Synthetic Indigo (Liquid)

Liquid indigo minimises human exposure to and interaction with chemicals. This is largely because the liquid indigo reduction process (which makes the indigo soluble in water) occurs at the chemical supplier, rather than at the denim mill. This also means that the process is done in a more controlled manner, often leading to fewer chemicals being used.

Improved Sulphur Dyes

The latest generation of sulphur-based dyes can replace older sulphur dyes or can potentially be used as a replacement for indigo with new shades of blue developed for denim. Improved sulphur dyes have a greater affinity for cotton which means fewer dips in the dye bath are needed, saving energy, water and time.

Synthetics

Conventional

Disperse Dyes

The disperse dye process requires high temperatures and high pressure, leading the process to have a significant energy footprint.

Many disperse dyes also contain azo compounds, which are amongst the chemical groups targeted by Greenpeace for elimination as part of its Detox campaign. This is because some dyes within this group may lead to the release of carcinogenic compounds. Commonly used on: polyamide, acrylic, acetate & polyester.

Less impactful

Solution (Dope or Spin Dyeing)

Conventionally, synthetic fibres are produced uncoloured and then dyed. Through Solution dyeing the colouring and spinning of the synthetic polymer is done in one single step.

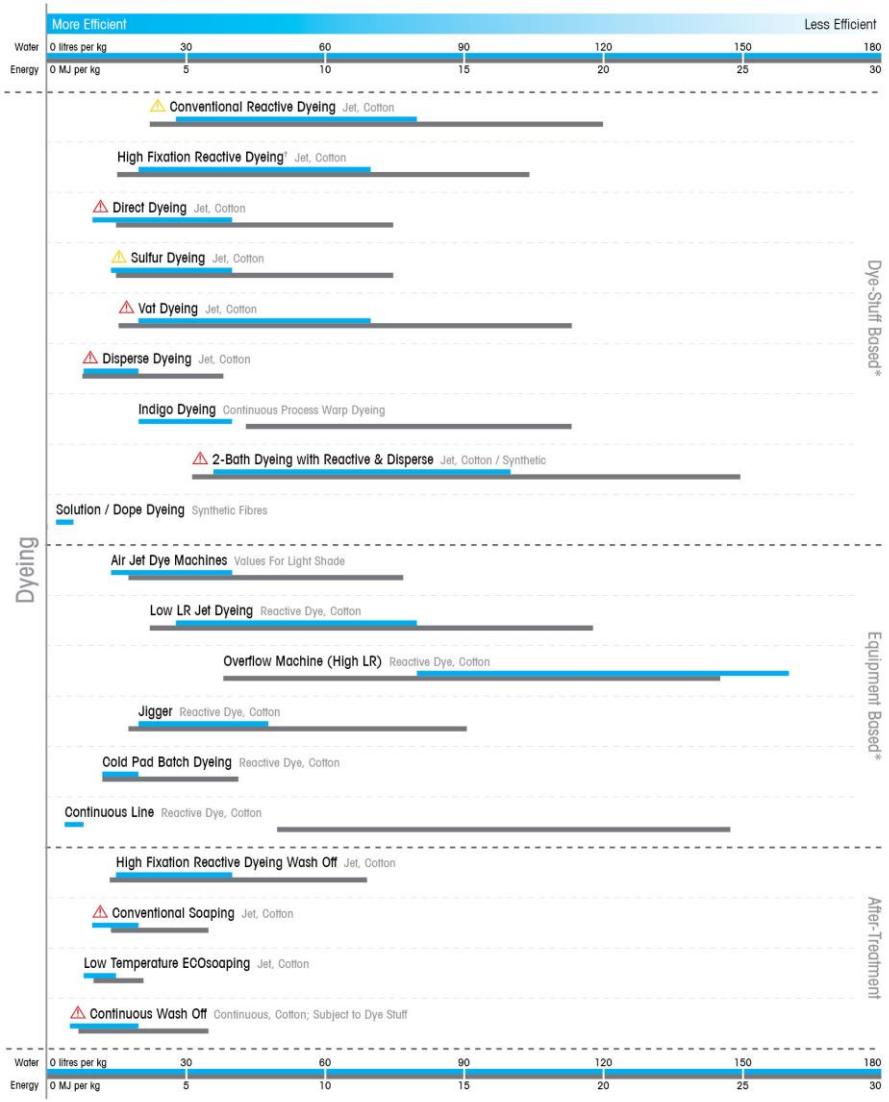
This process uses small amounts or in some cases no water.

Wet Processing Benchmark

To better understand the quantitative impact of common pre-treatment processes, view MADE-BY's publicly available Wet Processing Benchmark.

The Benchmark helps brands and retailers understand the range of impact that common wet processing techniques have in terms of water and energy. It can also be used as a tool to help the viewer better understand their efficiency compared to industry averages.

See made-by.org/benchmarks



WRAP's vision is a world where resources are used sustainably. It works in partnership with governments, businesses, trade bodies, local authorities, communities and individuals looking for practical advice to improve resource efficiency that delivers both economic and environmental benefits.

Our mission is to accelerate the move to a sustainable resource-efficient economy through:

- **re-inventing** how we design, produce and sell products;
- **re-thinking** how we use and consume products; and
- **re-defining** what is possible through recycling and re-use.