Waterless dying technology in textile processing

Taiwan, China

water scarcity impact

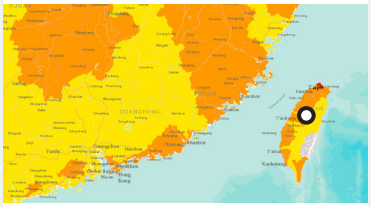
Reduced withdrawal	●
Reduced consumption	
Improved water quality	●
Increased productivity	●
Net basin benefit	●

volumetric impact
8 256 000 m^3/yr

capital cost
$6 239 000

estimated unit cost of water
20 ¢/m^3

Water Stress
Taiwan, China



Arid & low water use
Low (<10%)
Low to med (10-20%)
Med to high (20-40%)
High (40-80%)
Extremely high (>80%)
No data available

Water Stress Map:
F. Gassert, P. Reig, T. Shiao, M. Luck and M. Landis, 2015. "Aqueduct Global Maps 2.1."

Confidence level
Low Medium High

Water Scarcity Impact Key
Main Minor

Credits
We would like to acknowledge Melanie Wijnands and Maxim Willemse of Dyeco for their input in the preparation of this case study.

Project Overview

Conventional textile dyeing is water intensive and generates highly polluted water that must be subject to costly treatment processes prior to discharge into rivers.

A new commercial scale dyeing technology for dyeing synthetic fabric, DyeOx, has been implemented in Taiwan that utilises carbon dioxide ($C0_2$) instead of water in the dyeing process. The technology uses no water, no auxiliary chemicals and reduced energy when compared to conventional processes.

The technology was conceived at DELFT University and commercialized by the start up DyeCoo and Tong Siang Co., a dyehouse in Thailand.

Nike, the global sportswear chain, recognizing the potential of the technology in helping to achieve its sustainability objectives, entered into a strategic partnership with DyeCoo in 2012 to implement the waterless dyeing technology in one of their Taiwanese factories. This led to a further three Taiwanese factories, who supply other major sportswear brands such as Adidas, making the investment decision to implement the technology.

The factory that is the subject of this case study installed two machines that produce 920 000 kg of fabric per annum and resulted in a reduction in water withdrawals of 8 256 000m^3 when benchmarked against conventional dyeing methods.

Key Elements

- Waterless dyeing technology utilizes recycled $C0_2$ in a semi closed loop dyeing process for polyester fabrics.
- Strategic partnership with Nike Inc. established in 2012 as part of Nike's sustainability objectives led to waterless dyeing technology in four factories in Taiwan.
- Improved sustainability of the dyed products provides commercial advantage for Brands and factories.

Key Outcomes

- When benchmarked against conventional synthetic dyeing processes, the waterless dyeing technology resulted in 8 256 000m^3 reduction in water use.
- Elimination of chemical solvents.
- 49% reduction in energy usage.
- Zero effluent discharge.

Taiwan, China

Intervention Features

¬ Waterless dyeing technology ¬ Zero waste water discharge

Project Levers

(1) Private Sector Endorsement

Major global brands recognized a potential commercial advantage in integrating the waterless dyeing technology in its supply chain. Using the environmental credentials of the fabric produced, they are able to market the added value of products to consumers. Under encouragement from these brands, four factories in Taiwan installed the technology in their textile dyeing process.

(2) Availability of commercial scale waterless dyeing technology

The use of highly compressed carbon dioxide (supercritical) gas for dyeing fabric at laboratory scale has been well established for over two decades. However, DyeCoo is the first to apply this technique at commercial scale.

(3) Positive cost benefit ratio

In a consumer driven industry, where expectations for inexpensive clothing are well established, the capital cost associated with adopting new technology is a barrier to large scale uptake across the industry. When the savings associated with reductions in water, energy, chemical and dyestuff consumption are taken into consideration, the payback for replacing jet dyeing with waterless dyeing in the factory case studied was approximately 3 years.

Outcomes and Challenges

The technology is still in development and its capacity to dye a range of fabrics is limited; it is currently only applicable to 100% polyester fabrics. The technology is being developed further to enable it to dye all synthetic fabrics. Given 62% of the fibres produced worldwide are synthetic, this is a large market and presents potential with regards to mass reduction in water use and pollution across the industry.

Often, interventions that remove or reduce the need for water in this context lead to an increase in the use of chemical solvents. The supercritical CO_2 acts as a solvent in which the dyes dissolve naturally, without the addition of dispersing agents and other chemical additives.

The technology has a baseload energy consumption due to the need to maintain the temperature of the dyeing vessels. Therefore, use of the machine must be optimized to maximum production capacity in order fully realize the cost savings associated with reduced energy consumption per batch. This can be challenging to achieve in the initial stages after installation in contexts where operators are unfamiliar with the technology.

Following the precedent set by Nike, Adidas and others, Ikea, the global furniture retailer, also entered into a strategic partnership with DyeCoo to improve environmental performance.

Above: Waterless dyeing technology units (© DyeCoo)