

## Denim Washing Case Study:

Tonello ECOfree Ozone Washing of Carrefour Jeans at Tusuka Washing Ltd.

*This case study outlines the use of Tonello ECOfree ozone machines by Tusuka Washing Ltd. in Bangladesh, to produce for Carrefour's 2016 Spring/Summer collection. This case demonstrates the resource savings and quality improvements possible, with as much as 67% less water usage and 45% less energy usage. In addition it clearly shows how a supplier can increase their appeal to leading brands and retailers through adoption of more sustainable processing alternatives.*



### Introduction

The finishing of denim products can be highly complex, with the potential for each piece to undergo a significant number of individual processes. Nowadays denim products, and jeans in particular, are rarely sold in 'raw' original form. There is high demand for products that possess a worn-in look and feel. A key part of this look is a faded shade to the denim, which replicates the natural loss of indigo colour over years of wear and washing. This shading is principally achieved through a variety of processes known as denim washing – although a finished pair of jeans might require a significant amount of finishing beyond washing alone. Denim is traditionally dyed at the yarn stage before the weaving together of dyed and undyed yarns – each coated with a sizing agent for strength. Most resulting 'raw' denim fabric is a relatively dark shade, which is then finished to achieve the desired look. This enables flexibility in subsequent finishing and potential for greater tonal contrasts, but at the same time also means that some degree of shading is required for the vast majority of denim, which must also be preceded by desizing to avoid complications. This can ultimately come at high cost to the environment, with a wide variety of chemicals often used and an average water consumption of around 60 litres of water per pair of jeans in the washing stages alone.



The resource intensity of denim washing ultimately depends on two critical variables: the desired end-result, and the processes used to attain it. With the former, it is inherently the case that products that are required to achieve a more worn look and feel will require more intensive processing than those closer to raw form. In the case of processing, the efficiency depends on both the machinery/mechanical and the inputs used in the wash. When shading, most conventional procedures involve the use of a washing machine and a chemical bleach that acts to remove part of the indigo dye applied previously. Two basic forms of machine are used: front loading and belly washers. The former of these is regarded as the more contemporary, and tends to use far less water than the older belly washing machines.

Application of the bleaching chemicals can either be done in a bath – producing a lighter shade across the whole product – or by spot application to replicate wear to specific areas. For over 75% of bleached denim, the agent used is sodium hypochlorite (NaClO). Whilst it is effective in bleaching in itself, it also results in an undesirable smell in the resulting garment, necessitating the use of an 'anti-chor' process and repeated rinsing to remove residual chemicals. Not only is this a resource

intensive sequence of processes, but it the resulting wastewater contains a chlorinated species that can be difficult to treat properly. In addition, it should be noted that sodium hypochlorite itself is an extreme irritant, and can cause severe chemical burns to workers on contact.

### **Ozone-Based Denim Shading and Tonello ECOfree Machines**

Increasing recognition of the issues highlighted above has resulted in a demand for alternatives that can provide more resource effective shading of denim in a safe and environmentally friendly manner. Enzymes have emerged as a popular substitute for bleaching/shading chemicals, and certainly offer advantages in terms of resource use and wastewater treatment. A further innovation has centred around the use of ozone (O<sub>3</sub>) in dedicated front-loading washing machines. Ozone is a strong oxidising agent that can provide a bleaching effect for denims in a closed, batch-wise operation to lighten and soften garments. In addition, ozone can also be used to replicate other denim finishing processes beyond shading, such as stonewashing, and also carries advantages in minimising impacts on fibre strength.

The ozone itself is generated on site by application of energy to oxygen. The principal advantage of ozone-based bleaching is that it can fade jeans with the use of zero or miniscule amounts of water when injected into the machine drum as either a gas or dissolved in water. When used with water, not only is the quantity significantly less, but so too are the operating temperatures (25-40°C as compared to 45-60°C for most chemical agents). The technology also performs well in addressing a phenomenon known as 'backstaining', in which the lighter weft fibres are stained with dyes during processing, and degrading the final appearance. Use of an ozone machine can also allow multiple processes to be combined, providing a significant advantage over an approach that seeks to substitute chemicals in a more conventional process.



Tonello are an Italian company that sit amongst the pioneers in denim finishing technologies, particularly ozone. Their range of ECOfree front-loading washers has been created with the use of ozone in mind, although many of them also offer the ability of operating with conventional chemicals if required. The ECOfree ozone process involves dissolution of ozone in water as opposed to the more conventional approach of gas application. Whilst this means that water is still used in the process, the amount is around

50-80% less than would be the case through an enzyme-based procedure. This makes it possible to reduce the water required to wash a pair of jeans from 50 litres to just 15. Moreover, Tonello assert that this technique can produce results that can supersede gas-based ozone application, replicating a 9-bath process with improved tonal contrast and a more natural look. This also has the effect of greatly reducing the likelihood and/or number of additional processes carried out subsequently. These machines are also fitted with a number of safety systems to ensure minimisation of hazards to operators, and the ozone is fully neutralised before handling of garments.

### **A Partnership for More Sustainable Denims: Carrefour, Tonello & Tusuka Washing Ltd.**

Tusuka Washing Ltd. is a denim washing factory located in the Konabari cluster near Dhaka, Bangladesh. The factory has always sought means of improving their resource efficiency and reducing environmental footprint, and in recent years has been increasingly keen to utilise process innovations to achieve these goals. Subsequently, in 2015, having learned of the benefits of ozone washing Tusuka made the decision to install machinery that could make use of the technology. After reviewing options and communicating with various companies, it was decided that Tonello ECOfree

machines represented the best fit for their needs. Three ECOfree machines were subsequently installed with a total annual production capacity of 50,000 pieces, offering Tusuka the flexibility to use ozone when possible, and a more conventional process if needs be. A Tonello technical team also provided training and advisory services to staff at Tusuka, especially during installation and the early stages of use. To further minimise safety risks, Tusuka also took the measure of installing the oxygen reservoir outside of the factory.



In that same year Carrefour, a French retailer with significant lines of own-brand apparel, were building a case to reduce the environmental footprint and impacts of their products. In Bangladesh, they had identified an opportunity to work towards the use of more sustainable processes in production of certain denim lines. They were already aware of the utility of ozone washing in achieving these aims, and decided that it would be preferable to work with existing suppliers to expand the use of this technology in their products. Carrefour had an established relationship with Tusuka, and their expertise in the use of ozone for achieving various different finishes led them to discussions on scaling up its use in their orders.

A trial was subsequently agreed to in which a comparison was made between ozone and a more conventional process, incorporating chemical shading, in washing 50kg of jeans. This was facilitated by a third party, who took care to ensure that the processes were comparable in terms of the final look and feel they sought to achieve. Aside from resource consumption, an assessment of aesthetic and other qualities of the finished jeans was also conducted. The results were conclusive, with clear advantages for both product characteristics and resource use in favour of the ozone process. The assessors estimated that the process could help achieve a 45% reduction in energy use, and 67% reduction in water use as compared to the conventional process, as well as substantial reductions in chemical use and wastewater treatment requirements. Importantly, the shading performance of the ozone process was also adjudged to be the stronger of the two.

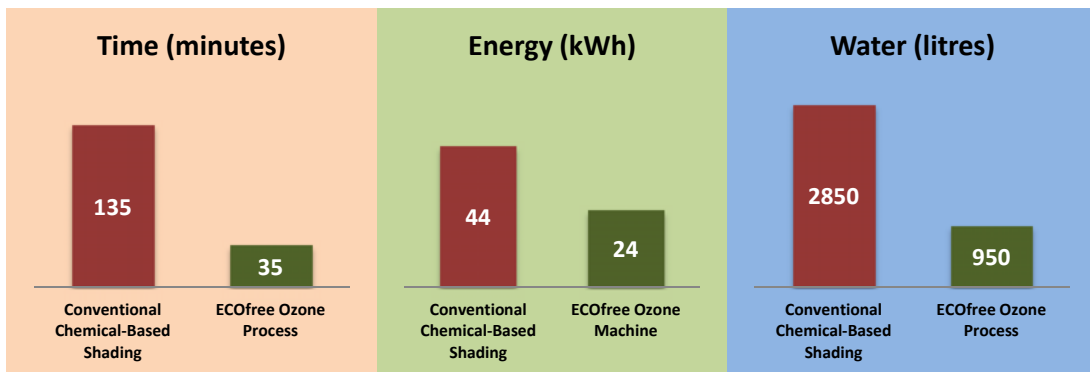
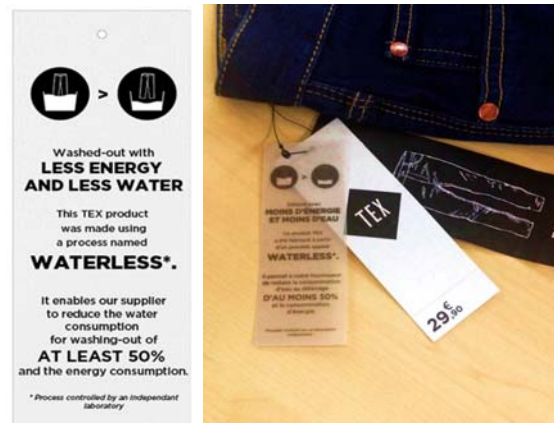


Figure 1: Comparison of Time and Resource Saving for 50Kg Trial Batch

By using ECOfree technology, the Tusuka has been able to substantially reduce resource use in denim shading and washing, with the following benefits identified:

- **Estimated water savings of 475,000 litre/year (67%)** through the water-efficient nature of the technology and removal of rinsing stages.
- **Reduction in processing time of 74%** for each batch of denim washing as compared to the slower sodium hypochlorite process, allowing for an increase in overall productivity;
- **Estimated 2500 kWh/year of energy saved**, primarily through reductions in groundwater extraction;
- **Estimated 775 m<sup>3</sup>/year natural gas saved** due to the shorter, simpler overall process that operates at a lower temperature;
- **Reduced wastewater treatment requirements** through reduced hydraulic load as well as removal of chemical stages. In particular, there are no absorbable organic halogens (AOX);
- **Product quality improvements** as a result of factors such as reduced backstaining and improved tonal contrast;
- **High batch-to-batch reproducibility** owing to the high-performance control systems. This improves product quality consistency as well as minimising waste and resource use accruing from any errors;

These results were extremely well received by Carrefour, who subsequently requested the use of the process in washing for bulk production of a line of jeans for their Spring/Summer 2016 collection for sale in select European markets. A decision was made to communicate these benefits to the consumer, with product labelling to indicate the overall water and energy savings throughout the washing process, with ECOfree ozone being an integral component. This case study therefore demonstrates how innovative, sustainable processes can yield benefits for suppliers and brands/retailers, not only in terms of direct resource savings and reduced environmental degradation, but also in increasing appeal and competitiveness. The proactive adoption of ECOfree technology by Tusuka and the support they received by Tonello was fundamental to the latter decision of Carrefour to select them for production in this line, illustrating how cooperation by brands, suppliers and technology providers is key to success in uptake of sustainable processing solutions. Going forward, Carrefour is also working to encourage Tusuka to expand their use of green technologies, and to continue to explore new solutions for more sustainable production.



## Carrefour

As a multi-local, multi-format, and omni-channel retailer, Carrefour employs more than 380,000 people worldwide. With 12,300 stores in more than 30 countries, the group generated revenues of €104.4 billion under banners in 2015. Carrefour is a partner for daily life. Every day, it welcomes more than 13 million customers around the





world. Carrefour is committed through its actions to sustainable and responsible trade. The Group's Corporate Social Responsibility worldwide approach is built on three pillars: fighting against waste in all its forms, protecting biodiversity and working alongside the company's partners.

For more information: [www.carrefour.com](http://www.carrefour.com), [@CarrefourGroup](https://twitter.com/CarrefourGroup) on Twitter



## Tonello

Tonello is a world leader in the manufacture of garment washing, dyeing and finishing machinery, with a particular focus on the denim sector. Based in North Italy, Tonello have been operating since 1981, and have developed a reputation for innovation and quality. Sustainability has always lain at the core of this vision, and they have played a key role in driving technological innovations that support improved environmental outcomes. As Tonello themselves note

*“When we started our work, the word ‘sustainability’ was just another word, and none of our customers were really interested in it. But despite this, Tonello has always imagined, engineered and made machines that are designed to consume less energy, less water, and fewer additives; machines that are efficient and productive, but that do not harm our environment. Ultimately also machines that are safe for workers and for their work environment. For Tonello, sustainability is an everyday matter, and always has been even when it was rarely discussed in the market. Over the years, our know-how has grown. Through ever-increasing sensitivity and tireless research, we have extended our vision of sustainability to include the consumer-health impacts of garments treated in our machines. Today, putting on a pair of jeans treated using Tonello technology means respecting oneself and one’s own health. Moreover, when launching a technology onto the market, we make sure that the effect and design on the garment can replicate that achieved by a ‘traditional’ system as well as opening up new possibilities and effects. One such example is our Safe Garment collection, which features denim garments with an authentic worn-out look that is realised without the use of any hazardous chemicals.”*

## Tusuka

Tusuka is an integrated garment manufacturer specialising in denim products. They have a number of facilities located around the Konabari cluster near Dhaka, Bangladesh.

The logo for Tusuka, featuring the word 'TUSUKA' in a stylized, handwritten-style blue font.

Tusuka Washing Ltd is one key unit, and is equipped for high quality stone and enzyme washing, and dyeing of jeans and casual wear. Computer operated machines produce consistent quality through automated control of water PH, steam pressure and temperature. The factory has 1125 machines with a wet processing capacity of 60,000 pieces per day. The washing plant also has a dry process capacity of 40,000 pcs per day where it has ability to carry out hand brushing, whiskering, grinding, tacking, laser and 3D whiskering on the jeans. In 2014, Tusuka Trousers Ltd participated in the PaCT program, and in 2016 Tusuka Washing Ltd joined the program at advanced ‘Deep Dive’ level with the support of Carrefour. Tusuka Trousers has installed a variety of resource saving measures based on PaCT recommendations such as LED lighting, servo motors, water flow meters for individual machines and groundwater extraction, condensate recovery. These measures have allowed them to reduce resource consumption significantly (see below), and it is likely that Tusuka Washing will enjoy similar successes.

Resource	Unit	Before PaCT	After PaCT	% Reduction
Ground Water	l/kg	125	115.5	7.6
Process water (Washing)	l/kg	93	83.6	10.1
Chemicals	gm/kg	227	177.3	5.0
Power	kWh/kg	0.71	0.61	14.6
Natural gas	m <sup>3</sup> /kg	0.68	0.55	18.5
GHG emission	CO <sub>2</sub> Tons	6,551	5,117	21.9

## PaCT - The Partnership for Cleaner Textiles

Partnership for Cleaner Textile is a holistic program that supports textile wet processing factories in adopting Cleaner Production practices, and engages with brands, government, communities, financial institutions, and other stakeholders to bring about systemic, positive environmental change for the Bangladesh textile wet processing sector, its workers, and surrounding communities, and to contribute to the sector's long-term competitiveness and environmental sustainability.

Funded by the Embassy of the Netherlands and led by the International Finance Corporation (IFC) of the World Bank Group, and NGO Solidaridad, PaCT is working in partnership with 15 leading global apparel brands, textile factories, industry associations including the Bangladesh Garment Manufacturers and Exporters Association (BGMEA), technology suppliers, government agencies, and banks and financial institutions.

For more information on the program, please visit [www.textilepact.net](http://www.textilepact.net)

## DSG - Decision Support Guidance

The Decision Support Guidance (DSG) has been developed under the PaCT program as the core of an innovative approach aiming to embed sustainability into product design, development and sourcing decisions within brands. This is intended to promote supply-chain collaboration between brands, their suppliers and technology producers to promote the adoption of more sustainable wet processing techniques. It was developed by Solidaridad in conjunction with MADE-BY and GoBlu International, and has been peer reviewed by a number of subject matter experts from the sector.

The DSG covers denim and lightweight knit categories, providing detailed information on a range of conventional and more sustainable wet processing techniques used for these products. For each of these techniques it provides information on water and energy intensiveness, and risk of hazardous chemical use (risk of RSL/MRSL failure), as well as effluent and safety considerations. Crucially, the DSG also contains specific information to demonstrate to brands how their decision making at three key levels (product design / development, sourcing / buying, quality assurance / fabric management) can influence the uptake or use of a particular technique.



Kingdom of the Netherlands



Solidaridad