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Multiplexed Laser Surface Enhancement

by Craig Lawrance

Water is used extensively throughout textile processing operations. Almost all dyes, specialty chemicals, and finishing chemicals are applied to textile substrates from water baths. In addition, most fabric preparation steps, including desizing, scouring, bleaching, and mercerizing, use aqueous systems. The amount of water used varies widely in the industry, depending on specific processes operated at the mill, equipment used, and prevailing management philosophy concerning water use. Textile operations vary greatly in water consumption. Wool and felted fabrics processes are more water intensive than other processing subcategories such as wovens, knits, stock, and carpet. Water use can vary widely between similar operations as well. For example, knitting mills average 45 litres of water per 0.5kg of production, yet water use ranges from a low of 11 litres to a high of 205 litres. The UK textile industry is currently facing significant challenges, associated mainly

with environmental legislation and overseas competition. Environment-related issues of current importance include the rising costs of effluent treatment/disposal as water companies respond to EC Directives to reduce the pollution levels of sewage works outfalls, more stringent legislation relating to effluent quality, e.g. toxicity, colour (some water companies have already introduced colour charges, and this trend could increase), rising water supply costs as water companies invest in improved distribution systems to reduce leakage, new treatment plants to improve water quality and new water supplies to meet increased demand.

Historically, water supply and effluent disposal costs have been an insignificant component of total operating costs, and managers have, rightly, focused on other priorities. This situation is now changing. Water is becoming a scarce resource in relation to demand, and water supply and effluent disposal costs have risen and will continue to rise. Environmental protection is now a reality. In addition to these environmental concerns, the textile industry is having to respond to rapidly changing market requirements, as dictated by fashion, seasonality and customer expectations.

TCoE commissioned the MLSE Technology to be developed for Textile Applications to reduce the consumption of water and also reduce the energy required for the preparation of the textile product for further finishing processes.

Prototype system based at Textile Centre of Excellence (Huddersfield)

MLSE (Multiplexed Laser Surface Enhancement) technology is an example of technology transfer between industries which has facilitated a leading edge development in the processing and performance of Textiles.

Both Plasma and UV systems are currently used for cleaning and ablation of polymeric materials. MLSE enhances these processes at a higher level. The Laser intensifies the effective power of the plasma as well as acting on the substrate in its own right.

The process has demonstrated the cleaning of a woven fabric that had not been aqueous or solvent scoured. Thus at the base level, cleaning of substrates is achieved. Increasing the treatment intensifies the ablation of the surface of the fibres, thus preparing them for secondary processing, e.g. dyeing. The controlled ablation of the surface of the fibres increases greatly the hydrophilicity of the textile substrate. The purchase of MLSE will be a considerable investment and may involve a licencing scheme. However, costs have been shown to be recouped within one year due to reduction in energy costs and water/water treatment costs. The MLSE Technology is designed to be used by any Textile Company regardless of modus operandi. The Patent Holder for the MLSE technology is MTiX.

MLSE impacts on Water Consumption and Energy Saving

By using a technology designed to reduce the energy required to process textile fabrics as well as reduce the requirement for water to carry out future textile processes, MLSE reduces textile process times and also massively reduces the impact of the textile process on the environment. The latest incarnation of the technology processes the textile fabric at a speed of up to 60m per minute and has a much smaller footprint than a traditional aqueous scouring system. The technology requires the textile to be 100% dry therefore water savings are immediate for the cleaning cycle, and the subsequent surface enhancement of the textile substrate lends itself to reduced water and chemical dye use for the dyeing industry for example. The energy saving has been calculated at greater than 99% and subsequent effluent and water consumption at a reduction of greater than 75%, with an environmental CO2 reduction in excess of 90%.

As the political and industrial movement is towards greater eco-friendly manufacturing and processing, legal requirements will also need to be developed to protect the eco-structure and the environment. MLSE is proven at production level and could have a big impact on the future of textile production if the take up of the system is successfully achieved by the dyeing, finishing and coatings industry.

Production system

From a concept machine installed and developed at the TcoE, there are now 2 operational machine in use in industry in our region and lessons learned from the concept machine have been fully addressed with the 2 industrial units.

As this is new technology, the correct conditions of the plasma/laser had to be worked out, gaseous recipes had to be developed and correct modulation of the plasma reaction chamber had to be closely monitored and set.

Different substrates need different levels of treatment and the user must ensure the substrate is as described as we found several instances of a substrate supposing to be cotton but was in fact polyester so control and correct identification of inward goods is crucial.

The durability of using MLSE could be analysed by the take up of the technology. There is worldwide interest in the MLSE process and many large corporate organisations are working with/wishing to engage with the technology. The MLSE technology is regarded as disruptive and will change the way textile companies have always processed their fabrics.

Improvement in the understanding of the technology will guide policy makers to give greater support. The technology could be developed for even greater success in other applications with support from scientists, post graduates etc. by finance opportunities to support the technology.

It is expected that MLSE may help to:

- Create Industry wide standard and raise eco awareness
- EU wide definition for standards, energy and water consumption per application
- Contributes to lower CO2 emissions into the environment
- The technology can be utilised in any region within Europe for the processing of textiles

Existing and new companies will need to invest in the new technologies. There will need to be a regular and reliable supplier of industrial gases e.g. argon, CO2, Oxygen, Nitrogen. Training will need to be provided for operation of the system.

Long and short terms context impacts on GP feasibility and transferability in terms of economic, political, social and cultural environment, involvement of special competencies and skills

The economic impact will be one of investment. Political/Social/Cultural may well need some form of research network to collaborate ideas, as well as some form of support mechanism for funding initiatives for investments. Regarding skills and competencies, there will be a need for training in operating and technical training for understanding.

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