Eco Innovation Technology Bulletin #1

Multiple Laser Surface Enhancement: An introduction

The Multiple Laser Surface Enhancement (MLSE) process has the potential to revolutionise the textile processing industry across Europe.

MLSE produces technically superior products and significantly reduces the environmental impact of materials processing in a sector that traditionally uses high levels of water, energy and chemicals.

Expert analysis suggests the following reductions can be achieved:

- greenhouse gas reduction over baseline of 90.9%;
- resource (chemical) use reduced by 94.8%;
- water consumption reduced by 75.5%;
- energy consumption reduced by 90.9%.

MLSE is a dry process, carried out at atmospheric pressures using safe, inert gases. The combination of plasma and photonic energy creates material synthesis in the surface of a substrate.

The process can be used for material cleaning and performance enhancement including low-temperature dyeing, water-proofing, and fire retardant and antimicrobial treatments.

The process, which operates at up to 20 metres a minute, has been fully patented and licensed. The technology can be integrated into an existing process line as a 'modular' unit, using the same materials handling system, or as an additional, stand-alone unit.

Technology

MLSE is an example of technology transfer between industries..

The use of photonics and plasma in a controlled vacuum environment of gases and sol-gels has long been established, particularly for the production of electronic components and metallic and non-textile polymeric substrates.

The unique feature of MLSE technology is the combination of combining energy sources in a controlled atmospheric environment in the presence of a material substrate. The net result is conversion and material synthesis in, or optionally on, the surface of the substrate.

MLSE technology works through the creation of high-frequency radio-frequency (RF) plasma in an envelope between rotating and driven rollers that extends across the width of the processing window. The plasma field generated has the unique benefit of operating at atmospheric pressures.

A high-power ultraviolet (UV) laser is shaped into a rectangular cross-section that has a consistent power density over its entire length of more than 2 metres. Sophisticated optics defract the laser beam into the plasma zone.

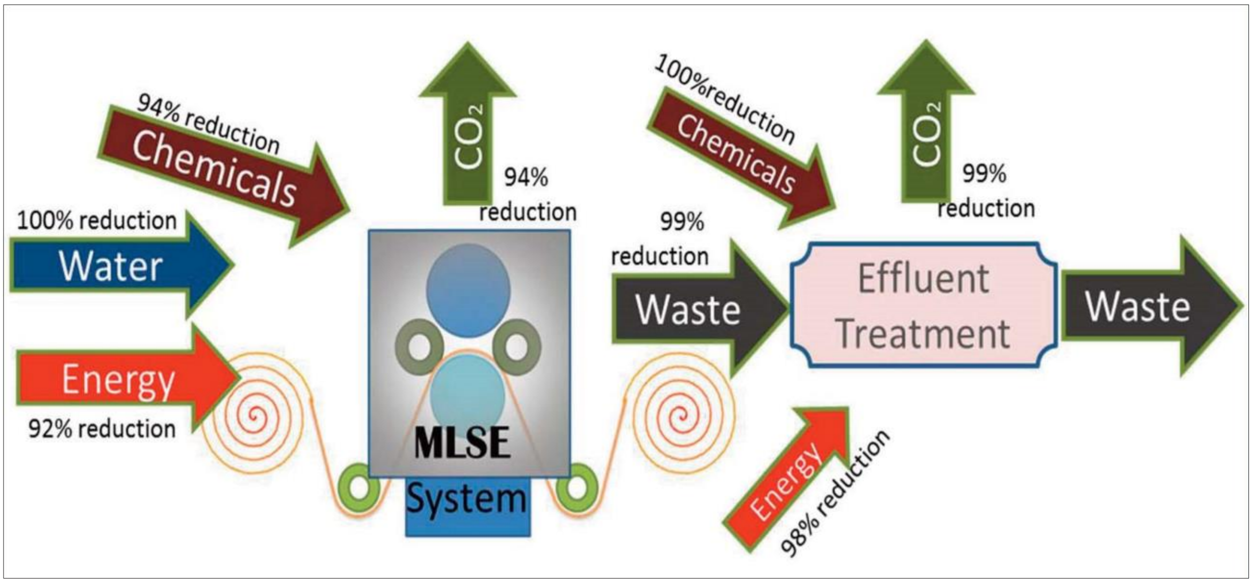
A gas delivery system is able to combine any combination of four environmental gases into a single feed that populates the plasma chamber.

The fourth element is the sol-gel delivery system, which is capable of applying a thin, consistent layer of precursors or process accelerants to the fabric, either pre- or post-processing.

Changing the power intensity and laser pulse profiles of the laser and the plasma, and then varying the environmental gases or the addition of precursors (i.e. changing the 'recipe') will allow the MLSE system to generate the wide variety of process applications.

Competitive systems

In recent years the textile industry has embraced several technological advances that have provided the performance enhancements described above.



Environmental benefits of the MLSE technology (based on fire retardancy treatment for textiles)

The Multiple Laser Surface Enhancement (MLSE) system

In all cases to date, treatments have involved coating systems, such as conventional spray, lick roller and vacuum physical vapour deposition processes, whereby a film is laid onto the textile to impart the necessary technical characteristics.

Most waterproofing and stain resistance has been achieved with Teflon-based finishes, using heat to set the finished treatment. As this process is a coating, cleaning of finished fabric causes degradation and ultimately the elimination of the required property.

Fire retardancy and antimicrobial treatments are complex and costly and again rely primarily on treatments, using multistage wet and heated processes.

There has been substantial academic and industry development work utilising plasma over recent years, with the best results being achieved using vacuum-based plasma systems for batch processing.

Some success has also been reported from Porton Down, the UK Ministry of Defence Development Centre, where plasma and fluorocarbon materials have been utilised to impart waterproofing treatments to a variety of fabrics.

However, the process has not been adopted appreciably by the industry.

UV lasers have been used by some researchers to investigate their effect on surface structure and functionality, but much has remained at the ‘laboratory bench’ level of curiosity. Other developments include the use of infrared lasers for textile cutting and textile marking and UV systems, which have been utilised for cleaning water and effluent.

While this latter process has been used for cleaning sheet materials in paper, polymeric materials and metallic sheets, there do not appear to be any documented results of tests on its application on textiles to the level currently being demonstrated by the MLSE process.

Prior to commissioning the development of the MLSE prototype system, the Textile Centre of Excellence (TCoE) commissioned an extensive work programme to review the state of the art in textile processing.

This concluded that the MLSE technology was both innovative and unique, and that the patent protection it enjoyed was both significant and strong.

Further information: www.textile-training.com. Look out for our future MLSE Technology Bulletins.