SUMMARY

The global consumption levels have rapidly increased on behalf of virgin materials. Alone in EU textile sector, the amount of clothes bought per person has increased by 40% in just few decades, driven by a fall in prices and so-called linear value chain. With extremely low recycling rates, the focus has shifted to reusing the natural resources and textile waste more efficiently. Today, various textile waste classifications and corresponding recycling methods exist along with products made of recycled materials. Though, to catch up with elevated consumption levels, more scalable applications incorporating recycled textile fibres are needed.

Based on the above reason, present study proposes a method of developing a scalable nonwoven application made of mechanically recycled textile waste for the packaging industry. The goal was to incorporate the textile fibres into a solid-structured composite matrix that holds its shape when folded into a box. Hence the focus was equally addressed on the design, enhancing properties like simplicity, convenient usage, and the fact that no extra components would be needed for sealing. Such application is widely used and preferred in the e-commerce sector, where the most important requirement for the packaging is to protect the goods from damage during the shipping.

Therefore, the widely used corrugated paperboard was set as a blueprint for analysing the mechanical performance of the developed application. Various material thicknesses and fibre compositions ratios of post-consumer recycled cotton with biodegradable binder were experimented. The goal during the material development was to achieve sufficient compressive strength as it is one of the most important measurements for determining the load-bearing capacity of packaging before the buckling occurs. Also was studied the water absorption that helped understand the suitable environmental conditions for the application. At the end of the research, two of the final products were designed and their compressive strengths measured.

Laboratory results showed that higher material thickness and fibre fraction volume of binding fibres yielded higher compressive strength compared to the specimens containing more cotton fibres. Likewise, the latter had also higher water absorbance level. Modulus, on the other hand, was dependant on the design and the size of the surface area with smaller area yielding higher modulus. In contrary, the elongation was higher for the design with higher surface area.

The experiments proved that mechanically recycled textile fibres could be successfully incorporated into a composite matrix with a relatively rigid structure that is suitable for

packaging application. Despite good compressive properties, the author notes that the surface of the application was not satisfactory for being commercially acceptable. The increase in the fibre fraction volume of the binding fibres resulted in darker plastic-like stains across the surface of the material. However, the experimental part showed that the quality of fibre carding along with the compression moulding temperature has the utmost importance on the final product. Changing those parameters can therefore improve the overall appearance of the material.

As the study attempted to analyse whether the developed composite material is suitable as a packaging application, more extensive research may be carried out for assessing additional properties that the industry requires from the cardboard packaging.

The author is also suggesting that the method and application mentioned above could be potentially produced from other types of fibres or post-consumer fibre blends. Even though the recycling of such application is viable in theory, more extensive research along with practical tests shall be carried out to finding viable method for creating truly circular application.