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Impact of connecting pattern of weft-knitted spacer fabric on compression behavior

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ABSTRACT

Spacer fabrics have long been used as breathable cushioning materials. This study investigates the effect of connecting pattern on the compression behaviour of weft-knitted spacer fabrics. A novel tree-root-inspired connecting structure was proposed to improve the stability and support of spacer fabrics under compression. Nine weft-knitted spacer fabric samples were developed using the same yarn materials and knitting conditions, with variations in connecting structure, number of connecting courses, and surface stitch density. Their thickness, fabric weight, course and wale densities, and compression properties were evaluated.

The results showed that the tree-root-inspired connecting structure increased the compression stiffness of the spacer fabrics compared with the conventional net-like connecting pattern, while causing only slight changes in fabric thickness, weight, and density. Variations in the sequence of connecting courses within the tree-root-inspired structure had little influence on compression behaviour. In contrast, the number of connecting courses and the tuck-to-miss stitch ratio affected the initial softness and overall stiffness of the fabrics. Changes in surface stitch density, particularly the transition from full-gauge to half-gauge knitting, significantly influenced fabric thickness and compression performance, producing softer fabrics with greater thickness and lower density. In addition, the imbalanced structure with different gauge settings on the two surface layers exhibited distinct compression behaviours on the two sides.

These findings demonstrate that both connecting structure and surface stitch density play important roles in determining the compression behaviour of weft-knitted spacer fabrics. The proposed tree-root-inspired structure expands the design possibilities of spacer fabrics and provides useful guidance for developing cushioning materials with tailored mechanical performance for different wearable and protective applications.

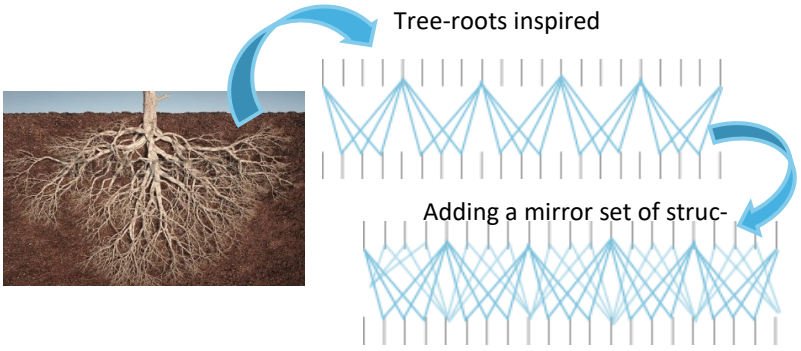

Fig. 1. Tree-root-inspired connecting structure for spacer fabric