Study on mechanical properties of coated biaxial warp knitted fabrics

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Abstract

In recent years, coated fabrics have become the major material used in membrane structures. Scholars have conducted a series of researches on mechanical properties of coated woven fabrics, however, there are few studies focusing on coated knitted fabrics which are generally used in pneumatic structures. In this paper, the mechanical properties of coated biaxial warp knitted fabrics (CBWKF) produced by Seaman Corporation are investigated. The CBWKF's basic layer is observed by electron microscope, and the unique design of warp knitted polyester and stitch structure can be seen from Fig.1. Then the uniaxial tensile and shear strength of warp and weft CBWKF samples were tested and the tensile strain at break are also measured, the typical tensile stress-strain curves are shown in Fig.2. Due to the special fabric structure, there are no crimp interchange between yarns, and the initial stress-strain curve is almost linear which is totally different from coated woven fabrics. The creep elongation are also tested under 24 hour's sustained uniaxial load, and the creep elongations are 1.9% and 3.8% in warp and weft directions respectively.

To further investigate the mechanical properties of CBWKF, standard biaxial test are performed. Fig.3 shows the stress-strain curves under five different biaxial load ratios, and the data points at each load ratio are recorded after three times 1:1 biaxial loading. As can be seen, the stress-strain curves are basically linear and there is no negative strain even under 1:2 and 2:1 biaxial load ratio. The elastic constants and Poisson's ratio are then calculated using least square method based on linear orthotropic assumption. It is found that the Poisson's ratios are only 0.10 in warp direction and 0.09 in weft direction, which are much smaller than coated woven fabrics. After comparing the test data with calculated results, conclusion can be obtained that the biaxial tensile property fits well with the linear orthotropic material assumptions.

Keywords: mechanical property, coated biaxial warp knitted fabrics, orthotropic assumption
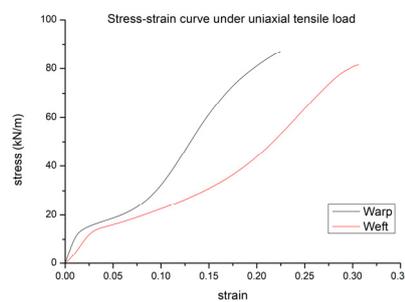

Fig.1 Warp knitted fabric structures

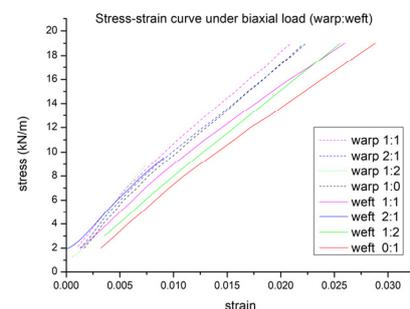Fig.2 Stress-strain curve under uniaxial tensile load

Fig.3 Stress-strain curve under five different biaxial load ratios