A STUDY ON BENDING HYSTERESIS BEHAVIOR OF 2-PLY MULTIFILAMENT YARN

J.W. PARK, S.J. KIM, D.L. KIM

Department of Textile Engineering, College of Engineering
Pusan National University, Pusan, Korea

Bending properties of yarns are one of the most important mechanical properties, since those are related to the end use of textile structural materials, such as crease-recovery, drapeability and hand, and to the fabric defects such as crimpability, skew and curl during textile process. And the bending deformations of synthetic multifilament yarns for industrial use, such as tire cord, timing belts of car are much related to the resistance to external force. But, the change of twist of the constituent filaments in the constituent strands during plying process will be occurred, therefore the geometry of 2-ply multifilament yarn becomes very complex.

For this reason, researches on the bending properties of 2-ply multifilament yarn have been little performed in the past. But, theoretical analysis on twisted yarn structure and bending properties of 2-ply multifilament yarn are prerequisite to design 2-ply multifilament yarn suitable for the industrial use. Therefore, in the previous work, the twisted structure and bending rigidity of 2-ply multifilament yarn were derived under assumption of no interaction between filaments and were discussed. But, practically, the hysteresis phenomena will be occurred when the 2-ply multifilament yarn is subjected to cyclic bending deformation.

Therefore, the coercive couple and hysteresis due to frictional force between filaments and strands during bending deformation must take into consideration for analysing bending properties of 2-ply multifilament yarn.

In this work, assuming that each constituent strand of 2-ply multifilament yarn is in contact with line and regarded as elastic body, and that finite friction between stands is occurred, the contribution of frictional force between strands to bending rigidity of 2-ply multifilament yarn was derived by consideration of the lateral pressure due to tensile stress on single strand axis and relative strand slippage during bending deformation by strain energy method.

And the coercive couple was derived from work done due to frictional force between strands during bending deformation, and then, numerical analysis with computer simulation to the derived theoretical results was performed and discussed.