2합 멀티필라멘트사의 굽힘특성에 관한 연구

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From the model of 2-ply multifilament yarn, bending rigidity(B_f) of constituent filament in single strand was theoretically derived in terms of helix angle of single strand before plying (α_s), plying helix angle (α_p) and the ratio of the distance to the filament from strand axis (r) to strand radius (R_s) by strain energy.

And the change of bending rigidity of constituent filament was analyzed and discussed with change of the ratio of the distance to filament from strand radius for the purpose of determining the plying twist processing condition.

And theoretical minimum bending rigidity of 2-ply multifilament yarn was derived by using of bending rigidities of constituent filaments.

The obtained results were as follows

1. Bending rigidity (B_f) of a constituent filament was derived as follows.

$$B_f = \frac{2\pi \cot\alpha_p}{\lambda^2}\left[\int_0^{2\pi}\left(\frac{\sqrt{(\operatorname{cosec}\alpha_p + K\sin\alpha_p\cos\phi_2)^2 + K^2(\lambda+\cos\alpha_p)^2}}{E_f I_f} - \frac{\cos^2\phi_2\left(\frac{1}{\lambda}-1\right)K^2(\lambda+\cos\alpha_p)^2}{\sqrt{(\operatorname{cosec}\alpha_p + K\sin\alpha_p\cos\phi_2)^2 + K^2(\lambda+\cos\alpha_p)^2}}\right.\right.$$
$$\left.\left. + \frac{\cos^2\phi_2\left(\frac{1}{\lambda}-1\right)K^2(\lambda+\cos\alpha_p)^2}{\sqrt{(\operatorname{cosec}\alpha_p + K\sin\alpha_p\cos\phi_2)^2 + K^2(\lambda+\cos\alpha_p)^2}}\frac{}{GI_p}\right) \times d\phi_2\right]^{-1}$$

2. In the case of $\alpha_p > \alpha_s$ and at below $\alpha_s = 30°$, bending rigidity, (B_f) of constituent filament was decreased with increasing K, but increased with increasing K at above $\alpha_s = 30$.

3. Maximum bending rigidity of constituent filament was obtained in the range from 5° to 10° of plying angle, α_p with condition which α_s, strand angle before plying was in the range of 5° to 25°.

4. Theoretical minimum bending rigidity of 2-ply multifilament yarn was derived as follows.

$$B_y = 2NR \int_{K=0}^{K=1} \int_{\phi=0}^{\phi=2\pi} B_f \cdot \mathrm{Cosec}\alpha_p \cdot K \cdot dK \cdot d\phi$$