講演番号 308

文献番号 20225308

Continuous Molding for Thin Plate of Carbon Fiber Reinforced Thermoplastics

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KEYWORDS: materials, polymer composite material, Continuous molding, Thin Plate [D3]

This research examined the effect of the base material on the mechanical properties of thin-walled plates as a preliminary step in the continuous molding process of thin CFRTP(Carbon Fiber Reinforced Thermoplastics) plate. This research aimed to clarify the effects of residual stitched yarns used in the base material on the mechanical properties of the moldings and the effects of twisting for the carbon fiber bundle on the mechanical properties of the moldings. Therefore, three types of base materials were prepared: fabric with twisted carbon fiber bundle and the non-melting stitching thread Insoluble_Twist, fabric with twisted carbon fiber bundle and the melting stitching threadMelt_Twist, and fabric with untwisted carbon fiber bundle and an non-melting stitching thread Insoluble_Straight. Based on previous research, the prepared base materials were compression-molded at a pressure of 5 MPa, a temperature of 270°C, and a molding time of 20 min.

The cross-sectional observation results showed that all of the materials exhibited high impregnation properties. The results of tensile and bending tests are shown in Table 1. The mechanical properties of the moldings with melting stitched yarn were greater than those of the moldings with non-melting stitched yarn. The moldings with twisted carbon fiber bundle had lower mechanical properties than the moldings with non-twisted one due to the twisting angle.

Table 1 Test results.

	Tensile modulus [GPa]	Tensile strength [MPa]	Bending modulus [GPa]	Bending strength [MPa]
Insoluble_Twist	120	1866	89	489
Melt_Twist	127	1929	122	1241
Insoluble_Straight	127	2100	97	622

It was expected that the twisting of the fiber bundle disperses compressive and tensile stresses in one fiber bundle. For this reason, bending tests were conducted using a single-layer molding. The results of the bending test with single-layer molding are shown in Table 2. The maximum bending stress of the moldings with twisted carbon fiber bundle was higher than that of the moldings with non-twisted one because the compressive and tensile stresses were offset.

In the absence of residual stitching threads, the thickness of the moldings was thinner and the percentage of carbon fiber per volume was higher, resulting in higher mechanical properties. In the case of residual stitched yarns, the mechanical properties were decreased due to the fractures starting from the stitched yarns. When a twisted structure was added, the mechanical properties in the 0° direction was decreased due to the twist angle in the fiber orientation, but the maximum bending stress was higher, as shown in Fig. 1, because the compressive and tensile stresses were distributed in one fiber bundle.

Table 2 Bending test results (1 ply).

	Bending modulus [GPa]	Bending strength [MPa]	Bend radius [mm]
Insoluble_Twist	58	920	9.3
Insoluble_Straight	80	898	16.1

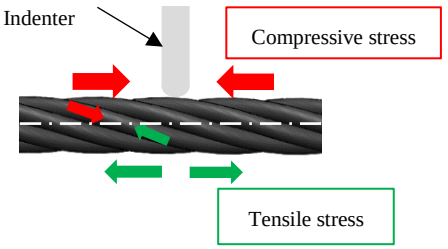

Fig. 1 Twist carbon fiber.