

## **Development of Recycled Carbon Spun Yarn for Continuous Fiber Reinforced Thermoplastic Composite Materials**

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[Abstract]

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For recycling of carbon fiber reinforced plastics, separation and extraction technologies are being developed by domestic research institutes. The extracted carbon fiber is chopped or milled and mixed with non-woven fabric or resin, and its use as lightweight member is limited. This is because the extracted carbon fibers are short fibers, not continuous or long fibers. In order to construct a recycling system for carbon fiber, it is necessary to use the extracted carbon fiber in a new form and expand its application.

In this study, we blended recycled staple carbon fibers with polypropylene fibers to fabricate yarn by spinning technology. Compared to commercially available carbon fiber spun yarn, the trial spun yarn had about 1/4 the strength, but about 2.7 times the breaking strength and about 16 times the elongation. The effects of twist angle and fiber volume content of spun yarn on elastic modulus were also investigated. The results showed that the elastic modulus decreased as the twist angle increased, but the elastic modulus increased as the fiber volume content increased, and the change was proportional to the content.

The prototype yarn was used to fabricate an intermediate material for thermoplastic carbon fiber-reinforced plastics, and the validity of the Tailored Fiber Placement technique was verified by fabricating reinforcements with complex geometries. Furthermore, it was confirmed that the technology could be applied to warp knitting and weaving technologies to fabricate reinforcement forms that realize complex shapes.

Hybrid molding was performed using an intermediate substrate made from the prototype yarn containing recycled carbon fiber. Hybrid molded products made from recycled carbon fiber spun yarn were found to have 89% of the compressive strength of hybrid molded products made from commercial carbon fiber raw materials.

From these trial results and others, the possibility of developing new forms of applications for recycled carbon fiber was found.