Manufacturing and performance evaluation of conductive composite thread according to the twisting process conditions

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1. Introduction

In this study, a conductive composite thread was developed by combining PET yarn and silver coated polyamide yarn under various twisting conditions. The manufactured composite thread was evaluated mechanical and electrical properties and the optimal process conditions for manufacturing conductive composite thread were established.

2. Experimental

The conductive composite threads were manufactured using conductive yarns and SD-PET with different twisting condition, using a twisting machine (TY 370, TesTex, China). Table 1 shows the twisting conditions for manufacturing conductive composite threads and the corresponding sample code. For the first twisting, two plies of PET yarn (75d) were twisted with Z-direction under various turns per meter (100, 200, 500, 1,000 TPM). Afterwards, one ply of silver coated yarn (100d) was added and twisted with S-direction under various turns per meter (100, 200, 500, 1,000 TPM). The mechanical property was measured by universal testing machine with yarn grip 2714-005 series (INSTRON, USA) and the linear resistance was measured with a multimeter (True RMS Multimeter 287, FLUKE, USA).

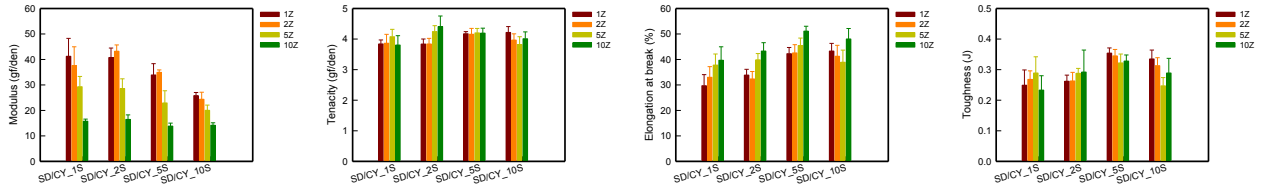
Table 1. Sample code and twist factor for manufacturing twisted conductive thread

Sample code	1st twisting		2nd twisting		Sample code	1st twisting		2nd twisting	
	Twisting direction & Used yarn	TPM (Turns per Meter)	Twisting direction & Used yarn	TPM (Turns per Meter)		Twisting direction & Used yarn	TPM (Turns per Meter)	Twisting direction & Used yarn	TPM (Turns per Meter)
***SD/**CY-1S/1Z**	S, PET SDY	100	Z, Ag coated PA	100	**SD/CY-5S/1Z**	S, PET SDY	500	Z, Ag coated PA	100
SD /CY-1S/2Z				200	**SD /CY-5S/2Z**				200
SD /CY-1S/5Z				500	**SD /CY-5S/5Z**				500
SD /CY-1S/10Z				1,000	**SD /CY-5S/10Z**				1,000
SD/CY-2S/1Z		200		100	**SD/CY-10S/1Z**		1,000		100
SD /CY-2S/2Z				200	**SD /CY-10S/2Z**				200
SD /CY-2S/5Z				500	**SD /CY-10S/5Z**				500
SD /CY-2S/10Z				1,000	**SD /CY-10S/10Z**				1,000

*SD: Spin Draw Yarn **CY: Conductive Yarn

3. Results and discussion

Figure 1 shows the mechanical properties of manufactured composite conductive threads with various twisting conditions. It was confirmed that the mechanical properties of conductive composite threads made from the same PET and CY yarns differ depending on the TPM. When the 1st twist number was same, it was confirmed that the modulus gradually decreased and elongation improved as the 2nd twist number increased. Tenacity remained relatively constant, and no clear trend was observed in toughness. The SD/CY_10S/10Z has largest linear resistance of 7.33Ω/cm. As the TPM increased, the linear resistance was gradually increased.



(a) Modulus (b) Tenacity (c) Elongation (d) Toughness

Figure 1. Mechanical properties of manufactured composite conductive threads

Acknowledgments

This study has been conducted with the support of the Korea Institute of Industrial Technology (kitech JE-23-0015).

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