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The Fabrication and Functional Properties of Cooling and Anti-UV Polyamide 6 Fiber Products

Kou-Bin Cheng*

[1]*Department of Fiber and Composite Materials, Feng Chia University, Taiwan*

[2]*Textile and Material Industrial Research Center, Feng Chia University, Taiwan*

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***Corresponding author:** Kou-Bin Cheng, Department of Fiber and Composite Materials, Feng Chia University, 100, Wenhua Road, Taichung 407, Taiwan; Email: kbcheng@fcuoa.fcu.edu.tw

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Short Communication

Due to rapid changes in climate and increasingly serious environmental pollution, the wearer gradually feels the discomfort caused by the hot weather. Therefore, the fiber products with cooling and anti-UV, antibacterial, moisture absorption and water absorption etc. functions become an urgent need. Recently, the composites of polymer and functional additives have attracted much more attention and made a great advance in the fiber, polymer, film, and composite materials field. One of the most prevalent or popular classes of fiber is composed of materials containing an organic binding matrix with inorganic material as the functional fillers [1-3]. To overcome the disadvantage of regular Polyamide 6 fiber products, composites incorporates organic polyamide and functional inorganic fillers have been developed to improve functional properties of polyamide fabrics. Recent functional Polyamide 6 (Nylon 6) fiber products were spun by melt spinning system in Taiwan have been included cooling, warming, antibacterial, deodorant, PA 6 yarns which could be used in Summer and Spring seasons' garments such as sport wear, underwear, jeans, socks, sleeves, shoes, pants and home textiles etc. The functional PA 6 fiber products were emphasized on comfort, health, safety, and skin care application fields [4-8]. This case study provides the recent developments in the rapidly changing and advancing field of PA 6 fiber products, fabrication and testing method. The current report demonstrates that fabric performance or functions can be tailored to amount and size of powder, fiber fineness, yarn denier, fabric density, and functional yarn content variations. The findings of this report suggest that a complete fabric system is possible through the integration of the different types of fiber based functional elements. This work intends to be a starting point for standardization and functionalization of functional fabric manufacturing techniques and e-textile fabrication methods. Finally, static and dynamic temperature difference, Qmax value, UPF value, and water absorption height of functional PA 6 fiber products in accordance to test standard FTTS-FA-005-2010, CNS 15687, AATCC 183-2010, and FA-004-2011 4,4 respectively would be investigated.

The fabrication of Compound Mineral Stone Cooling Particles (CMSCP) were produced by wet grinding method with non-ion dispersant was studied in this report. In order to obtain the uniform distribution of CMSCP in PA6 fiber, the CMSCP needs to be suspend evenly in aqueous slurry with a zeta potential of lower than -40mV. The certain amount of CMSCP aqueous slurry with 9-10pH value was mixed with Caplactum (CPL) in polymerization chamber. After ring opening reaction and polymerization PA6/CMSCP composite chips was synthesized. 40d/24f, 70d/48f Fully Draw Yarn (FDY) and 40d/34f, 70d/48f, 70d/68f DTY, 140d/ 96f and other commercialized specifications. It was expected that the cooling yarns could be used for the unique Win cool, Win dry, and all win fiber products with better cooling, UV shielding, thermal diffusivity, hand feeling, and water absorption functions. Finally, the yarns were used as the raw materials to fabricate knitted fabrics by circular knitting machine , the above-mentioned functions of knitted fabrics are test in accordance to CNS 15687 and related ASTM, AATCC standard. The submicron CMSCP powders, and PA 6/CMSCP filament yarns which can be interknitted or interweaved to fabricate knitted and woven fabrics have been fabricated successfully. However, the testing results of temperature difference should be controlled over 1.5 °C, Qmax value should be exceed over 0.15W/cm2, UPF value over 40, and water absorption height could be over

12cm/10min. Finally, the PA 6/ CMSCP knitted fabric has better bursting strength, dimensional stability, water absorption, dyeing ability, drape ability, air permeability, moisture transfer, soft and comfort hand feeling, silk like appearance, and without any electrostatic problem [9-11].

The cooling PA 6/ CMSCP yarn is a kind of excellent and unique yarn material to produce high grade cloth, and can be mixed with natural cotton or synthetic fibers to weave or knitted for improving the functions, hand feeling and appearance, which widely extends the application fields , The raw material and labor cost would be saved and also the efficiency would be modified. The end applications of the cooling woven and knitted fabrics such as scarf, under wear, short pants, socks, hat, bed clothes, pillow cover, sleeve, mask, T shirt, jacket and jeans etc used in spring and summer seasons. The commercialized Win cool, Win dry, and all win knitted and woven fabrics have been provided to the international brand such as Triumph, Wacoal, Victoria Secret (VS), Vanity Fair (VF), UA, Easy Shop, Avon etc, to sell in the USA, Asian countries [12]. It is also expected that satisfies customer's and market need regarding comfort, function, health care, safety, and sanitation etc. The fabrics made of PA6 cooling yarns can be dyed in various color with qualified fastness and maintain excellent functions. The AATCC100 test shows that after being washed 30 times in a home washing machine it retained 99% of its functions effectiveness. The PA 6 fiber products also passed the "OECD Guideline 401" oral toxicity test, ISO 10993-5 for cell toxicity, ISO10993-10 for skin irritation and ISO10993-10 for skin sensitivity.

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