A Study on the Dyeing Properties of the UMWPE Fiber

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1. Introduction

Ultra high molecular weight polyethylene (UHMWPE) also has advanced mechanical properties and excellent physical properties, which are valuable for protective clothing. Since the 1970s, UHMWPE-based fibers have been produced using gel-spinning technology through which high - performance fibers are commercially available.

Aside from their high modulus and strength, these fibers have additional advantages, in particular, light weight and high-energy dissipation in comparison to all other polymer fibers. However, UHMWPE fiber has a high crystallinity which may lead to higher bending stiffness and dyeing processing difficulty.

In this study, the influence of process parameters and different type disperse dye on the dyeing properties. In addition, the effect of dyeing with a disperse dye on the UHMWPE fiber on the low stress mechanical properties will also be discussed.

2. Experimental

Materials

Two type of UHMWPE were used a dyneema fiber and dyneema fabric. The fiber type(dyneema/span yarn, 554 denier) was purchased from MIDAS(Korea). The fabric type (1500 denier) was purchased Toyobo(Osaka, Japan)

Dyeing

A disperse dye, C.I.Disperse Red 60(E type), C.I.Disperse Red 167(S type), obtained as a commercial product, was used without further purification. The UHMWPE samples were dyed with different concentrations, 1% owf, and 3% owf, at a liquor-to-goods ratio of 20:1 in a shaking bath type dyeing machine. The dyeing curve was shown in figure 1 and the amount of auxiliaries used was shown table 1. The fabric samples were finally conditioned under standard atmospheric pressure at 65±2 % relative humidity and 21±1 ℃ for 24 h prior to further use.

Analysis

The dyed UHMWPE fiber were characterized using the colorimeter(X-Rite SP62, USA), Universal Testing machine (Instron, Model 5567), DSC(TA100) and Scanning electron microscope (HITACHI, S-3000N).

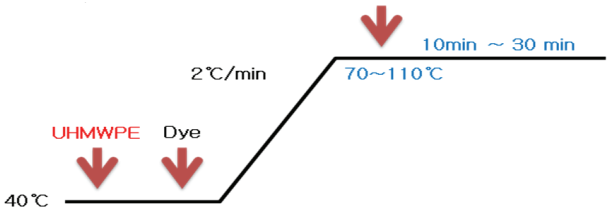

Fig. 1. Dyeing curve for Disperse dyeing

Table 1. Auxiliaries used for each dye concentration (recommended by dye supplier)

Chemicals	Concentration of dyes		
	1% owf	1% owf	3% owf
Disperse agent	0.25%	0.5%	0.25%
acetic acid	0.25%	0.5%	0.25%

3. Results and Discussion

For investigating the effect of the disperse dye content on UHMWPE fiber, the content of the dyeing solution was varied from 1 % owf to 3% owf. The dyeing effect of the dyed fiber increased gradually with increasing of dye concentration. Also E type was more excellent performance than other type dye in disperse dye. In addition, it was observed that dyed fiber showed lower dyeing temperature than high dyeing temperature at the increased mechanical properties on UHMWPE. This research was financially supported by dye concentration and dyeing temperature.

4. REFERENCES

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