Thermal History Determination of Textured Polyester Yarn

TA417

PROBLEM

Texturing is used in the textiles industry to achieve added bulkiness in synthetic fibers. It involves inducing a ‘false twist’ in the yarn under controlled tension, temperature, and time conditions. If not accomplished properly, however, texturing can lead to problems in the fiber. For example, fabric streakiness, a common problem during dyeing, is primarily due to structural differences in the textured yarn, which in turn give rise to variations in the dye uptake of the woven fabric. These structural differences in the textured yarn are often due to variations in the maximum temperature reached during texturing. The ability to estimate this temperature subsequent to texturing and prior to further processing and dyeing can therefore aid in:

- determining effects of texturing conditions on yarn dyeability
- controlling the texturing process
- assisting in determining causes of defects in fabrics

Density gradient-tubes are often used to estimate the texturing temperature. However, that approach is tedious and subject to operator bias.

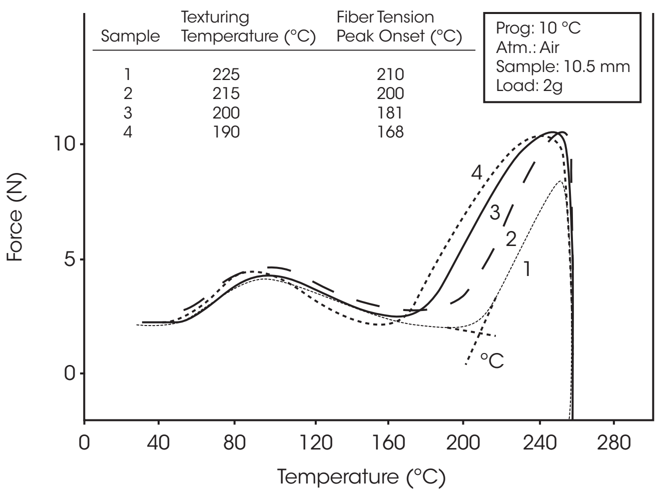

Figure 1. Polyethylene Terephthalate Texturing Temperature (Fiber Tension

SOLUTION

Thermomechanical analysis (TMA) is a thermal analysis technique normally used to measure dimensional change in materials with temperature. Using a different TMA experimental approach, however, it is possible to measure force required to maintain a material’s length, i.e., prevent shrinkage or elongation. For fibers, this latter approach yields experimental curves such as shown in Figure 1. In this case, the temperature onset associated with the high temperature TMA stress peak, which is due to structure changes in the fiber during texturizing and “frozen in” upon subsequent cooling, correlates directly to the texturing temperature and density gradient results. Figure 2 and Table 1). Other important fiber properties such as draw ratio, elongation at break, and knot strength can also be correlated with other aspects (e.g., peak area) of these TMA stress curves. Furthermore, the TMA curves can be obtained in less than 30 minutes with minimal operator expertise.

Sample	Actual Texturing Temperature °C	Fiber Tension Peak Onset °C	Density (g/cm³)
1	225	210	1.3963
2	215	200	1.3951
3	200	181	1.3923
4	190	168	1.3912
5	210	196	1.3942
6	220	208	1.3957

Table 1.

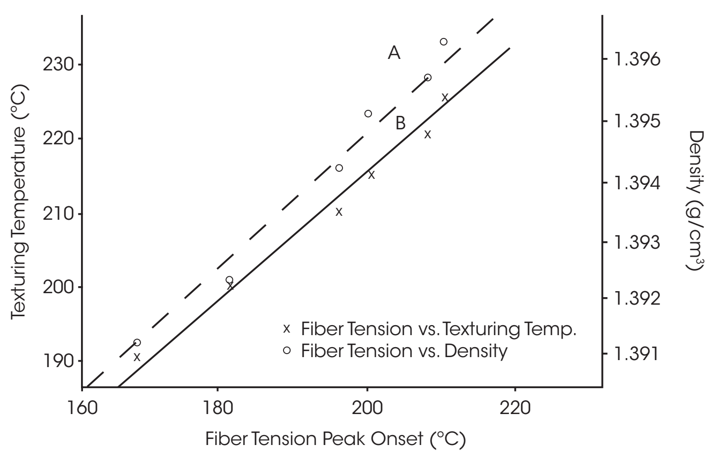

Figure 2. Polyethylene Terephthalate Fiber Tension Correlations

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