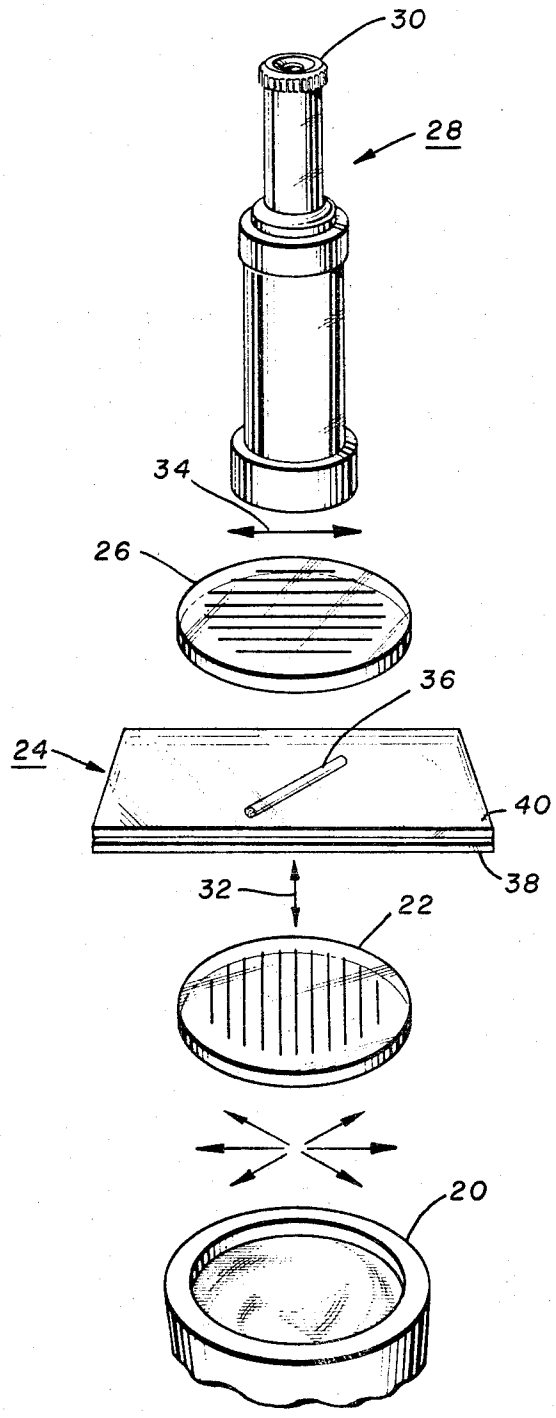
Jan. 14, 1969 M. C. HUEBSCHMAN 3,421,820

OPTICAL DETERMINATION OF LOW LUSTER IN DRAWN NYLON

Filed Dec. 3, 1964

FIG. 1.



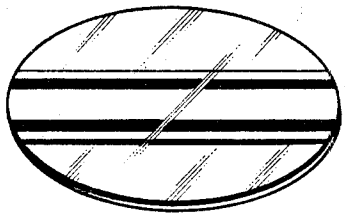


FIG. 2.

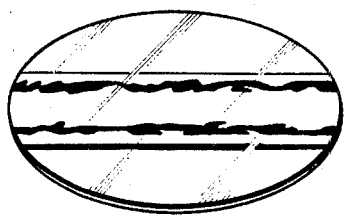


FIG. 3.

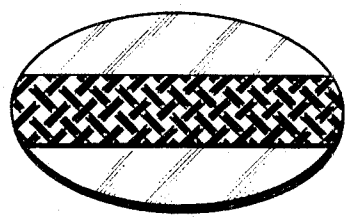


FIG. 4.

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3,421,820

OPTICAL DETERMINATION OF LOW LUSTER IN DRAWN NYLON

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Int. Cl. G01r 1/00

ABSTRACT OF THE DISCLOSURE

A drop of 67–78% aqueous formic acid is added to a drawn nylon filament. This creates characteristic changes in interference color bands of low-luster filaments when inspected with a polarizing microscope, but does not substantially affect normal nylon.

The present invention relates to a technique for determining low luster in drawn nylon by application of a particular chemical and inspection with polarized light.

A principal defective condition in nylon is the phenomenon commonly termed "low luster." As indicated by its name, low luster yarn does not have the bright sparkle which is present in normal spun nylon. In addition to this purely optical property, various other physical differences exist between low luster yarn and normal yarn, such as difference in breaking strength, dyeing properties, various processing peculiarities, etc. Low luster yarn may be caused by abnormally low spinneret temperatures, the presence of gel in the melt, or by various other conditions.

Freshly spun yarn may be checked for low luster quite readily by inspection of the freshly solidified yarn in the spinning chimney or quench chamber, by flashing a beam of light on the threadline as it is being extruded from the spinnert. Normal yarn will exhibit a definite brilliant sparkle just below the quench or freezing point, while low luster yarn does not exhibit such sparkle. When normal yarn and low luster yarn in the spun or undrawn state are examined using a polarizing microscope, the normal yarn exhibits well defined interference color patterns which extend axially along the filament in clearly defined parallel color bands. Low luster yarn, on the other hand, exhibits irregular color patterns in a cross-hatching or chevron effect.

If the low luster yarn is not detected before the yarn has been drawn or elongated, there are no known simple tests for positively determining the presence or absence of low luster, since drawn yarn exhibits well defined color bands parallel to the filament axis whether or not the yarn is low luster.

Accordingly, a primary object of the invention is to provide a simple procedure for determining whether or not drawn nylon was made from low luster spun yarn. Other objects of the invention will in part be obvious and will in part appear hereinafter.

The invention accordingly comprises the several steps and the relation of one or more of such steps with respect to each of the others thereof, which will be exemplified in the method hereinafter disclosed, and the scope of the invention will be indicated in the claims.

For a more complete understanding of the nature and objects of the invention, reference should be had to the following detailed description taken in connection with the accompanying drawing, in which:

FIGURE 1 is a schematic diagram of an exemplary optical system for practicing the present invention;

FIGURE 2 is a schematic diagram of a normal interference color pattern;

FIGURES 3 and 4 are schematic diagrams of interference color patterns indicating low luster.

Referring generally to FIGURE 1, a generalized optical system of a polarizing microscope is illustrated. Nonpolarized light from a source **20** passes successively through a polarizer **22**, the sample assembly **24**, analyzer **26** and optical lens system **28** to an eyepiece **30**, where the enlarged image of yarn **24** may be viewed. As is conventional, the nonpolarized light emitted from source **20** is plane polarized by polarizer **22** in the direction indicated by arrow **32**, while analyzer **26** is oriented to pass light polarized in the direction approximately perpendicular to arrow **32** as shown by arrow **34**. Sample assembly **24** includes a filament **36**, which is to be examined for low luster, supported on a transparent microscope slide **38** and covered by transparent cover slip **40**. The entire assembly **24** may be supported by a conventional rotating stage, so that the axis of filament **36** may be oriented in any direction in a plane perpendicular to the path of the light passing from polarizer **22** to analyzer **26**. The apparatus as thus described is entirely conventional and forms no part of the present invention.

If undrawn yarn is viewed while oriented a few degrees from extinction in the FIGURE 1 system, normal yarn will appear somewhat as shown in FIGURE 2, wherein the bands of interference colors are clearly defined, and run parallel to the filament axis. The color bands in low luster undrawn yarn are irregular in outline and extent as shown in FIGURE 2, and have edges which are increasingly inclined with respect to the filament axis as the degree of low luster increases. In an extreme example of low luster, the interference color bands may form a cross-hatching pattern as shown in FIGURE 4, wherein the several colors are disrupted and intermingled. Drawn yarn will appear substantially as illustrated in FIGURE 2 whether or not low luster is present.

According to the present invention, if the drawn yarn is treated with the proper concentration of aqueous formic acid, low luster yarn will again take on the characteristic irregular patterns of the types depicted in FIGURES 3 or 4 while normal yarn will retain the clearly defined color bands as shown in FIGURE 2. This allagochromic (color-changing) concentration of formic acid is just below the concentration necessary to dissolve the yarn, and is directly related to the degree of orientation of the yarn. The formic acid may be added by inserting a drop between slide **38** and cover slip **40**. The drop will spread and envelop filament **36** by capillary action.

Table I showns a comparison of dissolution points and birefringence of several nylon 66 yarns.

TABLE I

Item	Birefringence	Percent formic acid
1	.0060	62
2	.0154	63
3	.0207	65
4	.0242	65
5	.0520	72
6	.0541	73
7	.0550	73
8	.0569	75

In Table I, the first four items refer to spun yarn, i.e., yarn which is substantially not oriented, while the last four items refer to commercially available drawn yarn. It should be noted that the concentration of formic acid required to dissolve the yarn increases with increasing orientation of the yarn. As noted above, the optimum concentration required to produce the most clearly defined change in interference color patterns is usually one or two percent below the dissolution concentration. A formic acid concentration which is several percent below

the optimum concentration will produce no change in interference colors, or only a slight change. On the other hand, if the acid concentration is too high the interference colors will soon disappear or the yarn will completely dissolve. With most drawn yarns, the optimum concentration will be between about 67% and 78% formic acid. Selection of the optimum concentration to suit a specific yarn sample is well within the scope of one skilled in the art. In practice, an initial trial concentration of 72% formic acid will usually bring out sufficient interference color changes to indicate to one skilled in the procedure whether or not low luster is present, even though this might not be the optimum concentration of formic acid for a given yarn sample.

The optimum allagochromic concentration of formic acid is defined by

$$\left[\left(56+\frac{\text{birefringence}}{.0035}\right)\right]\%$$

although with particular yarns the concentration may be varied by one or two percent in either direction and still yield a visible distinction between normal and low-luster yarns.

While the invention may be efficiently practiced by viewing the light transmitted through the filament by a polarizing microscope as disclosed above, various minor modifications will occur to those skilled in the art.

In this specification and in the appended claims, all references to the percentage concentration of the formic acid solution refer to percentage of formic acid by volume where not otherwise specified, and the term birefringence always refers to the birefringence of the filament being treated with the formic acid.

It will thus be seen that the objects set forth above, among those made apparent from the preceding description, are efficiently attained and, since certain changes may be made in carrying out the above process without departing from the scope of the invention, it is intended that all matter contained in the above description shall be interpreted as illustrative and not in a limiting sense.

Having described my invention, what I claim as new and desire to secure by Letters Patent is:

1. A process for determining the presence of low-luster in a drawn nylon filament, comprising in combination:
   (a) treating said filament with an allagochromic concentration of aqueous formic acid,
   (b) passing through said treated filament a beam of light which is plane polarized in a particular plane,
   (c) and inspecting the polarized light transmitted through said filament through an analyzer oriented to pass light in a plane parallel to said beam and approximately 90° from said particular plane.

2. A process for determining the presence of low-luster in a drawn nylon filament, comprising in combination:
   (a) treating said filament with an aqueous solution of

$$\left[\left(56+\frac{\text{birefringence}}{.0035}\right)\right]\% \text{ formic acid}$$

   (b) passing through said treated filament a beam of light which is plane polarized in a particular plane,
   (c) and inspecting the polarized light transmitted through said filament through a plane polarizer oriented to pass light in a plane approximately 90° from said particular plane.

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U.S. Cl. X.R.

73—160; 356—115, 238