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(JTETC/JCFA/JSA)

**Testing methods for quantitative analysis  
of fibre mixtures — Part 1: Testing meth-  
ods for fibre identification**

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## Foreword

This translation has been made based on the original Japanese Industrial Standard revised by the Minister of Economy, Trade and Industry through deliberations at the Japanese Industrial Standards Committee as the result of proposal for revision of Japanese Industrial Standard submitted by Japan Textile Evaluation Technology Council (JTETC), Japan Chemical Fibers Association (JCFA)/Japanese Standards Association (JSA) with the draft being attached, based on the provision of Article 12 Clause 1 of the Industrial Standardization Law applicable to the case of revision by the provision of Article 14.

Consequently **JIS L 1030-1:2006** is replaced with this Standard.

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**JIS L 1030** consists of the following 2 parts under the general title “*Testing methods for quantitative analysis of fibre mixtures*”:

*Part 1: Testing methods for fibre identification*

*Part 2: Testing methods for quantitative analysis of fibre mixtures*

# Testing methods for quantitative analysis of fibre mixtures — Part 1 : Testing methods for fibre identification

## Introduction

This Japanese Industrial Standard was established in 1998 and has been revised twice up to the present. The revision at this time is for modifying some of the contents to adapt to changes in actual usage of the testing methods that have occurred since the last revision made in 2006.

No corresponding International Standard has been established at this point.

## 1 Scope

This Standard specifies the testing methods for identifying the kinds of fibres used for textile goods.

**WARNING** This Standard calls for the use of substances <sup>1)</sup> and/or procedures that may be injurious to health if adequate precautions are not taken. It refers only to technical suitability and does not absolve the user from legal obligations relating to health and safety at any stage. It has been assumed in the drafting of this Standard that the execution of its provisions is entrusted to appropriately qualified and experienced people.

Note <sup>1)</sup> Information on substances which may damage the health is described in the Safety Data Sheet (SDS) in detail.

## 2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this Standard. The most recent editions of the standards (including amendments) indicated below shall be applied.

JIS K 0050 *General rules for chemical analysis*

JIS K 0117 *General rules for infrared spectrophotometric analysis*

JIS L 0105 *General principles of physical testing methods for textiles*

JIS L 0208 *Glossary of terms used in textile industry — Testing*

JIS L 1030-2 *Testing methods for quantitative analysis of fibre mixtures of textiles — Part 2 : Testing methods for quantitative analysis of fibre mixtures*

## 3 Terms and definitions

For the purpose of this Standard, the terms and definitions given in JIS L 0208 apply.

#### 4 Classification of tests

The classification of tests shall be as follows.

The figures in parentheses indicate the subclauses under which the respective tests are given in the text.

- a) Combustion test (6.1)
- b) Confirmation test of chlorine in fibre (6.2)
- c) Confirmation test of nitrogen in fibre (6.3)
- d) Microscopical test (6.4)
- e) Colouring test by iodine-potassium iodide solution (6.5)
- f) Xanthoprotein reaction test (6.6)
- g) Test of solubility in reagents (6.7)
- h) Measurement test of infrared absorption spectrum (6.8)

#### 5 Sampling and pretreatment of sample

##### 5.1 Sampling

Sampling shall be in accordance with clause 6 of JIS L 0105.

##### 5.2 Pretreatment of sample

If necessary, the resin and the like adhering to the taken sample that may impair the test results shall be removed by the method specified in 5.7 of JIS L 1030-2 or an appropriate treatment such as decolouring and dyeing which would not hinder the identification shall be performed. Sample shall then be ravelled to filiform or fibriform before being supplied for the test.

#### 6 Testing methods

Identification of fibre shall be carried out by one or combination of the following tests. Annex B describes an example of the systematic identification method.

##### 6.1 Combustion test

Subject a sample of yarns or a bind of fibres of a suitable size to a flame approximately 5 mm to 10 mm in length, and examine the state of the fibre, odour of smoke and state of ash as the sample is held close to the flame, as it is inside the flame and as it is withdrawn from the flame.

State and odour of fibre, and state of ash for each fibre under respective conditions are listed in table 3.

NOTE : Examination of odour should be based on the smell of the smoke generated when the flame of the burning sample is extinguished.

##### 6.2 Confirmation test of chlorine in fibre

Attach a sample to a red-heated copper wire and put it in an oxidizing flame of gas

burner. The flame turning green at this time indicates the presence of chlorine in the fibre, in which case possible fibres are the following (see table 3) :

- vinylidene;
- polyvinyl chloride;
- acrylic series;
- polychlal.

NOTE : Some types of acrylic series do not contain chlorine, and some types of acrylic contain chlorine.

### 6.3 Confirmation test of nitrogen in fibre

Put the mixture of soda lime or sodium hydroxide and calcium oxide (mass ratio 1 : 1.4) in a test tube, add a small amount of sample to it, and while heating the bottom of the test tube, place a red litmus paper moistened with water of quality at least equal to A2 specified in **JIS K 0050** over the tube opening. The litmus paper turning blue at this time indicates the presence of nitrogen in the fibre, in which case possible fibres are the following (see table 3) :

- silk;
- animal fibre;
- promix;
- nylon;
- acrylic;
- acrylic series;
- polyurethane;
- aramid (A, B and C)<sup>2)</sup>.

Note <sup>2)</sup> Colour change of the litmus paper in this test should be observed carefully since the change is only slight.

### 6.4 Microscopical test

Observe the sides and sections of the fibre by an optical microscope of about 100 times to 500 times magnifications or an electronic microscope of least about 400 times magnifications.

See table 3 for descriptions of appearance of various fibres under a microscope, and figure 1 and Annex A for photographic examples of various fibres.

### 6.5 Colouring test by iodine-potassium iodide solution

The colouring test by iodine-potassium iodide solution shall be as follows.

- a) **Preparation of reagent** Prepare the iodine-potassium iodide solution by dissolving 20 g of iodine in 100 ml of saturated potassium iodide solution.
- b) **Testing method** Immerse the sample unravelled to fibriform in the iodine-potassium

iodide solution for 30 s to 1 min, rinse it sufficiently in water and observe the coloured condition of the fibre with the naked eye or under a microscope. See table 3 for coloured conditions of various fibres.

### 6.6 Xanthoprotein reaction test

Put the sample on a slide glass placed under a microscope, and drop nitric acid on it. If the fibre turns yellow by this operation, and then orange by subsequent neutralization with ammonium, it indicates the presence of protein in the fibre, in which case possible fibres are the following (see table 3) :

- silk;
- animal fibre;
- promix.

### 6.7 Test of solubility in reagents

Take 4 ml to 15 ml of a reagent in a test tube of 18 mm diameter, put about 10 mg of sample in it, treat it at a prescribed temperature for a prescribed duration and observe the solubility of fibre in the reagent. See table 4 for solubility of fibres in various reagents.

### 6.8 Measurement test of infrared absorption spectrum

Measure the infrared absorption spectrum of sample by means of an infrared spectrophotometer according to the following.

See table 1 for the principal absorption band and characteristic wave number of infrared absorption spectrum of each fibre and see figure 2 for infrared absorption spectrum of various fibres.

- a) **Method A (potassium bromide tablet method)** Crush the potassium bromide for infrared absorption finely in an agate mortar, filter it to obtain powder of 53 µm to 74 µm and heat it to dry at 120 °C to 150 °C for 24 h or longer and cool <sup>3)</sup> it in a desiccator (containing phosphorus pentaoxide). Chop the sufficiently dried sample into small pieces, and put 2 mg to 4 mg of it in an agate mortar together with about 400 mg of the previously cooled potassium bromide dry powder, and crush and mix it taking care the mixture does not absorb moisture. Put approximately 200 mg of this mix powder in a tablet moulding machine, and while exhausting to about 0.13 kPa with a vacuum pump, form a tablet by applying a pressure of 19.61 MPa to 39.23 MPa for 5 min to 10 min and measure the infrared absorption spectrum according to **JIS K 0117**.

Note <sup>3)</sup> Since absorption of moisture by potassium bromide affects the spectrum, cooling and drying of potassium bromide should be thorough.

- b) **Method B (film method)** Dissolve the sample in the dissolving reagent in table 2, pour it into an evaporation pan and dry under reduced pressure or dry by heat taking care not to decompose the sample. Then strip off the dry film carefully not to break it, cut the film into an appropriate size, put it between cardboards and measure the infrared absorption spectrum according to **JIS K 0117**. The film shall

be thin enough to be transparent and at least 1 cm<sup>2</sup> in size since the film size depends on the infrared spectrophotometer to be used.

- c) **Method C [ATR (attenuated total reflection) method]** Flatten the surface of sample sufficiently and mount the sample on an ATR prism. Adhere the sample uniformly to the prism closely by pressuring from the back surface of the sample and measure the infrared absorption spectrum according to **JIS K 0117**. It is required to select an appropriate material of prism and an incident angle of infrared light in consideration of the reflective index of sample. Only prism shall be used for the control sample.

## 7 Test report

The report of test results shall contain the following information.

- a) The date of test
- b) The number of this Standard
- c) The type of test performed
- d) The testing method used
- e) The test results (name of fibre)

**Table 1 Principal absorption band and characteristic wave number of various fibres by infrared absorption spectrum**

| Number | Name of fibre               | Preparation of sample | Principal absorption band and its characteristic wave number $\text{cm}^{-1}$       |
|--------|-----------------------------|-----------------------|-------------------------------------------------------------------------------------|
| 1      | Cotton                      | K                     | 3 450 to 3 250 2 900 1 630 1 430 1 370 1 100 to 970 550                             |
| 2      | Flax (linen)                | K                     | 3 450 to 3 250 2 900 1 730 1 630 1 430 1 370 1 100 to 970 550                       |
| 3      | Ramie                       | K                     | 3 400 to 3 350 2 900 1 630 1 430 1 370 1 100 to 970 550                             |
| 4      | Animal fibre <sup>a)</sup>  | K                     | 3 400 to 3 250 2 900 1 720 to 1 600 1 500 1 220                                     |
| 5      | Raw silk <sup>b)</sup>      | K                     | 3 300 to 3 200 2 950 1 710 to 1 500 1 220 1 050                                     |
| 6      | Degummed silk               | K                     | 3 300 to 2 950 1 710 to 1 630 1 530 to 1 500 1 440 1 220 610 540                    |
| 7      | Styrene grafted silk        | K                     | 3 300 3 050 2 950 1 710 to 1 630 1 530 to 1 490 1 450 1 220 750 690 540             |
| 8      | Polystyrene                 | F                     | 3 050 2 950 1 600 1 490 1 450 1 020 750 690 540                                     |
| 9      | Rayon                       | K                     | 3 450 to 3 250 2 900 1 650 1 430 to 1 370 1 060 to 970 890                          |
| 10     | Polynosic                   |                       |                                                                                     |
| 11     | Cupro/Lyocell <sup>c)</sup> |                       |                                                                                     |
| 12     | Acetate                     | F                     | 3 500 2 950 1 750 1 430 1 370 1 230 1 040 900 600                                   |
| 13     | Triacetate                  |                       |                                                                                     |
| 14     | Promix                      | K                     | 3 300 2 900 2 250 1 680 to 1 630 1 530 1 450 1 230 540                              |
| 15     | Nylon 6                     | K                     | 3 500 to 3 250 2 950 2 850 1 680 to 1 630 1 560 to 1 510 680                        |
| 16     | Nylon 6                     | F                     | 3 300 3 050 2 950 2 850 1 630 1 530 1 450 1 250 680 570                             |
| 17     | Nylon 66                    | K                     | 3 500 to 3 250 2 950 2 850 1 680 to 1 630 1 560 to 1 510 930 680                    |
| 18     | Nylon 66                    | F                     | 3 300 to 2 950 2 850 1 630 1 530 1 470 1 270 930 680 570                            |
| 19     | Vynlon                      | F                     | 3 400 to 2 950 1 430 to 1 400 1 090 to 1 050 1 020 850 790                          |
| 20     | Vinylidene                  | K                     | 3 000 1 730 1 400 1 350 1 270 1 070 to 950 590 530 450                              |
| 21     | Vinylidene                  | F                     | 3 000 1 730 1 400 1 350 1 070 1 050 to 650 600 530 450                              |
| 22     | Polyvinyl chloride          | F                     | 2 950 2 900 1 420 1 350 1 250 1 090 to 950 690 650 to 600                           |
| 23     | Polyester                   | K                     | 1 770 to 1 670 1 500 1 410 1 320 1 200 1 130 to 1 050 870 720                       |
| 24     | Polyester                   | F                     | 1 730 1 410 1 340 1 250 1 120 1 100 1 020 to 870 720                                |
| 25     | Acrylic A                   | F                     | 2 950 2 250 1 730 1 450 1 360 1 220 1 160 1 060 540                                 |
| 26     | Acrylic B                   |                       |                                                                                     |
| 27     | Acrylic C                   | F                     | 2 950 2 250 1 730 1 450 1 360 1 220 1 070 to 1 020                                  |
| 28     | Acrylic D                   | F                     | 2 950 2 250 1 730 1 680 1 450 1 360 1 160 1 070 530                                 |
| 29     | Acrylic series A            | F                     | 2 950 2 250 1 510 1 450 1 360 1 250 990 620                                         |
| 30     | Acrylic series B            | F                     | 3 550 2 950 2 250 1 730 1 450 1 250 1 050 990 620                                   |
| 31     | Polyethylene                | F                     | 2 900 2 850 1 470 1 460 1 370 740 720                                               |
| 32     | Polypropylene               | F                     | 2 970 to 2 940 2 850 1 450 1 370 1 160 990 970 840                                  |
| 33     | Polychlal                   | K                     | 3 400 2 900 1 430 1 240 1 100 to 1 050 1 010 850 600                                |
| 34     | Benzoate                    | F                     | 1 710 1 610 1 510 1 360 1 270 1 240 1 160 1 100 1 050 930 840 770 690               |
| 35     | Polyurethane A              | F                     | 3 300 2 950 2 850 1 730 1 630 1 590 1 530 1 410 1 370 1 300 1 220 1 100 760 650 510 |
| 36     | Polyurethane B              |                       |                                                                                     |
| 37     | Polyurethane C              |                       |                                                                                     |
| 38     | Polyurethane D              | F                     | 3 300 2 950 1 730 1 590 1 530 1 410 1 300 1 220 1 160 1 070 810 760 510             |

**Table 1 (concluded)**

| Num-ber                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Name of fibre | Prepa-ration of sam-ple | Principal absorption band and its characteristic wave number $\text{cm}^{-1}$                   |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|-------------------------|-------------------------------------------------------------------------------------------------|
| 39                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Aramid A      | K                       | 3 500 to 3 200 1 650 1 540 1 510 1 400 1 310 1 260 1 110<br>1 020 890 860 820 780 720 520       |
| 40                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Aramid B      |                         | 3 500 to 3 200 1 660 1 600 1 540 1 480 1 430 1 410 1 300<br>1 240 780 720 680 570               |
| 41                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Aramid C      |                         | 3 500 to 3 200 1 650 1 600 1 510 1 400 1 310 1 260 1 210<br>1 140 1 020 890 860 830 780 720 520 |
| 42                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Polylactide   | F                       | 1 760 1 460 1 380 1 360 1 270 1 180 1 130 1 090 1 050<br>870 760                                |
| <p>NOTE 1 K in the column of sample preparation indicates the sample for infrared absorption by the potassium bromide tablet method and F indicates that by the film method.</p> <p>NOTE 2 A, B, C, and D in the column of the name of fibre indicate the type of fibre.</p> <p>NOTE 3 In the absorption wave number of each fibre, there can be a variation of about <math>\pm 20 \text{ cm}^{-1}</math> depending on the infrared spectrophotometer used.</p> <p>NOTE 4 In the spectrum of modified fibre and the like, the absorption of modified substance is overlapped on the absorption of fibre itself.</p> <p>Notes <sup>a)</sup> Animal fibre generally shows a broad absorption between <math>1\,800 \text{ cm}^{-1}</math> to <math>1\,000 \text{ cm}^{-1}</math>.<br/> <sup>b)</sup> Raw silk generally shows a broad absorption between <math>1\,710 \text{ cm}^{-1}</math> to <math>1\,370 \text{ cm}^{-1}</math>.<br/> <sup>c)</sup> Cupro and lyocell are almost identical in property, and differentiation between them is sometimes difficult.</p> |               |                         |                                                                                                 |

**Table 2 Dissolving reagents for various fibres  
in infrared spectrum measurement (film method)**

| Name of fibre         | Ni-<br>tric<br>acid | Gla-<br>cial<br>acetic<br>acid | Ace-<br>tone | Dime-<br>thyl-<br>form-<br>amide | Tetra-<br>hydro-<br>furan | Dio-<br>xane | Mono-<br>chloro-<br>ben-<br>zene | Xy-<br>lene | Nitro-<br>ben-<br>zene | <i>m</i> -<br>Cresol | Dich-<br>loro-<br>me-<br>thane | Di-<br>me-<br>thyl-<br>sul-<br>foxide | Deca-<br>hydro-<br>naph-<br>tha-<br>lene | Chlor-<br>form |
|-----------------------|---------------------|--------------------------------|--------------|----------------------------------|---------------------------|--------------|----------------------------------|-------------|------------------------|----------------------|--------------------------------|---------------------------------------|------------------------------------------|----------------|
| Acetate               | —                   | ○                              | ○            | ○                                | ○                         | ○            | —                                | —           | ○                      | ○                    | —                              | ○                                     | —                                        | —              |
| Triacetate            | —                   | ○                              | ○            | ○                                | —                         | ○            | —                                | —           | ○                      | ○                    | ○                              | ○                                     | —                                        | —              |
| Nylon 6               | ○                   | ○                              | —            | —                                | —                         | —            | —                                | —           | —                      | ○                    | —                              | —                                     | —                                        | —              |
| Nylon 66              | ○                   | ○                              | —            | —                                | —                         | —            | —                                | —           | —                      | ○                    | —                              | —                                     | —                                        | —              |
| Vinylon               | —                   | —                              | —            | —                                | —                         | —            | —                                | —           | —                      | —                    | —                              | ○                                     | —                                        | —              |
| Vinylidene            | —                   | —                              | —            | ○                                | ○                         | ○            | ○                                | —           | ○                      | —                    | —                              | ○                                     | —                                        | —              |
| Polyvinyl<br>chloride | —                   | —                              | —            | —                                | ○                         | —            | ○                                | —           | —                      | ○                    | —                              | —                                     | —                                        | —              |
| Polyester             | —                   | —                              | —            | —                                | —                         | —            | —                                | —           | ○                      | ○                    | —                              | —                                     | —                                        | —              |
| Acrylic A             | —                   | —                              | —            | —                                | —                         | —            | —                                | —           | —                      | —                    | —                              | ○                                     | —                                        | —              |
| Acrylic B             | —                   | —                              | —            | —                                | —                         | —            | —                                | —           | —                      | —                    | —                              | ○                                     | —                                        | —              |
| Acrylic C             | —                   | —                              | —            | —                                | —                         | —            | —                                | —           | —                      | —                    | —                              | ○                                     | —                                        | —              |
| Acrylic D             | —                   | —                              | —            | —                                | —                         | —            | —                                | —           | —                      | —                    | —                              | ○                                     | —                                        | —              |
| Acrylic series A      | —                   | —                              | —            | —                                | —                         | —            | —                                | —           | ○                      | ○                    | —                              | ○                                     | —                                        | —              |
| Acrylic series B      | —                   | —                              | —            | —                                | —                         | —            | —                                | —           | ○                      | ○                    | —                              | ○                                     | —                                        | —              |
| Polyethylene          | —                   | —                              | —            | —                                | —                         | —            | —                                | —           | —                      | —                    | —                              | —                                     | ○                                        | —              |
| Polypropylene         | —                   | —                              | —            | —                                | —                         | —            | —                                | ○           | —                      | —                    | —                              | —                                     | ○                                        | —              |
| Benzoate              | —                   | —                              | —            | —                                | —                         | —            | —                                | —           | ○                      | ○                    | —                              | —                                     | —                                        | —              |
| Polyurethane A        | —                   | —                              | —            | ○                                | —                         | —            | —                                | —           | ○                      | ○                    | —                              | ○                                     | —                                        | —              |

**Table 2 (concluded)**

| Name of fibre                                                            | Ni-<br>tric<br>acid | Gla-<br>cial<br>acetic<br>acid | Ace-<br>tone | Dime-<br>thyl-<br>form-<br>amide | Tetra-<br>hydro-<br>furan | Dio-<br>xane | Mono-<br>chloro-<br>ben-<br>zene | Xy-<br>lene | Nitro-<br>ben-<br>zene | <i>m</i> -<br>Cresol | Dich-<br>loro-<br>me-<br>thane | Di-<br>me-<br>thyl-<br>sul-<br>foxide | Deca-<br>hydro-<br>naph-<br>tha-<br>lene | Chlor-<br>form |
|--------------------------------------------------------------------------|---------------------|--------------------------------|--------------|----------------------------------|---------------------------|--------------|----------------------------------|-------------|------------------------|----------------------|--------------------------------|---------------------------------------|------------------------------------------|----------------|
| Polyurethane B                                                           | —                   | —                              | —            | ○                                | —                         | —            | —                                | —           | ○                      | ○                    | —                              | ○                                     | —                                        | —              |
| Polyurethane C                                                           | —                   | —                              | —            | ○                                | —                         | —            | —                                | —           | ○                      | ○                    | —                              | ○                                     | —                                        | —              |
| Polyurethane D                                                           | —                   | —                              | —            | ○                                | —                         | —            | —                                | —           | ○                      | ○                    | —                              | ○                                     | —                                        | —              |
| Poly lactide                                                             | —                   | —                              | —            | ○                                | —                         | —            | —                                | —           | ○                      | ○                    | ○                              | —                                     | —                                        | ○              |
| The mark ○ indicates the most suitable dissolving reagent for the fibre. |                     |                                |              |                                  |                           |              |                                  |             |                        |                      |                                |                                       |                                          |                |

Table 3 Table of properties of various fibres for identification of fibre (informative)

| Name of fibre                    | Combustion test                                   |                                                                              |                                                                            |                                                         |                                                               | Pres-<br>ence<br>of chlo-<br>rine | Pres-<br>ence<br>of nitro-<br>gen | Appearance under microscope                                                                                                            |                                                                                                                                        | Colouring by<br>iodine-potassium<br>iodide solution                                                                        | Xantho-<br>protein<br>reaction |
|----------------------------------|---------------------------------------------------|------------------------------------------------------------------------------|----------------------------------------------------------------------------|---------------------------------------------------------|---------------------------------------------------------------|-----------------------------------|-----------------------------------|----------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------|--------------------------------|
|                                  | When it is held up<br>to the flame                | When it is inside the<br>flame                                               | When it is withdrawn<br>from the flame                                     | Odour                                                   | Ash                                                           |                                   |                                   | Side                                                                                                                                   | Section                                                                                                                                |                                                                                                                            |                                |
| Cotton                           | It burns<br>immediately when<br>it touches flame. | It burns.                                                                    | It continues to burn,<br>and burns very fast.<br>There is an afterglow.    | Smell of paper<br>burning.                              | Very fine, soft and<br>grey                                   | No                                | No                                | Flat and ribbon shaped,with<br>a natural twist all over the<br>full length (the twist is<br>small in mercerized cotton.)               | Hollow, and in many<br>different shapes, including<br>broad bean shape, horseshoe<br>shape (round in the case of<br>mercerized cotton) | Turns faintly<br>light brown. The<br>colour dissapears<br>with time (light<br>blue in the case<br>of mercerized<br>cotton) | No                             |
| Hemp<br>[flax (linen) and ramie] | Same as above                                     | Same as above                                                                | Same as above                                                              | Same as above                                           | Same as above                                                 | No                                | No                                | Streaks observed in fibre<br>axis direction and knots<br>present in some places. The<br>tips are sharp in flax and<br>obtuse in ramie. | Hollow, and polygonal in the<br>case of flax (linen) and flat<br>elliptical in the case of<br>ramie                                    | Turns faintly<br>light brown. The<br>colour dissapears<br>with time.                                                       | No                             |
| Silk                             | It frizzles and<br>separates from<br>flame.       | It frizzles and<br>burns.                                                    | It burns similarly to<br>animal fibre, but with<br>slight flash.           | Smell of human<br>hair burning                          | Swelling black ash<br>that crumbles<br>easily                 | No                                | Yes                               | The surface is smooth and<br>uniform.                                                                                                  | Triangle                                                                                                                               | Turns light<br>yellow                                                                                                      | Yes                            |
| Animal fibre                     | Same as above                                     | Same as above                                                                | It continues to burn<br>with difficulty and<br>frizzles before<br>burning. | Same as above                                           | Same as above                                                 | No                                | Yes                               | Scale pieces are observed.                                                                                                             | Circular in many cases                                                                                                                 | Same as above                                                                                                              | Yes                            |
| Rayon                            | It burns<br>immediately when<br>it touches flame. | It burns.                                                                    | It continues to burn<br>and burns very fast.<br>There is no afterglow.     | Smell of paper<br>burning                               | Hardly no<br>remnant ash,<br>except if it is dull             | No                                | No                                | Several streaks observed in<br>fibre axis direction.                                                                                   | The contours are in<br>irregular petal shapes.                                                                                         | Turns black<br>bluish green<br>colour                                                                                      | No                             |
| Polynosic                        | Same as above                                     | Same as above                                                                | Same as above                                                              | Same as above                                           | Same as above                                                 | No                                | No                                | The surface is rough.                                                                                                                  | Circular                                                                                                                               | Same as above                                                                                                              | No                             |
| Cupro/lyocell <sup>a)</sup>      | Same as above                                     | Same as above                                                                | Same as above                                                              | Same as above                                           | Same as above                                                 | No                                | No                                | The surface is smooth.                                                                                                                 | Same as above                                                                                                                          | Same as above                                                                                                              | No                             |
| Acetate                          | It melts and<br>separates from<br>flame.          | It melts and burns.                                                          | It continues to burn<br>while melting.                                     | Smell of acetic acid                                    | Black, hard,<br>fragile and<br>irregularly-shaped             | No                                | No                                | One or two streaks in fibre<br>axis direction                                                                                          | Clover-leaf shaped                                                                                                                     | Turns light<br>yellow                                                                                                      | No                             |
| Triacetate                       | Same as above                                     | Same as above                                                                | Same as above                                                              | Same as above                                           | Same as above                                                 | No                                | No                                | Same as above                                                                                                                          | Same as above                                                                                                                          | Same as above                                                                                                              | No                             |
| Promix                           | It burns with<br>flame while<br>shrinking.        | It burns.                                                                    | It continues to burn.                                                      | Smell of human<br>hair burning                          | Black and slightly<br>fragile                                 | No                                | Yes                               | A fine streak observed in<br>fibre axis direction.                                                                                     | Elliptical or cocoon shaped,<br>with irregular, uneven<br>periphery                                                                    | Turns light<br>brown                                                                                                       | Yes                            |
| Vynlon                           | It shrinks and<br>melts.                          | It melts and burns.                                                          | Same as above                                                              | Specific sweet<br>smell of burning<br>polyvinyl alcohol | Hard, dark brown,<br>irregularly-shaped<br>lump               | No                                | No                                | A white line observed at the<br>central part in fibre axis<br>direction.                                                               | The presence of cocoon<br>shaped core layer is<br>recognized. The sections can<br>be circular.                                         | Turns light dark<br>blue                                                                                                   | No                             |
| Nylon                            | It melts.                                         | Same as above                                                                | It does not continue<br>to burn.                                           | Specific smell of<br>amide                              | Hard beads with a<br>colour between<br>dark brown and<br>grey | No                                | Yes                               | The surface is smooth.                                                                                                                 | Circular in many cases                                                                                                                 | Turns light<br>brown                                                                                                       | No                             |
| Vinylidene                       | It shrinks and<br>separates from<br>flame.        | It melts and burns<br>while emitting<br>smoke. The base<br>part turns green. | Same as above                                                              | Piquant and<br>irritating smell                         | Fragile, irregular<br>black lump                              | Yes                               | No                                | Same as above                                                                                                                          | Same as above                                                                                                                          | Not coloured                                                                                                               | No                             |

Table 3 (concluded)

| Name of fibre                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Combustion test                               |                                                             |                                                         |                                                           |                                                              | Pres-<br>ence<br>of chlo-<br>rine | Pres-<br>ence<br>of nitro-<br>gen | Appearance under microscope                                                             |                                                  | Colouring by<br>iodine-potassium<br>iodide solution | Xantho-<br>protein<br>reaction |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------|-------------------------------------------------------------|---------------------------------------------------------|-----------------------------------------------------------|--------------------------------------------------------------|-----------------------------------|-----------------------------------|-----------------------------------------------------------------------------------------|--------------------------------------------------|-----------------------------------------------------|--------------------------------|
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | When it is held up<br>to the flame.           | When it is inside the<br>flame                              | When it is withdrawn<br>from the flame                  | Odour                                                     | Ash                                                          |                                   |                                   | Side                                                                                    | Section                                          |                                                     |                                |
| Polyvinyl chloride                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Same as above                                 | It melts and burns<br>while emitting black<br>smoke.        | Same as above                                           | Similar to the<br>smell of<br>vinylidene, but<br>weaker   | Same as above                                                | Yes                               | No                                | Same as above                                                                           | Same as above                                    | Same as above                                       | No                             |
| Polyester                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | It melts.                                     | It melts and burns<br>while emitting black<br>smoke.        | It continues to burn.                                   | Very sweet smell<br>(weak)                                | Hard, round and<br>black                                     | No                                | No                                | The surface is smooth, but<br>not uniform since there are<br>many kinds.                | Same as above                                    | Same as above                                       | No                             |
| Acrylic                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | It melts and<br>ignites.                      | Same as above                                               | It burns quickly.                                       | Somewhat similar<br>to the smell of<br>meat being grilled | Hard, black and<br>irregular                                 | (No)                              | Yes                               | There are many kinds and<br>thus not uniform. The<br>surface can be smooth or<br>rough. | Many are circular, but some<br>are heart-shaped. | Turns light<br>brown                                | No                             |
| Acrylic series                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | It shrinks and<br>separates from<br>flame.    | It melts and burns<br>while emitting black<br>smoke.        | It does not continue<br>to burn.                        | Similar to the<br>smell of soap<br>burning                | Fragile, irregular<br>black lump                             | (Yes)                             | Yes                               | One thick line observed in<br>fibre axis direction.                                     | Horseshoe shaped                                 | Turns light<br>brown                                | No                             |
| Polypropylene                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Same as above                                 | It melts and<br>gradually burns<br>while emitting<br>smoke. | It burns as melting<br>gently.                          | Similar to the<br>smell of paraffin<br>burning            | Hard, grey beads                                             | No                                | No                                | The surface is smooth.                                                                  | Circular                                         | Not coloured                                        | No                             |
| Polyurethane                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | It melts.                                     | It melts and burns.                                         | It does not continue<br>to burn.                        | Specific smell                                            | Rubber-like<br>adhesive lump                                 | No                                | Yes                               | The surface is smooth.                                                                  | Variousely shaped, and not<br>uniform.           | Turns dark<br>brown                                 | No                             |
| Benzoate                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Same as above                                 | It melts and burns<br>while emitting black<br>smoke.        | It continues to burn.                                   | Very sweet smell<br>(weak)                                | Hard, dark brown<br>and lumpy                                | No                                | No                                | Same as above                                                                           | Triangle                                         | Not coloured                                        | No                             |
| Polychlal                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | It shrinks and<br>separates from<br>flame.    | Same as above                                               | It does not continue<br>to burn.                        | Sweet and<br>irritating smell                             | Dark brown with<br>black periphery                           | Yes                               | No                                | A thick streak observed in<br>fibre axis direction.                                     | Cocoon shaped                                    | Turns light dark<br>blue                            | No                             |
| Aramid (A)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | It glows, but does<br>not burn with<br>flame. | It glows.                                                   | The glow<br>disappeares.                                | Sweet and<br>irritating smell                             | Remnant of black<br>ash with the<br>fibriform<br>maintained. | No                                | Yes                               | The surface is smooth and<br>uniform. Some are observed<br>with knots.                  | Circular                                         | Not relevant                                        | No                             |
| Aramid (B)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | It shrinks and<br>separates from<br>flame.    | It shrinks and<br>burns.                                    | It does not continue<br>to burn.                        | Sweet smell                                               | Black, hard and<br>fragile                                   | No                                | Yes                               | The surface is smooth and<br>one streak is observed in<br>fibre axis direction.         | Similar to heart shape                           | Not relevant                                        | No                             |
| Aramid (C)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | It glows and burns<br>with flame.             | It burns.                                                   | It burns for a while,<br>and soon<br>self-extinguishes. | Sweet and sour<br>smell                                   | Black, hard and<br>fragile                                   | No                                | Yes                               | The surface is smooth.                                                                  | Circular                                         | Not relevant                                        | No                             |
| Poly lactide                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | It melts.                                     | It melts and burns.                                         | It burns while<br>gradually melting.                    | Fragrant and<br>slightly sweet<br>smell                   | Hard, black and<br>lumpy                                     | No                                | No                                | Same as above                                                                           | Circular in many cases                           | Not coloured                                        | No                             |
| <p>NOTE 1 The microscopic appearances of the chemical fibres (from rayon under) described in the table represent the property of the standard variety and not of modified fibres, which can be different from the standard in some many cases.</p> <p>NOTE 2 “Yes” or “No” in parentheses in the colomn of “presence of chlorine” can be contrary depending on variation of the fibre.</p> <p>NOTE 3 In confirmation of presence of nitrogen in aramid, the colour change of the litmus paper should be observed carefully since the change is only slight.</p> <p>Note <sup>a)</sup> The cupro and lyocell have almost the same properties, and therefore differentiation between them can be impossible in some cases.</p> |                                               |                                                             |                                                         |                                                           |                                                              |                                   |                                   |                                                                                         |                                                  |                                                     |                                |

Table 4 Solubility of various fibres in various reagents (informative)

| Name of fibre                       | Solvent              |   |                      |   |                            |                    |                          |                    |                               |   |                        |   |                        |   |                     |        |                      |   |                      |   |               |                        |
|-------------------------------------|----------------------|---|----------------------|---|----------------------------|--------------------|--------------------------|--------------------|-------------------------------|---|------------------------|---|------------------------|---|---------------------|--------|----------------------|---|----------------------|---|---------------|------------------------|
|                                     | 60 % Sulfuric acid   |   | 70 % Sulfuric acid   |   | Concentrated sulfuric acid |                    | Concentrated nitric acid |                    | Copper oxide ammonia solution |   | 20 % Hydrochloric acid |   | 35 % Hydrochloric acid |   | Glacial acetic acid |        | 5 % Sodium hydroxide |   | Sodium hypochlorite  |   | 100 % Acetone |                        |
|                                     | Ordinary temperature |   | Ordinary temperature |   | Ordinary temperature       |                    | Ordinary temperature     |                    | Ordinary temperature          |   | Ordinary temperature   |   | Ordinary temperature   |   |                     |        | Boiling              |   | Ordinary temperature |   |               |                        |
| Cotton                              | I                    |   | S                    | ① | S                          | ①                  | I                        |                    | S                             | ① | I                      |   | I                      |   | I                   | △      | I                    |   | I                    |   | I             | △                      |
| Flax (linen) and ramie              | I                    |   | S                    | ① | S                          | ①                  | I                        |                    | S                             | ② | I                      |   | I                      |   | I                   | △      | I                    |   | I                    |   | I             | △                      |
| Silk                                | S                    | ① | S                    | ① | S                          | ①                  | I                        | Swelling           | S                             | ○ | SS                     | ③ | S                      | ① | I                   | △      | S                    | ③ | S                    | ① | I             | △                      |
| Animal fibre                        | I                    |   | I                    |   | SS                         | ③                  | I                        |                    | I                             |   | I                      |   | I                      |   | I                   | △      | S                    | ② | S                    | ② | I             | △                      |
| Rayon, cupro, lyocell <sup>a)</sup> | CS ※                 | ① | S                    | ○ | S                          | ○                  | I                        |                    | S                             | ○ | I                      |   | S                      | ① | I                   | △      | I                    |   | I                    |   | I             | △                      |
| Acetate                             | S                    | ① | S                    | ○ | S                          | ○                  | S                        | ○                  | I                             |   | I                      |   | S                      | ○ | S                   | □<br>○ | CS                   | ③ | I                    |   | S             | □<br>○                 |
| Triacetate                          | CS                   | ③ | S                    | ② | S                          | ①                  | S                        | ①                  | I                             |   | I                      |   | SS                     | ③ | S                   | □<br>① | I                    |   | I                    |   | SS            | □<br>○                 |
| Promix                              | I                    |   | I                    |   | I                          | △<br>○<br>Swelling | I                        | △<br>○<br>Swelling | I                             |   | I                      |   | I                      |   | I                   | △      | SS                   | ③ | I                    |   | I             | △                      |
| Nylon 6                             | S                    | ① | S                    | ○ | S                          | ○                  | S                        | ○                  | I                             |   | S                      | ○ | S                      | ○ | S                   | △<br>○ | I                    |   | I                    |   | I             | △                      |
| Nylon 66                            | S                    | ① | S                    | ○ | S                          | ○                  | S                        | ○                  | I                             |   | S                      | ○ | S                      | ○ | S                   | △<br>○ | I                    |   | I                    |   | I             | △                      |
| Vinylon (formalized)                | S                    | ① | S                    | ○ | S                          | ○                  | S                        | ○                  | I                             |   | S                      | ○ | S                      | ○ | I                   | △      | I                    |   | I                    |   | I             | △                      |
| Acrylic                             | I                    |   | I                    |   | S                          | ○                  | S                        | ○                  | I                             |   | I                      |   | I                      |   | I                   | △      | I                    |   | I                    |   | I             | △                      |
| Acrylic series                      | I                    |   | I                    |   | S                          | ○                  | CS                       | ③                  | I                             |   | I                      |   | I                      |   | I                   | △      | I                    |   | I                    |   | ※<br>S        | 40 °C to<br>50 °C<br>○ |
| Polyester                           | I                    |   | I                    |   | S                          | ○                  | I                        |                    | I                             |   | I                      |   | I                      |   | I                   | △      | I                    |   | I                    |   | I             | △                      |

Table 4 (continued)

| Name of fibre            | Solvent                   |               |                           |               |                                 |            |                                    |            |                                              |  |                             |  |                             |   |                     |                    |                      |   |                           |               |               |        |
|--------------------------|---------------------------|---------------|---------------------------|---------------|---------------------------------|------------|------------------------------------|------------|----------------------------------------------|--|-----------------------------|--|-----------------------------|---|---------------------|--------------------|----------------------|---|---------------------------|---------------|---------------|--------|
|                          | 60 % Sulfuric acid        |               | 70 % Sulfuric acid        |               | Concen-<br>trated sulfuric acid |            | Concen-<br>trated ni-<br>tric acid |            | Copper ox-<br>ide ammo-<br>nia solu-<br>tion |  | 20 % Hydro-<br>chloric acid |  | 35 % Hydro-<br>chloric acid |   | Glacial acetic acid |                    | 5 % Sodium hydroxide |   | Sodium hypochlo-<br>rite  |               | 100 % Acetone |        |
|                          | Ordinary tempera-<br>ture |               | Ordinary tempera-<br>ture |               | Ordinary tempera-<br>ture       |            | Ordinary tempera-<br>ture          |            | Ordinary tempera-<br>ture                    |  | Ordinary tempera-<br>ture   |  | Ordinary tempera-<br>ture   |   |                     |                    | Boiling              |   | Ordinary tempera-<br>ture |               |               |        |
| Polyvinyl chloride       | I                         |               | I                         |               | I                               |            | I                                  |            | I                                            |  | I                           |  | I                           |   | I                   | △                  | I                    |   | I                         |               | SS            | △<br>③ |
| Vinylidene               | I                         |               | I                         |               | I                               |            | I                                  |            | I                                            |  | I                           |  | I                           |   | I                   | △                  | I                    |   | I                         |               | I             | △      |
| Polypropylene            | I                         |               | I                         |               | I                               |            | I                                  |            | I                                            |  | I                           |  | I                           |   | I                   | △                  | I                    |   | I                         |               | I             | △      |
| Polyurethane             | ※                         |               | ※                         |               | ※                               |            | ※                                  |            | I                                            |  | I                           |  | ※                           |   | ※                   |                    | I                    |   | I                         |               | I             | △      |
| Benzoate                 | I                         |               | I                         |               | S                               | ○          | I                                  |            | I                                            |  | I                           |  | I                           |   | I                   | △                  | I                    |   | I                         |               | I             | △      |
| Polychlal                | I                         | ③<br>Swelling | I                         | ③<br>Swelling | SS                              | ③          | SS                                 | ③          | I                                            |  | I                           |  | SS                          | ③ | I                   | △<br>③<br>Swelling | I                    |   | I                         |               | I             | △      |
| Aramid (A) <sup>b)</sup> | I                         |               | I                         |               | S                               | ○          | I                                  |            | I                                            |  | I                           |  | I                           |   | I                   | △                  | I                    |   | I                         | <sup>b)</sup> | I             | △      |
| Aramid (B)               | I                         |               | I                         |               | S                               | ①          | I                                  |            | I                                            |  | I                           |  | I                           |   | I                   | △                  | I                    |   | I                         |               | I             | △      |
| Aramid (C)               | I                         |               | I                         |               | SS                              | ③<br>Lumpy | I                                  |            | I                                            |  | I                           |  | I                           |   | I                   | △                  | I                    |   | I                         |               | I             | △      |
| Poly lactide             | I                         |               | I                         |               | S                               | ○          | SS                                 | ③<br>Lumpy | I                                            |  | I                           |  | I                           |   | I                   | △                  | S                    | ※ | I                         |               | I             | △      |

Table 4 (continued)

| Name of fibre                       | Solvent      |        |                    |                     |                              |   |                  |        |         |        |                |  |         |  |               |            |                             |                 |                  |                     |                  |        |
|-------------------------------------|--------------|--------|--------------------|---------------------|------------------------------|---|------------------|--------|---------|--------|----------------|--|---------|--|---------------|------------|-----------------------------|-----------------|------------------|---------------------|------------------|--------|
|                                     | 80 % Acetone |        | Dimethyl-formamide |                     | 65 % Potas-sium thio-cyanate |   | Tetrahy-drofuran |        | Dioxane |        | Chloro-benzene |  | Xylene  |  | Nitroben-zene |            | Phenol/ethane tetrachloride |                 | <i>m</i> -Cresol |                     | Dichlorom ethane |        |
|                                     |              |        |                    |                     | 70 °C to 75 °C               |   |                  |        |         |        | Boiling        |  | Boiling |  | Boiling       |            |                             |                 |                  |                     |                  |        |
| Cotton                              | I            | △      | I                  | △                   | I                            |   | I                | △      | I       | △      | I              |  | I       |  | I             |            | I                           | △               | I                | △                   | I                | △      |
| Flax (linen) and ramie              | I            | △      | I                  | △                   | I                            |   | I                | △      | I       | △      | I              |  | I       |  | I             |            | I                           | △               | I                | △                   | I                | △      |
| Silk                                | I            | △      | I                  | △                   | I                            |   | I                | △      | I       | △      | I              |  | I       |  | I             |            | I                           | △               | I                | △                   | I                | △      |
| Animal fibre                        | I            | △      | I                  | △                   | I                            |   | I                | △      | I       | △      | I              |  | I       |  | I             |            | I                           | △               | I                | △<br>③<br>Swell-ing | I                | △      |
| Rayon, cupro, lyocell <sup>a)</sup> | I            | △      | I                  | △                   | I                            |   | I                | △      | I       | △      | I              |  | I       |  | I             |            | I                           | △               | I                | △                   | I                | △      |
| Acetate                             | S            | □<br>○ | S                  | □<br>○              | I                            |   | S                | □<br>① | S       | □<br>② | I              |  | I       |  | S             | ○          | S                           | □<br>②          | S                | □<br>②              | SS               | △<br>③ |
| Triacetate                          | I            | △      | S                  | □<br>○              | I                            |   | SS               | △<br>③ | S       | □<br>③ | I              |  | I       |  | S             | ○          | S                           | □<br>①          | S                | □<br>②              | S                | □<br>○ |
| Promix                              | I            | △      | I                  | △<br>③<br>Swelling  | I                            |   | I                | △      | I       | △      | I              |  | I       |  | I             |            | I                           | △               | I                | △                   | I                | △      |
| Nylon 6                             | I            | △      | S                  | △<br>①              | I                            |   | I                | △      | I       | △      | I              |  | I       |  | I             | ③<br>Lumpy | S                           | □<br>○          | S                | □<br>①              | I                | △      |
| Nylon 66                            | I            | △      | I                  | △                   | I                            |   | I                | △      | I       | △      | I              |  | I       |  | I             |            | S                           | □<br>○          | S                | □<br>①              | I                | △      |
| Vnylon (formalized)                 | I            | △      | I                  | △                   | I                            |   | I                | △      | I       | △      | I              |  | I       |  | I             |            | SS                          | △<br>③          | I                | △<br>③<br>Swell-ing | I                | △      |
| Acrylic                             | I            | △      | ※<br>S             | 40 °C to 50 °C<br>○ | S                            | ○ | I                | △      | I       | △      | I              |  | I       |  | I             |            | I                           | △<br>③<br>Lumpy | I                | △                   | I                | △      |

Table 4 (continued)

| Name of fibre      | Solvent      |        |                    |                        |                              |  |                  |                    |         |                           |                |                           |         |            |               |                           |                             |                           |                  |                           |                  |               |
|--------------------|--------------|--------|--------------------|------------------------|------------------------------|--|------------------|--------------------|---------|---------------------------|----------------|---------------------------|---------|------------|---------------|---------------------------|-----------------------------|---------------------------|------------------|---------------------------|------------------|---------------|
|                    | 80 % Acetone |        | Dimethyl-formamide |                        | 65 % Potas-sium thio-cyanate |  | Tetrahy-drofuran |                    | Dioxane |                           | Chloro-benzene |                           | Xylene  |            | Nitroben-zene |                           | Phenol/ethane tetrachloride |                           | <i>m</i> -Cresol |                           | Dichlorom ethane |               |
|                    |              |        |                    |                        | 70 °C to 75 °C               |  |                  |                    |         |                           | Boiling        |                           | Boiling |            | Boiling       |                           |                             |                           |                  |                           |                  |               |
| Acrylic series     | SS           | △<br>③ | S                  | □<br>○                 | I                            |  | CS               | △<br>③             | ※<br>I  | △<br>③<br>Lumpy           | I              | ③<br>Lumpy                | I       | ③<br>Lumpy | ※<br>S        | ○                         | S                           | 65 °C<br>to<br>70 °C<br>○ | S                | △                         | I                | △             |
| Polyester          | I            | △      | ※<br>SS            | △                      | I                            |  | I                | △                  | I       | △                         | I              |                           | I       |            | S             | ○                         | S                           | 55 °C<br>to<br>60 °C<br>○ | S                | 80 °C<br>to<br>90 °C<br>○ | I                | △             |
| Polyvinyl chloride | I            | △      | S                  | □<br>○                 | I                            |  | S                | □<br>○             | S       | 70 °C<br>to<br>75 °C<br>○ | S              | 75 °C<br>to<br>80 °C<br>○ | I       |            | S             | 35 °C<br>to<br>40 °C<br>○ | S                           | △<br>○                    | S                | △<br>○                    | S                | △<br>○        |
| Vinylidene         | I            | △      | S                  | 50 °C to<br>60 °C<br>○ | I                            |  | S                | □<br>○             | S       | 65 °C<br>to<br>70 °C<br>○ | S              | ○                         | S       | ○          | S             | ①                         | S                           | △<br>○                    | S                | △<br>○                    | SS               | △<br>③        |
| Polypropylene      | I            | △      | I                  | △                      | I                            |  | I                | △                  | SS      | △<br>③                    | S              | ○                         | S       | ○          | S             | ①                         | I                           | △<br>③<br>Lumpy           | I                | △<br>③<br>Lumpy           | I                | △             |
| Polyurethane       | I            | △      | S                  | △<br>○                 | I                            |  | I                | △<br>※<br>Swelling | I       | △<br>Swelling             | I              |                           | I       |            | S             | ①                         | ※                           |                           | S                | △<br>※<br>②               | I                | △<br>Swelling |
| Benzoate           | I            | △      | CS                 | △<br>③                 | I                            |  | I                | △                  | I       | △                         | SS             | ③                         | I       |            | S             | ①                         | S                           | △<br>①                    | S                | △<br>○                    | I                | △             |
| Polychlal          | I            | △      | I                  | △<br>③<br>Swelling     | I                            |  | I                | △                  | I       | △                         | SS             | ③                         | I       |            | I             | ③<br>Swelling             | I                           | △<br>③<br>Swelling        | I                | △<br>③<br>Swelling        | I                | △             |

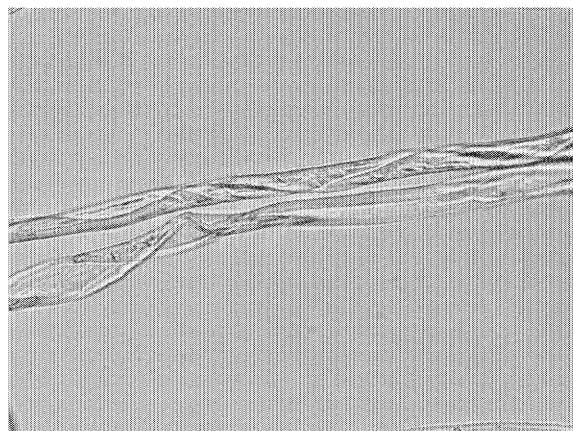
Table 4 (concluded)

| Name of fibre                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Solvent      |   |                    |   |                              |  |                  |   |         |                           |                |  |         |   |               |   |                              |                           |                  |        |                  |   |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|---|--------------------|---|------------------------------|--|------------------|---|---------|---------------------------|----------------|--|---------|---|---------------|---|------------------------------|---------------------------|------------------|--------|------------------|---|
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 80 % Acetone |   | Dimethyl-formamide |   | 65 % Potas-sium thio-cyanate |  | Tetrahy-drofuran |   | Dioxane |                           | Chloro-benzene |  | Xylene  |   | Nitroben-zene |   | Phenol/ ethane tetrachloride |                           | <i>m</i> -Cresol |        | Dichlorom ethane |   |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |              |   |                    |   | 70 °C to 75 °C               |  |                  |   |         |                           | Boiling        |  | Boiling |   | Boiling       |   |                              |                           |                  |        |                  |   |
| Aramid (A) <sup>b)</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | I            | △ | I                  | △ | I                            |  | I                | △ | I       | △                         | I              |  | I       |   | I             |   | I                            | △                         | I                | △      | I                | △ |
| Aramid (B)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | I            | △ | I                  | △ | I                            |  | I                | △ | I       | △                         | I              |  | I       |   | I             |   | I                            | △                         | I                | △      | I                | △ |
| Aramid (C)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | I            | △ | I                  | △ | I                            |  | I                | △ | I       | △                         | I              |  | I       |   | I             |   | I                            | △                         | I                | △      | I                | △ |
| Polylactide                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | I            | △ | S                  | △ | I                            |  | CS               | □ | CS      | △<br>I<br>Swell-<br>ing □ | I              |  | S       | ○ | S             | ○ | S                            | 65 °C<br>to<br>70 °C<br>○ | S                | △<br>○ | S                | □ |
| <p>NOTE: The meanings of symbols in table are as follows.</p> <p>I : Insoluble after 3 min-treatment   SS : Slightly soluble   CS : Considerably soluble   S : Soluble</p> <p>○ : Immediately   ① : For 1 min   ② : For 2 min   ③ : For 3 min</p> <p>□ : Ordinary temperature   △ : Boiling</p> <p>※ : The solubility does not agree depending on the type.</p> <p>Notes <sup>a)</sup> Rayon, cupro and lyocell have almost the same properties, and therefore differentiation among them can be impossible in some cases.</p> <p><sup>b)</sup> Aramid (A) is finely cut by sodium hypochlorite.</p> |              |   |                    |   |                              |  |                  |   |         |                           |                |  |         |   |               |   |                              |                           |                  |        |                  |   |

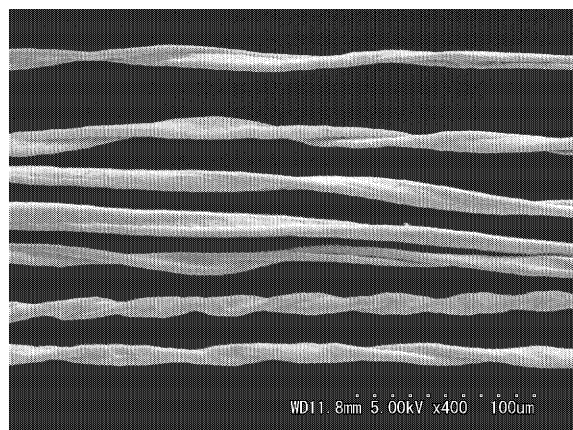
**Figure 1 Examples of standard microscopic photographs of fibres (List)**

| No.                                                                                                                                                                                                                                                                                                              | Name of fibre                         | No. | Name of fibre                                                   |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------|-----|-----------------------------------------------------------------|
| 1                                                                                                                                                                                                                                                                                                                | Cotton (A)                            | 49  | Rayon                                                           |
| 2                                                                                                                                                                                                                                                                                                                | Cotton (B)                            | 50  | Modal                                                           |
| 3                                                                                                                                                                                                                                                                                                                | Cotton (C)                            | 51  | Acetate                                                         |
| 4                                                                                                                                                                                                                                                                                                                | Cotton (D)                            | 52  | Triacetate                                                      |
| 5                                                                                                                                                                                                                                                                                                                | Cotton (E)                            | 53  | Melt-spun cellulose fibre                                       |
| 6                                                                                                                                                                                                                                                                                                                | Cotton (F)                            | 54  | Cupro                                                           |
| 7                                                                                                                                                                                                                                                                                                                | Cotton (F) [mercerized]               | 55  | Lyocell (A)                                                     |
| 8                                                                                                                                                                                                                                                                                                                | Cotton (F) [liquid ammonia processed] | 56  | Lyocell (B)                                                     |
| 9                                                                                                                                                                                                                                                                                                                | Banana fibre                          | 57  | Nylon 6                                                         |
| 10                                                                                                                                                                                                                                                                                                               | Pineapple fibre                       | 58  | Nylon 66                                                        |
| 11                                                                                                                                                                                                                                                                                                               | Rope hemp                             | 59  | Aramid (para series)                                            |
| 12                                                                                                                                                                                                                                                                                                               | Ramie [A] (false nettle)              | 60  | Aramid (meta series)                                            |
| 13                                                                                                                                                                                                                                                                                                               | Ramie [B]                             | 61  | Vinyon (elliptical cross-section type)                          |
| 14                                                                                                                                                                                                                                                                                                               | Ramie [C]                             | 62  | Vinyon (cocoon shape cross-section type)                        |
| 15                                                                                                                                                                                                                                                                                                               | Flax (linen) [A]                      | 63  | Vinylidene (monofilament)                                       |
| 16                                                                                                                                                                                                                                                                                                               | Flax (linen) [B]                      | 64  | Vinylidene (hollow fibre)                                       |
| 17                                                                                                                                                                                                                                                                                                               | Jute                                  | 65  | Polyvinyl chloride                                              |
| 18                                                                                                                                                                                                                                                                                                               | Hemp                                  | 66  | Polyester (semi dull type)                                      |
| 19                                                                                                                                                                                                                                                                                                               | Sisal hemp                            | 67  | Polyester (full dull type)                                      |
| 20                                                                                                                                                                                                                                                                                                               | Kenaf                                 | 68  | Polyester (trilobal cross-section type)                         |
| 21                                                                                                                                                                                                                                                                                                               | Silk (domesticated silk worm)         | 69  | Polyester (microfibre)                                          |
| 22                                                                                                                                                                                                                                                                                                               | Silk (Chinese oak silk worm)          | 70  | Polyester (flat type segmented fibre)                           |
| 23                                                                                                                                                                                                                                                                                                               | Silk (Japanese oak silk worm)         | 71  | Polyester (bicomponent cross-section type)                      |
| 24                                                                                                                                                                                                                                                                                                               | Silk (MUGA silk worm)                 | 72  | Polyester (islands-in-sea type fibre)                           |
| 25                                                                                                                                                                                                                                                                                                               | Wool (A)                              | 73  | Polyester (sheathe-core fibre)                                  |
| 26                                                                                                                                                                                                                                                                                                               | Wool (B) [extra fine]                 | 74  | Polyester (bimetal type)                                        |
| 27                                                                                                                                                                                                                                                                                                               | Wool (C) [lamb]                       | 75  | Polyester [modified cross-section (cross shape) fibre]          |
| 28                                                                                                                                                                                                                                                                                                               | Cashmere (A)                          | 76  | Polyester (electrical conductive fibre)                         |
| 29                                                                                                                                                                                                                                                                                                               | Wool (shrink resistant finish-1)      | 77  | Polyester (side-by-side type)                                   |
| 30                                                                                                                                                                                                                                                                                                               | Wool (shrink resistant finish-2)      | 78  | Polybutylene terephthalate (PBT)                                |
| 31                                                                                                                                                                                                                                                                                                               | Wool (shrink resistant finish-3)      | 79  | Polytrimethylene terephthalate (PTT) [hollow fibre]             |
| 32                                                                                                                                                                                                                                                                                                               | Wool (shrink resistant finish-4)      | 80  | Polytrimethylene terephthalate (PTT) [PET/PTT composite fibre]  |
| 33                                                                                                                                                                                                                                                                                                               | Cashmere (B)                          | 81  | Acrylic (A)                                                     |
| 34                                                                                                                                                                                                                                                                                                               | Cashmere (C)                          | 82  | Acrylic (B)                                                     |
| 35                                                                                                                                                                                                                                                                                                               | Yak (A)                               | 83  | Acrylic (C)                                                     |
| 36                                                                                                                                                                                                                                                                                                               | Yak (B)                               | 84  | Acrylic series                                                  |
| 37                                                                                                                                                                                                                                                                                                               | Cashmere (D) [baby]                   | 85  | Polypropylene                                                   |
| 38                                                                                                                                                                                                                                                                                                               | Cashmere (E)                          | 86  | Polyurethane                                                    |
| 39                                                                                                                                                                                                                                                                                                               | Yak (C)                               | 87  | Poly lactide                                                    |
| 40                                                                                                                                                                                                                                                                                                               | Mohair (somewhat fine)                | 88  | Polyimide                                                       |
| 41                                                                                                                                                                                                                                                                                                               | Camel                                 | 89  | Acrylate series fibre                                           |
| 42                                                                                                                                                                                                                                                                                                               | Alpaca                                | 90  | Ethylene vinyl alcohol fibre                                    |
| 43                                                                                                                                                                                                                                                                                                               | Vicuna                                | 91  | Polyarylate series fibre                                        |
| 44                                                                                                                                                                                                                                                                                                               | Angora                                | 92  | Polyether ester series fibre                                    |
| 45                                                                                                                                                                                                                                                                                                               | Guanaco                               | 93  | Polyphenylene sulfide fibre (PPS)                               |
| 46                                                                                                                                                                                                                                                                                                               | Llama                                 | 94  | Polyphenylene sulfide fibre (PPS) [trilobal cross-section type] |
| 47                                                                                                                                                                                                                                                                                                               | Polyvinyl alcohol (PVA) [nanofibre]   | 95  | Fluorine series fibre                                           |
| 48                                                                                                                                                                                                                                                                                                               | Polyacrylonitrile (PAN) [nanofibre]   | —   | —                                                               |
| <p>NOTE : The magnifications * shown in the photographs are the magnifications at the time of photographing, and since the photographs are reduced at the time of printing, back calculation is not possible.</p> <p>However, back calculation by using the individual scales in the photograph is possible.</p> |                                       |     |                                                                 |

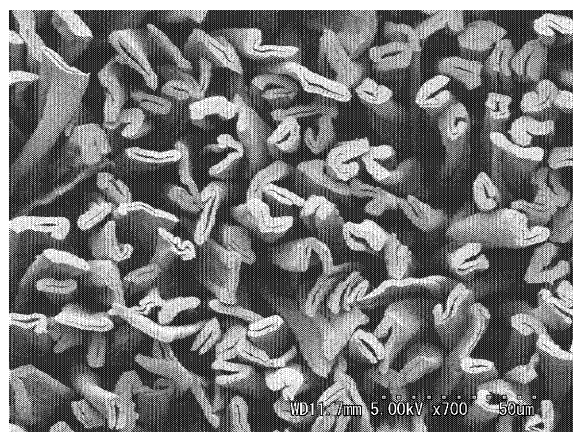
1 Cotton (A)



Optical microscope  $\times 400^*$

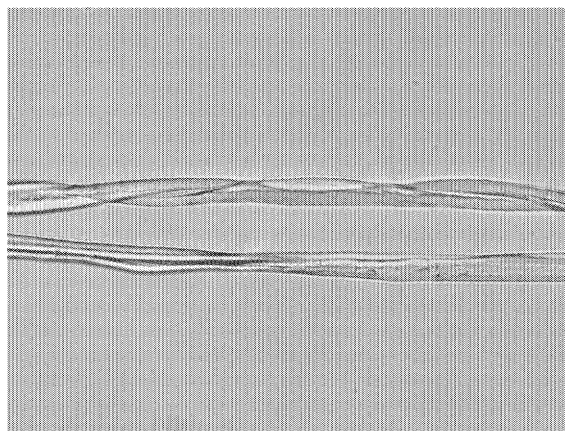


Electronic microscope 400 times\*

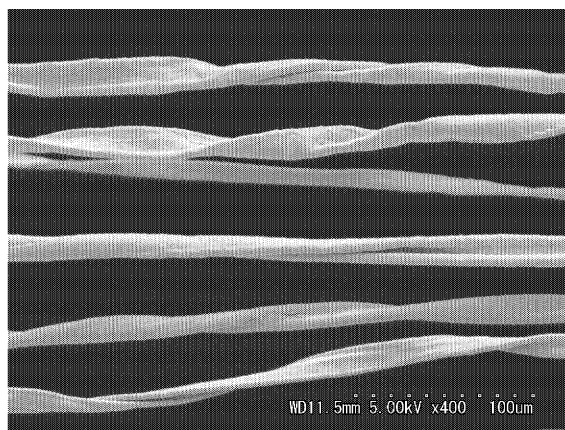


Electronic microscope 700 times\*

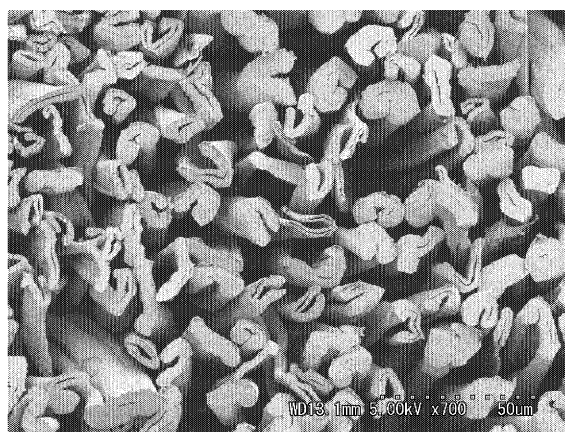
2 Cotton (B)



Optical microscope  $\times 400^*$



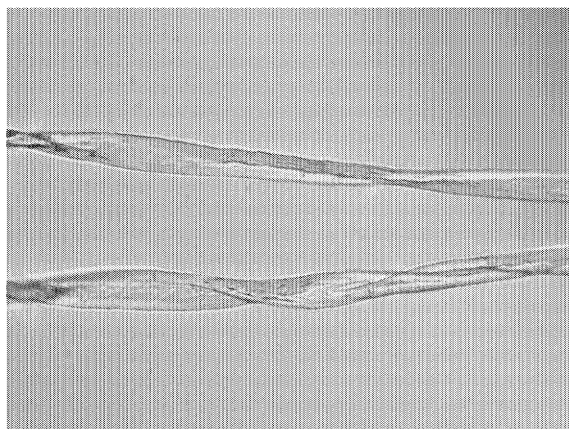
Electronic microscope 400 times\*



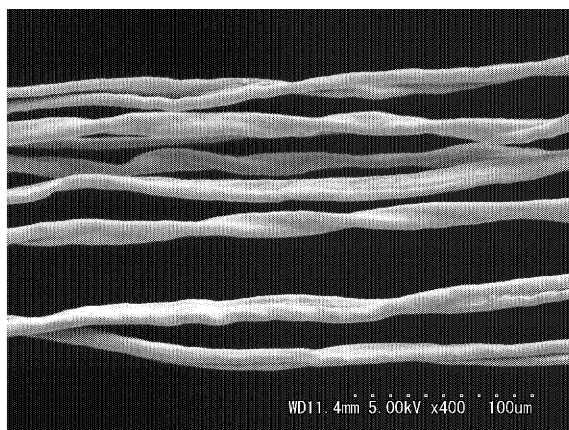
Electronic microscope 700 times\*

**Figure 1 Examples of standard microscopic photographs of fibres**

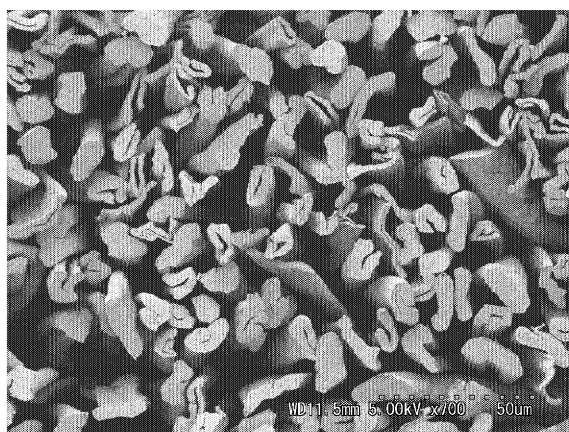
3 Cotton (C)



Optical microscope 400 times\*

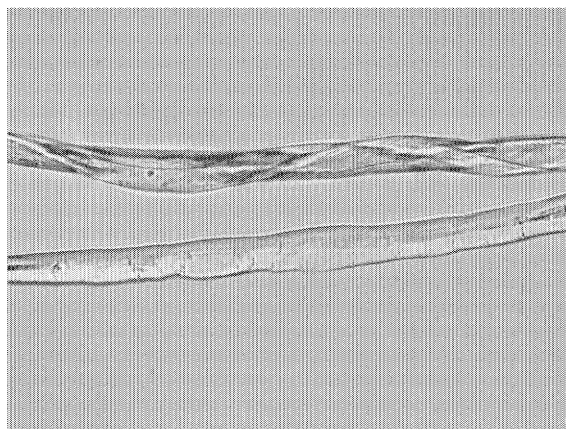


Electronic microscope 400 times\*

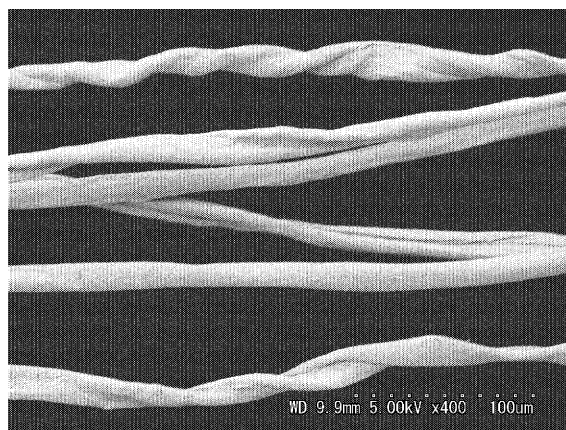


Electronic microscope 700 times\*

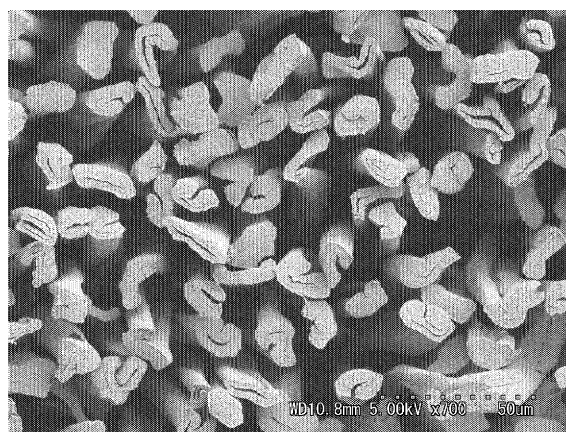
4 Cotton (D)



Optical microscope 400 times\*



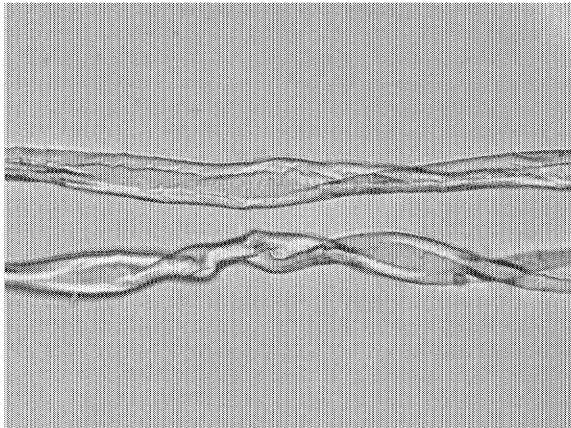
Electronic microscope 400 times\*



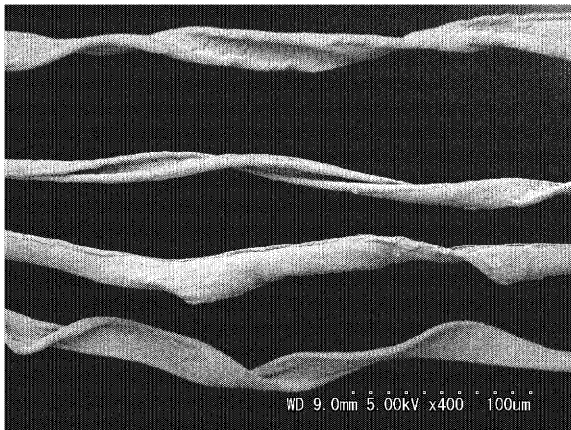
Electronic microscope 700 times\*

Figure 1 (continued)

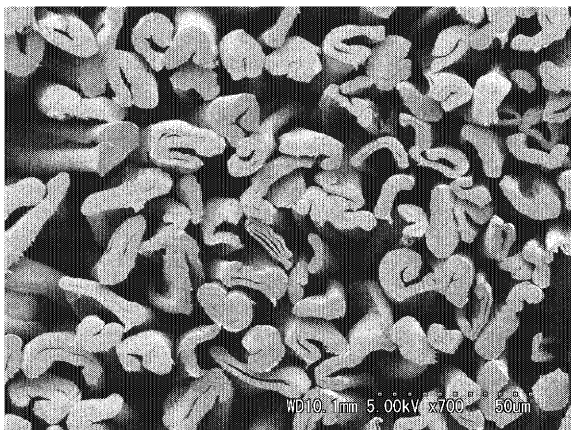
5 Cotton (E)



Optical microscope 400 times\*



Electronic microscope 400 times\*

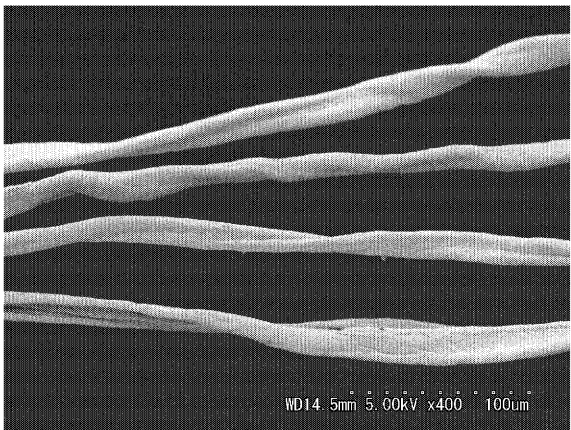


Electronic microscope 700 times\*

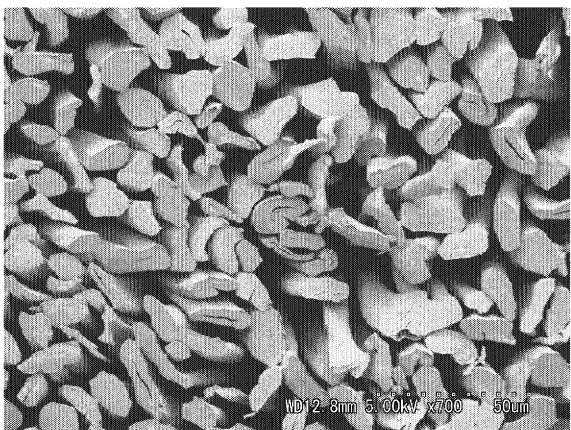
6 Cotton (F)



Optical microscope 400 times\*



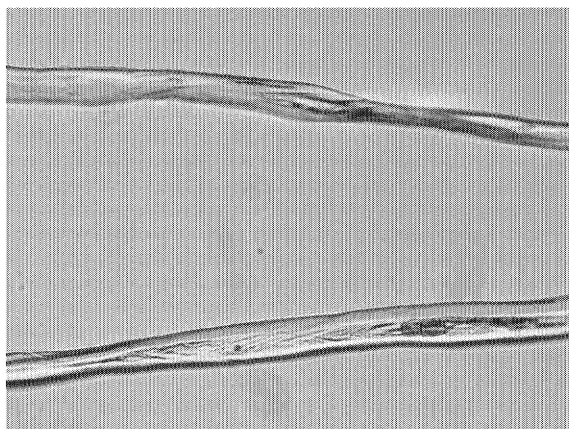
Electronic microscope 400 times\*



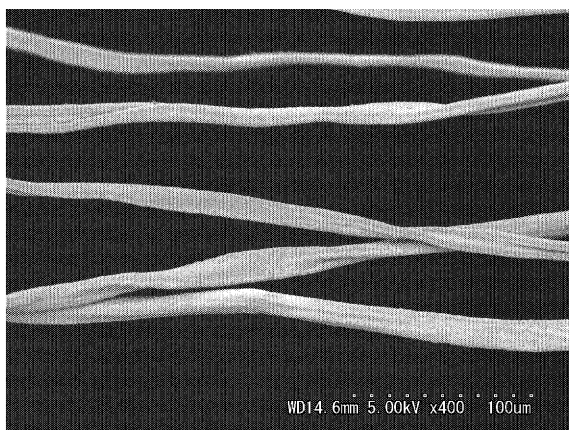
Electronic microscope 700 times\*

Figure 1 (continued)

7 Cotton (F) [mercerized]



Optical microscope 400 times\*

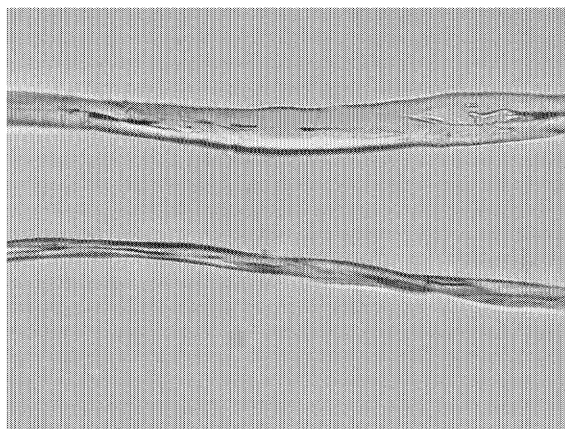


Electronic microscope 400 times\*

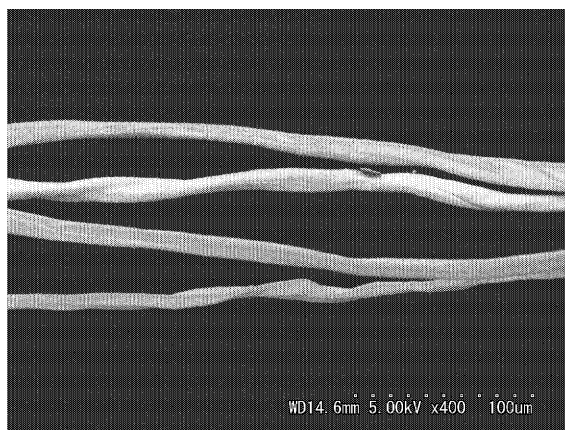


Electronic microscope 700 times\*

8 Cotton (F) [liquid ammonia processed]



Optical microscope 400 times\*



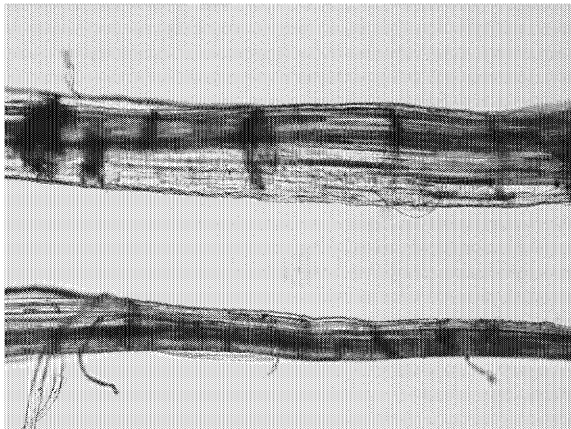
Electronic microscope 400 times\*



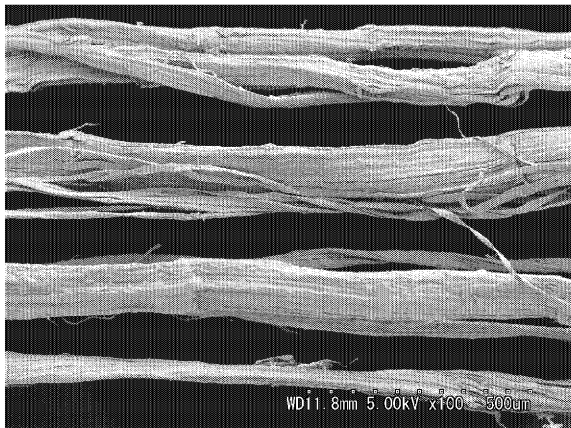
Electronic microscope 700 times\*

Figure 1 (continued)

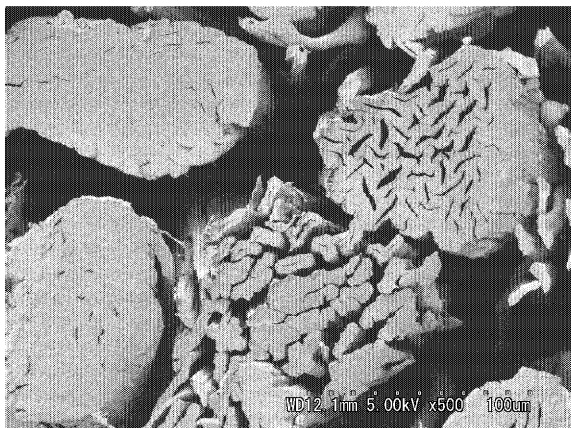
9 Banana fibre



Optical microscope 100 times\*

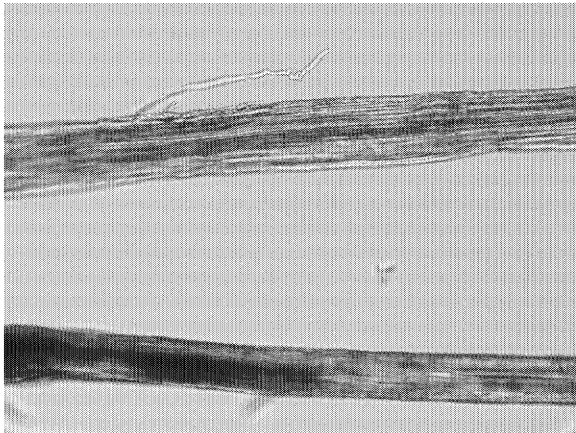


Electronic microscope 100 times\*

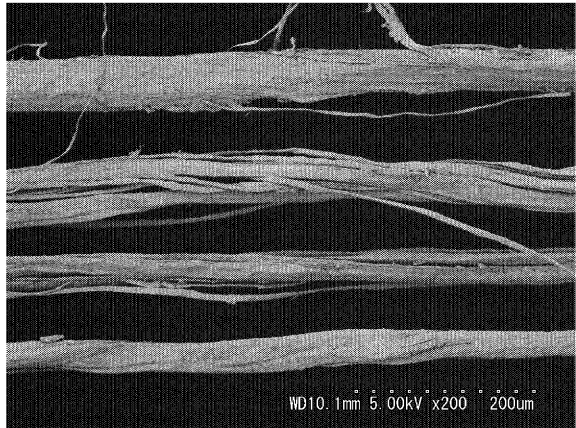


Electronic microscope 500 times\*

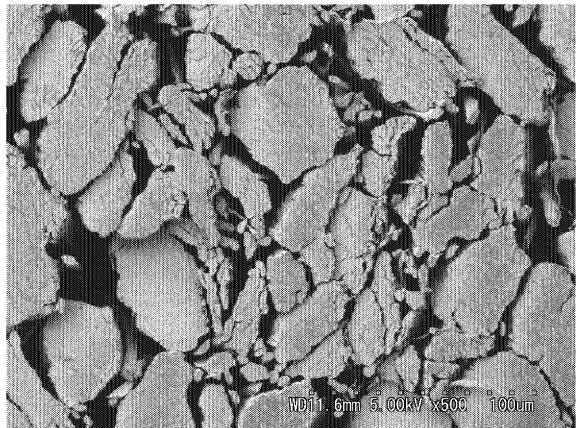
10 Pineapple fibre



Optical microscope 200 times\*



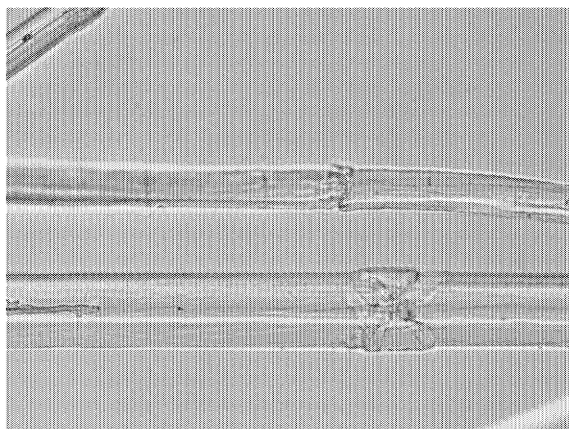
Electronic microscope 200 times\*



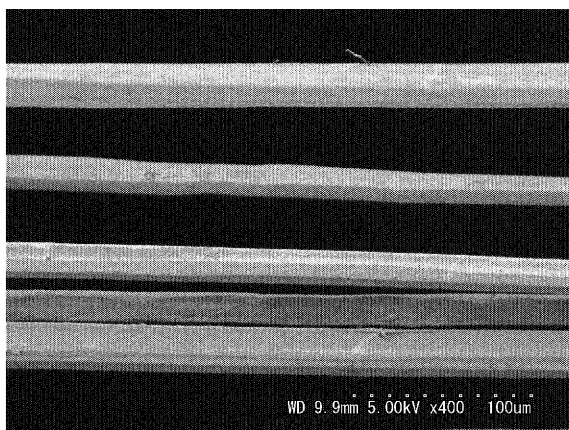
Electronic microscope 500 times\*

Figure 1 (continued)

11 Rope hemp



Optical microscope 400 times\*

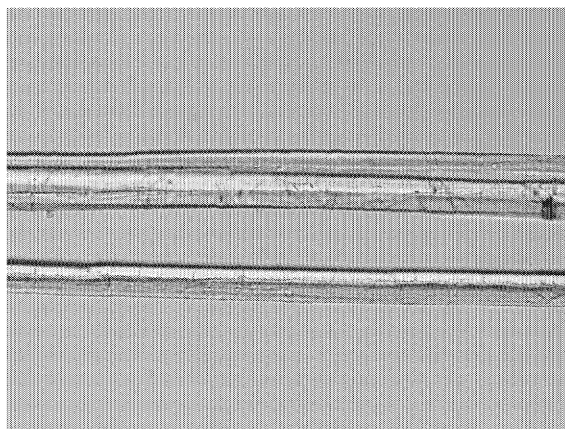


Electronic microscope 400 times\*

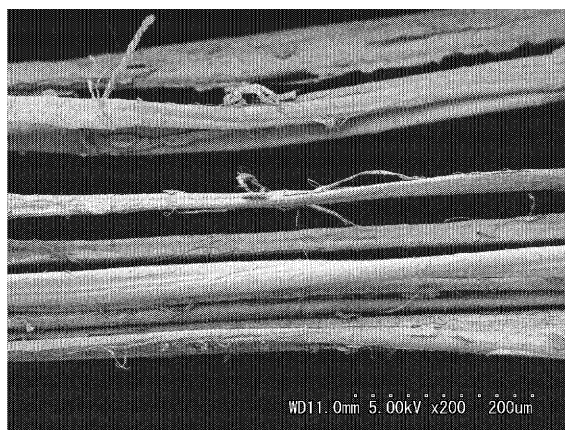


Electronic microscope 500 times\*

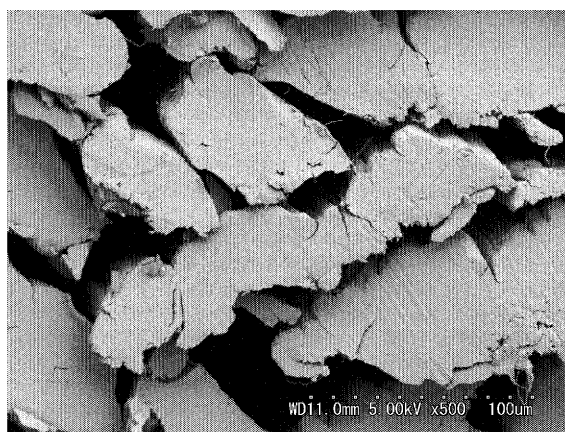
12 Ramie [A] (false nettle)



Optical microscope 200 times\*



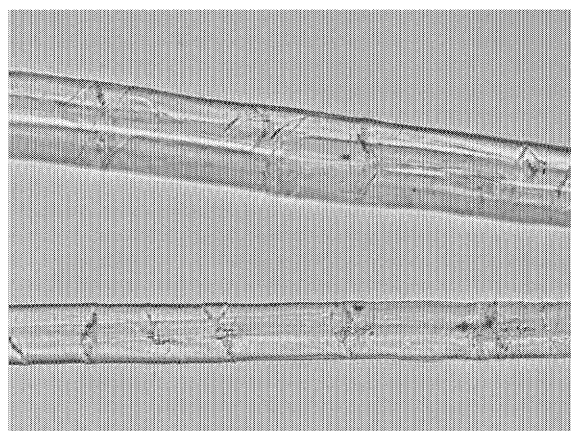
Electronic microscope 200 times\*



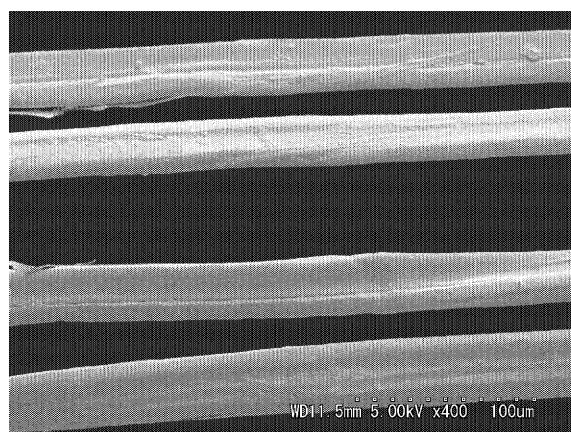
Electronic microscope 500 times\*

Figure 1 (continued)

13 Ramie [B]



Optical microscope 400 times\*

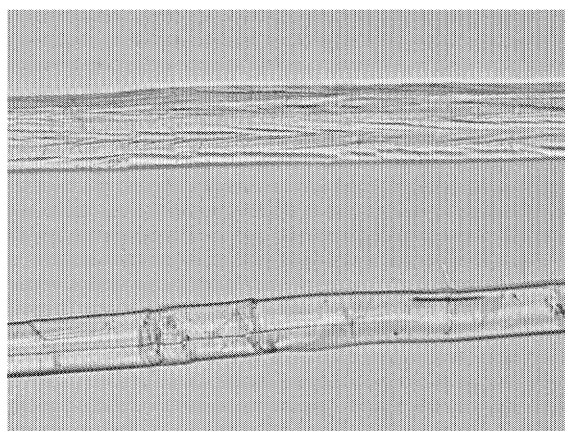


Electronic microscope 400 times\*

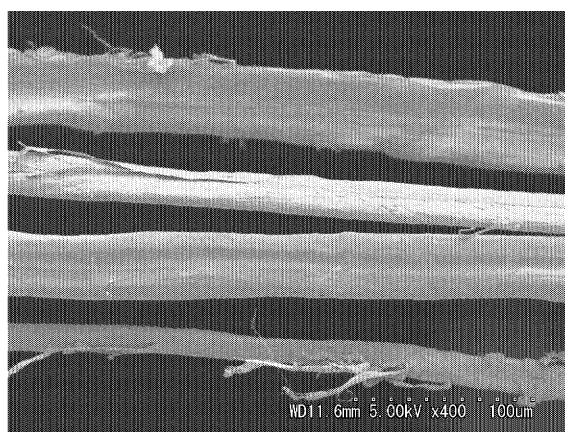


Electronic microscope 500 times\*

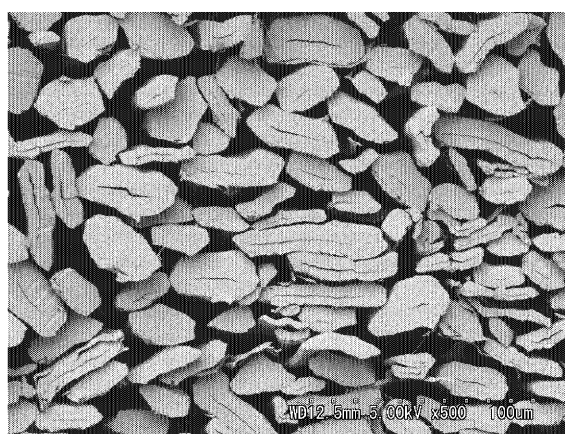
14 Ramie [C]



Optical microscope 400 times\*



Electronic microscope 400 times\*



Electronic microscope 500 times\*

Figure 1 (continued)