

A PHOTOELECTRIC METHOD FOR THE DETERMINATION OF THE AVERAGE DIAMETER OF FINE WIRES, FILAMENTS, FIBRES, ETC.

THEORY

A BEAM of light of uniform intensity emerging from a rectangular slit is made to fall on a photoelectric cell producing a current i_1 which is accurately measured. Next, a parallel bunch of fine wires, filaments or fibres, which are opaque to the light, is interposed in the path of the beam. The current is reduced, depending upon the number and average diameter of the fibres, the new current after the interposition of the wires, fibres, etc., being i_2 . If it is assumed that the current produced is proportional to the area of illumination, then it can be easily shown that the average diameter of the wires, filaments or fibres is given by the following formula:—

$$d = l/n \cdot \frac{i_1 - i_2}{i_1},$$

where l is the length of the slit and n the number of wires, fibres, etc., which may be counted either with the naked eye or with the help of a low-power microscope.

The two assumptions necessary for this formula are (1) that the wires, fibres, etc., are opaque to the light and (2) that there is not any appreciable overlapping. If the fibres are not originally opaque, it may be possible to render them opaque by dyeing. The condition for avoiding the overlapping may be satisfied either by mounting the fibres, filaments, wires, etc., individually, or by taking sufficient care in the process of parallisation to ensure that there is no appreciable overlapping. In actual practice it is possible to satisfy both these conditions in most cases.

APPARATUS

An apparatus has been designed at the Technological Laboratory which satisfy the above-mentioned conditions and enables the diameter of fine wires, filaments or fibres to be measured quickly and accurately. Essentially it consists of a hollow cylinder which is supported on two uprights. An electric bulb is placed at one end of the cylinder, and the current in this bulb is maintained at constant level by means of a sliding rheostat. A condenser and diaphragms are provided to obtain a uniform beam of light which is made to pass through a water cell for the absorption of the heat rays. The light emerging from the water cell passes through a slit which is made exactly rectangular with great care, and the plate of this slit is provided with a suitable stand for holding a slide on which the fibres, filaments, wires, etc., may be mounted. These slides can be interchanged rapidly to enable a fairly large number of readings to be taken on the same or different materials. The photoelectric cell is held at the other end of the cylinder and the light passing through the slit with or without interposition of the fibres, wires and filaments falls upon the photoelectric cell and photoelectric current generated is measured with the help of a galvanometer with a shunt in the circuit.

In the preliminary study single fibres, fine wires of copper, silver, human hair, wool, artificial and natural silk, etc., were mounted individually, and the results of the average diameter obtained in this way were compared with those obtained by microscopic measurements. This method was found to give accurate results. Since, however, mounting of single fibres takes considerable time when as in the case of the textile fibres it may be necessary to examine a large number of them on account of their variability, in the later work relating to cotton fibres, a method has been developed in which a parallel bunch of fibres, which is first mercerised and dyed black, is mounted on a slide. The diameter measured in this way is found to agree fairly well with the microscopic measurement. In this way measurements have been made on wires, fibres, etc., ranging from 20 to 120 microns and good agreement has always been obtained. This method is found to be simple, quick and accurate and has the additional advantage of giving the average diameter. This is particularly useful in measurements where a large number of fibres or filaments have to be examined for their diameter. Apart from fine wires and filaments, it may be used for fibres of wool, cotton, artificial silk, natural silk, etc.

A full account of the method, the apparatus, and the results will appear elsewhere.

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ACTION OF SODIUM HYPOCHLORITE SOLUTIONS ON COTTON IN PRESENCE OF REDUCED VAT DYES

NABAR, Scholefield and Turner¹ have investigated the effect of reduced vat dyes on the hypochlorite oxidation of cellulose and have shown that an extraordinary increase in the intensity of oxidation occurs when a leucovvat dye is present on the cellulose. They studied the reaction in greater detail using cotton yarn dyed with Cibacron Orange R² and showed that the amount of oxygen consumed was simply related to the various chemical properties such as cuprammonium fluidity, copper number, carboxylic acid groups, etc. of the oxidised cellulose. This behaviour could be attributed to the simplification in the mechanism of oxidation of cellulose. The striking feature of their results, however, was the constant ratio of 2 obtained between the aldehydic and carboxylic acid groups, formed in the products of oxidation which were prepared under different experimental conditions such as pH of the hypochlorite, concentration of the dyestuff on the fibre, etc.

With a view to investigate if similar behaviour is exhibited by other vat dyes, the work was extended to a few vat dyes including those susceptible to chemical modification or destruction. (Well-known example of a dye belonging to the latter category is Indanthrene Blue R which on treatment even with air or mild oxidising agents forms the greenish azine compound.) The chemical properties of the