METHOD FOR
DETERMINATION OF THE SURFACE TENSION OF RUBBER LATICES

BS 4561 : 1970

BRITISH STANDARDS INSTITUTION
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THIS BRITISH STANDARD, having been approved by the Rubber Industry Standards Committee, was published under the authority of the Executive Board on 27 February, 1970.

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This standard makes reference to the following British Standards:
BS 1672. Methods of testing rubber latex.
BS 3397. Methods of testing synthetic rubber latices.
BS 3978. Water for laboratory use.

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The following BSI references relate to the work on this standard:
Committee reference RUC/10/7 Draft for comment 68/32804

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The Rubber Industry Standards Committee, under whose supervision this British Standard was prepared, consists of representatives from the following Government department and scientific and industrial organizations:

British Association of Synthetic Rubber Manufacturers
*British Rubber Manufacturers Association Ltd.
*Institution of the Rubber Industry
*Ministry of Technology
*Natural Rubber Producers' Research Association
*Rubber and Plastics Research Association of Gt. Britain
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British Latex Foam Manufacturers' Association
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BRITISH STANDARD METHOD FOR

DETERMINATION OF THE SURFACE TENSION OF RUBBER LATICES

FOREWORD

This British Standard describes a method applicable to both natural rubber and synthetic rubber latices. It is issued as a separate document because BS 1672* and BS 3397† refer individually and respectively to the testing of natural rubber latex and synthetic rubber latices. It replaces the method given in BS 3397†.

This method is technically identical with that being considered in Technical Committee ISO/TC 45—Rubber, of the International Organization for Standardization (ISO), which is at present given in ISO Draft Recommendation No. 1409. However an appendix has been added giving a calibration procedure.

Before the determination of surface tension in accordance with this British Standard, natural rubber latex should be sampled in accordance with BS 1672* and synthetic rubber latices should be sampled in accordance with BS 3397†.

METHOD

1. SCOPE

This British Standard describes a method for the determination of the surface tension of synthetic or natural rubber latices. The surface tension of the latex is determined in mN/m‡ at a total solids content of 40% by mass, or less.

2. APPARATUS

The following apparatus is required:

(1) A *du Nouy tensiometer,* with platinum ring of 40 mm nominal circumference.

(2) A *glass dish,* 50 ml capacity with an internal diameter of at least 45 mm.

3. PROCEDURE

Clean the tensiometer ring by washing in water and then heating in the oxidizing section of a bunsen flame. Take extreme care to avoid distortion when handling the tensiometer ring.

Carefully calibrate the tensiometer scale against a standard weight in accordance with the manufacturer's instructions (see Appendix A). If the

*BS 1672, 'Methods of testing rubber latex'.
†BS 3397, 'Methods of testing synthetic rubber latices'.
‡1 mN/m = 1 dyn/cm.

total solids content of the latex is greater than 40 % by mass, dilute the latex to a total solids content of 40 ± 1 % with water complying with the requirements of BS 3978*. Clean the dish carefully, since any contamination may produce variable results. Strain approximately 25 ml of the latex, adjusted to a temperature† of 25 ± 2 °C, into the dish. Clean any skin or air bubbles from the surface of the latex by wiping with a piece of filter paper, and measure the surface tension immediately to avoid errors due to the formation of surface skin.

With the tensiometer protected from air currents, place the dish containing the latex beneath the ring on the adjustable platform of the instrument. With the instrument adjusted so that the beam is in its balance position when the ring is dry and the scale reading is zero, raise the platform until the latex makes contact with the ring. Immerse the ring beneath the surface of the latex. Now slowly lower the platform by means of the platform-adjusting screw and, simultaneously, increase the torsion of the wire, proportioning these two adjustments so that the beam remains exactly in its balance position. As the film adhering to the ring approaches the breaking point, proceed more slowly with the adjustments to make certain that the system is in its balance position when rupture occurs. Note, as the preliminary reading, the calibrated scale reading at which the ring detaches from the latex. Clean the ring as above and repeat the determination three times.

Discount the preliminary reading and record the average of the next three readings.

NOTE. The three readings should agree within 0·5 mN/m.

4. EXPRESSION OF RESULTS

Calculate the surface tension, in mN/m, as follows:

Surface tension, mN/m $= M \times F$

where M is the calibrated scale reading of the tensiometer,

F is a factor calculated as follows:

$$F = 0{\cdot}7250 + \sqrt{\frac{0{\cdot}03678 \times M}{R^2} + P}$$

where P is a constant calculated as follows:

$$P = 0{\cdot}04534 - \frac{1{\cdot}679 \times S}{R}$$

where S is the radius of the wire of the ring, expressed in millimetres,

R is the mean radius of the ring, expressed in millimetres.

NOTE. Surface tension and surface free energy are synonymous and have equal numerical values when expressed in mN/m and mJ/m² respectively.

*BS 3978, 'Water for laboratory use'.

†The temperature coefficient of surface tension of SBR and NBR latices over the temperature range 20 °C to 30 °C is −0·1 mN/m per °C. The corresponding value for natural rubber latex is +0·1 mN/m per °C.

APPENDIX A

CALIBRATION PROCEDURE

A typical calibration procedure is as follows:

Place a small piece of clean tissue paper on the clean ring and adjust the beam to its balanced or horizontal position and also adjust the scale pointer to its zero position. Put a 500 mg calibration weight on the paper and adjust the scale pointer until the beam is again at its balanced position. Note the scale reading. Repeat the whole procedure until two consecutive scale readings agree within 0·5 mN/m and calculate their average. Calculate the calibration factor for the scale reading from the relationship that 500 mg is equivalent to $2450/L$ mN/m, where L is the mean circumference of the ring expressed in millimetres.

NOTE. Before calibration, adjustment may be made if necessary to the length of the beam or the length of the torsion wire so that readings in the range 0 to 70 mN/m cover a reasonable proportion of the dial.

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