

A physical indicator for sterilisation procedures

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THE problem of a suitable time-temperature indicator for sterilising autoclaves has been without a satisfactory solution. Previous methods (Brown & Ridout, 1960; 3M's Co. Ltd.; Propper; Klintex; Browne's Tubes) all have disadvantages. The device described below consists of filter paper laminated to aluminium foil with an adhesive, one end being impregnated with a 2,4-dinitrophenylhydrazone of suitable melting-point. The whole is then sealed in a perforated transparent polypropylene envelope. The time at which the device is maintained above the particular temperature is satisfactorily indicated by the progression of the coloured zone along the paper.

EXPERIMENTAL

2,4-Dinitrophenylhydrazones (DNP) are intensely coloured compounds which can be prepared in a wide range of melting-points. 4-Methylcyclohexanone-2,4-dinitrophenylhydrazone, m.p. 132-134°, was used in the present work when dealing with the sterilisation of fabrics at 134°. The 2,4-DNP of methylethylketone may be used at a temperature of 115°, that of phenylacetaldehyde at 121° and that of acetone at 126°.

To obtain a uniform length of travel of the 2,4-DNP, aluminium foil, 0.02 mm thick, was incorporated to act as a heat distributor. Using a constant area of foil, a reproducible length of flow of the derivative was obtained for a given time. This was found by observing the enveloped laminate in an experimental glass autoclave evolved in these laboratories, and relating time and length of flow to the temperature shown by a thermocouple in contact with the envelope.

Of a range of filter papers investigated, Whatman No. 54 and Green's No. 406 were the most satisfactory. Various adhesives for the lamination were examined. Starch paste least restricted the flow of 2,4-DNP along the paper but was poor as an adhesive. "Q5" (Gerald Young Laboratories, Ltd., London) was satisfactory as an adhesive and the length of flow was but little less than that obtained using starch paste.

A device made from Green's No. 406 filter paper and foil, cut to 0.5 cm × 3 cm, was submitted to the following autoclave procedures uncovered and wrapped in fabrics:

- (a) Evacuation to 20 mm Hg absolute.
- (b) Introduction of steam to 2.06 kg cm⁻².
- (c) Maintaining at this pressure for a period.
- (d) Evacuation to 30 mm Hg absolute.

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The 2,4-DNP travelled 12 mm along the paper in 3 min at 134°. With a similar indicator with starch paste replacing the "Q5" adhesive, the indicator travelled 17 mm under identical autoclave conditions.

DISCUSSION

The device described has advantages over others currently available. Flow of the 2,4-DNP along the paper stops if the temperature falls below its melting-point, the indication of time at temperature is thus unequivocal. With a pure chemical, storage conditions are less important, and there is no deterioration similar to that which occurs with spore papers (Sykes, 1958), or Browne's tubes (Darmady, Hughes & Jones, 1958; Sykes, 1958; Brown & Ridout, 1960).

Although the paper and 2,4-DNP used require standardisation, this is easily achieved in the glass autoclave, in which the behaviour can be examined during the whole of the sterilisation cycle and if required the filter paper can be printed with calibration marks.

A series of indicators made for use in dry heat at different temperatures by varying the 2,4-dinitrophenylhydrazones can be used.

By selecting 2,4-DNP's which melt at the recommended sterilisation temperatures (M.R.C. Working Party, 1959) a device can be made which will indicate only at these temperatures. A curve has been superimposed

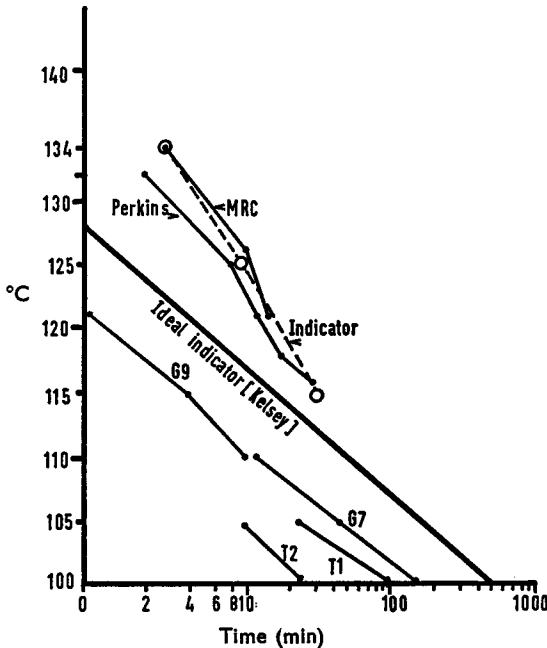


FIG. 1. Graph showing the thermal death curves of typical gas gangrene organisms (G.7 and G.9) and tetanus organisms (T.1 and T.2) compared with the curves for an ideal indicator and the sterilising times at temperature suggested by Perkins and the M.R.C. Working Party (after Kelsey). The curve for the indicator reported is superimposed.

on those of Perkins (1956) and the M.R.C. (1959) (Fig. 1): it shows that there is a safety margin above the levels suggested as an ideal indicator.

References

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