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DEPARTMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH AND FIRE OFFICES' COMMITTEE
JOINT FIRE RESEARCH ORGANIZATION

# INTERIM REPORT ON THE IGNITION OF TEA FLUFF

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## Summary

The ignition of tea fluff and some other dusts by by deposition on a hot metal surface has been investigated for a range of surface temperatures. The lowest surface temperature at which the dusts ignited depended on both the thickness of the deposit and the fineness of the dust; with deposits of the tea fluff not more than a few inches in thickness, and not subjected to previous heating, ignition is not considered likely at surface temperatures below about 200°C (392°F). For safety, however, it is strongly recommended that normal working temperatures of metal surfaces, should be appreciably below 200°C (392°F) so that this temperature would never be reached, even in the most unusual circumstances.

If the tea fluff had previously undergone prolonged heating at 93.3°C (200°F) then ignition might be possible at temperatures below 200°C (392°F). Experiments on the effects of pre-heating on ignition are not yet complete, however, and further information will be sent in a later report.

Attention is also drawn to the ease with which tea fluff, even if undried and unheated, can be ignited by sparks. Particular care should therefore be taken to avoid installing electrical apparatus producing sparks which may come into contact with tea fluff.

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The results and comment in this report are concerned chiefly with experimental determinations of the minimum temperatures of a surface in contact with tea fluff, and some other dusts, necessary for the ignition of the dusts. The effect of preheating at 93.3°C (200°F) on the ignition of tea fluff will be discussed in a later report, when the experimental programme has been completed.

The experimental method used in the determination of the minimum temperature required for the ignition of dust on a hot surface was to deposit a dust layer of known depth on a horizontal, electrically heated, hotplate whose temperature was maintained thermostatically at the required value. The dust was initially at room temperature. If the dust ignited the temperature of the hotplate was lowered at 10°C intervals in further experiments until the dust did not ignite after standing for a long period, often overnight. The ignition of the dust gave rise to smouldering combustion, and measurements were made of the time between the initial deposition of dust and the penetration of the smouldering to the outer surface of the dust layer. The smouldering was accompanied by visible glowing and, in the presence of a slight air draught, could easily lead to a serious fire. As the supply of tea fluff was limited the dependence of the minimum temperature for ignition upon the thickness of the dust layer was investigated using a fine hardwood sawdust, and the dependence upon the particle size of the dust was studied with cork dust; both sawdust and cork dust being readily available in greater quantity.

Table 1

Minimum surface temperatures for the ignition of dusts
Dust depth : 2.5 cm. (1.0 in.)

| Dust | Minimum surface temperature for ignition °C | °F | Time for emergence of smouldering min. |
|---|---|---|---|
| Tea fluff | 230* | 500* | 35 |
| Wood sawdust | 270 | 518 | 51 |
| Cork dust: | | | |
| 0.36 cm diameter | 320 | 608 | 9 |
| 0.043 " " | 280 | 536 | 21 |
| 0.0065 " " | 260 | 500 | 45 |

* reduced to 250°C (482°F) on heating to 200°F for 32 days.

The results given in Table 1 show that the minimum temperatures of the hot surface for the ignition of dusts varied with the dust, but that the temperature for tea fluff was close to that for fine sawdust and cork dust. It may also be seen that the ignition temperature of cork dust fell as the particle size decreased; under practical conditions, therefore, the possibility of the segregation of fine fractions of a dust (e.g. by elutriation) should be borne in mind. If such separation did occur the resulting accumulation could ignite at a lower temperature than a sample taken from the main bulk of the dust. In the particular instance of tea drying, deposits of abnormally fine material could be expected on high rafters, beams, etc. and probably in the cavity of hollow walls; consideration should be given to this when installing heaters.

Table 2

Change in ignition temperature with depth of dust deposit

| Dust | Depth of dust layer cm | Minimum surface temperature for ignition °C | °F | Time for emergence of smouldering. |
|---|---|---|---|---|
| Wood sawdust | 2.5 | 270 | 518 | 51 min |
| | 5.0 | 240 | 464 | 3 hr 37 min |
| | 7.5 | 230 | 446 | 6 hr 57 min |
| | 10.0 | 230 | 446 | 7 hr 30 min |
| | 12.5 | 230 or less | 428 or less | 15 hr 40 min |
| Tea fluff | 2.5 | 260 | 500 | 35 min |
| | 5.0 | 230 | 446 | 2 hr 15 min |

Increasing the thickness of the dust layer considerably reduces the surface temperature required for ignition (Table 2), and the ignition may be delayed for several hours. It appears likely that tea fluff in layers 5 in. in depth could ignite at not 230 °C (446°F) and that thicker layers would ignite at still lower temperatures. Further experiments with sawdust layers at depths of greater than 12·5 cm (5 in.) were not undertaken because with the 9 cm (3½ in.) hot plate the thickness of the dust layer already exceeded its radius (7 in. diameter) and lateral heat losses could become important. In practice, if a shallow dust deposit on a hot surface covered an area large in proportion to its depth the lateral heat flow from the centre of the deposit would be small compared with that to the dust surface. In the present enquiry, if extensive fluff deposits deeper than 5 in. are considered possible, then further experimental work, involving the construction of a larger hot plate, would be necessary. However, if deeper deposits are not considered, then the minimum surface temperature for the ignition of tea fluff could be taken as about 200°C (or 392°F). This temperature, therefore, should not be exceeded under any circumstances.

It will obviously be desirable, in designing heating apparatus, to insist upon as wide a safety margin as possible between the normal working temperature and 200°C. A further point to be considered in the design of heaters is the thermal insulation effects of dust deposits; thus if dust accumulates on a hot surface the rate of heat loss from the surface to the atmosphere is reduced and the temperature of the surface increases, unless the rate of supply of heat is reduced.

In a previous letter (22/12/51) it was stated that tea fluff which had been preheated might be more readily ignited than fluff in the normal undried condition. It has since been shown that the undried tea fluff, as received, can be ignited by sparks from an ordinary flint gas lighter and that smouldering combustion will then spread through the mass of fluff. Particular care should therefore be taken to avoid the production of sparks, frictional or electrical, near deposits of tea fluff; if electric motors, for example, are installed they should be of the totally enclosed type. It is possible that some fires in tea fluff caused by small, unseen, sparks have been attributed to ignition by heated surfaces, as mentioned in the earlier letter.

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