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DRY POWDER EXTINGUISHING AGENTS

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Both sodium bicarbonate and common salt have been used for a long time for "damping down" fires in grates, and one of the first dry chemical extinguishers consisted of a container from which the chemical (sodium bicarbonate) was either thrown or sprinkled on the fire. About forty years ago a gas pressurized unit which expelled dry chemical at a high velocity was developed in Germany. The chemical used was sodium bicarbonate containing about 15 per cent borax, which, it was hoped, would make the powder effective against solid combustible materials by fusing on the surface. A metallic stearate was also added as a waterproofer.

Although dry powders have been much more widely used since 1945, there has been little change in the constituents. It has been found that smaller particle sizes give better results but the majority, if not all the powders used at present contain about 95 per cent sodium bicarbonate, and metallic stearates are widely used as additives.

The present commercial dry chemical hand extinguisher is very efficient for dealing with small spill fires and the 20 lb dry chemical extinguisher, comparable in size to the 2 gal. foam extinguisher is rated by the Factory Mutual Laboratories as capable of extinguishing a $12\frac{1}{2}$ square foot petrol fire, the comparable figure for a 20 lb CO_2 extinguisher is 7 square feet. Experiments so far would suggest that in trained hands the 20 lb dry chemical extinguisher is capable of dealing with a much larger area of burning petrol than $12\frac{1}{2}$ square feet.

Because of the possibility of a rapid extinction or reduction in intensity of a petrol fire by dry chemicals the main development of large-scale equipment has been directed to aircraft crash fire use. One application which has been suggested is that relatively small amounts of dry chemical (400 lb) should be used in conjunction with foam for aircraft crash firefighting. However, the Royal Canadian Air Force and some overseas commands of the Royal Air Force have equipped themselves with large mobile trucks carrying 4,000 lb of dry chemical. No report has yet been received of Service experience of the efficiency of this equipment, but the Canadian Air Force claim to have carried out successful tests on large simulated crash fires.

One of the obvious disadvantages of this type of medium is that it does not give any protection against reignition of the petrol, and because of this its use in conjunction with foam might be more satisfactory. Experience both here and in America has shown that many commercial powders cause the breakdown of foam, when the extinguishing media are applied together, particularly if the powder is applied on the foam. The effect is due mainly to the metallic stearates included in the powders, which indeed are often used commercially as defoaming agents. Any decomposition of the sodium bicarbonate under fire conditions can make the foam more alkaline which will also aid breakdown.

Dry powders have also been developed for the extinction of metal fires. The mechanism in this case is fairly simple. In one type the powder has as one constituent a fusible material which will melt on the burning metal and exclude the oxygen. Bitumen and "hoof and horn" meal have been used for this purpose. It is essential, of course, that neither the carrier powder nor its products of decomposition should react violently with the metal.

The mechanism of extinction by dry powders

The mechanism by which dry powders extinguish a liquid fuel fire is probably much more complicated than the mechanism of any other extinguishing agent, and at present, although a number of plausible suggestions including the following have been made, there is no experimental evidence on which to decide which is correct.

1) The powder cools the flames.

2) Some powders (sodium bicarbonate) decompose in the flame giving water and carbon dioxide which have some effect.

3) The powder acts as a radiation shield between the flames and the liquid surface reducing the rate of burning.

4) Certain elements have an inhibitory effect on the combustion reaction - examples of which are the alkali metals and the halogens.

It is unlikely that the amount of CO_2 released by the powder has much effect and it may well be that a number of the above factors are important in extinguishing the fire.

With any one type of powder the efficiency will depend on the method of application and the particle size. Whether the mechanism of extinction is thermal or chemical it would be expected that the smaller the particle size the more efficient the powder.

A programme of work has been started at the Joint Fire Research Organization and so far measurements are being made on the effect of the fineness of the powder on the time taken to extinguish a petrol fire when the powder is applied at varying rates. While it is too early yet to give a final account of the work the indications are that the fineness of the powder is particularly important when the powders are being used most economically i.e. near to the critical rate. This is illustrated in Figure 1. These tests were carried out on a petrol fire 3 ft x 3 ft, and the powder was applied as a flat spray. As with vaporizing liquids, this method of application appears to be the most effective. The amounts of powder used in extinguishing the fire at different rates are shown in Figure 2.

Future work will include comparison of the efficiencies of different chemical compounds in fire extinction, and a quantitative investigation of the effects of dry powders on the stability of foam.

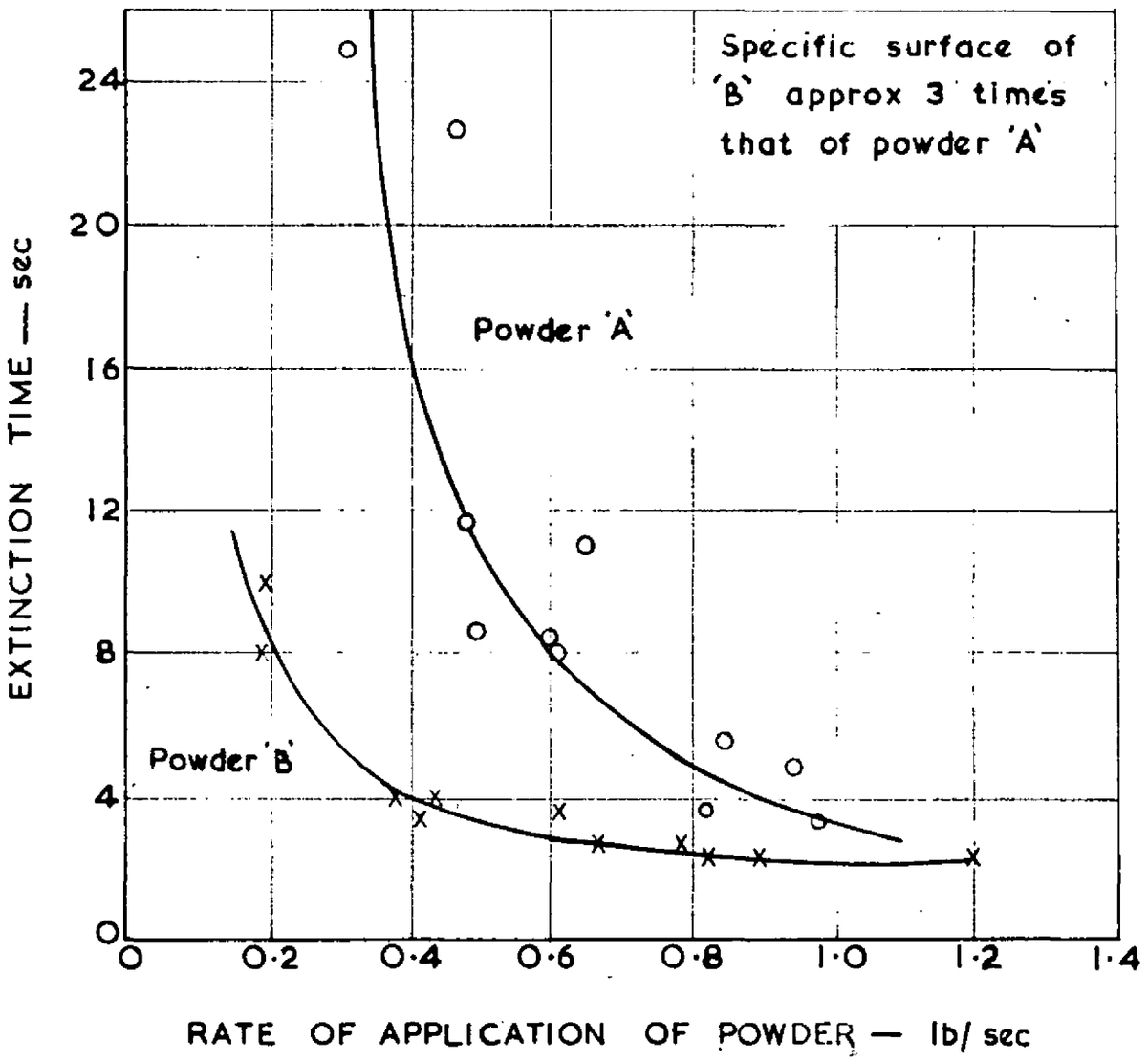

FIG. 1. EFFECT OF SPECIFIC SURFACE OF POWDER ON EXTINCTION OF PETROL FIRE 3 ft x 3 ft

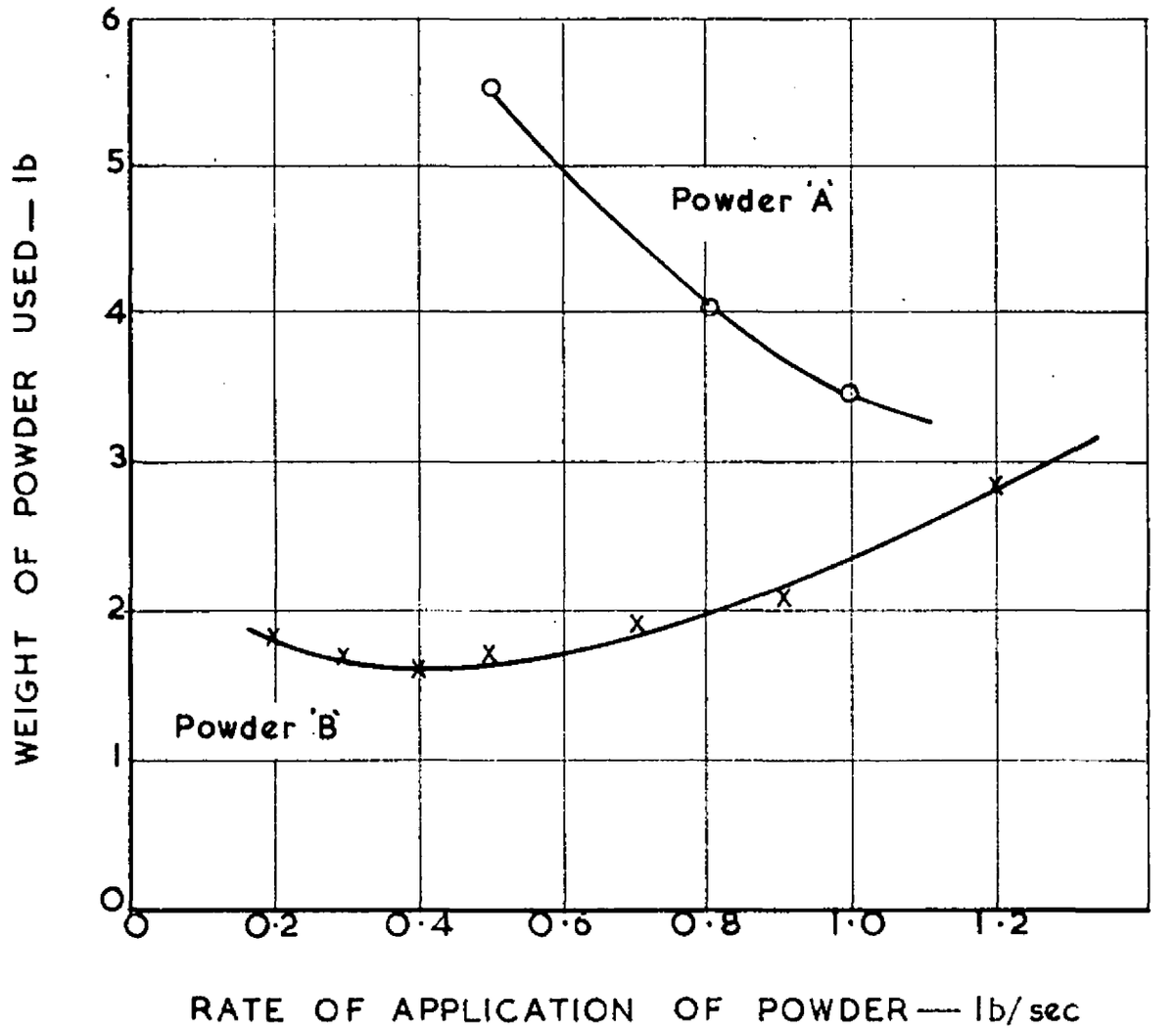

FIG. 2. AMOUNT OF POWDER REQUIRED TO EXTINGUISH FIRE 3ft x 3ft AT DIFFERENT RATES