COMBINED AGENT (DRY CHEMICAL-FOAM) FIRE FIGHTING MODEL TEST

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1.INTRODUCTION

The combined agent (dry chemical-foam) fire fighting technique is a technique that is quick and reliable in putting out large oil fires,especially when there are obstructions in the fire areas.

Following the development and application of the fluoroprotein fire extinguishing agent in our country,this technique has received increasing attention and has been more and more widely applied.

The combined agent (dry chemical-foam) fire fighting analog test is carried out on a setup that includes a 0.6 sq.m. oil receiver.the aim of the test is to find the technical parameters needed for fighting fire in large areas,through a series of experiments on a miniature analog-setup under various conditions.These parameters point to the optimum order,intervals and magnitudes in using the combined agent to extinguish a fire.

2.THE COMBINED AGENT (DRY CHEMICAL-FOAM) FIRE FIGHTING MODEL TEST SETUP

The setup is illustrated in Fig.1.below:

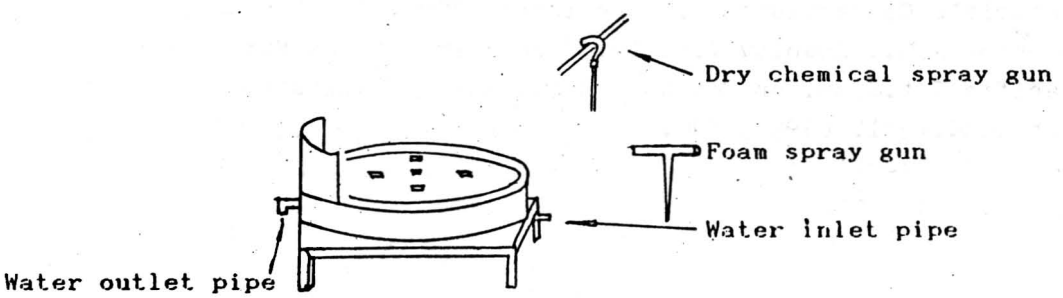

Fig.1.Schematic drawing of the combined agent fire-fighting analog test setup

The setup is made up of the following parts:

(1) Oil Receiver For The Test

The oil receiver of the setup is shaped like a round tray,0.5 m deep and 0.6 m in area.Inside the oil receiver are placed 5 cylindrical steel tubes as analogous obstructions.Water is first injected to form the bottom layer in the receiver.Then 18 litres of oil is added,so that the surface of the oil is 3 cm from the top of the receiver.

(2) Dry Chemical Spraying System
The dry chemical fire extinguishing agent spraying system consists of a dry chemical spray gun,a pneumatic valve,a dry chemical container,a gas regulator,an air pressurizer and a spray gun nozzle swinging device.The magnitude of the supply of dry chemical is adjustable mainly through adjusting the diameter of the aperture at the tip of the nozzle.The range of adjustment is from 2 kg/min/sq.m. to 8.3 kg/min/sq.m.The spray gun is fixed on a stand that allows it to oscillate automatically.Its horizontal oscillating period is 1.5 cycles per second.The spray gun and the stand are placed at a distance of 170 cm from the center of the oil receiver.
(3) Foam Spraying System
The foam spraying system consists of a foam spray gun,a foam solution storage tank,an air pressurizer and a stand for the spray gun.The flow of the foam in the spray gun is 5 litres per minite and the working pressure is 0.7 MPa . The supply of the foam solution is adjustable through regulating the quantity of foam released.The range of adjustment is from 2.5 l/min/sq.m. to 8.3 l/min/sq.m. The distance between the spray gun and the oil receiver should be so adjusted that the foam sprayed just reached the screen across the oil receiver.An automatically-controlled computerized data collecting system is attached to the setup.

3.THE METHOD AND RESULTS OF THE TEST

In this experiment fluoroprotein foam solution (foam for short) and wholly siliconized dry sodium bicarbonate (dry chemical for short) are used to fight fire under varying conditions.
(1) Fire Fighting Experiments With Foam or Dry Chemical.
The results of the experiments are shown respectively in table 1 and table 2.

Table 1:Results of fire fighting experiment with foam supplied at varying magnitudes

Foam magnitude (l/min/sq.m.)	8.3	6.7	5.0	3.3	2.5
Time taken to extinguish fire (sec.)	43	60	74	95	119

From the data in the above table it can be seen the fire extinguishing effect is best when the foam supply magnitude is 5.0 l/min/sq.m.

Table 2:Results of fire fighting experiment with dry chemical supplied at varying magnitudes.

Dry chemical magnitudes (kg/min/sq.m.)	8.3	6.0	4.5	3.0	2.6
Time taken to extinguish fire (sec.)	30	n.e. (not extinguished)	n.e.	n.e.	n.e.

From the data in the above table it can be seen fire with

obstructions cannot be extinguished when the supply magnitude of the dry chemical is under 6.0 kg/min/sq.m.

(2) Fire Fighting Experiment With Dry Chemical and Foam Sprayed Simultaneously In Combination.

the results of this experiment are shown in table 3 and table 4:

Table 3:Results of fire fighting experiment with foam supplied at varying magnitudes while dry chemical supply stands at the magnitude of 2 kg/min/sq.m.

Table 3

Foam magnitude (l/min/sq.m.)	8.3	6.7	5.0	3.3	2.5
Time taken to extinguish fire (sec.)	28	30	35	48	60

From the data in the above table it can be seen that through the combined use of dry chemical and foam,while the dry chemical supply magnitude stands at 2 kg/min/sq.m. a better result is achieved when the foam supply magnitude is 5.0 l/min/sq.m.

Table 4: Fire fighting experiment with varying dry chemical supply magnitudes while foam supply magnitude stands at 2.5 l/min/sq.m.

Table 4

Dry chemical magnitude (l/min/sq.m.)	8.3	6.0	4.5	3.0	2.0
Time taken to extinguish fire (sec.)	9	17	30	48	58

From the data in the above table it can be seen while the foam supply magnitude stands at 2.5 l/min/sq.m.,the greater the supply magnitude of dry chemical,the less is the time taken to extinguish the fire.

The data obtained through the above experiments show that the use of the dry chemical and foam in combination can extinguish a fire in a much shorter time than using either of the two fire extinguishing agents alone.These experiments testify fully to the high efficiency of the combined fire extinguishing agent (dry chemical-foam) in fire protection.

(3) Fire Fighting Experiment With the Combined Agent (Dry Chemical-Foam),With Foam Sprayed First and Dry Chemical Sprayed After An Interval.

A.Table 5 contains results of the fire fighting experiment with the combined agent (dry chemical-foam)--using dry chemical in varying magnitudes after varying intervals,while the foam supply stands at the magnitude of 2.5 l/min/sq.m.

Table 5

Magnitudes of dry chemical (kg/min/sq.m.) / Extinguish fire time (sec.) / Intervals (sec.)	8.3	6.0	4.5	3.0	2.0
0	9	17	30	48	58
10	20	23	26	41	44
20	25	28	32	45	47
30	32	34	42	51	56

Figure 2 shows when the magnitude of the foam supply stands at the same level, how the changes in the magnitudes of dry chemical and in the intervals affect the time needed to extinguish in the fire.

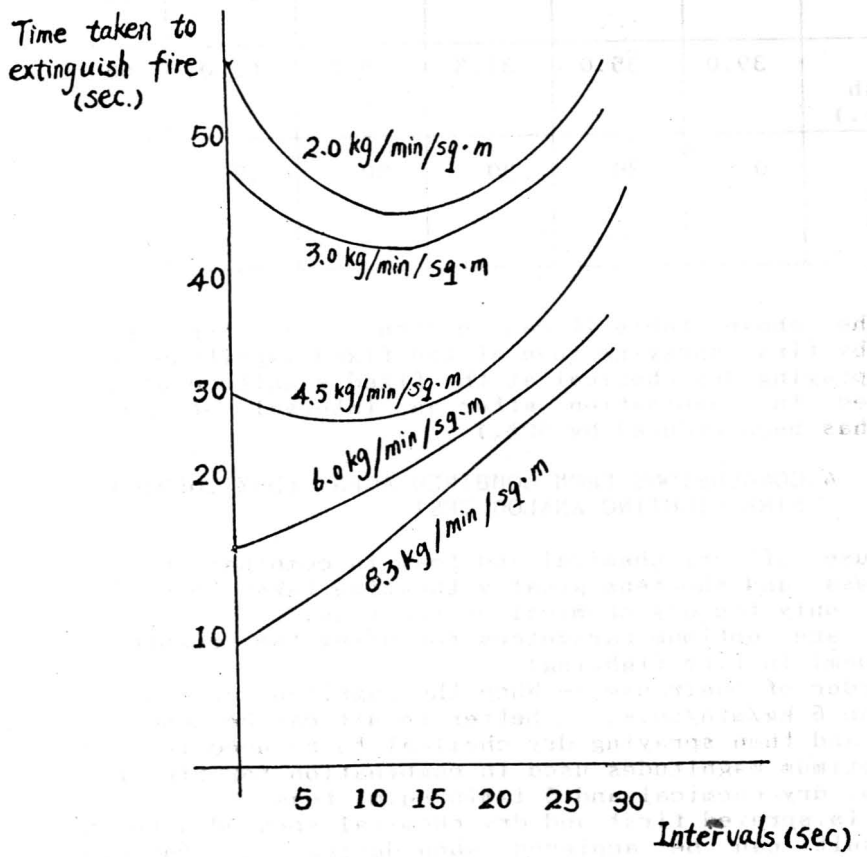

Fig.2

From Fig.2 it can be seen :(a) when the magnitudes of the dry chemical are greater than 6 kg/min/sq.m. the time taken to extinguish the fire varies according to the changes in the magnitudes of the dry chemical.Hence,the shorter the interval,the less time it takes to extinguish the fire.(b) When the magnitude of the dry chemical is smaller than 6 kg/min/sq.m.,the effectiveness of it is reduced.Also,the curves indicating the relation between the lenth of the interval and the time taken to extinguish the fire all show an extreme value,i.e.,there is an optimum time interval.If the dry chemical supply magnitude gets smaller,the optimum time interval becomes longer.

B.Table 6 shows results of the fire fighting experiment with the combined agent (dry chemical-foam),with foam first sprayed at the fixed magnitude of 5 l/min/sq.m. and dry chemical sprayed after varying intervals when the fire has been weaken to a certain extent (counted in heat reduction rates) at the fixed magnitude of 3 kg/min/sq.m.

Table 6

Foam supply magnitude 5 l/min/sq.m Dry chemical supply magnitude 3kg/min/sq.m.							
Interval (sec.)	0	10	14	20	25	32	35
Time to extinguish fire (sec.)	39.0	35.0	37.5	38.5	42.0	43.0	44.0
Heat radiation reduction (%)	0	20	30	50	65	80	90

From the above table it can be seen a greater effectiveness is achieved by first spraying foam at the fixed magnitude of 5 l/min/sq.m. and then spraying dry chemical at the fixed magnitude of 3 kg/min/sq.m. to be used in combination after an interval of 20 seconds.(Heat radiation has been reduced by 50%.)

4.CONCLUSIONS FROM COMBINED AGENT (DRY CHEMICAL-FOAM) FIRE FIGHTING ANALOG TEST

(1) The use of dry chemical and foam in combination has a greater effectiveness and shortens greatly the time taken to extinguish a fire than using only the dry chemical or the foam.

(2) There are optimum parameters for using the combined agent (dry chemical-foam) in fire fighting:

A. The order of their use -- When the magnitude of the dry chemical is smaller than 6 kg/min/sq.m. a better result can be achieved by spraying foam first and then spraying dry chemical to be used in combination.

B. The optimum magnitudes used in combination for fire fighting are 3 kg/min/sq.m. dry chemical and 5 l/min/sq.m. foam.

C. If foam is sprayed first and dry chemical sprayed after an interval,a better result can be achieved when during the interval the heat radiation has already been reduced by 50%.

(3) The 0.6 sq.m. setup used in the combined agent (dry chemical-foam)

fire fighting analog test is easy to operate,with stable performance and good data repeatability.
(4) The test has a guiding significance for the use of the combined agent (dry chemical-foam) in extinguishing oil fire in a large area.

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