EVALUATION OF ANTIFIREOL—A FOAM FIRE FIGHTING COMPOSITION

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Antifireol has been tested for its stability, compression ratio, density, drainage of liquid and the throwing range. Commercially available foam compositions have also been tested for a comparative study.

Introduction

Chemical foams have been known for a long time to be very useful as fire extinguishers.[1] They act in many different ways e.g.(1) by enveloping the fire with an atmosphere of carbon dioxide which reduces the supply of oxygen; (2) by generating steam from the liquid draining from the foam which again restricts the access of oxygen; (3) by depositing a layer of chemicals which acts as a barrier between the burning material and air and (4) by absorbing heat from the burning material thus imparting a cooling effect. Antifireol has been developed in these laboratories [2] and bears quite a few advantages over the commercially available compositions. The ingredients are a mixture of soluble and insoluble carbonates which, when mixed with a solution of aluminium sulphate, sets in two types of reactions: one involving the soluble carbonates or bicarbonates results in an instantaneous evolution of carbon dioxide and the other is a slow one with the insoluble carbonates which keeps on reacting even after the first reaction has ceased. This gives a two fold advantage: one is the production of dense foam, sodium bicarbonate alone does not produce thick foams and the other is the added stability to the foam. The last named property is due to the slow reaction.

The stability of foam may be dependent upon two different phenomena.(1) The rate of drainage of liquid from the foam and (2) the rate of breakdown of the foam. If a good stabiliser is at hand, the rate of drainage is not affected by the breakdown of foam.[3,4,5] In estimating the stability of the foams particular attention has been directed towards determining the time required for the collapse of the foam to half the initial volume and to find out the drainage of the liquid from the foam. The other tests required for the evaluation of a fire fighting composition are the density of foam, the compression ratio, the range covered when the foam is expelled through the nozzle of a two-gallon container and the effectiveness in extinguishing the fire. Laboratory studies were carried out for all of these tests except the last named for which only the field test was undertaken.

Experimental

Tests were carried out by preparing two sets of solutions. The acidic solution was poured into the alkaline solution by means of a delivery tube in a way that its tip reached the lower most portion of the funnel thus ensuring complete admixture of the two solutions. For estimating the drainage time the tests were carried out in a large separatory funnel with a conical base. The drained liquid was collected and measured at regular intervals. The stability and compression ratio tests were performed in large graduated cylinders. The volume of the foam was noted at regular intervals. For the measurement of the density, the weight of a definite volume of foam from the field tests and also from the laboratory tests was noted. The range of the throw of the foam was found by performing a series of tests on solutions prepared according to the directions. A two-gallon container was used for the purpose.

Results

Six commercial foam compositions were tested in order to compare with the results of Antifireol. Most of these compositions have been imported from abroad. It was thought that some of these samples got deteriorated due to long storage and hence the results on Antifireol were checked by exposing it to air for three months. Very little, if any, deterioration had occurred. This is attributed to the excellent property of the stabiliser and the insoluble carbonates which are known to act as desiccants.

Table 1 shows the throwing range and density of foams and Table 2 gives the drainage of liquid from the foam. The volume occupied by the foam and the compression ratio are given in Tables 3 and 4. By observing the volume of the foam at regular intervals, it is found that only 1,

TABLE 1.—THROWING RANGE AND DENSITY OF FOAMS FROM DIFFERENT FIRE FIGHTING COMPOSITIONS.

Composition	Density g./ml.	Throwing range
1. Antifireol	0.178	32′.6″
2. Antifyre	0.178	22′.6″
3. Foamite	0.160	26′.0″
4. Firex	0.135	30′.0″
5. Phomene	0.180	26′.2″
6. Simplex	0.132	28′.6″
7. Invincible	0.143	26′.6″

3 and 7 do not collapse easily. The volume of foam from Antifireol remains remarkably constant, for at least 30 minutes indicating higher stability. The half life period of the foam, found from Fig. 1 is shown in the last column of Table 3.

Discussion

Table 1 showing the throwing range and density compares favourably with Table 4, since the throwing range depends on the compression ratio. A notable feature in the case of Antifireol is

TABLE 2.—DRAINAGE OF LIQUID FROM FOAMS (VOLUME OF LIQUID DRAINED).

Composition	Minutes						Initial volume ml.	Volume of liquid retained after 20 mins. %
	10	20	30	40	50	60		
1. Antifireol	65	9	8	7	5	2	150	50.6
2. Antifyre	44	20	14	10	7	4	150	57.2
3. Foamite	25	20	9	8	6	5	150	70.0
4. Firex	31	15	12	7	5	3	150	69.2
5. Phomene	62	17	10	7	4	2	150	47.2
6. Simplex	52	18	10	6	5	4	150	53.2
7. Invincible	30	21	12	8	6	4	150	66.0

TABLE 3.—STABILITY OF FOAMS (VOLUME OF FOAM IN ML.)

Composition	Minutes						Initial volume ml.	Half life of Foam
	10	20	30	40	50	60		
1. Antifireol	1500	1420	1360	1200	1160	1060	1500	120
2. Antifyre	800	600	440	360	300	300	1300	18
3. Foamite	1260	1000	900	700	600	500	1320	43
4. Firex	1000	700	580	400	300	260	1260	25
5. Phomene	840	580	380	360	300	300	1400	15
6. Simplex	860	700	580	440	400	400	1300	23
7. Invincible	980	860	600	540	480	460	1100	38

TABLE 4.—THE COMPRESSION RATIOS OF FOAMS (COMPRESSION RATIO).

Composition	Minutes						
	Initial	10	20	30	40	50	60
1. Antifireol	10.0	10.0	9.6	9.4	9.0	8.8	8.8
2. Antifyre	8.6	5.3	4.0	2.9	2.4	2.0	2.0
3. Foamite	8.8	8.4	6.6	6.0	4.6	4.0	3.3
4. Firex	8.4	6.6	4.6	3.8	2.6	2.0	1.7
5. Phomene	9.3	5.6	3.8	2.5	2.4	2.0	2.0
6. Simplex	8.6	5.7	4.6	3.8	2.9	2.6	2.6
7. Invincible	9.3	5.6	3.8	2.5	2.4	2.0	2.0

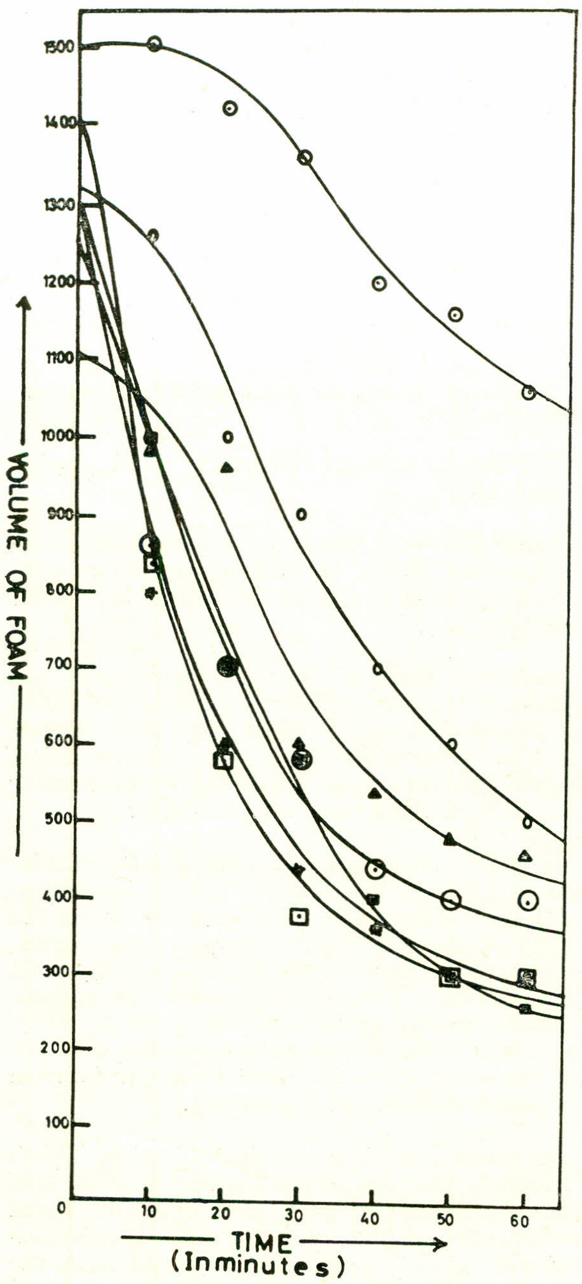

Fig. 1.—Showing plot of the volume of the foam obtained from the various foaming compositions Vs. time.

that the same compression ratio is maintained for almost 60 minutes. This is also seen from Table 3 which gives the volume of foam. The stability of foam from Antifireol is attributed to the stabilizer which is a combination of vegetable gums and proteins. The maintenance of volume as depicted in Fig. 1 is obviously due to the slow reaction between aluminium sulphate and the insoluble carbonates like those of calcium and magnesium. The higher throwing range obtained for the present case therefore becomes apparent.

The stability may also be judged from the drainage of liquid from the foam. It is observed from Table 2 that in certain cases e.g. those of 3, 4 and 7 there is only partial drainage of liquid while in others about 50 percent of it drains in the first twenty minutes. The drainage of liquid leaves a dispersion of carbon dioxide in a skeleton of chemicals which would be effective for fire extinguishing provided the desired density of foams is maintained. The drainage of liquid in the case of chemical foams is then different from air foams in which the ready breakdown of foams or early drainage of liquid are both undesirable.[5] The drainage of liquid would help to retard the fire as pointed out earlier and the chemical skeleton would restrict the access of air to the burning material.

Stability is a guide of the ability of the foam to retain its volume and thus keep the inert gas trapped for a definite period. Dense foams with a good stability would therefore be better for fire extinguishing.

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