Fire Research Note No.860

NOTES ON DIBROMOTETRAFLUOROETHANE (DBE)

by

P. F. THORNE and T. B. CHITTY

February 1971

FIRE RESEARCH STATION

F.R. Note No. 860
February 1971

NOTES ON DIBROMOTETRAFLUOROETHANE (DBE)

by

P. F. Thorne and T. B. Chitty

SUMMARY

Some properties of dibromotetrafluoroethane relevant to its use as a fire-fighting agent in the form of a vaporising liquid and a foam additive, are reviewed.

KEY WORDS Extinguishing agent; Vaporizing liquid; Toxicity.

DEPARTMENT OF THE ENVIRONMENT AND FIRE OFFICES' COMMITTEE
JOINT FIRE RESEARCH ORGANIZATION

F.R. Note No. 860
February 1971

NOTES ON DIBROMOTETRAFLUOROETHANE (DBE)

by

P. F. Thorne and T. B. Chitty

GENERAL INFORMATION

Dibromotetrafluoroethane ($C_2Br_2F_4$) is a halogenated hydrocarbon also known as Halon 2402 or Freon $114B_2$. It is available from a number of major international chemical manufacturers. Some of its properties relevant to fire fighting are shown in Table 1.

Current interest in this chemical is concerned with its use as:

1. A vaporising liquid extinguishing agent.
2. An additive for fire-fighting foam.

DBE is one of the many halogenated hydrocarbons which have been considered from time to time for use as extinguishing agents (see e.g. ref. 4). The result of these considerations has usually been the choice of BTM or BCF as the preferred agent. Recently, an extensive reassessment of DBE under a wide range of conditions has been made by Montecatini-Edison SpA and reported by Runza[1] and Rainaldi[2]. DBE is understood to be used in the U.S.S.R. mixed with ethyl bromide in the proportions 27 per cent DBE/73 per cent ethyl bromide as an extinguishing agent for fire fighting on ships. This mixture is also emulsified with water or ammonium phosphate solution for use in forest fire fighting[3].

FIRE EXTINCTION

The Montecatimi reports[1 2] contain results for a large number of fire tests. Unfortunately there are no results of comparative tests using other agents. There is little information which can be directly compared with data already available for other agents. For example, out of 43 tray fire results, only three are for petrol fires, the majority of testing being done with a 50/50 mixture of petrol and kerosine, which is not a standard British or Continental test fuel.

TOXICITY

The lowest value of A.L.C. or dangerous concentration (DC) of the undecomposed material reported is 8.5 per cent v/v[4] for a 15 minute exposure. Rainaldi[2] reports a value of 13.2 per cent v/v for a 4 hour exposure. This value of DC is not suitable for the calculation of 'R' as defined in Fire Research Note 659 and therefore the value of R = 0.265 reported by Rainaldi is not strictly correct.

Using DC = 8.5 and a value of EC = 3.5 (for n-hexane)[2] 'R' is calculated to be 0.41. Both the above values of 'R' are, however, acceptable according to the criteria proposed by the Home Office ($R \leqslant 4$) for use in portable fire extinguishers, and the criteria proposed in F.R. 659 ($R < 1$) for use in total flooding systems. Some damage by DBE to visceral organs has previously been reported[4] although this is not confirmed by the latest work[1].

FLOODING SYSTEMS

Although DBE is acceptable for use in total flooding systems according to the criteria $R < 1.0$, its relatively high boiling point (47.3°C) may be a disadvantage under certain conditions. It is clear that under hot (fire or climatic) conditions, vaporisation of a DBE discharge in the form of a very fine spray would be rapid. However, in non-fire or cold climatic conditions, vaporization may not occur immediately. This may result in the inhalation of droplets (and consequently a higher concentration of) DBE by personnel present in the discharge, and may also delay the establishment of the design concentration. These points, (which would apply even more to CB and rather less to BCF under very cold climatic conditions), should be borne in mind by systems designers.

USE WITH FOAMING AGENTS

The most interesting use of DBE is in conjunction with water-based extinguishing agents. Its use in an emulsion with water has already been referred to. Current interest is in the incorporation of DBE into foam liquids, particularly of the synthetic (detergent based) type. This could be done either by making the DBE/foam liquid/water system completely miscible over the appropriate ranges of concentration by the use of a suitable mutually miscible solvent, or by making foam from an emulsion of DBE and foam solution. The advantage claimed for foams incorporating DBE is the release of flame inhibiting DBE vapour whenever foam is broken down by heat e.g. by flames or hot metal surfaces. No extensive comparative test results have yet been reported.

RECOMMENDATIONS

Any assessment of DBE as a fire extinguishing agent should include the following:

1) Fire tests on a range of standard flammable liquid (Class B) fires e.g. CENTRI 2 test fires. For these tests, the discharge nozzles used should be of a design appropriate to DBE.

2) Methods for incorporating DBE into foam liquids and solutions.

3) Fire testing of foams treated with DBE.

TABLE 1

Some properties of DBE, CB and BCF

Property	DBE	BCF	CB
Molecular Weight	259.8	165.4	129.4
Boiling Point (^{o}C)	47.3	-4	67
Freezing Point (^{o}C)	-111.5	-160.5	-88.9
Liquid density gm/cm^3	2.1	1.83	1.95
Peak Value (hexane) (EC) %	3.5	5.2	6.35
$lb/1000\ ft^3$	25.4	24	22
Dangerous Concentration (DC) %	8.5	24	2.6
$lb/1000\ ft^3$	.62	110	9.2
R = EC/DC	0.41	0.22	2.4

REFERENCES

(1) RUNZA, M. (Montecatini-Edison)
Antincendio e Protezione Industriale October 1968 pp. 711-716
"Informational Notes on 'Fluobrene'."

(2) RAINALDI, N. (Montecatini-Edison)
N.F.P.A. Annual Meeting New York May 16 1969. "Advance Report on Halon 2402." (Available from Imperial Smelting Corporation, Avonmouth, Bristol).

(3) LORBERBAUM, V. G. Lesnoe Khoziaistuo No 7 1968 63-64. "New emulsions for suppressing forest fires." Canadian Department of Forestry Translation No 274 (1968).

(4) ENGIBOUS, D. L. and TORKELSON, T. R. "A study of vaporizable extinguishants." W.A.D.C. Technical Report 59-463 (January 1960).