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MOTHPROOFING TREATMENT FOR AMMUNITION FELT,(U)
FEB 78 W R HINDSON, F G MAY, B T MOORE
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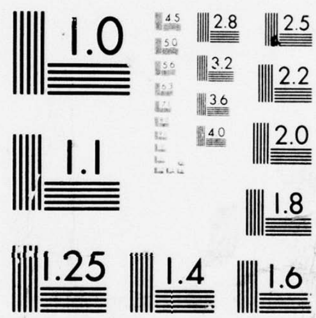

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REPORT

MRL-R-706

MOTHPROOFING TREATMENT FOR AMMUNITION FELT

W.R. Hindson, F.G.J. May, B.T. Moore,
and G. Southwell

Approved for Public Release

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C O N T E N T S

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MOTHPROOFING TREATMENT FOR AMMUNITION FELT

1. INTRODUCTION

The purpose of the work described in this paper was to find an acceptable replacement for 2,4-dinitroalphanaphthol (DAN) as a mothproofing agent for wool felts used in ammunition and ammunition packaging. DAN has been specified and used for many years but it is no longer being manufactured in commercial quantities.

Wool can be attacked by various keratin-consuming insects such as clothes moths and carpet beetles which are common in Australia, and wool felt therefore requires protection, especially during storage. For use with ammunition it is essential that any compounds used to give that protection should not accelerate corrosion of metal components of the ammunition and that they should be compatible with any explosives compositions with which they may come into contact.

The two possible replacements for DAN seemed to be Mitin FF (Ciba/Geigy) and Eulan WA new (Bayer) both of which are substituted and chlorinated diphenyl ethers widely used in Australia for imparting insect-resistance to woven and knitted wool goods; they are essentially colourless dyestuffs. The compounds are usually applied to wool from an aqueous bath containing acetic acid, treatment conveniently being combined with conventional dyeing. There is however a risk of traces of acid being retained in the wool and this risk is not acceptable for ammunition use. The dyeing-type application is required only to ensure that the compounds are not readily removed by laundering or dry-cleaning and this property is not required for ammunition felts; it was expected that the compounds could be directly padded on to the felt.

No information is available on the corrosive effects of Eulan WA new on metals and such information as is available on the effects of Mitin FF is scanty and affected by the compound having been applied from an acetic acid bath. We have also been unable to find any useful information on the compatibility of the compounds with explosive compositions.

2. EXPERIMENTAL

2.1 Application of Compounds to Wool

The usual method of applying both Mitin FF and Eulan WA new to wool goods is from an aqueous bath acidified with about 1% acetic acid (or sometimes formic acid) calculated on the mass of wool to be treated, the temperature of the bath being gradually raised from about 30°C to the boil at which it is held for 30-45 min to ensure complete and uniform application of the compounds. The structure of felt is such that it is unlikely that acid will be completely removed and the risk that some acid will be retained in the felt is too great for this method of application to be acceptable for the present purpose. In any case substantivity of the compounds is not important as the treated felt will be neither laundered nor dry-cleaned.

Laboratory tests showed that either compound could be readily applied to felt by padding. As a matter of convenience it was decided to apply the compounds to plain woven worsted cloth (approx. 180 g/m^2) for use in the tests described in subsequent sections.

Strips of cloth, sufficient for all the tests, were treated by padding on to them from neutral aqueous baths Mitin FF high conc. to leave about 1.0% compound on the cloth or Eulan WA new to leave about 0.5% compound on the cloth, these amounts being somewhat higher than the 0.75% and 0.4% respectively recommended by the manufacturers as necessary to provide adequate protection against insect attack. An equal amount of untreated cloth was reserved as a control. For comparison purposes, wool felt 6 mm thick containing a nominal 0.5% DAN was used. The actual amounts of agents determined to be present on the cloths were 1.0% Mitin FF high conc., 0.45% Eulan WA new, and 0.55% DAN.

The pH's of aqueous extracts of the four cloths were 6.1 for untreated cloth, 5.8 for Mitin-treated cloth, 6.2 for Eulan-treated cloth and 5.6 for DAN-treated felt, all of which are normally considered as acceptable for use in ammunition cloths; these are typically required to have a pH of not less than 5.0 nor more than 8.5 (1) or to be neither acid to methyl orange nor alkaline to phenolphthalein (2).

2.2 Corrosivity Tests

Test specimens were prepared by folding in half cloth or felt specimens 51 mm x 76 mm and sandwiching them between two similar prepared metal panels 38 mm x 76 mm and securing the assemblies with nylon thread. The assemblies were suspended in desiccators containing appropriate saturated salt solutions to give 63, 75, 80 and 95% RH at 60°C for up to 17, 33, 21 and 89 days respectively. Bare metal panels were simultaneously exposed as controls. Only similar cloths were placed in the one desiccator.

The following metals were used :

- Mild steel
- Stainless steel (18% Cr, 8% Ni, 0.7% Mn)
- Cartridge case brass (70% Cu, 30% Zn)
- Gilding brass (90% Cu, 10% Zn)
- Tin plate
- Zinc and passivated zinc
- Cadmium and passivated cadmium
- Aluminium - 100 series (99 + % Al)
- Aluminium alloy 2024 (4.5% Cu, 1.5% Mg, 0.5% Si)
- Aluminium alloy 5052 (2.5% Mg)
- Aluminium alloy 6061 (1.0% Mg, 0.6% Si)

All panels were first degreased twice in benzene vapour, their surfaces being wiped with tissue paper after each degreasing, and then prepared as follows :

Mild steel and tinplate - no further preparation

Stainless steel - abraded with 400 and 600 grade silicon-carbide paper

Brasses - abraded to bright finish with 220, 400 and 600 grade silicon-carbide paper

Zinc and cadmium - electrolytically polished in a phosphoric acid/ethanol solution at 2A for 2 min.

Passivated zinc and cadmium - after electrolytic polishing as for the unpassivated metals, specimens were rinsed, treated with 1% $NaHCO_3$ solution, rinsed, activated in 0.5% H_2SO_4, rinsed, and then chromated by a 10 s immersion in a "Cronak" solution (182 g/l $Na_2Cr_2O_7$ $2H_2O$, 6 ml AR H_2SO_4).

Aluminium and Al alloys - abraded to a dull grey finish using metallographic polishing cloth with pumice and water.

2.3 Tests for Compatibility with Explosives

Since the felts may come into contact with a wide range of explosives, compatibility tests were done with primary and secondary explosives, gunpowder and gun propellants to try to cover the possible range. Tests were done using untreated and treated wool cloths and in some tests the mothproofing compounds were mixed with the explosive composition.

2.3.1 High Explosives Materials

Three compositions were selected - RDX/TNT (Composition B), CE and PETN.

(i) Vacuum Stability

Mitin FF was tested with each explosive using the standard vacuum stability test for compatibility with high explosives (3). No tests were done with Eulan WA new which was available only as a liquid or with DAN which was not available. 0.25 g Mitin FF high conc. was mixed with 4.75 g explosive and tested for 40 h at 100°C. Control samples (5 g HE or 0.25 g Mitin) were also tested.

(ii) Compatibility after Extended Storage

Storage tests were done using pellets of cast Composition B and pressed CE. Each of the four cloths was tested; specimens were held against the end faces of pellets 38 mm diameter and 13 mm thick using aluminium strips tied with cotton and maintained at 60°C in both dry and humid (95 + % RH) conditions. After 60 days explosive was removed from the faces of the pellets in contact with the cloths by remotely operated microtome and subjected to the vacuum stability test. Further portions of the explosive were subjected to thermal analysis. Activation energies for decomposition of each of the samples were determined by heating them through decomposition at rates varying from 2°C/min to 64°C/min and applying the method of Wendlandt (4).

2.3.2 Propellants

Propellants NH 055 and NQ 034 were chosen as being representative of single and double based propellants respectively. Their nominal compositions are :

NH 055	NC (13.2% N)	86%
	DNT	10%
	DBT	3%
	DPA	1%
NQ 034	NC	21.5%
	NG	20%
	Picrite	55%
	Carbamite	3.5%

Analysis showed the actual stabiliser contents to be 0.72% diphenylamine in NH 055 and 3.52% carbamite in NQ 034.

Compatibility after Accelerated Storage

Tests were done using whole grains of NH 055 and sticks of NQ 034. The NH grains were placed between consecutive layers of cloth, the NQ sticks were cut into 120 mm lengths, tied into bundles about 20 mm diameter and assembled through holes in the cloths. The samples were sealed in screw top jars with aluminium foil sealing discs and maintained at 60°C for 60 days.

Deterioration of propellants was measured by checking a number of propellant properties.

(i) Stabiliser content of all samples was determined by steam distillation/gravimetric analysis. NH samples were also examined using thin layer chromatography to determine degradation within the diphenylamine stabiliser. Total stabiliser as normally determined by steam distillation/gravimetric analysis is equivalent to DPA + 0.75 (2 NDPA + NNODPA) where 2 NDPA = 2 nitrosodiphenylamine and NNODPA = N nitrosodiphenylamine.

(ii) Abel heat tests (5) were done on all samples of NH propellant at 71°C.

(iii) Temperatures of ignition at heating rates of 16°C/min and 64°C/min were measured by differential scanning calorimetry in an oxygen atmosphere.

(iv) Portions of all propellant samples were ground to Abel heat test intermediate size (5), dried under vacuum at 60°C for 24 h, and then subjected to the extended vacuum stability test (6). 5 g samples were tested for 168 hours at 90°C for NH and 80°C for NQ.

2.3.3 Gunpowder

Samples of each of the following were weighed into petri dishes -

Gunpowder G20 - 2.0 g

Mitin FF high conc. - 0.1 g

Eulan WA new - 0.1 g

Gunpowder G20 2.0 g mixed with Mitin FF high conc. 0.1 g

Gunpowder G20 2.0 g mixed with Eulan WA new 0.1 g

The various samples were heated at 100 ± 0.5°C for 7 days, weighing every 24 h.

2.3.4 Primary Explosives and Filled Caps

Although it is unlikely that proofed felt would ever be in direct contact with primary explosives, filled caps are customarily packed and stored in felt-lined cartons with felt between the layers of caps. Consequently a storage trial of caps/cloths was done. Loose caps were packed in direct contact with the cloths in sealed containers (tinplate, detonator ICI type) and stored at 60°C for 60 days; controls were done using kraft paper instead of the cloths, one container being held at room temperature and another at 60°C. The stores used were Caps, SAA 7.62 mm filled with

VH2 composition and Primers, Percussion M42 filled with Primer Mix PA101. The compositions of these fillings are :

	VH2 %	PA101 %
Tetracene (RD 1357)	2	5
Lead styphnate (RD 1302)	38	-
Basic lead styphnate (RD 1346)	-	53
$Ba(NO_3)_2$	39	22
$CaSi_2$	11	-
Sb_2S_3	5	10
PbO_2	5	-
Al	-	10

After storage the caps were broken down and partial analyses for tetracene, styphnate and barium nitrate were done. Further portions of extracted composition were examined by differential scanning calorimetry. Samples were heated at 16°C/min in a dried helium atmosphere. Decomposition temperatures were measured and remaining tetracene determined.

A further series of caps was tested using the standard temperature ignition test (7) except that the standard borosilicate glass tube was replaced by a stainless-steel tube of the same dimensions; the caps were heated 5°C/min from ambient temperature through ignition. Ignition delays at temperatures in the range 200 to 350°C were also measured using MRL modifications to the ignition test.

Composition extracted from the caps was subjected to the standard ball and disc test of sensitivity (8) using drop heights of 40, 50, 60, 70 and 80 mm.

3. RESULTS AND DISCUSSION

3.1 Corrosivity Tests

3.1.1 At 63% RH, the mild steel specimens in contact with the untreated cloth and the cloths treated with Mitin and Eulan all showed moderately heavy corrosion but this was less than on the bare metal; the DAN-treated felt had a slight inhibitory effect. Although some of the other metals showed slight tarnishing or corrosion there were no differences between the bare metal and metal in contact with any of the cloths.

3.1.2 At 75% and 80% RH, corrosion and tarnishing were greater than at 63% but no further differences were observed between the effects of the various cloths.

3.1.3 At 95% RH corrosion was more rapid and extensive but the pattern was little changed.

(i) Mild steel - In contrast to the tests at lower humidities, DAN-treated felt showed no inhibitory effect on either rate or extent of corrosion. The control specimens and the specimens in contact with the four cloths all deteriorated at about the same rate and to the same extent.

(ii) Stainless steel - All specimens showed only slight staining and there was no obvious difference between any of the specimens.

(iii) Cartridge case brass - Although all specimens were badly tarnished at the end of the test, during the earlier stages the DAN-treated felt noticeably slowed the tarnishing. The other specimens showed similar tarnishing at all times.

(iv) Gilding brass - In the early stages of test the specimens in contact with the untreated cloth tarnished more rapidly than all other specimens. However during the latter half of the test tarnishing was heavy and similar on all panels.

(v) Tin plate - Corrosion was no more than mild at any time but all treated cloths (Mitin, Eulan and DAN) produced rather more corrosion than the untreated cloth.

(vi) Zinc - White corrosion product formed on all panels in contact with cloths and at the end of the test all these panels were covered with varying amounts of heavy white corrosion product. Panels in contact with the treated cloths were in the worst and equally poor condition, those in contact with the untreated cloth being in rather better condition. Although a moderate iridescent stain was noted on the control panel there was little white corrosion product.

(vii) Passivated zinc - No specimen showed any corrosion.

(viii) Cadmium - Gradual formation of heavy yellow deposits was noted on all specimens in contact with any of the cloths. All the deposits gave a positive sulphide test and were obviously derived from interaction between cadmium and wool. The only deterioration of the blank specimen was a slight dark staining, free from sulphide.

(ix) Passivated cadmium - No specimen showed any corrosion.

(x) Aluminium-100 series - Small amounts of white corrosion product formed on all specimens but no differences were detected between the various specimens.

(xi) Aluminium-2024 - This alloy performed the same as the aluminium.

(xii) Aluminium-5052 - A small amount of white corrosion product developed on the control specimen and that in contact with Mitin-treated cloth, the other specimens being only slightly stained.

(xiii) Aluminium-6061 - The control specimen was corrosion free and all other specimens showed slight white spotting.

3.1.4 With only two exceptions specimens in contact with cloth treated with Mitin FF or Eulan WA new showed no greater corrosion than those in contact with untreated cloth. Unpassivated zinc specimens were worst in contact with the treated cloths but Mitin FF and Eulan WA new were no worse than DAN. Aluminium alloy 5052 (Al-Mg) showed corrosion on specimens in contact with Mitin-treated cloth but not on other panels in contact with cloths; however the control specimen showed similar corrosion.

3.1.5 Conclusion from Corrosivity Tests

The results indicate that either Mitin FF or Eulan WA new could replace DAN as a mothproofing agent for ammunition felts with no risk of accelerating metal corrosion.

3.2 Compatibility with Explosives

3.2.1 High Explosives

(i) Vacuum Stability

The average volumes of gas (cm^3) evolved in the tests are tabulated below.

Material	Volume of Gas (V)	ΔV
CE	3.2	-
Composition B	1.2	-
PETN	0.1	-
Mitin FF	0.03	-
CE & Mitin FF	4.2	1.0
Comp. B & Mitin FF	2.9	1.7
PETN & Mitin FF	2.3	2.2

In Australia samples are considered to pass this test if ΔV does not exceed 4 cm^3. The results for Mitin FF are all well within this limit.

(ii) Compatibility after Extended Storage

The average volumes of gas (cm^3) evolved in the tests are tabulated below.

	Comp. B		CE	
	Wet	Dry	Wet	Dry
Control	0.6	0.6	1.5	3.4
Untreated cloth	1.0	0.8	2.0	3.9
Cloth treated with Mitin FF	1.2	0.8	4.1	2.2
Cloth treated with Eulan WA new	12.0	13.4	12.0+	2.6
Felt treated with DAN	-	0.8	6.4	3.8

The interaction between Mitin FF treated cloth and the high explosives tested was less in all instances than with the DAN treated felt; the reaction was greatest with CE under conditions of high humidity. However, Eulan WA new showed considerable interaction with both CE and Composition B. This evidence of reactivity was confirmed by thermal analysis which showed for Eulan WA new only, a lowering of activation energy (145.6 kJ/mole to 61.1 kJ/mole) and of pre-exponential (log A 15.2 to 10.5).

3.2.2 Propellants

(i) Results of stabiliser analysis are tabulated below.

Sample	Total Stabiliser, %	TLC Analysis		
		DPA, %	2 NDPA, %	NNODPA, %
NH blank ambient	0.72	0.64	0.03	0.07
NH blank 60°C	0.69	0.50	0.10	0.16
NH/Mitin FF	0.69	0.51	0.10	0.15
NH/Eulan WA new	0.69	0.49	0.10	0.18
NH/DAN	0.70	0.51	0.09	0.16
NQ blank ambient	3.52			
NQ blank 60°C	3.41			
NQ/Mitin FF	3.34			
NQ/Eulan WA new	3.36			
NQ/DAN	3.46			

There are no significant differences between the results from the treated cloths or between them and untreated cloth.

(ii) In the Abel heat test, all specimens gave a time to colouration of the test paper of 20 min. For acceptance NH propellant must give a test time of not less than 20 min at 82°C; subsequent surveillance tests at 3-year intervals are maintained as long as the test time at 71°C is not less than 10 min. All specimens meet this criterion and there is therefore no evidence of interaction between any of the compounds and NH propellants.

(iii) The results of the extended vacuum stability tests are given in the following two tables and are shown graphically in Figs. 1 and 2.

Time (h)	Average Gas Evolved (cm^3)			
	NH Control	NH/Mitin	NH/Eulan	NH/DAN
15	1.34	1.06	1.03	1.20
23	1.45	1.30	1.25	1.55
39	1.74	1.50	1.47	1.71
47	1.90	1.67	1.59	1.93
63	2.17	1.96	1.90	2.59
71	2.47	2.26	2.18	3.01
135	5.16	4.70	4.47	5.67
143	5.56	5.09	4.82	6.42
159	6.20	5.63	5.37	7.08
168	6.48	6.00	5.67	7.47

Time (h)	Gas Evolved (cm^3)			
	NQ Control	NQ/Mitin	NQ/Eulan	NQ/DAN
2	0.07		0.16	0.06
18	0.22		0.27	0.22
19		1.40		
25		1.83		
26	0.42		0.47	0.42
42		2.30		
43	0.80		0.85	0.81
48		2.61		
50	1.00		1.10	0.98
66	1.32		1.40	1.33
74	1.50		1.51	1.49
114		3.74		
137		4.01		
139	2.52		2.43	2.43
145		4.09		
146	2.64		2.54	2.51
161		4.13		
163	2.87		2.80	2.73
169	3.01	4.21	2.86	2.82

In all cases interaction between compound and propellant was minor. All compounds passed this test.

3.2.3 Gunpowder

Sample masses (g) are shown in the following table.

Sample	DAY							
	1	2	3	4	5	6	7	8
G20	2.0000	1.9575	1.9577	1.9609	1.9393			1.9570
	2.0005	1.9579	1.9669	1.9670	1.9694			1.9595
Mitin FF	0.1000	0.0906	0.0938	0.0925	0.0920			0.0889
	0.1020	0.0927	0.0933	0.0922	0.0926			0.0807
Eulan WA new	0.1121	0.0237	0.0186	0.0180			0.0214	
	0.1067	0.0229	0.0180	0.0165			0.0214	
G20 + Mitin FF	2.1000	2.0536	2.0486	2.0530	2.0562			2.0421
	2.1010	2.0525	2.0492	2.0557	2.0613			2.0507
G20 + Eulan WA new	2.1468	2.0057	1.9967	1.9908			1.9903	
	2.1015	1.9664	1.9587	1.9445				

The degree of interaction is indicated by mass loss. After correction for mass loss of controls, mixtures should lose not more than 1% of initial sample mass in any 24 hour period. During the first 24 hours approximately 1% water can be driven off. Both candidate materials passed this test.

3.2.4 Primary Explosives and Filled Caps

(i) Accelerated storage - The results of the partial analyses of the storage caps are tabulated below.

Sample	Average Content (%)		Tetracene
	Styphnate (as lead styphnate)	Nitrate (as $Ba(NO_3)_2$)	
Caps SAA, 7.62 mm			
Control Ambient	36.0	40.6	1.55
Control 60°/60	36.9	39.3	1.41
Mitin FF	36.4	40.1	1.43
Eulan WA new	36.7	38.7	1.35
Primers M42			
Control Ambient	47.4	29.8	4.18
Control 60°/60	47.8	27.9	4.00
Mitin FF	51.7	28.3	3.92
Eulan WA new	46.9	29.2	3.95

These results show no significant differences between the controls and the test specimens.

(ii) Ignition temperature results are tabulated below.

Sample	Average temp. of ignition, °C	
	Caps SAA 7.62 mm	Primer M42
Control ambient	275	258
Control 60°/60	279	255
Mitin FF	277	258
Eulan WA new	278	259

These results also indicate no interaction between the compounds and the stores.

(iii) Ignition delay times are tabulated below.

Sample	Average Time to Ignition (s) at °C						
	175	200	225	250	275	300	350
Caps SAA 7.62 mm							
Control Ambient		300	*	25	20	18	16
Control 60°/60		300		25	21	19	12
Mitin FF		300		25	23	18	14
Eulan WA new		300		25	22	17	14
Primers M42							
Control Ambient	300	30-35	25-30	20	14	13	11
Control 60°/60	300	30-35	25-30	20	18	14	11
Mitin FF	300	30-35	25-30	20	16	16	9
Eulan WA new	300	30-35	25-30	20	16	14	9

*At this temperature 7.62 mm caps (from all samples) either functioned at 25 s or failed to fire within 5 min; in all four cases the percentage not firing at 25 s was constant.

Delay times are the same at each temperature for all caps showing again no evidence of interaction.

(iv) Ball and disc sensitivity test. The test results are tabulated below.

	Height (mm) - 50% Probability of Ignition	
	Caps SAA 7.62 mm	Primers M42
Control ambient	5.7	4.9
Control 60°/60	5.9	4.7
Mitin FF	5.7	4.3
Eulan WA new	6.0	4.7

The results with Mitin FF/Primer M42 were erratic and additional tests were done to obtain a statistically useful result. This test does give erratic results on occasions and this is not to be construed as indicating any evidence of interaction. All results are consistent with no interaction between compounds and compositions.

(v) Composition extracted from caps after test was also examined by thermal analysis. Exotherms corresponding to decomposition of tetracene and lead styphnate were recorded. These curves were analysed to measure decomposition temperature of active components and to determine the amount of tetracene remaining after storage. The results are tabulated below.

	% Tetracene	Temp. of decomposition of Tetracene (°C)	
		Onset	Max
Caps SAA 7.62 mm			
Control ambient	1.56	137	143
Control 60°/60	1.20	139	144
Mitin FF	1.58	139	143
Eulan WA new	1.35	140	143
Primers M42			
Control ambient	3.60	134	143
Control 60°/60	4.30	135	142
Mitin FF	4.31	135	141
Eulan WA new	4.24	134	141

The results show no significant differences between caps from the various storage environments.

3.2.5 It was established by larval tests conducted by Australian Wool Testing Authority that the activity of both Mitin FF and Eulan WA new was not impaired by prolonged contact with the two propellants. As there was only minor (and not significant) interaction between compounds and propellants it seems reasonable to conclude that in the absence of significant interaction the insecticidal properties of the two compounds would not be adversely affected by contact with explosives.

3.2.6 <u>Conclusions on Compatibility with Explosives</u>

There is no evidence of significant interaction between Mitin FF or cloth treated with it and any of the explosives compositions studied that would present any hazard or result in the explosives deteriorating more rapidly than normally. The results from cloths treated with Mitin FF were not significantly different from those obtained from DAN-treated felt. Mitin FF may therefore be judged to have passed the compatibility tests.

There is clear evidence of interaction between cloth treated with Eulan WA new and high explosives compositions although the compound appears to be compatible with all other explosives compositions studied.

4. GENERAL CONCLUSION

Mitin FF high conc. applied to felt by padding from a neutral bath to leave 0.75 - 1.0% on the felt is a suitable replacement for 2,4-dinitro-alphanapthol for mothproofing felt for ammunition use. At this concentration Mitin FF high conc. will adequately protect wool from attack by the common keratin-consuming insects and at 1.0% it shows no tendency to cause accelerated corrosion of metals typically used in ammunition and no incompatibility with a wide range of explosives compositions.

Eulan WA new, the other compound considered as a possible alternative to Mitin FF, provides satisfactory protection against insect attack at a concentration of 0.4 - 0.5% on wool and it shows no tendency to accelerate corrosion of metals. It is compatible with most explosives compositions tested but at 0.5% it showed interaction with high explosives compositions thus rendering it unacceptable.

The Australian Army has been advised to this effect and it is recommending the use of Mitin FF high conc. at a minimum amount of 0.75% on the felt for all future purchases.

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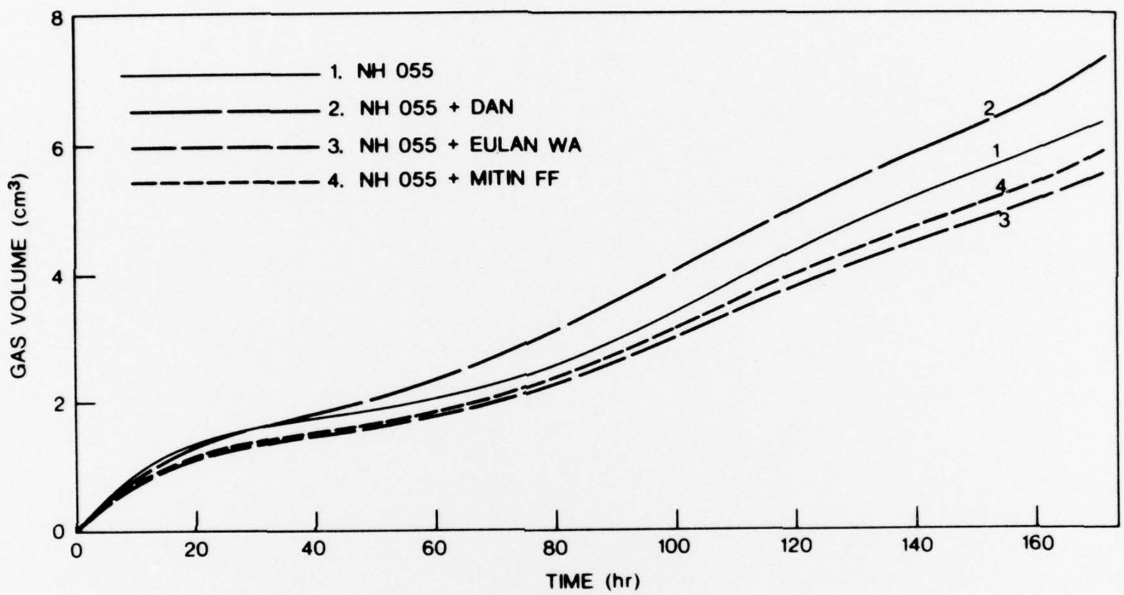

FIG. 1 - Compatibility of Mothproofing Agents with Propellant NH 055. Extended vacuum stability test at 90°C after storage at 60°C for 60 days with treated cloth.

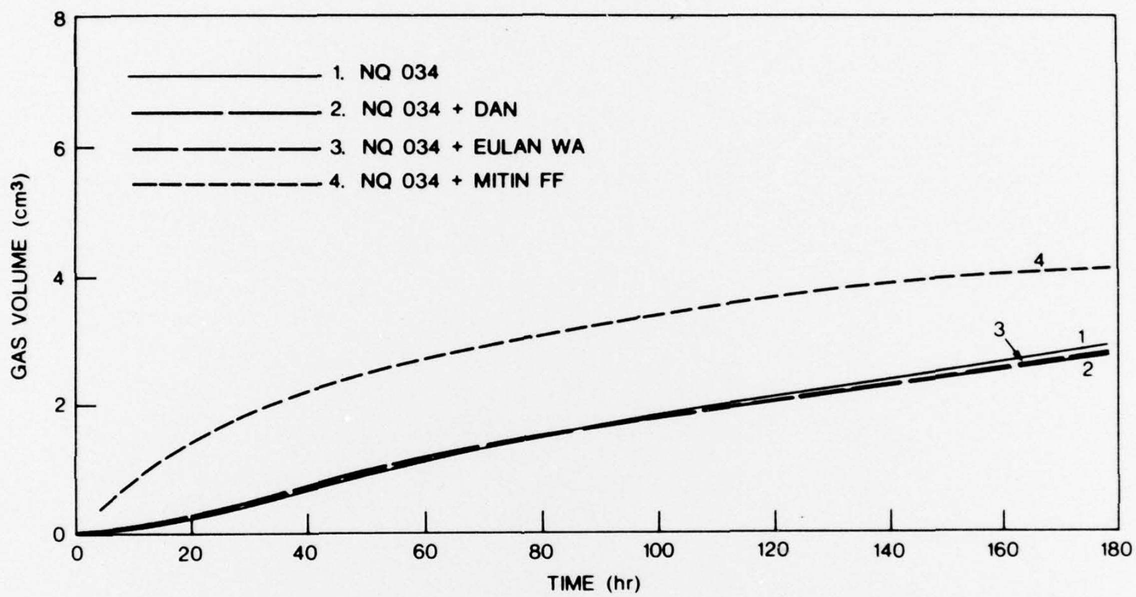

FIG. 2 - Compatibility of Mothproofing Agents with Propellant NQ 034. Extended vacuum stability test at 80°C after storage at 60°C for 60 days with treated cloth.

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