HANDHELD FIRE EXTINGUISHER DEVELOPMENT

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INTRODUCTION

This project compared the relative performance of a series of fire suppressants being considered for use in MetalCraft 2¾-lb. halon handheld fire extinguishers as replacements for the current Halon 1301. This study resulted in a recommended agent (50% potassium acetate) for continued consideration for use in US Army portable fire extinguishers in combat vehicles. Additional testing of this agent is currently underway.

Project extinguisher performance, and environmental and toxicity goals are listed below.

Project extinguisher performance goals

- Extinguish 2B jet fuel (JP8) fire
- Employ existing MetalCraft 2% lb. halon extinguisher
- Operation range –40 to + 140 °F
- Storage – 60 to + 160 °F
- Following discharge No re-suspension of powders from surfaces
- No or low visual obscuration following discharge

Environmental and toxicity goals

- Minimize HF
- Low to no toxicity (Equivalence to Halon 1211)
- ODP < 0.02, No Class I or II ODC's
- Low Atmospheric Lifetime
- Low or no Global Warming Potential

DISCUSSION

To date, FM-200 (HFC-227ea) has been considered a leading candidate for replacing Halon 1301 in US Army portable extinguishers. However, high levels (–4000 ppm) of hydrogen fluoride (HF) produced during fire suppression events present a very significant inhalation hazard. Suppressants based on blends of bicarbonate salts and FM-200 were evaluated for their post extinguishment HF levels and effects on visual obscuration. The sodium and potassium bicarbonates employed were expected to trap the acidic HF gases.

The detailed results of this HF reduction testing will be part of a comprehensive presentation on this subject scheduled during the *HOTWC* 2000 conference. Although these tests demonstrated

HF levels were substantially below those employing only FM-200, the HF levels were still judged unacceptable.

Addition of bicarbonate salts did, however, dramatically improve the firc suppression performance of FM-200 without creating a significant degree of visual obscuration. The advantages and disadvantages of the bicarbonate salt/FM-200 blends are itemized below.

FM-200 with $KHCO_3$ or $NaHCO_3$: Observed Advantages

- Enhances fire suppression performance of all HFCs tested
- HF production is reduced by approximately a factor of 10
- Visibility not seriously affected
- Relatively clean
- Adequate performance in existing hardware

FM-200 with $KHCO_3$ or $NaHCO_3$: Disadvantages

- 3-min [HF] at levels aprox. 400–600 ppm
- GWP (FE-36, FM-200) a problem eventually
- Potential corrosion ($K+ > Na+$)
- Slight residue requiring minimal cleanup
- Other as yet unidentified problems may exist for specific applications

Also tested as part of this study were solutions of 50 and 60% KOAc by weight in water. Potassium acetate produces no HF, presents minimal environmental and toxicity concerns, and is a very effective extinguishing compound. It does, however, leave a wet residue upon discharge. Although the residue was observed to dry rapidly to an adherent white surface, it was easily removed with water. The authors are aware of at least one commercial potassium acetate extinguisher on the market that has a UL C-rating, which suggests that this modified MetalCraft extinguisher *may* also achieve a C-rating. Further testing and evaluation are underway.

Testing has demonstrated that the modified MetalCraft extinguisher charged with 1.8 lbs of 50% KOAc is capable of extinguishing four 2B pan fires in succession. The average time to extinguishment of each 2B fire was approximately ***2.6*** sec in this testing. This extinguisher/agent combination is also capable of extinguishing a 5B Jet-A fire.

The identified advantages and disadvantages of the KOAc extinguishant are listed below.

H_2O / Potassium Acetate (50%): Observed Advantages

- When misted, excellent fire suppressant (5B and 2B jet fuel fire extinguishment)
- No environmental impact
- Low toxicological impact if any
- Clean-up similar to HFC/K or Na bicarbonate
- Residue will not re-suspend
- Electrical "C" rating in KOAc extinguishers
- NO HF or other fluorinated decomposition byproducts generated
- Modified MetalCraft extinguisher, 1.8 lb KOAc, 450 psi pressurization is capable of extinguishing four 2B Jet-A fires with agent to spare

H_2O/Potassium Acetate (50%): Disadvantages

- Post-extinguishment residue. (Note: KOAc is very water soluble)
- Potential corrosion (K^+)
- Other as yet unidentified problems may exist for specific applications

The test fixture employed in the visual obscuration and HF testing is presented below in Figure 1.

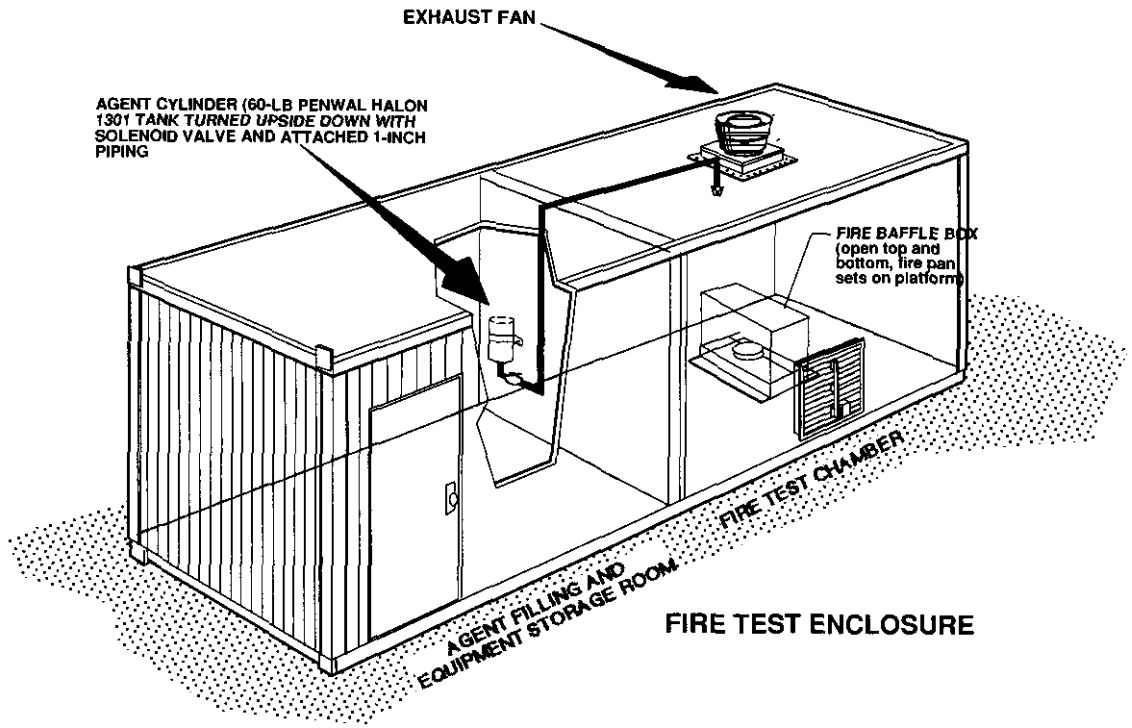

Figure 1. HF and visual obscuration test and evaluation equipment.