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Development of environment Friendly Clean Agent for Replacement of Halons Used In Combat Tanks.

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Abstract

The present work is an effort to control the depletion of ozone layer byreplacement of halons fire extinguishant used in combat vehicles with suitableenvironment friendly near equivalent clean alternatives. In this context other fire extinguishing agents like fluorocarbons having less ozone depletion potential have been experimented by using actual hazard volume of combat Tanks and observed that the effectivenessand capability offluorocarbon fire extinguishing agents are near

Keywords: Halons, fire extinguishing systems, Hexafluorocarbon,Aqueous Film Farming Foam,Chlorofluorocarbons, Combat vehicles,Ozone depletion potential, Global warming potential, Montreal protocol,Fire detection and suppression system.

1. Introduction

Halon 1301 has been used for decades as the primary fire extinguishing material for a multitude of military applications. However, Halons have very high ozone depleting potentialswhich results in higher levels of ultraviolet radiation at Earth's surface andgives rise to serious health effectstherefore its production was stopped in 1994 in most of the world. As per Montreal protocol use of Halons have been banned however developing nationsare allowed to use Halons up to 2010which has been further extended temporarily for its mission critical applications.Accordinglyresearch initiated to identify and develop replacement agents and technologies to satisfy the performance requirements of fire protection in combat vehicles.

Halons are used in crew compartment, hand held extinguishers and engine compartment of Tanks Accordingly this research will be based on Halon elimination efforts in three separate grounds of combat vehicle applications.The research program is to identify alternatives to Halons used in fire extinguishing systems (FES) of Army ground based Combat tanks and trucks .

Based on the requirements, individual chemical agents having near equivalent fire extinguishing capabilitywith low ozone depleting potentials have been experimented.

Initial investigations indicated that a universal solution would not be available for drop in replacement of Halons Accordingly it is decided to develop near equivalent clean agent having similar fire extinguishing property.

2. Synopsis

The research has been divided in three stages which are given as under-

STAGE - I Comprehensive study of near

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equivalent fire extinguishing agents.

The study wasbased a on review of the extensive research and engineering literature covering the physical and chemical processes active in flames and involved in flame extinguishment. Published lists of prospective Halon replacements have been evaluated. Ozone depletion potential (ODP), a useful metric found in regulatory legislation, has been examined in the light of recent work for alternative agents. Also Global warming potential (GWP), a measure of agent effect on climate, has been examined

STAGE -II Testing for fire extinguishing capability of agents for effectiveness.

The extinguishing concentrations of gaseous agents are determined by small-scale tests. Developmentaltesting of the most promising concepts, by simulating hazard area of of existing combat vehicles. Crew Survivability Criteria has been taken in to consideration for the minimum acceptable requirements of automatic fire extinguishing systems for occupied vehicle compartments.

STAGE –III Technical feasibility of agents wrt existing technology in Combat vehicles-

Technical feasibility of agents wrt existing fire extinguishing systems and technology in combat vehicles, test methodology, including agent toxicology, storage stability, and extinguishment effectiveness, have been studied. Thefull-scaletest simulating actual hazard area of of existing combat vehicles,thermal decomposition products

and potential for retro fitment wrt most promising alternatives on existing platforms to be examined.

3. Methodology of Experiments-

This research for halon replacements has been based on modifying the molecular structure of halons toreduce or eliminate the chlorine and bromine atoms which are responsible for ozone depletion.In thisconnection halon-like halocarbons includes hydrofluorocarbons (HFCs), hydrochlorofluorocarbons (HCFCs),Viz- FE-13 ,FE-25, FM-200, FE-36 have been studied and most promising agents have been tested for fire suppression performance . The extinguishing concentrations of gaseous agents are determined by small-scale tests which are given as under

Agents Trade Name	**Chemical Formula**	**Chemical Name**	**Vapor Pressure**	**Boiling Point (F)**	**Ozone Depletion Potential (ODP**	**Liquid Density @77 F(lb/ft3)**	**Performance factor(Hept) CB Ext Conc %**
FM-200	C3F7H	1,1,1,2,3,3,3heptafluoropropane	66.5	2.5	0	86.7	5.8
FE-36	C3F6H2	1,1,1,3,3,3 hexafluoropropane	39.9	33.2	0	85.5	5.6
FE-13	CF3H	Trifluoromethane	665	-115.7	0	41.8	12
FE-25	C2F5H	Pentafluoroethane	190	-55.3	0	78.0	8.1
Halon 1301	CF3Br	Bromo Trifluoromethane	234.8	-72.0	12– 16	96.0	2.9

4. Conclusion

We are aggressively pursuing alternatives to Halon 1301 in ground combat vehicles. As of now, we are reliant on Halons for fire detection and suppression system of our combat Tanks , but the use of Halons have been banned as per Montreal protocol. Developing nations are allowed to use Halons in mission critical application up to 2010. Accordingly Halocarbon agents having similarmolecular structures to halon are

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modified to reduce or eliminate the chlorine and bromine atoms that are responsible for ozone depletion for all combat vehicle applications have been identified and experimented Their fire extinguishing performance has been evaluated It has been shown that the agents are able to extinguish fires at their design concentration. However most agents listed above having higher extinguishing concentrations than Halon 1301 and, therefore, are less effective.

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