Halon Replacement for Airplane Portable Fire Extinguishers - Progress Report

International Aircraft Systems Fire Protection Working Group

Köln, Germany
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Objective

Provide a progress report on the implementation of BTP (2-bromo-3,3,3-trifluoropropene), American Pacific Halotron BrX, a new environmentally progressive Halon 1211 replacement agent for handheld fire extinguishers.
Agenda

- Handheld Agent Comparison
- Steps to Implementation
- BTP Development Time Line
- Current Progress
- Future
- Questions
# Handheld Agent Comparison

<table>
<thead>
<tr>
<th>Agent</th>
<th>UL 711 Rating</th>
<th>Agent Weight (#)</th>
<th>Ozone Depleting Potential (ODP)</th>
<th>Global Warming Potential (GWP) (100 year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Halon 1211</td>
<td>5-B:C</td>
<td>2.5</td>
<td>6.9(^1)</td>
<td>1750 (^1)</td>
</tr>
<tr>
<td><strong>Halotron BrX (BTP)</strong></td>
<td><strong>5-B:C</strong></td>
<td><strong>3.75</strong></td>
<td><strong>0.0028</strong>(^{1,2})</td>
<td><strong>0.26</strong>(^{2,3})</td>
</tr>
<tr>
<td>Halotron 1</td>
<td>5-B:C</td>
<td>5.5</td>
<td>0.01 (^1)</td>
<td>79 (^1)</td>
</tr>
<tr>
<td>(HCFC Blend B)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FE-36 (HFC-236fa)</td>
<td>5-B:C</td>
<td>4.75</td>
<td>0</td>
<td>8060 (^1)</td>
</tr>
<tr>
<td>FM-200 (HFC-227ea)</td>
<td>5-B:C</td>
<td>5.75</td>
<td>0</td>
<td>3350 (^1)</td>
</tr>
</tbody>
</table>


4. HCFC -123 (primary constituent of Halotron 1) is currently regulated as a Class II substance in the U.S. under the Montreal Protocol and the Clean Air Act Amendments (CAA) of 1990. It is subject to US production phase-out in 2020, so supply will be limited to recycling unless HCFC-123 is removed from the Montreal Protocol and the Clean Air Act is amended.

**BTP is the only agent with no environmental restrictions**
Steps to Implementation

- Cup burner testing - 2002
- Initial toxicity tests (Ames, cardiotox...) - 2002
- 2-Dimensional Ozone Depleting Potential (ODP), Global Warming Potential (GWP), atmospheric lifetime - 2004
- Prototype extinguisher, near drop-in replacement for Boeing 1211 extinguisher - 2009
- Underwriters’ Laboratory (UL) 711 5-B pan fire tests - 2009
- UL 711 cold temperature pan fire test - 2009
- Federal Aviation Administration (FAA) Minimum Performance Standard (MPS) AR-01/37 hidden fire tests - 2009
- 3-Dimensional model analysis of ODP and GWP - 2010
- FAA MPS AR-01/37 seat fire toxicity tests - 2011
- American Society for Testing and Materials (ASTM) flammability tests (per NFPA 704) - 2011
- Airplane material compatibility tests - 2011
- Synthesis of BTP for toxicology testing - 2011
- Publication of 3D ODP/GWP scientific paper - 2011
- Additional BTP physical properties testing – 2011
- Physiologically based pharmacokinetic (PBPK) testing and modeling – 2013
- Toxicology testing – 2013
- Provide PBPK data to FAA for inclusion in Advisory Circular (AC) 20-42D & FAA/AR-08/3 – 2013
- US EPA Significant New Alternatives Policy (SNAP) application – 2013
- EU Registration, Evaluation, Authorization & Restriction of Chemicals (REACH) application - 2014
- European Chemicals Agency (ECHA) REACH registration - 2014
- US EPA Toxic Substances Control Act (TSCA) inventory listing - 2016
- US EPA SNAP approval – 2016
- ASTM standards D8060-16 and D8061-16 for BTP - 2016
- 3.25” diameter extinguisher for Boeing production/retrofit and completion of UL testing - 2016
- UL approval/listing – 2017
- FAA certification – TBD
BTP Development Time Line

Goal - FAA certified
UL 5B:C 2-BTP fire extinguisher available for customer selection

2009
- Contract with American Pacific
- Boeing material compatibility tests
- Initial meeting with EPA
- UL 711, and FAA MPS hidden fire tests

2010
- Boeing fire extinguisher procurement contract
- Prototype developed
- Passed FAA MPS seat fire tests
- Start toxicity testing
- 3D ODP and GWP published .0028 ODP .26 GWP
- Initial meeting with EPA

2011
- FAA 747 hidden fire tests
- NFPA 704 flammability tests F=0
- EPA SNAP application
- Start toxicity testing
- FAA Halon Replacement Aviation Rulemaking Committee

2012
- REACH application submittal
- REACH registered
- ASTM standards D8060-16 D8061-16
- Toxicology testing report
- EU deadline (new type cert)

2013
- EPA SNAP approval
- Certification pending at FAA
- EU EASA Halon Replacement Rulemaking Group

2014
- Certification pending at FAA
- Toxicology testing report
- REACH application submittal
- ASTM standards D8060-16 D8061-16

2016
- Certification pending at FAA
- REACH application submittal
- ASTM standards D8060-16 D8061-16

2017
- Certification pending at FAA
- EPA SNAP approval 9/26/2016
- EU deadline 12/2018
- REACH registered
- Toxicology testing report
- REACH application submittal
- ASTM standards D8060-16 D8061-16

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BTP Current Progress

- ICAO Halon handheld replacement date moved from 2016 to 2018.

  - Supports BTP implementation delays.
  - Align with EASA CS26 rule.
  - Align Foreign Civil Aviation Authorities and Member States.

ICAO A39-WP/235:
http://www.icao.int/Meetings/a39/Documents/WP/wp_235_rev1_en.pdf#search=portable%20extinguishers

BTP implementation before December 31, 2018
BTP Current Progress

- Underwriters Laboratories approved BTP fire extinguisher:
  - UL listing of the Kidde Halotron BrX fire extinguisher:
  - Awaiting UL qualification report

**UL 5-B:C Fire Extinguisher per AC20-42D**
BTP Current Progress

BTP Current Progress

- New chemical registration
  - BTP is US EPA SNAP approved.
  - BTP is EU REACH registered.
  - Boeing is evaluating BTP registration/notification requirements to support customer import obligations for new chemicals (varies by country).

CAS No.: 1514-82-5

Seamless Halon replacement for our Customers
Awaiting FAA certification/approval:

- FAA AC 20-42D, “Hand Fire Extinguishers for use in Aircraft” states: “We accept hand fire extinguishers approved by: U.S - Underwriters Laboratories, Inc...or equivalent.”

- Boeing proposed compliance to AC20-42D based on UL approval, meeting SAE AS6271.
- The FAA required an issue paper (IP) to document approval of new fire extinguisher and compliance with toxicity requirements at airplane level.
  - Requires FAA review of FAA MPS seat fire data, UL/MPS data, and EPA data.

Late requirements documentation continues to delay Halon 1211 replacement
FAA certification/approval:

- AC20-42D neat agent toxicity method of compliance shows Boeing flight decks are too small for Halon 1211 (or BTP) discharge, even using a stratification factor. Aircraft Certification Office requires IP for test data as well as toxicity.

  - Halon 1211 has been safely used for decades.
  - An IP is required since the AC doesn’t provide acceptable methods.
  - DOT/FAA/TC-14/50 stratification factors fell short of goal.

AC20-42D should be revised
Future

- Boeing and the FAA are working together on Halon replacement lessons learned.
  - Project management, requirements management, and documentation of acceptance criteria form the basis of Boeing’s lessons learned.
  - The goal is to improve cargo/propulsion Halon replacement projects, as well as future certification projects.

- Boeing BTP fire extinguisher airplane implementation pending FAA certification.

BTP fire extinguishers with GWP < 1 to replace Halon 1211 with 6.9 ODP and 1750 GWP