Revised Cup Burner Data

Quantitative Determination of Acidic Decomposition Products

FE-25
FE-13

Inerting Concentrations

FE-25
FE-13

Vapor Pressure vs. Composition Data

FE-13 / FE-232 Blends

R. E. Fernandez
April 1991
Revised Cup Burner Data

<table>
<thead>
<tr>
<th>Agent</th>
<th>Heptane</th>
<th>Methane</th>
</tr>
</thead>
<tbody>
<tr>
<td>FE-25</td>
<td>9.1</td>
<td>12.4</td>
</tr>
<tr>
<td></td>
<td>(10.1)</td>
<td>(13.0)</td>
</tr>
<tr>
<td>FE-13</td>
<td>13.0</td>
<td>21.6</td>
</tr>
<tr>
<td></td>
<td>(14.0)</td>
<td>(23.8)</td>
</tr>
<tr>
<td>FE-232</td>
<td>7.5</td>
<td>11.3</td>
</tr>
<tr>
<td></td>
<td>(7.2)</td>
<td>(10.7)</td>
</tr>
<tr>
<td>H-1301</td>
<td>3.5</td>
<td>7.7</td>
</tr>
<tr>
<td></td>
<td>(4.2)</td>
<td>(8.6)</td>
</tr>
<tr>
<td>H-1211</td>
<td>5.2</td>
<td>7.6</td>
</tr>
<tr>
<td></td>
<td>(6.2)</td>
<td>(8.5)</td>
</tr>
</tbody>
</table>

( ) = Old values.

R. E. Fernandez
April 1991
Acidic Decomposition Products

0 The Apparatus
0 The Experiment
0 Analytical
0 Results
   FE-25
   FE-13
   Comparative Data
0 Regression Analysis
0 Conclusions

R. E. Fernandez
April 1991
8 cu. ft. Test Chamber
FE-25 BOX TESTS

"VERY LARGE FIRE"

EXTINGUISHMENT TIME (SEC)

DISCHARGE TIME (SEC)

□ EXPT ——— ET = 0.467(DT)
FE-25 BOX TESTS

"VERY LARGE FIRE"

[Graph showing data points with labels and a trend line labelled HF = 61.21(DT)]
FE-25 BOX TESTS

"MEDIUM FIRE"

[Graph showing data points and lines for FE-25 box tests.]

EXTINGUISHMENT TIME (SEC)

□ EXPT

HF = 28.495(ET)
FIRE TESTING ON "VERY LARGE" FIRES

14 VOL % IN 8 FT³ BOX

EXTINGUISHMENT TIME (SEC)

DISCHARGE TIME (SEC)

□ EXPOL  ET = 0.402(DT)
FE-13 TESTING ON "VERY LARGE" FIRES

14 VOL % IN 8 FT^3 BOX

HF CONC (PPM) (Thousands)

DISCHARGE TIME (SEC)

□ Example
— HF = 81.606(D^0)

H-1301
FE-13 TESTING ON "MEDIUM" FIRES

14 VOL % IN 8 FT3 BOX

EXPTL

ET = 0.407(DT)
FE-13 TESTING ON "MEDIUM" FIRES

14 VOL % IN 8 FT3 BOX

HF CONC (PPM)

DISCHARGE TIME (SEC)

□ EXPTL

HF = 6.292(DT)
FE-13 TESTING ON "MEDIUM" FIRES

14 VOL % IN 8 FT3 BOX

HF CONC (PPM)

EXTINGUISHMENT TIME (SEC)

□ EXPTL

HF = 15.334(ET)
Comparative Data

**Very Large Heptane Fires**

<table>
<thead>
<tr>
<th>Agent</th>
<th>DT (Sec)</th>
<th>ET (Sec)</th>
<th>HF (ppm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>FE-25</td>
<td>10.0</td>
<td>4.55 +/- 0.45</td>
<td>612 +/- 154</td>
</tr>
<tr>
<td>FE-13</td>
<td>10.0</td>
<td>4.05 +/- 0.85</td>
<td>816 +/- 187</td>
</tr>
<tr>
<td>H-1301</td>
<td>10.0</td>
<td>3.0 +/- 1</td>
<td>555 +/- 204</td>
</tr>
</tbody>
</table>

**Medium Heptane Fires**

<table>
<thead>
<tr>
<th>Agent</th>
<th>DT (Sec)</th>
<th>ET (Sec)</th>
<th>HF (ppm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>FE-25</td>
<td>10.0</td>
<td>4.05 +/- 0.75</td>
<td>137 +/- 28</td>
</tr>
<tr>
<td>FE-13</td>
<td>10.0</td>
<td>4.1 +/- 113</td>
<td>63 +/- 27</td>
</tr>
</tbody>
</table>

**Small Heptane Fires**

- FE-25 < 5 ppm HF
- FE-13 < 5 ppm HF
Regression Analysis

0 FE-25 "Very Large" Fires

\[ ET = [0.457 \pm 0.0125 \times DT] \pm 0.330 \]
\[ HF = [61.21 \pm 4.223 \times DT] \pm 111.43 \]
\[ HF = [141.32 \pm 4.13 \times ET] \pm 119.05 \]

0 FE-25 "Medium" Fires

\[ ET = [0.482 \pm 0.0177 \times DT] \pm 0.571 \]
\[ HF = [13.70 \pm 0.671 \times DT] \pm 21.650 \]
\[ HF = [28.495 \pm 0.710 \times ET] \pm 11.148 \]

0 FE-25 "Small" Fires

< 5 ppm all cases

R. E. Fernandez
April 1991
Regression Analysis

0 FE-13 "Very Large" Fires

\[ ET = [0.402 (+/- 0.020) \times DT] +/- 0.661 \]
\[ HF = [81.606 (+/- 4.362) \times DT] +/- 143.85 \]
\[ HF = [200.212 (+/- 8.681) \times ET] +/- 117.60 \]

0 FE-13 "Medium" Fires

\[ ET = [0.407 (+/- 0.021) \times DT] +/- 1.109 \]
\[ HF = [6.292 (+/- 0.429) \times DT] +/- 22.311 \]
\[ HF = [15.334 (+/- 0.797) \times ET] +/- 17.280 \]

0 FE-13 "Small" Fires

< 5 ppm all cases

R. E. Fernandez
April 1991
Box Testing Conclusions

0 Longer Discharge times gives Longer extinguishant times.

0 Longer extinguishant times gives larger HF concentrations.

0 Extinguishant times are less than Discharge times.

0 FE-25 and FE-13 give slightly longer extinguishant times vs. H-1301.

0 FE-25, FE-13 and H-1301 gives comparable HF concentrations.

R. E. Fernandez
April 1991
HALON ALTERNATIVE EVALUATION

FLAMMABILITY DIAGRAM

FUEL: METHANE
AGENT: FE-25
IGN ENERGY = 68 J
HA ON ALTERNATIVE EVOLUTION

FLAMMABILITY DIAGRAM

FUEL, VOL %

AGENT, VOL %

FUEL: PROpane
AGENT: FE-25
IGN ENERGY = 70 J

□ Non-Flammable + Flammable
HALON ALTERNATIVE EVALUATION

FLAMMABILITY DIAGRAM

FUEL: PROPANE
AGENT: H-1301
IGN ENERGY = 70 J

Non-Flammable  Flammable

AGENT, VOL %  FUEL, VOL %
HALON ALTERNATIVE EVALUATION

FLAMMABILITY DIAGRAM

FUEL: METHANE
AGENT: FE-13
IGN ENERGY = 68 J

% FUEL in air, Agent Free Basis

- Non-Flammable  + Flammable
HALON ALTERNATIVE EVALUATION

FLAMMABILITY DIAGRAM

FUEL: PROPANE
AGENT: FE-13
IGN ENERGY = 68 J

% FUEL in air, Agent Free Basis

□ Non-flammable

+ Flammable
Inerting Concentrations

<table>
<thead>
<tr>
<th>Agent</th>
<th>Methane</th>
<th>Propane</th>
</tr>
</thead>
<tbody>
<tr>
<td>FE-25</td>
<td>15</td>
<td>16</td>
</tr>
<tr>
<td>FE-13</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>H-1301</td>
<td>7*</td>
<td>a</td>
</tr>
</tbody>
</table>

* From NFPA 12A

R. E. Fernandez  
April 1991
V.P. OF FE-13/FE-232 BLENDS

8.1 WT % FE-13
V.P. OF F≤-13
FROM MATHERSON