FM-200: RECENT FINDINGS

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FM-200 RECENT FINDINGS

- Thermodynamic Properties
  - CSD Equation of State
  - FM-200/Nitrogen Isometrics
  - Nitrogen Solubility
- Environmental Impact
  - Reaction rate with OH radical
  - Atmospheric Lifetime
  - Global Warming Potential (GWP)
- Fire Suppression
- Toxicology

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THERMODYNAMIC PROPERTIES OF FM-200

CSD EQUATION OF STATE

- CSD "C" coefficients updated, based upon experimentally measured heat capacities of FM-200*
- Excellent agreement between experimental heat capacities and those predicted by the CSD equation of state
- The CSD equation of state accurately describes the thermodynamic properties of FM-200

* Wirbser, et. al., J. Chem. Thermodynamics, 24, 761(1992)

THERMODYNAMIC PROPERTIES OF FM-200

CSD EQUATION OF STATE: HEAT CAPACITY

Pressure (kPa)	Temp (C)	Cp (kJ/kg K), CSD	Cp (kJ/kg K), EXP.	% Deviation
50	0	0.7604	0.7662	-0.73
50	30	0.8114	0.8136	-0.27
50	60	0.8593	0.8601	-0.08
50	90	0.9041	0.9038	0.03
50	120	0.9457	0.9454	0.03
50	150	0.9841	0.9837	0.04
100	30	0.8161	0.8202	-0.51
100	60	0.8632	0.8641	-0.11
100	90	0.9073	0.9068	0.06
100	120	0.9484	0.9474	0.11
300	60	0.8906	0.8834	0.82
300	90	0.9211	0.9195	0.17
300	120	0.9597	0.9559	0.41

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FM-200 THERMODYNAMIC PROPERTIES

FM-200/NITROGEN ISOMETRICS

- Pressure/temperature relationship for FM-200 superpressurized to 360 psig with nitrogen at 70 degrees Farenheit experimentally measured as a function of fill density
- DOT regulations require pressure less than 625 psig at 130 degrees Farenheit
- Maximum fill density for FM-200 superpressurized to 360 psig with nitrogen at 70 degrees Farenheit is 72 lb/cubic foot

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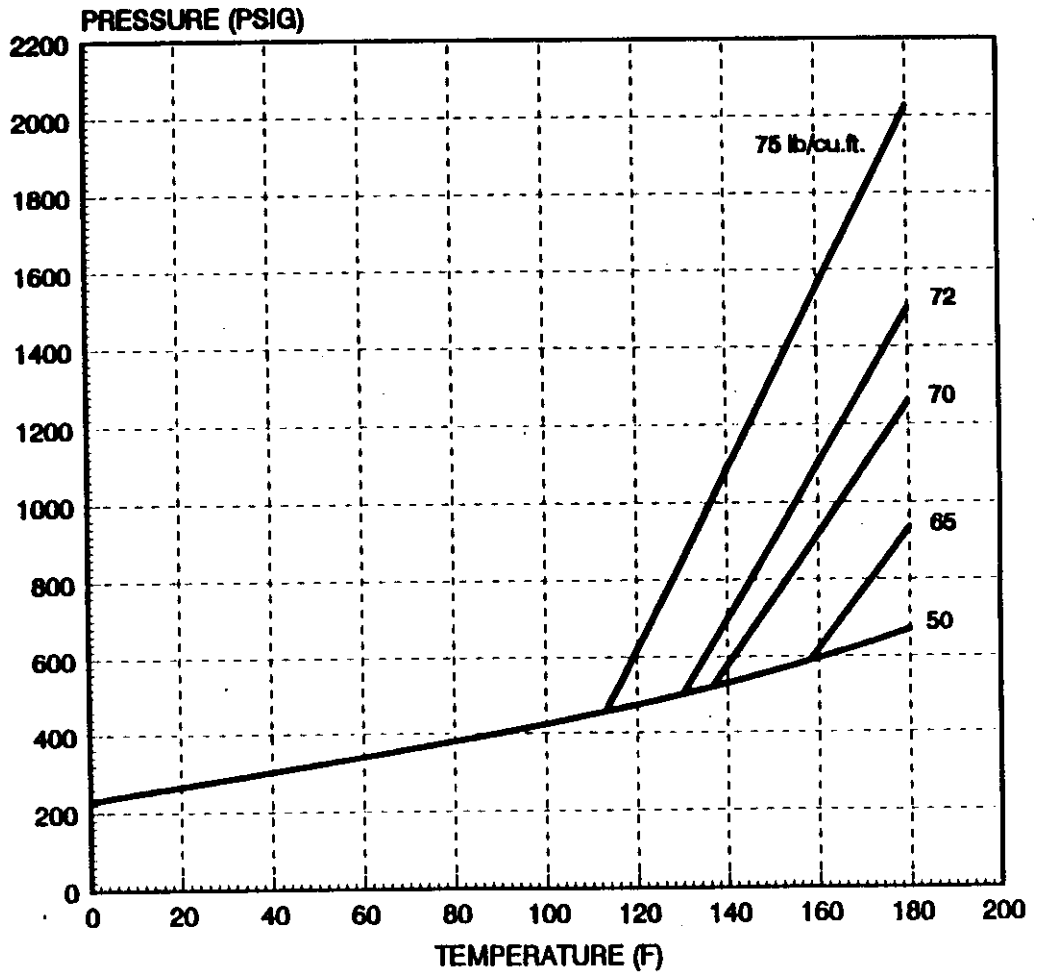
Isometric Diagram. FM-200 Pressurized with Nitrogen to 360 psig at 70 degrees Farenheit



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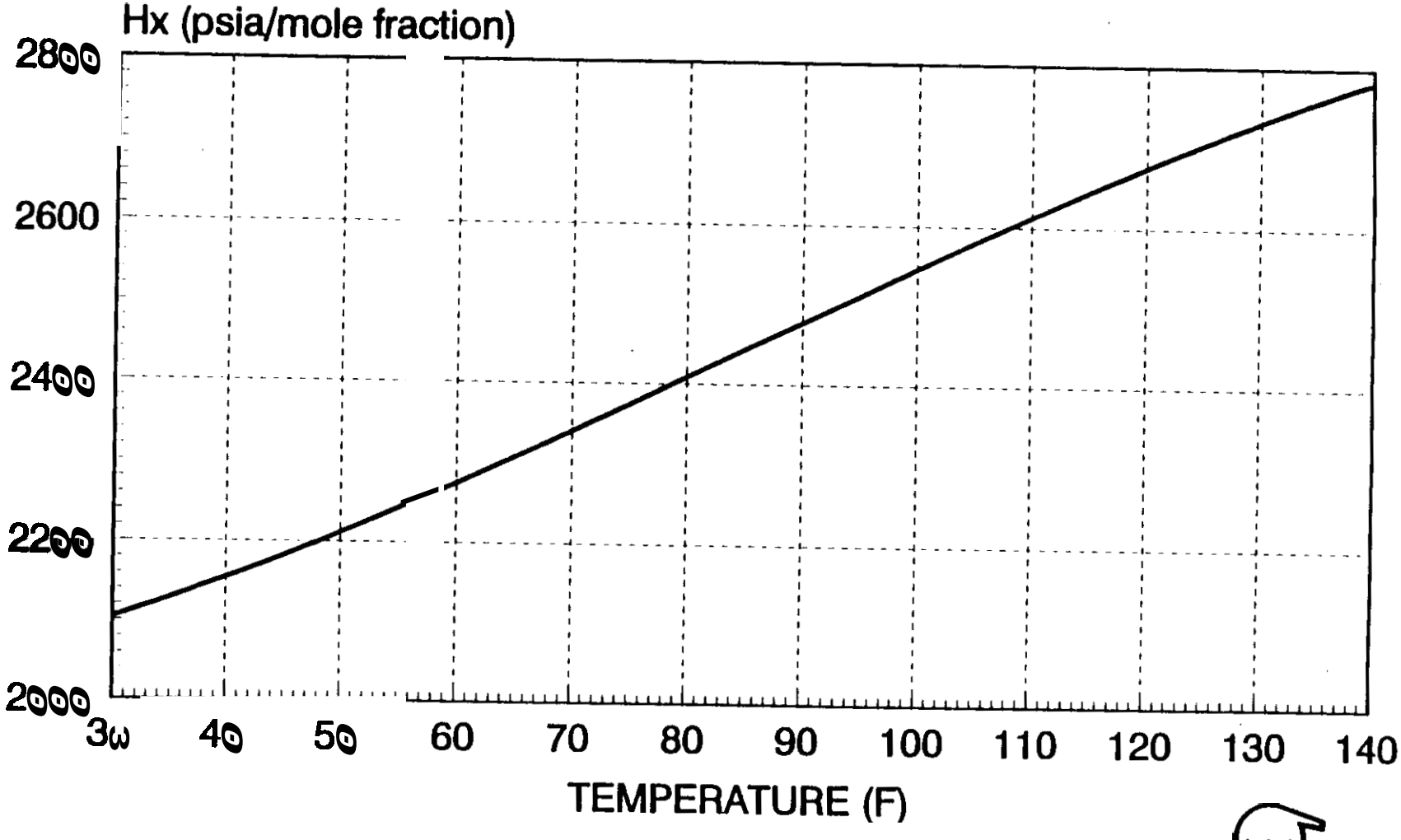
Henry's Law Constant for Nitrogen Solubility in Liquid FM-200



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FM-200: ENVIRONMENTAL IMPACT

Reaction Rate with OH Radical

- Rate constants for the reaction of the OH radical with FM-200 measured as a function of temperature
- Discharge wave technique, laser induced fluorescence detection of OH
- Arrhenius parameters for reaction of OH with FM-200

  A = 3.7E-13 cc / molecule
  E/R = 1615 K

*D.D. Nelson, et. al., Geophys. Res. Lett., 20, 197 (1993).

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FM-200 ENVIRONMENTAL IMPACT

Atmospheric Lifetime and Global Warming Potential

- Rate coefficient at 277 K for reaction of OH radical with FM-200 equals 1.09E-15 cc/molecule s
- Atmospheric Lifetime = 31 - 42 years
- GWP = 0.3 - 0.6 (CFC-11 = 1.0)

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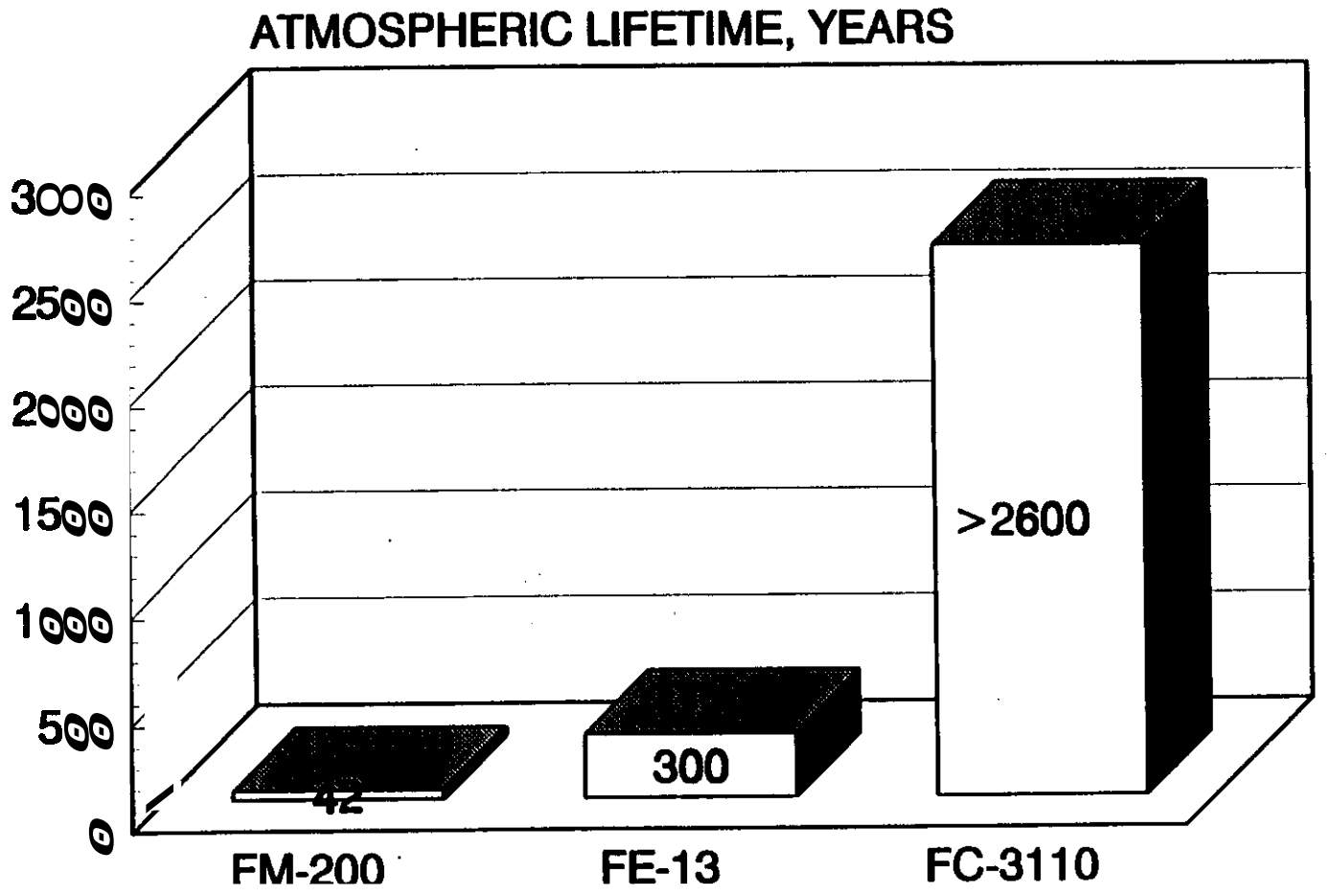
ATMOSPHERIC LIFETIMES OF HALON ALTERNATIVES



* Atmospheric lifetime shown for FC-3110 is a lower limit; actual atmospheric lifetime is likely considerably longer (A.R. Ravishankara, et. al., Science, 259, 194 (1993).

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FM-200 FIRE SUPPRESSION

- 1200 Cubic Foot Test Enclosure

- Class A Fires
  - Wood cribs, shredded paper, excelsior fires extinguished at 5.8 % by volume FM-200

- Class B Fires
  - 2 square foot n-Heptane pan fires extinguished at 5.8 % by volume FM-200

- Nozzle Area Coverage
  - 1800 square foot coverage achievable at as low as 5.0 % by volume FM-200

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FM-200: TOXICOLOGY

- Acute Inhalation Toxicity
  - LC50 > 800,000 ppm
  - 4 hour, rats

- Cardiac Sensitization
  - Test results indicate an NOAEL of 9.7 % and an LOAEL of 10.5% for FM-200
  - Final report currently under review by the US EPA

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US005124053A

United States Patent [19]

Iikubo et al.

[11] Patent Number: 5,124,053

[45] Date of Patent: Jun. 23, 1992

[54] FIRE EXTINGUISHING METHODS AND BLENDS UTILIZING HYDROFLUOROCARBONS

[75] Inventors: Yuichi Iikubo; Mark L. Robin, both of West Lafayette, Ind.

[73] Assignee: Great Lakes Chemical Corporation, West Lafayette, Ind.

[21] Appl. No.: 439,738

[22] Filed: Nov. 21, 1989

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 396,841, Aug. 21, 1989, abandoned.

[51] Int. Cl.[5] A62D 1/08

[52] U.S. Cl. 252/8; 252/2; 169/46; 169/47

[58] Field of Search 252/8, 3, 2; 169/47, 169/46

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Attorney, Agent, or Firm—Woodard, Emhardt, Naughton, Moriarty & McNett

[57] ABSTRACT

Highly fluorinated, saturated, C_2 and C_3 hydrofluorocarbons are efficient, economical, non-ozone-depleting fire extinguishing agents used alone or in blends with other fire extinguishing agents in total flooding and portable systems.

25 Claims, No Drawings