INVESTIGATION OF THE PRESSURE DYNAMICS OF FM-200 SYSTEM DISCHARGE

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Pressure Dynamics During Halocarbon Agent Discharge

- Initial Negative Pressure Event
  - Phase change from liquid to vapor at nozzle
  - Heat absorbed from enclosure air
  - Decrease in pressure to below atmospheric
- Positive Pressure Event
  - Heat transfer from enclosure and contents to cooled air
  - Expansion of agent
  - Increase in pressure to above ambient

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Pressure Dynamics of Halocarbon Agent Discharges

- Magnitude of pressure change development upon:
  - Agent properties
  - Agent concentration
  - Discharge time
  - Room dimensions
  - Leakage area
  - Fire size
  - Room Construction

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Test Enclosure

- 8m x 2m x 3m height
- Volume = 95 cu.m.
- Concrete cinder block walls
- Ceiling and floor 2 layers 3/4" plywood on 2x6 joists
- Equipped with ventilation inlet, exhaust system

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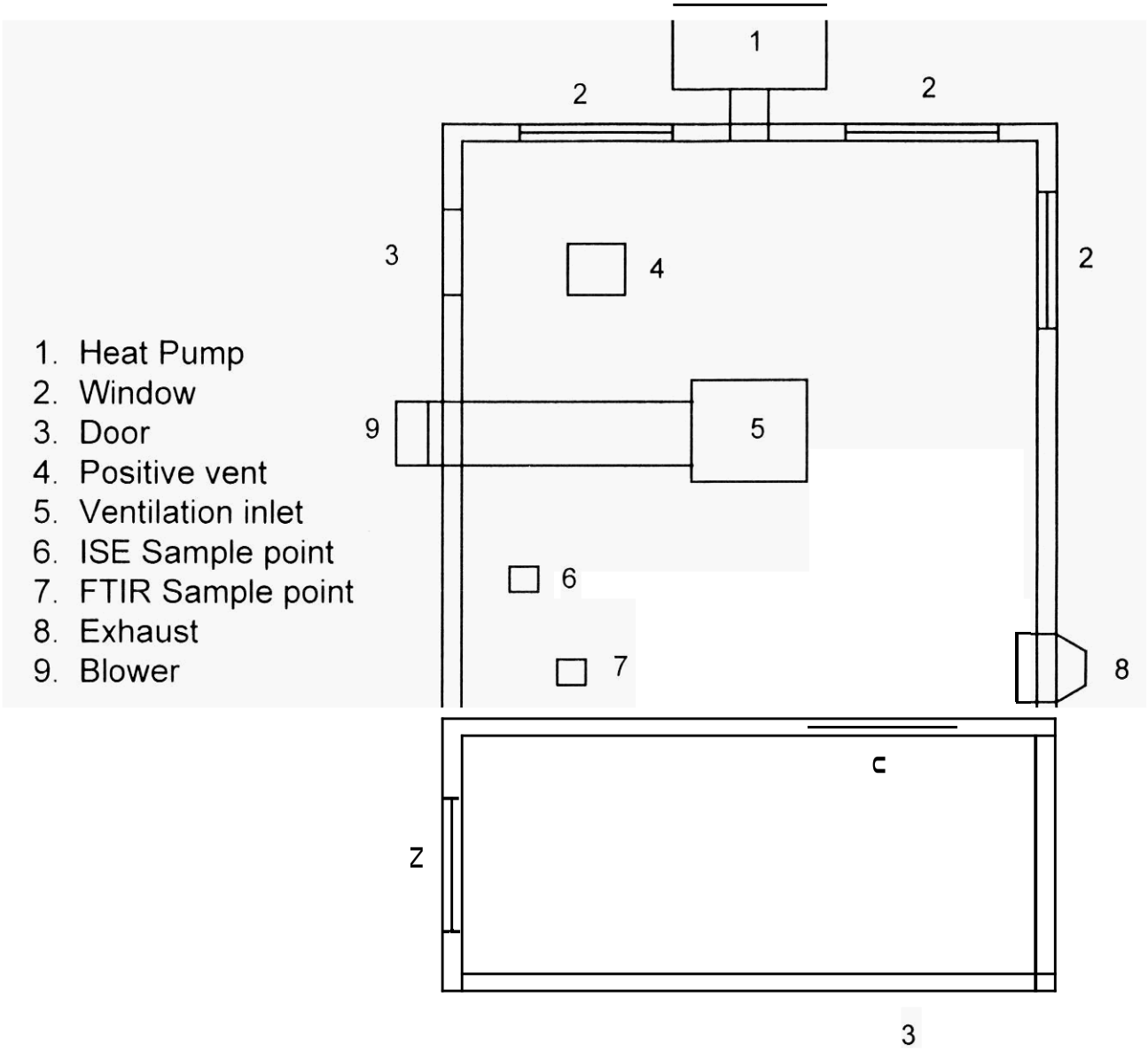

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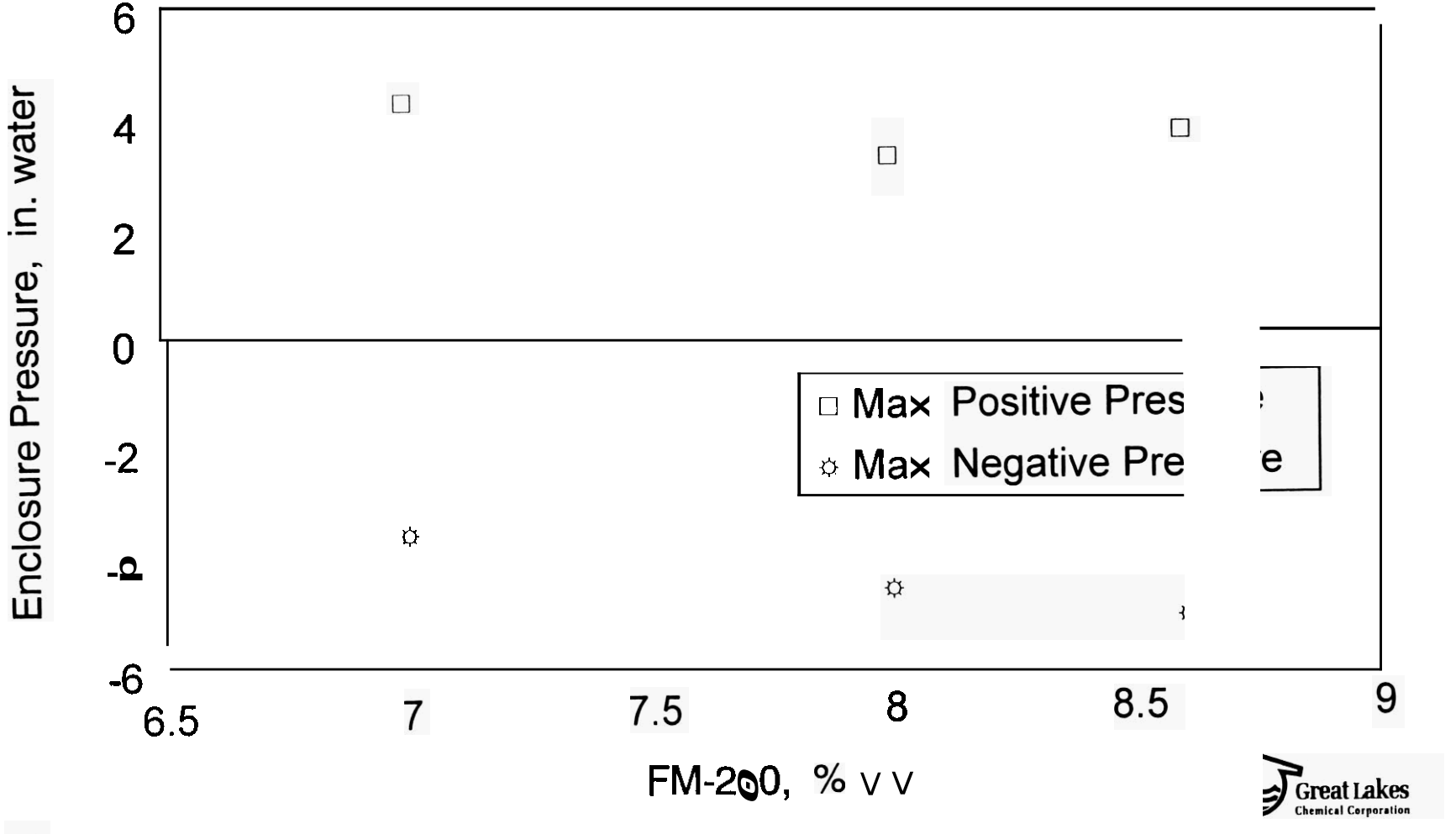
Test Facility

Effect of Concentration on Enclosure Pressure: 445 mm Heptane Pan fires

8 Second Discharge



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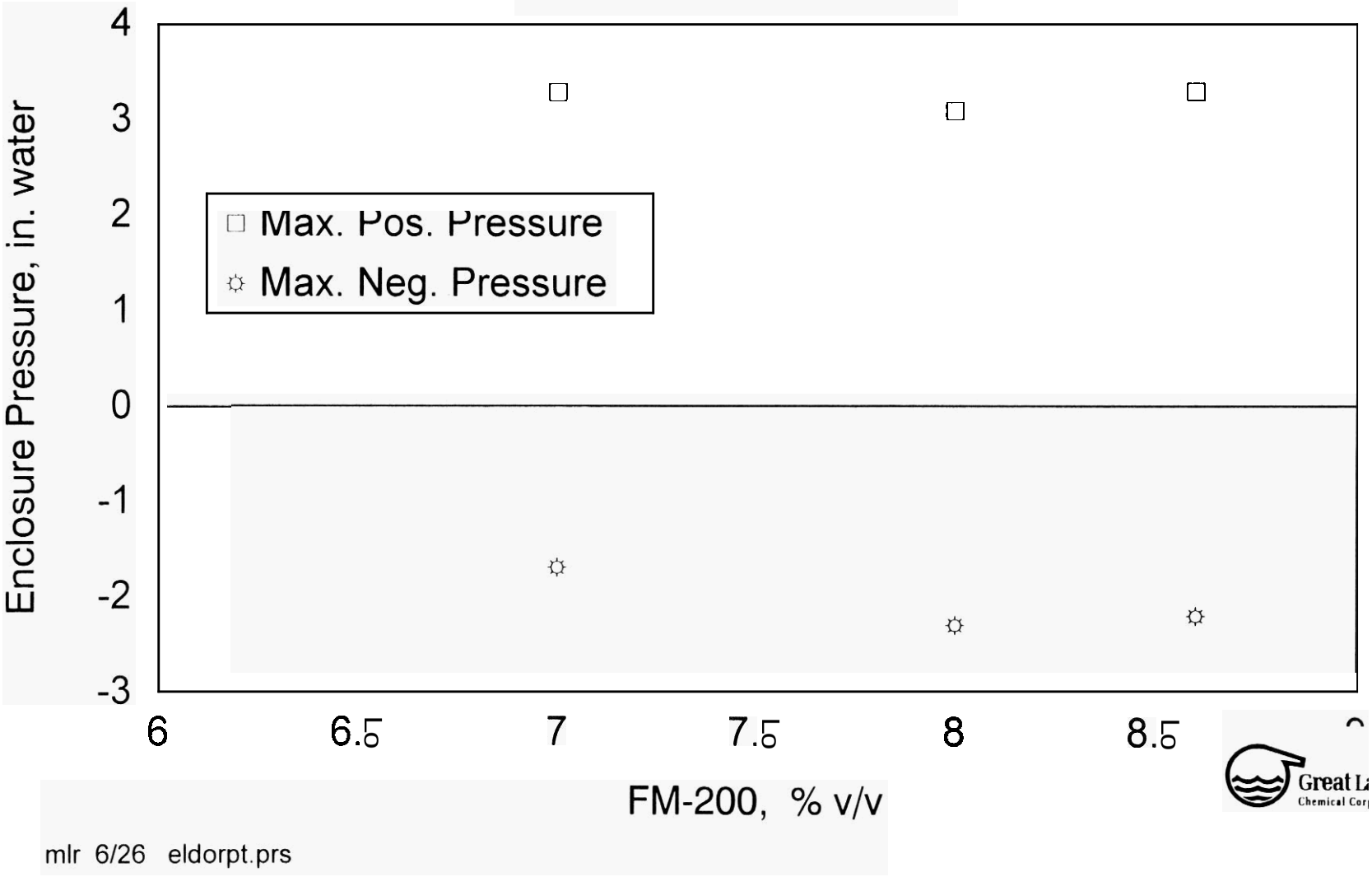
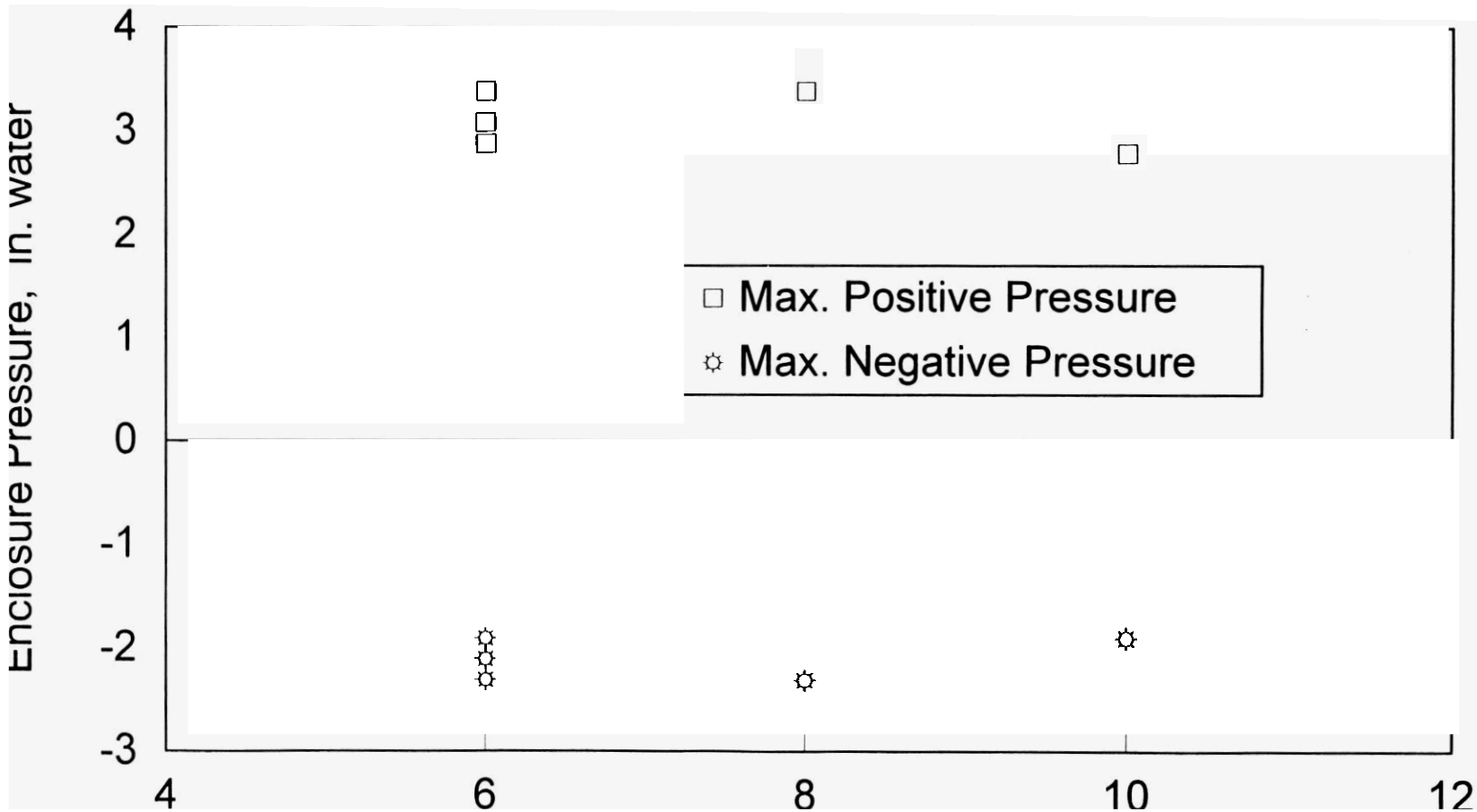
Effect of Concentration on Enclosure Pressure: 300 mm Heptane Pan fires

8 Second Discharge



Effect of Discharge Time on Enclosure Pressure: 445 mm n-Heptane Pan Fires

8% FM-200



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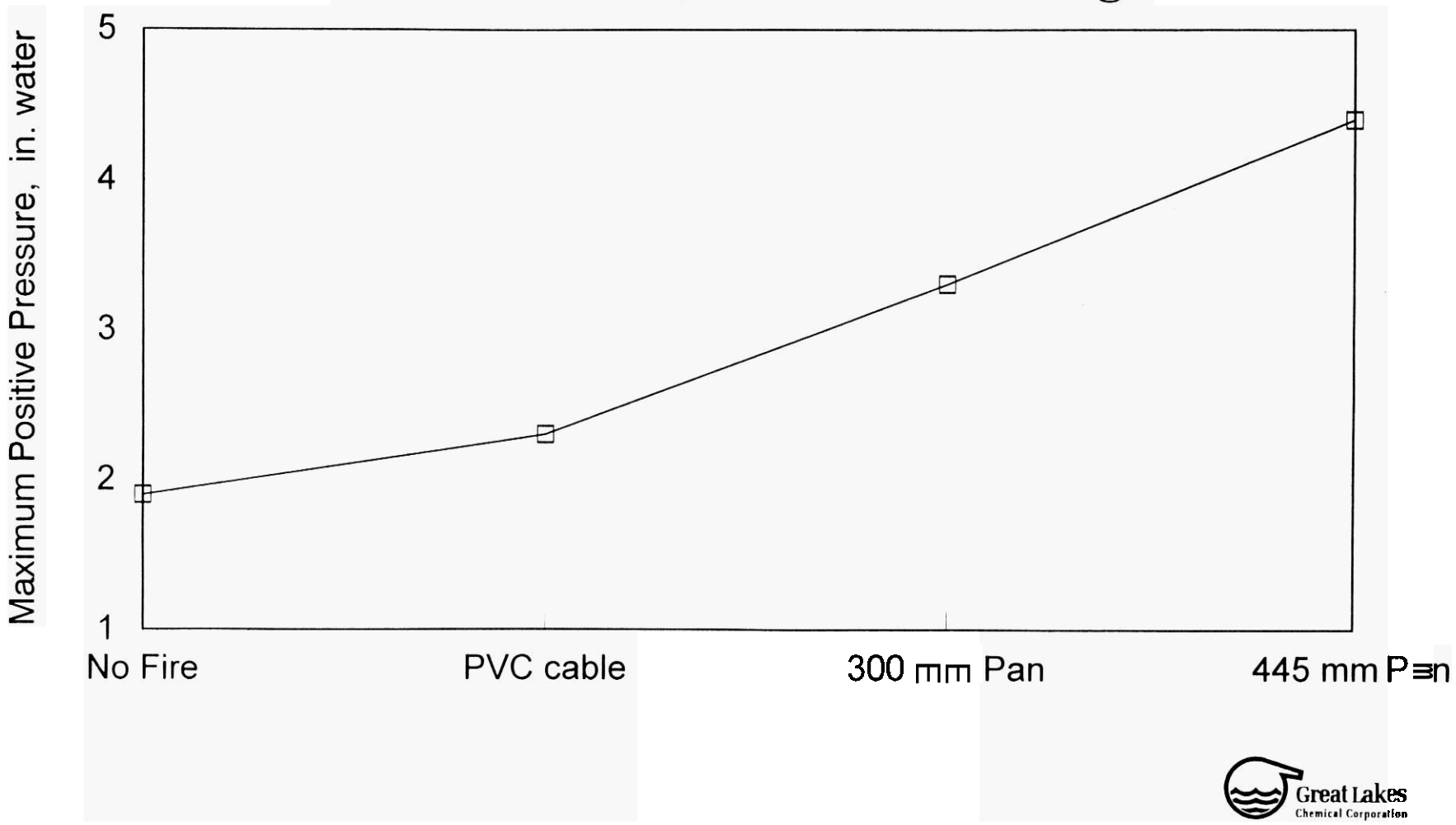
Effect of Fire Size on the Maximum Positive Enclosure Pressure

7% v/v FM-200; 8 Second Discharge



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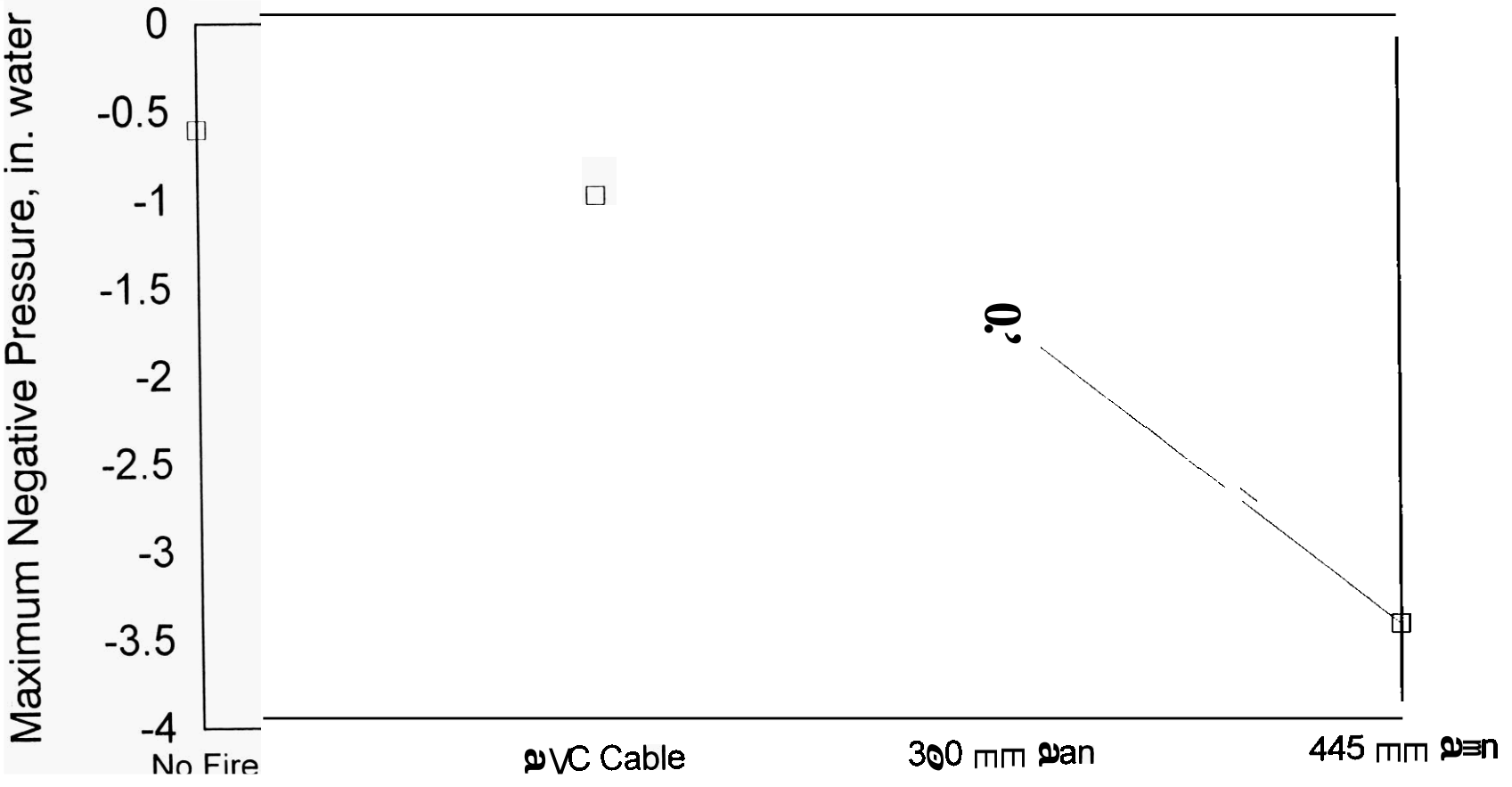
Effect of Fire Size on the Maximum Negative Enclosure Pressure

7% v/v FM-200; 8 Second Discharge



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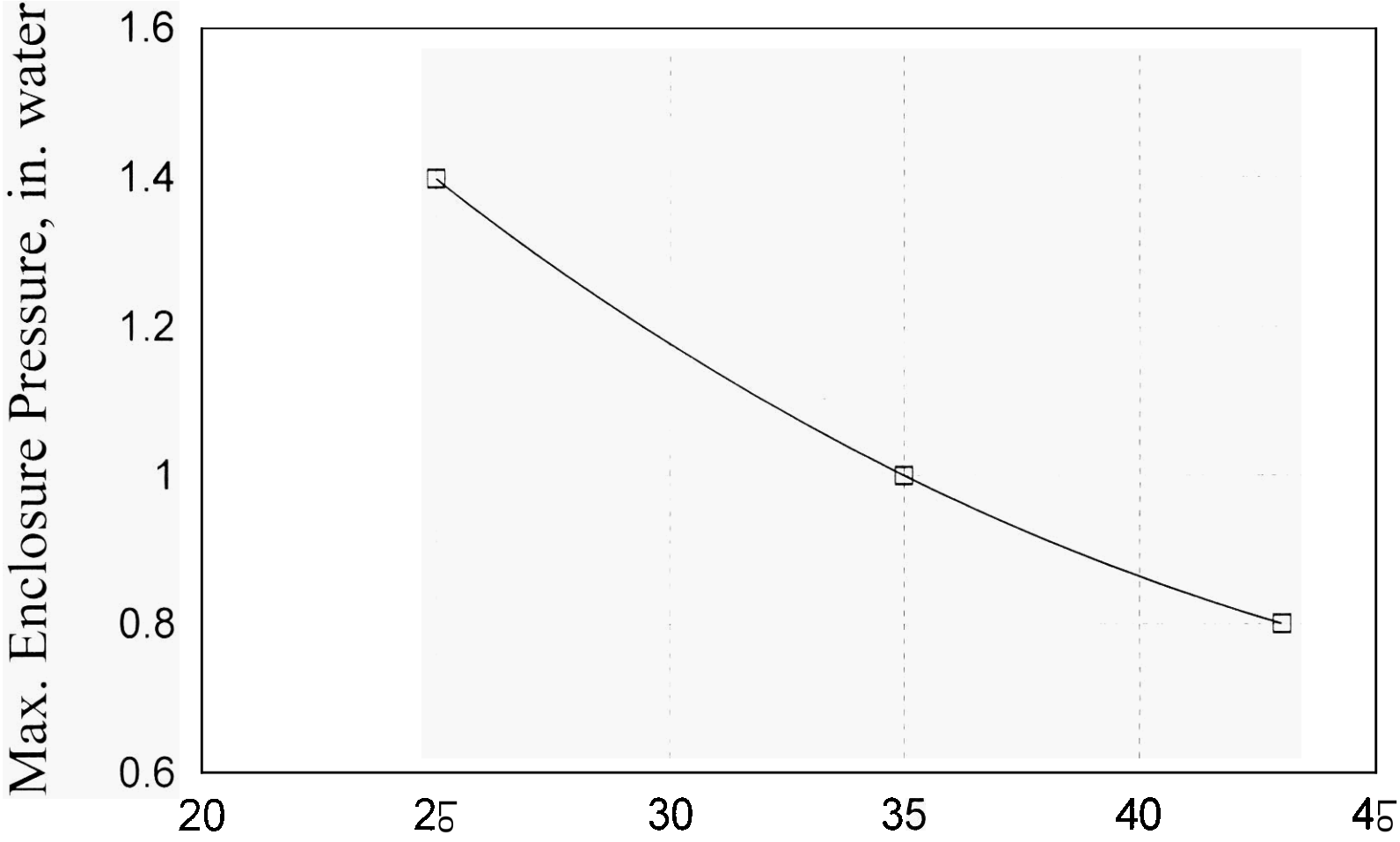
Effect of Leakage Area on Enclosure Pressure

7% v/v FM-200; 8 s Discharge; Wallboard Construction



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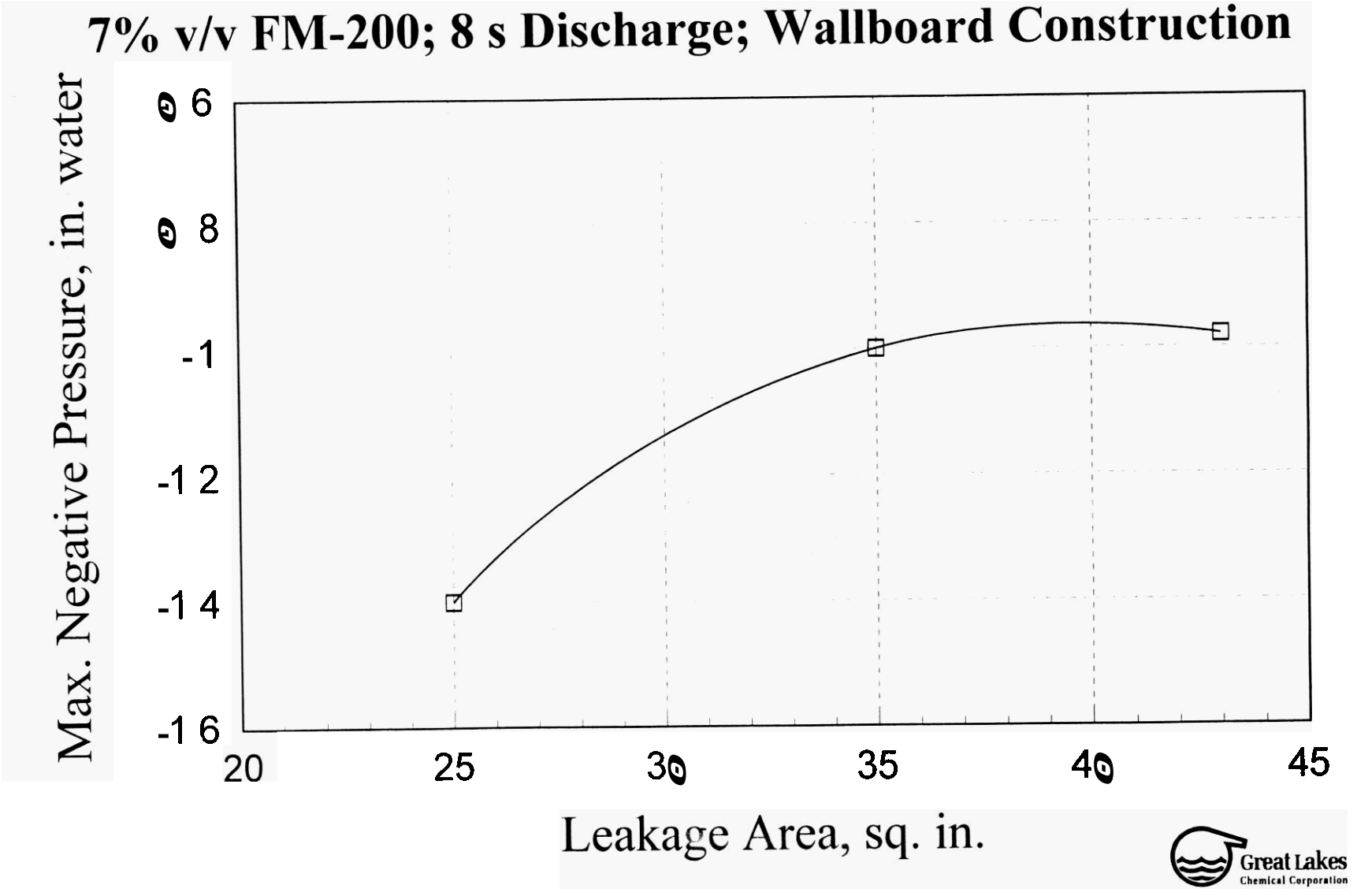
Effect of Leakage Area on Enclosure Pressure

7% v/v FM-200; 8 s Discharge; Wallboard Construction



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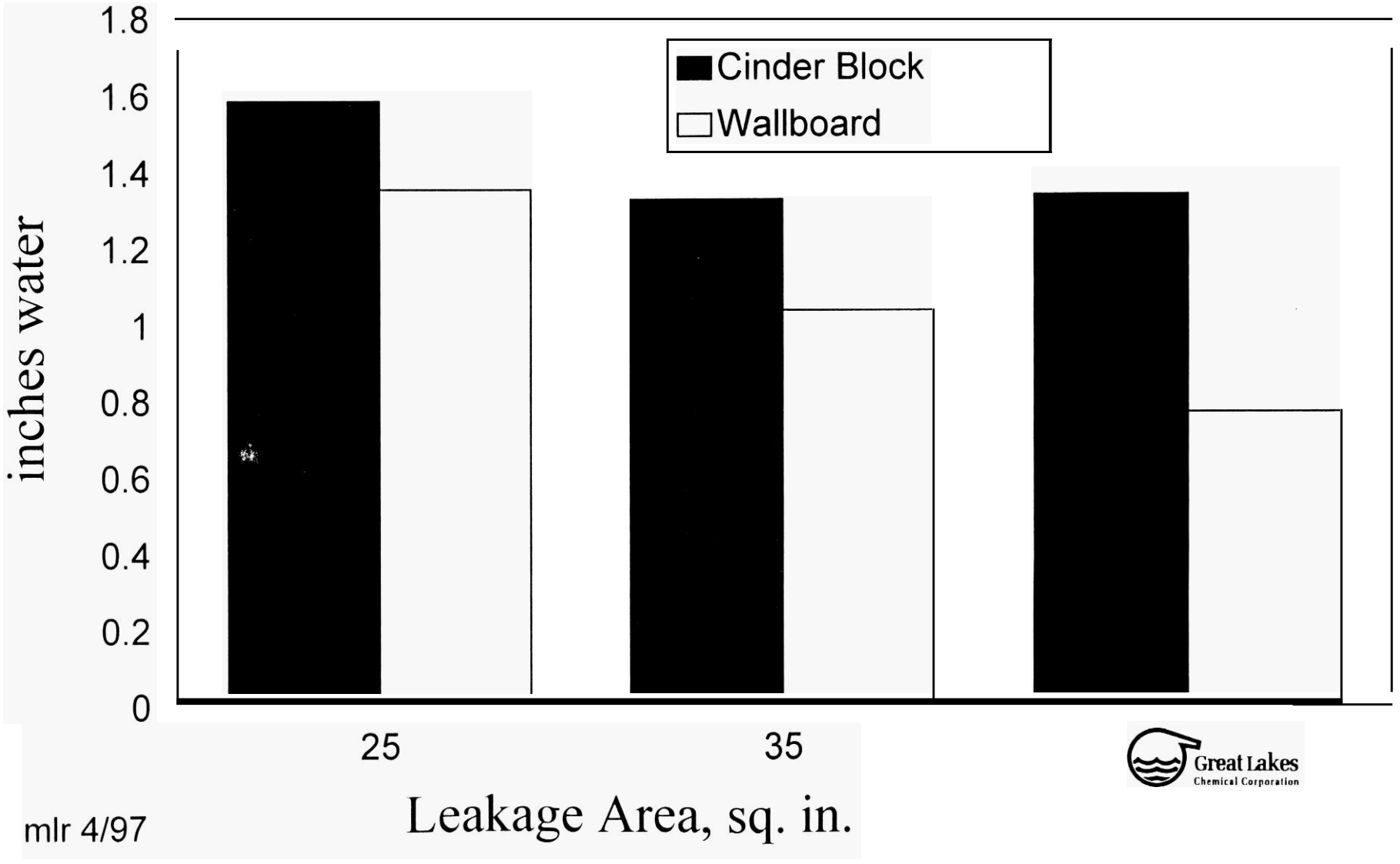
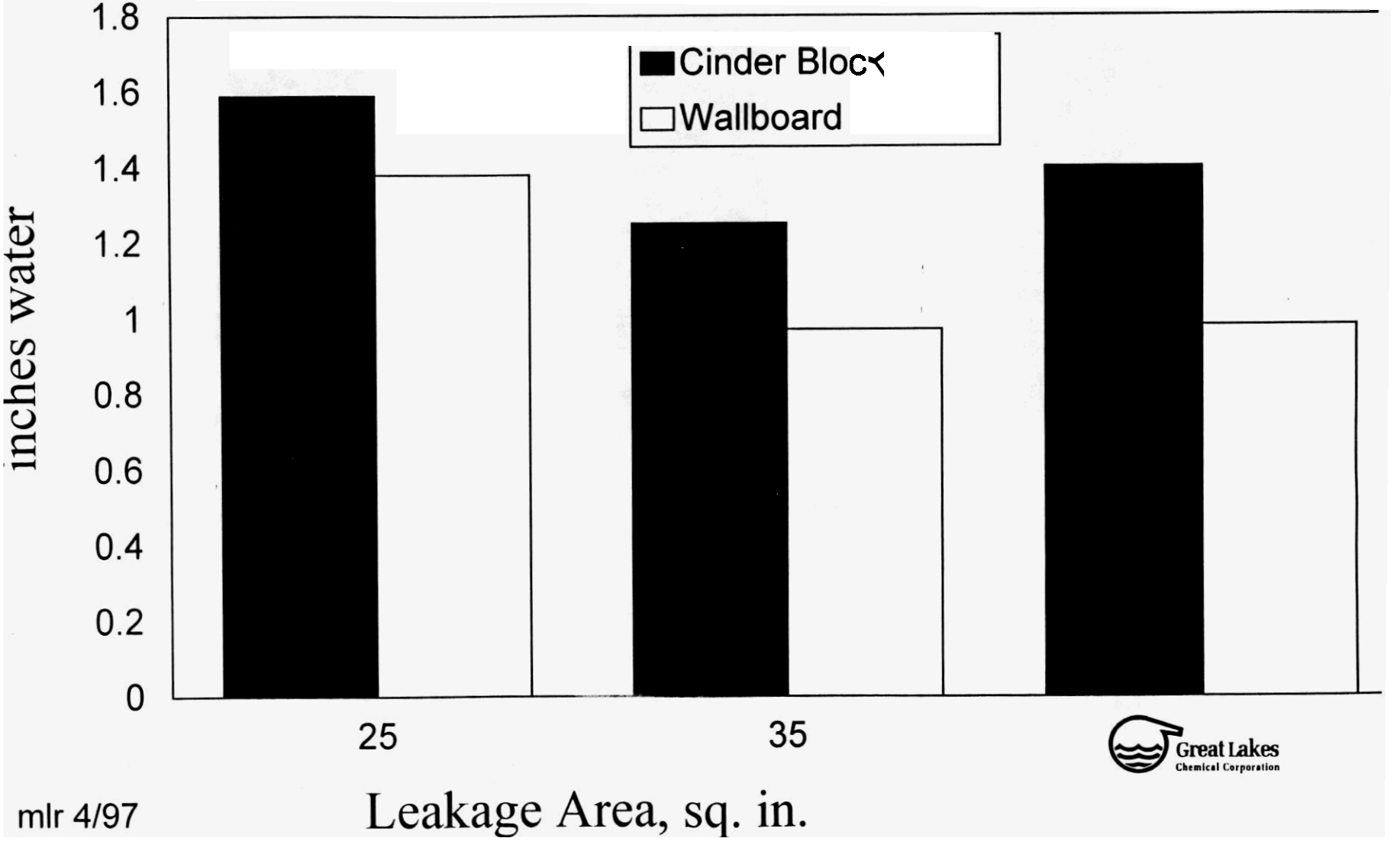
Effect of Construction on Enclosure Pressure

7% v/v FM-200; 8 s Discharge; Positive Pressure



Effect of Construction on Enclosure Pressure

7% v/v FM-200; 8 s Discharge; Negative Pressure



Magnitude of Pressure Development: Wallboard Construction

Hughes Associates, Inc.

- **Typical EDP Fires**
  - ▸ **Paper, PC boards, PVC cable, Magnetic tape**
  - ▸ **Fire Sizes 3 to 36 kW**

- **Maximum Positive Pressures**
  - ▸ **range: 0.2 to 1.4 inches water**
  - ▸ **average: 0.6 inches water**

- **Maximum Negative Pressures**
  - ▸ **range: -0.1 to -1.4 inches water**
  - ▸ **average: -0.6 inches water**

- **No structural damage**

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Magnitude of Pressure Development: Wallboard Construction

Hughes Associates, Inc.

- Class A Standard Tests: 511 cu.ft. enclosure
  - PMMA, ABS, PP, HDPE, LDPE, PVC, Pine
  - Fire Sizes 1-36 kW

- Maximum Positive Pressures
  - range: 0.4 to 0.7 inches water
  - average: 0.5 inches water

- Maximum Negative Pressures
  - range: -0.6 to -1.7 inches water
  - average: -0.7 inches water

- No structural damage

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Magnitude of Pressure Development: Wallboard Construction

Hughes Associates, Inc.

- Class A Standard Tests: 2562 cu.ft. enclosure
  - 30 minute hold time
  - PMMA, ABS, PP, HDPE, LDPE, PVC, Pine
  - Fire Sizes 10-25 kW

- Maximum Positive Pressures
  - range: 0.9 to 1.8 inches water
  - average: 1.1 inches water

- Maximum Negative Pressures
  - range: -1.3 to -2.2 inches water
  - average: -1.8 inches water

- No structural damage

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Summary

- Developed enclosure pressures are strongly dependent on:
  - Fire Size
  - Enclosure Leakage Area
  - Enclosure Construction

- For typical wallboard construction and hold times of approximately 10 minutes, the positive and negative pressures developed upon discharge of FM-200 are under 1 5 inches water.

- Pressures developed in wallboard construction enclosures under typical conditions have not been observed to present a problem with regard to structural damage.

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