2746

ChemRisk/Shonka Research Associates, Inc., Document Request Form

(This section to be completed by subcontractor requesting document)

J. Lamb / 1034A

Requestor / Document Center (is requested to provide the following document)

Date of request ~~[illegible]~~ 3/29/96 Expected receipt of document ~~[illegible]~~ 4/30/96

Document number KS-508 Date of document 9/21/55

Title and author (if document is unnumbered)

(This section to be completed by Document Center)

Date request received 4/5/96

Date submitted to ADC 4/15/96

Date submitted to HSA Coordinator 4/5/96

(This section to be completed by HSA Coordinator)

Date submitted to CICO 4/15/96

Date received from CICO 4/19/96

Date submitted to ChemRisk/Shonka and DOE 4/23/96

(This section to be completed by ChemRisk/Shonka Research Associates, Inc.)

Date document received

Signature

2746

Date of Issue: September 21, 1955

Report Number: KS-508

Subject Category: ENGINEERING

RAPID-FREEZING TESTS FOR MATERIAL-RELEASE CONTROL

J. C. Bailey and J. R. Knight

Work Supervised By:
H. F. Henry

Safety and Protection Division
W. L. Richardson, Superintendent

UNION CARBIDE NUCLEAR COMPANY
UNION CARBIDE AND CARBON CORPORATION
K-25 Plant
Oak Ridge, Tennessee

Union Carbide Nuclear Company, Oak Ridge Gaseous Diffusion Plant, Operating Contractor for the U.S. Atomic Energy Commission.

RAPID-FREEZING TESTS FOR MATERIAL-RELEASE CONTROL

Introduction

Since releases of UF_6 from containers may result in air-borne and surface contamination and in other ways interfere considerably with normal operating activities, preliminary tests were conducted to see if a more effective method of freezing off a release than the ones currently used might be practicable.

One of the methods now used consists of cooling the point of the release with dry ice formed by a CO_2 fire extinguisher, and this method was used as a comparison standard in these tests. The effectiveness of the CO_2 when used alone is apparently limited by the rather poor thermal contact of the dry ice with the surface being cooled, and it was thus felt that use of a liquid, either separately or in conjunction with the CO_2, might produce a greater cooling effect.

Water might be considered for certain applications but criticality considerations would sharply limit such use, and freezing of the water might make its application difficult. Thus, trichlorethylene was chosen as a test vehicle becuase it remains liquid at the temperature of dry ice and is suitable with regard to criticality considerations. In addition, its characteristics with regard to flammability and toxicity permit safe handling with only relatively simple protective measures.

Summary

Elementary tests have indicated that when dry ice from a CO_2 fire extinguisher is applied simultaneously with a spray of trichlorethylene, it produces a cooling effect almost 4 times as great as that of CO_2 alone.

Method

The tests consisted of directing streams of various cooling agents against the surface of a 1-gallon can of water for a 10-second period, the can lying on its side on top of [illegible]nd empty can to prevent accumulations of the liquid from occurring on [illegible] the can or around its base; both 1-gallon cans were placed inside a larger container to catch the liquids involved. The decrease in temperature of the water was considered to be a measure of the effectiveness of the cooling action.

In some of the tests a thin layer of ice formed on the inside wall of the can, and in this event the water was stirred until the ice had melted and the water was thoroughly mixed.

The following cooling agents and methods were tested:

1. CO_2 was released from a 15-pound CO_2 fire extinguisher with formation of dry-ice powder.

2. Trichlorethylene, initially at room temperature, was sprayed from a nozzle, producing cooling by evaporation of the trichlorethylene.

3. Trichlorethylene was cooled by releasing the contents of a 15-pound CO_2 fire extinguisher under the surface of 2 gallons of the liquid, and the liquid was subsequently poured over the test can.

4. Trichlorethylene was cooled by crushed dry ice and forced from a sealed cylinder in a stream by the pressure of the evaporating dry ice.

5. Trichlorethylene and CO_2 from 2 separate 15-pound fire extinguishers were introduced simultaneously into a 1-1/4-inch diameter copper tube, thus producing a cold trichlorethylene spray. Figure 1 shows the assembly used for mixing the trichlorethylene and the CO_2.

6. Trichlorethylene was ejected under pressure from a nozzle attached to the open end of a 15-pound CO_2 fire-extinguisher funnel concurrent with the release of the CO_2. The trichlorethylene flow was approximately 1.5 gallons per minute. Figure 2 shows the assembly, figure 3 shows the trichlorethylene spray pattern, and figure 4 shows the arrangement used for the cooling test.

Results

The results of the tests are given in the table below.

COOLING EFFECTS OF VARIOUS AGENTS

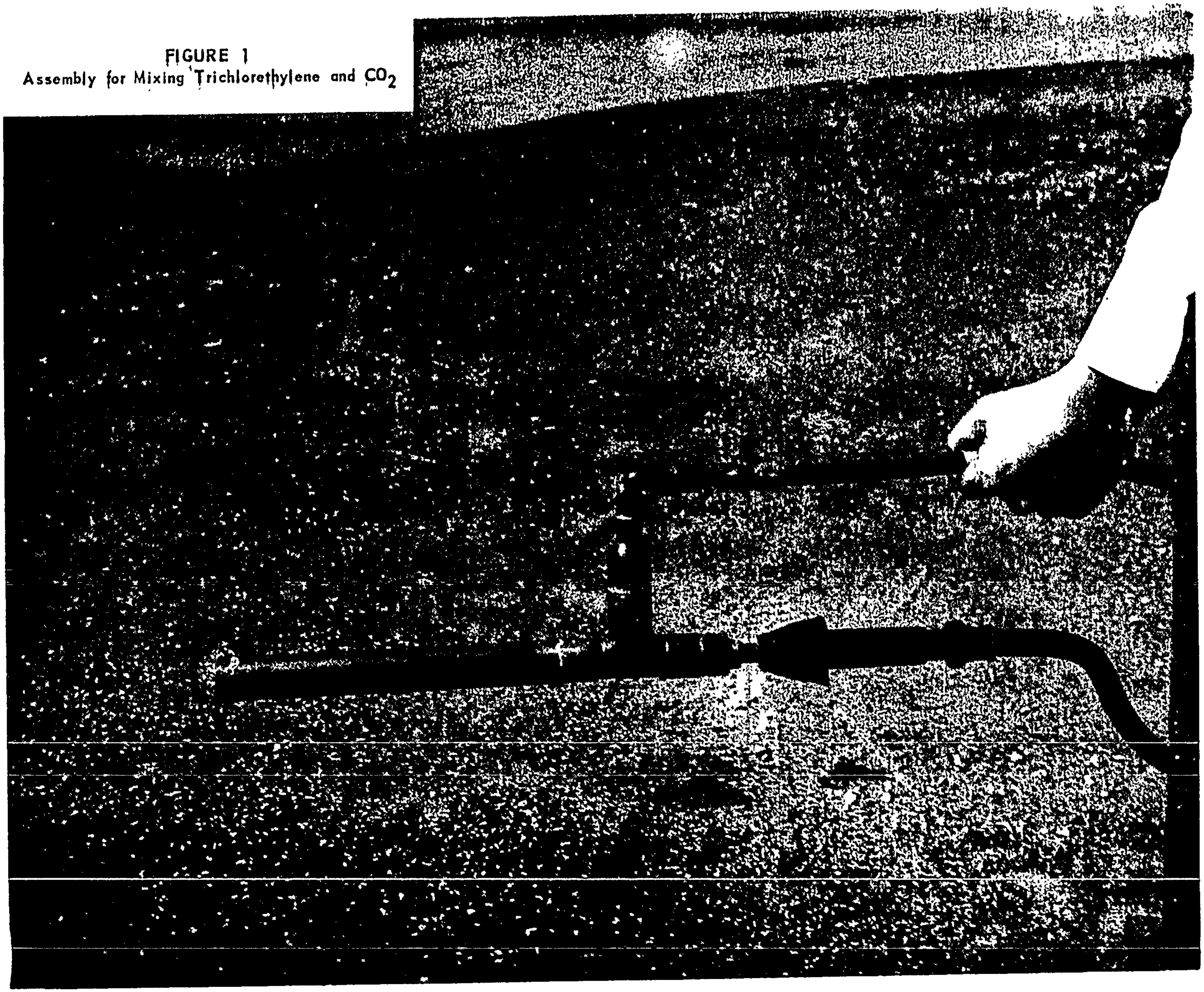
Test No.	Cooling Agent	Temperature Drop (°C.)
1	CO_2	1.5
2	Trichlorethylene spray	1.0
3	Trichlorethylene chilled by CO_2 from fire extinguisher (poured)	3.2
4	Trichlorethylene chilled with dry ice (stream from hose)	3.0
5	CO_2 and trichlorethylene from same tube	1.5
6	CO_2 from fire extinguisher and trichlorethylene from spray nozzle	5.6

Conclusions

These brief tests indicate that a mixture of CO_2 and a liquid can produce much more rapid cooling than can the CO_2 alone. It appears that further investigation of other materials than the trichlorethylene used may be warranted and that the development of permanently installed cooling systems for operations involving possible gaseous releases of UF_6 may be feasible. A possible advantage of such a system is that it could probably be retained in stand-by condition with very little attention and maintenance.

The possibility that similar use of a suitable liquid might enhance the fire-extinguishing effects of a CO_2 fire extinguisher may also be worthy of further investigation.

FIGURE 1
Assembly for Mixing Trichlorethylene and CO_2



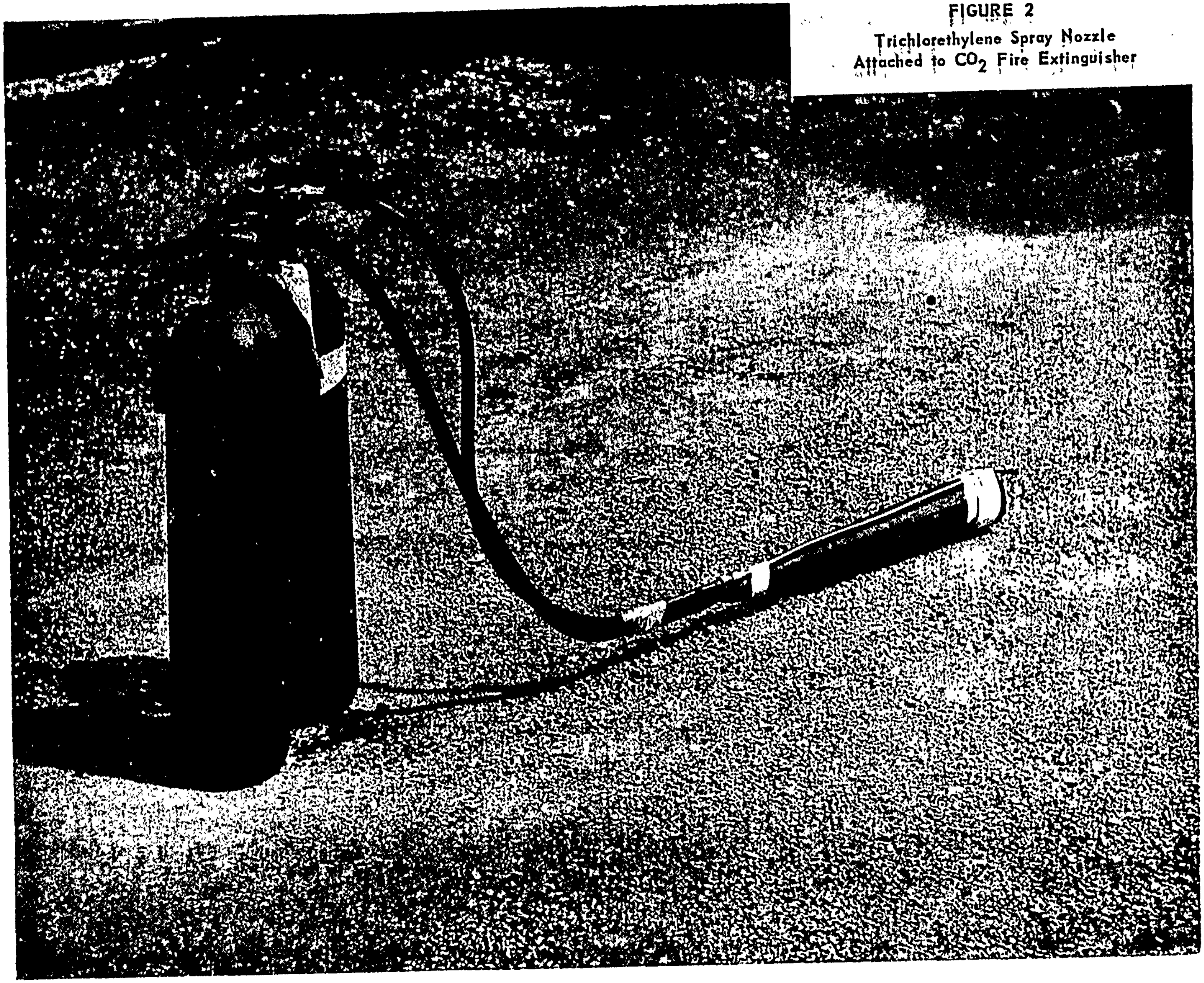
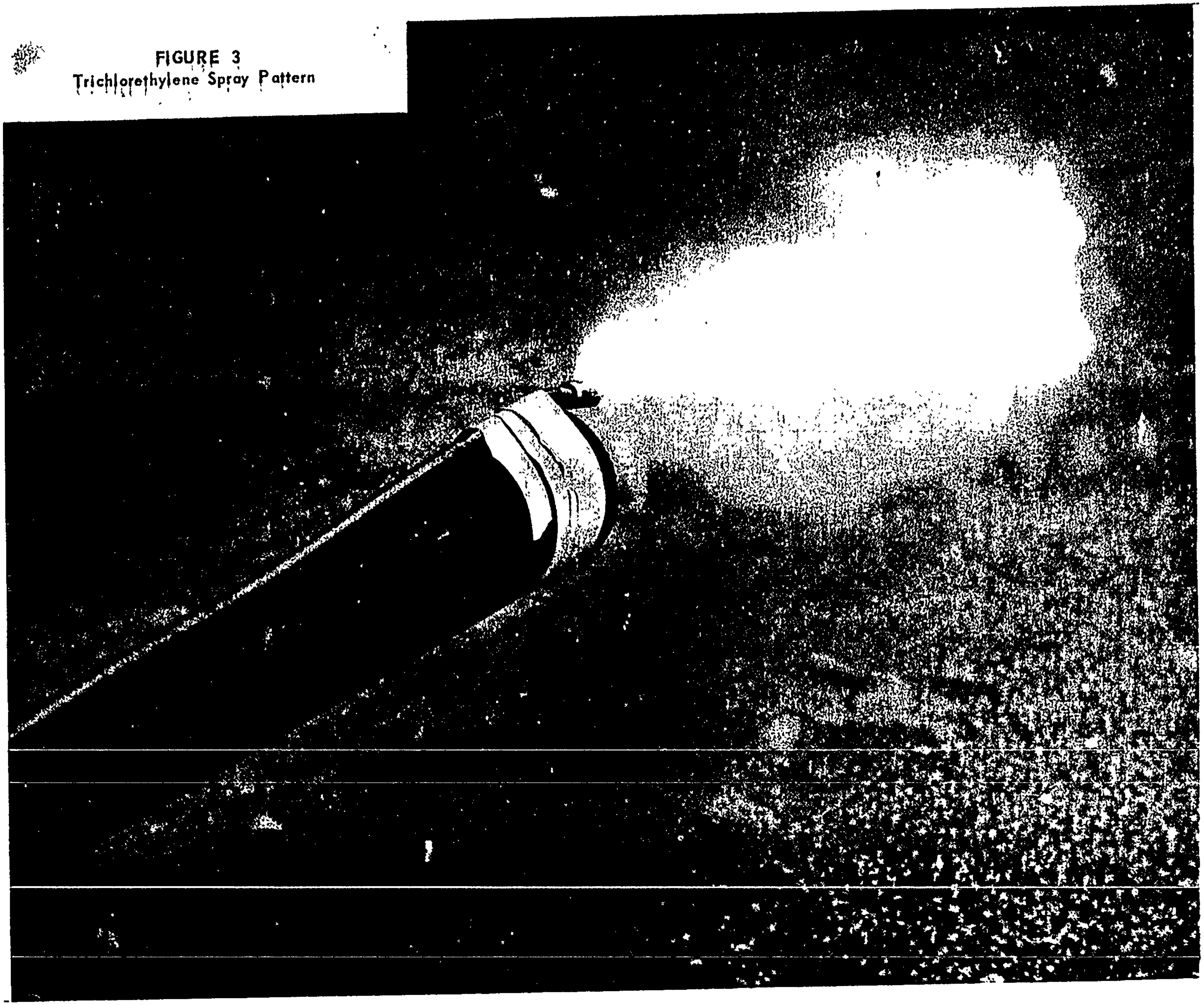


FIGURE 2
Trichlorethylene Spray Nozzle
Attached to CO_2 Fire Extinguisher

FIGURE 3
Trichlorethylene Spray Pattern



RAPID-FREEZING TESTS FOR MATERIAL-RELEASE CONTROL

Introduction

Since releases of UF_6 from containers may result in air-borne and surface contamination and in other ways interfere considerably with normal operating activities, preliminary tests were conducted to see if a more effective method of freezing off a release than the ones currently used might be practicable.

One of the methods now used consists of cooling the point of the release with dry ice formed by a CO_2 fire extinguisher, and this method was used as a comparison standard in these tests. The effectiveness of the CO_2 when used alone is apparently limited by the rather poor thermal contact of the dry ice with the surface being cooled, and it was thus felt that use of a liquid, either separately or in conjunction with the CO_2, might produce a greater cooling effect.

Water might be considered for certain applications but criticality considerations would sharply limit such use, and freezing of the water might make its application difficult. Thus, trichlorethylene was chosen as a test vehicle becuase it remains liquid at the temperature of dry ice and is suitable with regard to criticality considerations. In addition, its characteristics with regard to flammability and toxi..ty permit safe handling with only relatively simple protective measures.

Summary

Elementary tests have indicated that when dry ice from a CO_2 fire extinguisher is applied simultaneously with a spray of trichlorethylene, it produces a cooling effect almost 4 times as great as that of CO_2 alone.

Method

The tests consisted of directing streams of various cooling agents against the surface of a 1-gallon can of water for a 10-second period, the can lying on its side on top of [illegible] nd empty can to prevent accumulations of the liquid from occurring on [illegible] the can or around its base; both 1-gallon cans were placed inside a la.. .r container to catch the liquids involved. The decrease in temperature of the water was considered to be a measure of the effectiveness of the cooling action.

In some of the tests a thin layer of ice formed on the inside wall of the can, and in this event the water was stirred until the ice had melted and the water was thoroughly mixed.

The following cooling agents and methods were tested:

1. CO_2 was released from a 15-pound CO_2 fire extinguisher with formation of dry-ice powder.

2. Trichlorethylene, initially at room temperature, was sprayed from a nozzle, producing cooling by evaporation of the trichlorethylene.

3. Trichlorethylene was cooled by releasing the contents of a 15-pound CO_2 fire extinguisher under the surface of 2 gallons of the liquid, and the liquid was subsequently poured over the test can.

4. Trichlorethylene was cooled by crushed dry ice and forced from a sealed cylinder in a stream by the pressure of the evaporating dry ice.

5. Trichlorethylene and CO_2 from 2 separate 15-pound fire extinguishers were introduced simultaneously into a 1-1/4-inch diameter copper tube, thus producing a cold trichlorethylene spray. Figure 1 shows the assembly used for mixing the trichlorethylene and the CO_2.

6. Trichlorethylene was ejected under pressure from a nozzle attached to the open end of a 15-pound CO_2 fire-extinguisher funnel concurrent with the release of the CO_2. The trichlorethylene flow was approximately 1.5 gallons per minute. Figure 2 shows the assembly, figure 3 shows the trichlorethylene spray pattern, and figure 4 shows the arrangement used for the cooling test.

Results

The results of the tests are given in the table below.

COOLING EFFECTS OF VARIOUS AGENTS

Test No.	Cooling Agent	Temperature Drop (°C.)
1	CO_2	1.5
2	Trichlorethylene spray	1.0
3	Trichlorethylene chilled by CO_2 from fire extinguisher (poured)	3.2
4	Trichlorethylene chilled with dry ice (stream from hose)	3.0
5	CO_2 and trichlorethylene from same tube	1.5
6	CO_2 from fire extinguisher and trichlorethylene from spray nozzle	5.6

Conclusions

These brief tests indicate that a mixture of CO_2 and a liquid can produce much more rapid cooling than can the CO_2 alone. It appears that further investigation of other materials than the trichlorethylene used may be warranted and that the development of permanently installed cooling systems for operations involving possible gaseous releases of UF_6 may be feasible. A possible advantage of such a system is that it could probably be retained in stand-by condition with very little attention and maintenance.

The possibility that similar use of a suitable liquid might enhance the fire-extinguishing effects of a CO_2 fire extinguisher may also be worthy of further investigation.