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EVALUATION OF CLOTHS FOR DECONTAMINATION BY WIPING (U)

by

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ABSTRACT

Treated polyester cloth was evaluated in laboratory-scale and larger-scale tests as an alternative to atomic wipes and cotton cloth for use in decontamination by wiping. The advantages of the treated polyester are as follows:

- Does not react with nitric acid to form unstable product,
- More fire resistant,
- Less volume of radioactive waste generated (versus atomic wipes), and
- Product can be recovered by soaking the polyester cloths in nitric acid.

Results are that even though treated polyester wiping cloths are slightly less effective than atomic wipes and cotton cloth, its many other benefits greatly outweigh this slight disadvantage.

INTRODUCTION AND SUMMARY

"Atomic wipes" and cotton cloths are widely used throughout the nuclear industry in decontamination by wiping. There are several problems with using these products at Savannah River. Our separations processes are nitric-acid based. These products contain large amounts of cellulose. A dangerous, unstable material can form when cellulose is exposed to nitric acid. In addition, cellulose is very flammable. Wipes are used in facilities where we try to minimize the amount of flammable materials. The use of cloths rather than atomic wipes would greatly reduce the amount of radioactive waste generated because cloths have less volume. In addition, product could be recovered from polyester wiping cloths by soaking them in nitric acid. Highlights of the evaluation are:

- The sorbency of a wide variety of materials was evaluated using an ASTM Procedure. Replicate specimens were evaluated by U. S. Testing Laboratory. Results were that the treated polyester was not as absorbent as cotton, but it was high enough to continue evaluating this material for decontamination by wiping[1].

- Lab-scale tests were conducted to determine the effect of the variables of decontamination by wiping: 1) The material used for wiping had a slight effect. Atomic wipes and cotton cloth were slightly more effective than treated polyester wiping cloths. 2) Cloths with a smooth surface finish were more effective. This was attributed to increased contact area. 3) Stainless steel with a smoother surface finish was easier to decontaminate. There are fewer sites for entrapment of radioactive material. 4) Cloths moistened with liquid were much more effective than dry cloths.

- The use of treated polyester cloth to recover plutonium was demonstrated. First, the cloths were used to decontaminate a section of a plutonium-contaminated glove box and glove box waste from a plutonium production facility. The cloth effectively removed the plutonium contamination. The plutonium was leached from the cloth with nitric acid.

- Fire tests were conducted to demonstrate the difference in flammability between polyester and atomic wipes. The atomic wipes immediately caught on fire when contacted by a flame. The polyester cloth was much more fire resistant.

MATERIALS EVALUATED

Both cotton and polyester cloths were evaluated. Both types of cloth generate less radioactive waste than atomic wipes because of their smaller volume. Cotton cloth has the same disadvantages as atomic wipes at Savannah River of incompatibility with nitric acid and low fire resistance. Cotton, however, is a very sorbent material. It sorbs approximately 5 times its weight in water.

Polyester cloth is compatible with nitric acid, it is much more fire resistant than cotton, and the radioactive material can be removed by soaking the cloths in nitric acid. This advantage is especially beneficial if the radioactive material, such as plutonium, needs to be recovered. Polyester cloth is, however, not as sorbent as cotton. It sorbs only approximately 3 times its weight in water.

Two types of polyester cloths have been identified that have increased sorption properties (Figures 1 and 2). These cloths sorb approximately 4 times their weight in water. One type is made from a "modified fiber to achieve superior properties desired in a clean room wiper".* The other type is "treated by a textile chemistry process to increase its sorption".** This treatment is claimed to be more permanent than the "modified fiber". This would be important if the cloths were laundered for reuse.

* Scientific Textiles, Inc.
339 Farmer Industrial Boulevard
Suite C
Newnan, GA 30263

** Hornwood, Inc.
P. 0. Box 799
Wadesboro, NC 28179

STABILITY IN NITRIC ACID

The stability of the treated polyester cloth in dilute nitric solution was demonstrated. Small samples of the fabric were immersed in water, O.1M HNO_3, O.5M HNO_3, and 1.OM HNO_3 for a total of 20 days. Solution color and fabric integrity (by squeezing) were observed frequently during the immersion period. No evidence was found of fabric alteration in any of the solutions.

EFFECT OF VARIABLES

Lab-scale tests were conducted to determine the effect of the variables of decontamination by wiping (Figure 3).

- Effect of Material - Atomic wipes are approximately 11% more effective than polyester wiping cloths. Cotton is slightly more sorbent than treated polyester.

- Effect of Cloth Finish - Polyester cloth with a smooth finish is approximately 15% more effective than a polyester cloth with a rough surface finish. This attributed to increased contact area.

- Effect of Finish of Surface being Decontaminated - As expected, Type 304L stainless steel with a #2B surface finish (hot rolled, pickled, and cold rolled) is easier to decontaminate by wiping than the same material with a #1 surface finish (hot rolled and pickled) (approximately 42% removed vs. approximately 28%).

- Effect of Solvents - Moistening a polyester cloth or an atomic wipe greatly increases its effectiveness. The percent reduction effected by a single swipe with the cloth moistened with the various solvents is shown below.

20%	Dry
33%	Water
35%	95% Ethyl Alcohol
44%	O.lM Nitric Acid

PRODUCT RECOVERY DEMONSTRATION

The concept of using of treated polyester cloth to recover plutonium was demonstrated.

- Glove Box Test - A spot on the floor of a glovebox used routinely for ion exchange studies with plutonium was smeared for activity, wiped with 95% ethanol using the treated polyester cloth, and then smeared again to determine if the surface had been cleaned. The cloth was then smeared for activity, rinsed in O.lM $HN0_3$, and smeared again. Finally, the rinse solution was analyzed for alpha activity. Activity values were as follows:

Floor before wiping	80,000 d/m
Floor after wiping	20,000 d/m
Fabric after wiping	120,000 d/m
Fabric after rinsing	20,000 d/m
Rinse solution	146,000 d/m/ml

  These results indicate that the fabric removed contamination from the glovebox floor and the contaminate could be removed from the fabric after use. The material dissolved in the fabric rinse could be recovered using normal Savannah River chemical processes such as ion exchange or solvent extraction.

- Test with Glove Box Wastes - Treated polyester cloths were used to clean wastes from glove boxes in a plutonium facility. Materials cleaned in this evaluation included plastic waste bags, lead-lined gloves, glove-port ring nut driver, small filter, small rubber gasket, Allen wrench, and green plastic tape. The amount of plutonium on these materials before they were cleaned was determined by surveying with an instrument. The wastes were cleaned by wiping using treated polyester cloth wetted with one molar nitric acid solution. The cloth was rinsed in one molar nitric acid to remove the plutonium from the cloth. The resulting solution was analyzed.

- Results are that approximately 20 weight percent of the plutonium on the wastes was recovered. Cleaning these items by hand wiping, however, was cumbersome. In a production environment, radiation exposure concerns may make the concept unfeasible unless the process can be automated.

FIRE TESTS

Fire tests were conducted to demonstrate the difference in flammability. In the first test, an atomic wipe and a 9-inch-square piece of treated polyester cloth were suspended from a coat hanger (Figure 5). In the second test, 87 atomic wipes were placed on the ground in a pile (Figure 4). A pile of 87 9-inch-square pieces of treated polyester was also placed on the ground. In both tests, the materials were contacted by the flame from a burning propane torch.

The atomic wipes immediately caught on fire when contacted by the flame. The single wipe suspended from the coat hanger fell to the ground in approximately 15 seconds (the end of the wipe that was tied around the hanger was destroyed). The wipe was fully consumed in approximately 3 minutes. The pile of 87 atomic wipes immediately caught on fire when contacted by the flame. The entire pile of wipes was fully consumed in approximately 12 minutes.

The polyester cloth was much more fire resistant. When contacted by the flame, it softened. This caused the cloth to move away from the flame. No combustion was started by contacting the specimens in both tests many times with the flame. Combustion was finally achieved by holding the flame directly on the cloth for approximately 6 seconds. The cloth burned slowly. The flame got smaller and smaller. After a few minutes, combustion ceased. Only part of the material was consumed.

CONCLUSIONS

Even though treated polyester wiping cloths are slightly less effective than atomic wipes and cotton cloth, the fact that this material does not contain cellulose, is more fire resistant, and its use provides a means for product recovery, greatly outweigh this disadvantage.

CLOTH SPECIFICATION

The following is a list of properties believed to be important:

- Absorb 4X its weight in water.

- Smooth finish.

- The cloth does not have to be laundered for clean room use. It must, however, be finished so that it is clean. It must be lint-free, and have a low level of extractables (surfactants, sizing, oils, etc.).

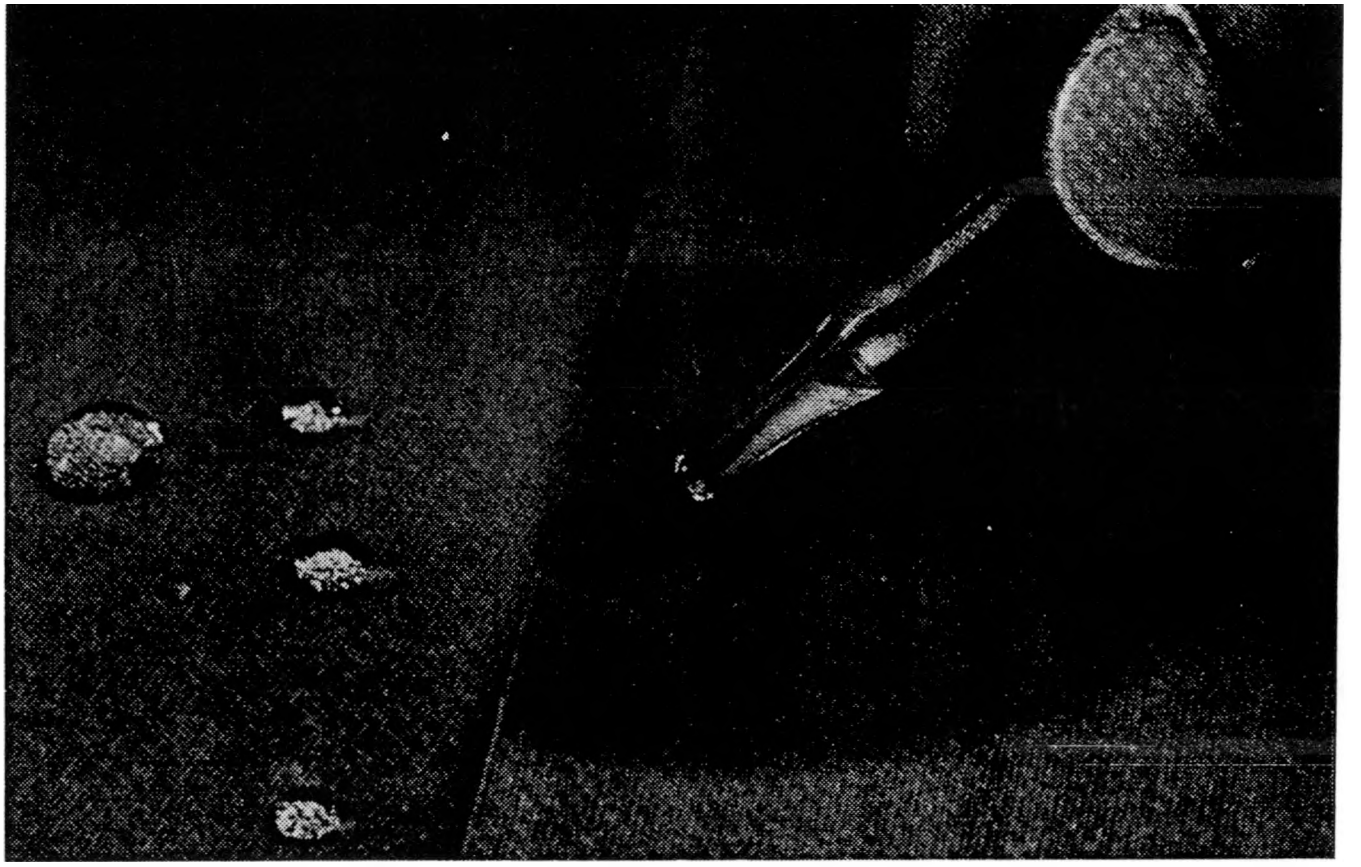

Figure 1. Absorbency Test

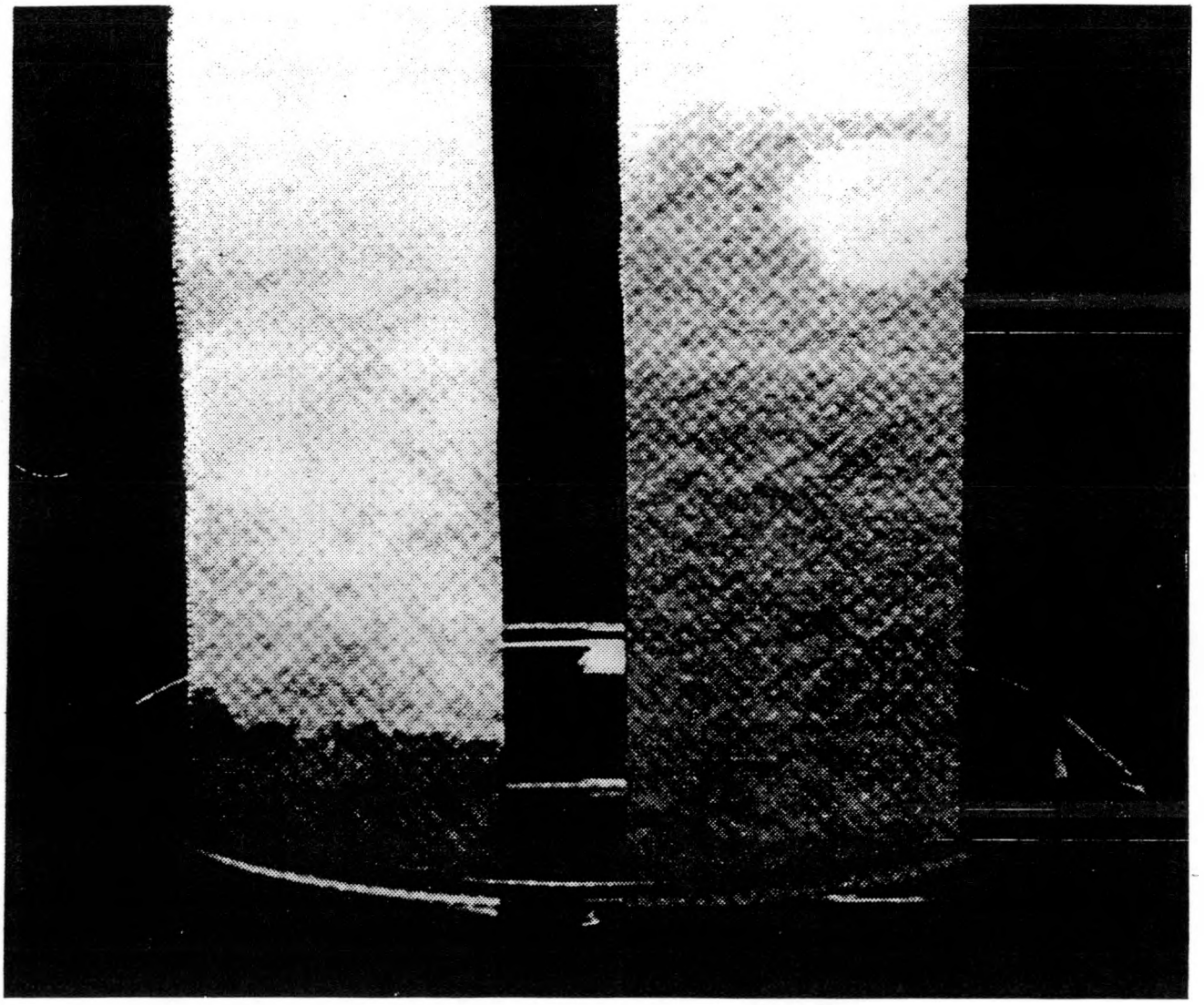

Figure 2. Wicking Test

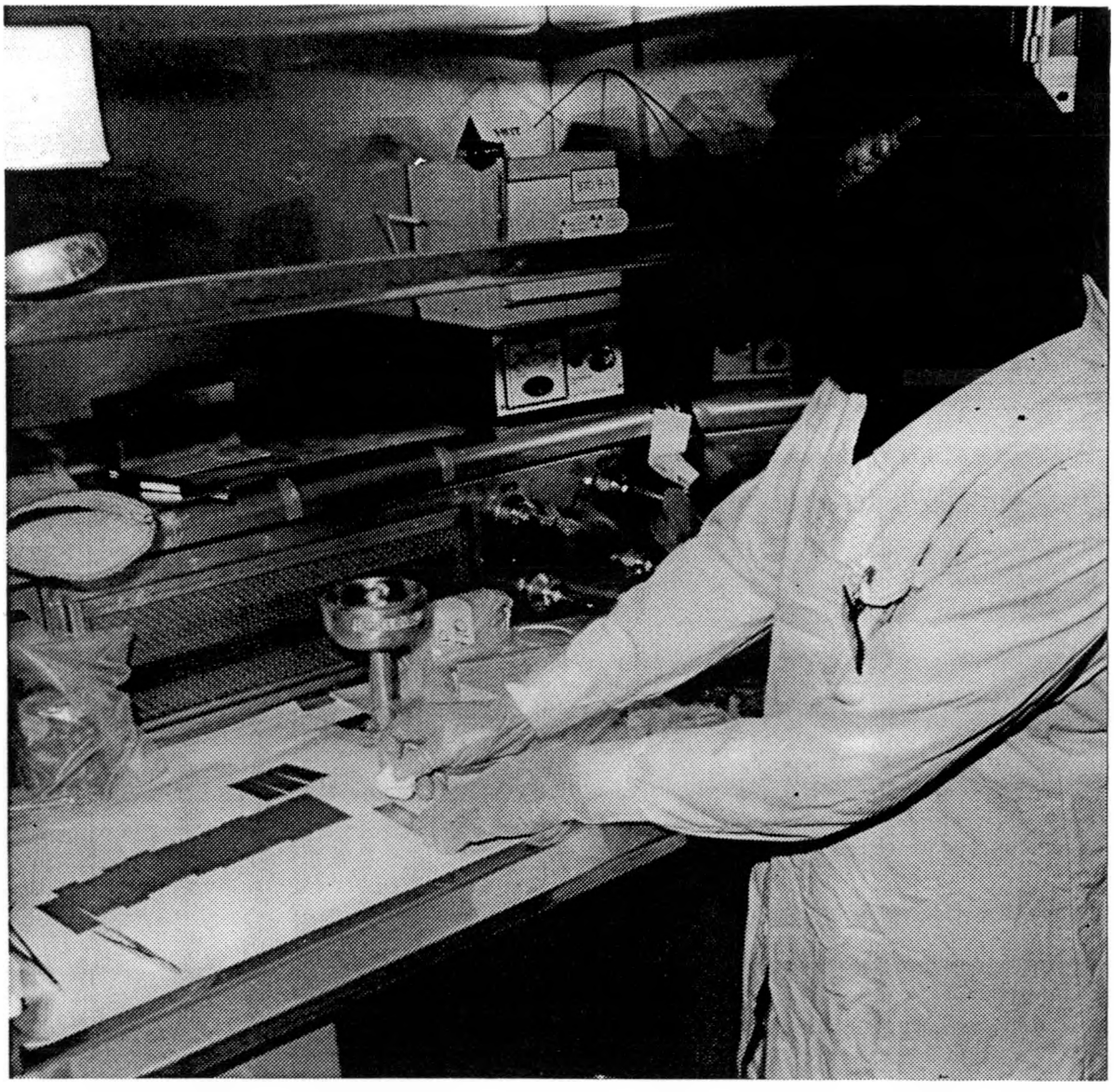

Figure 3. Laboratory-scale Wiping Tests

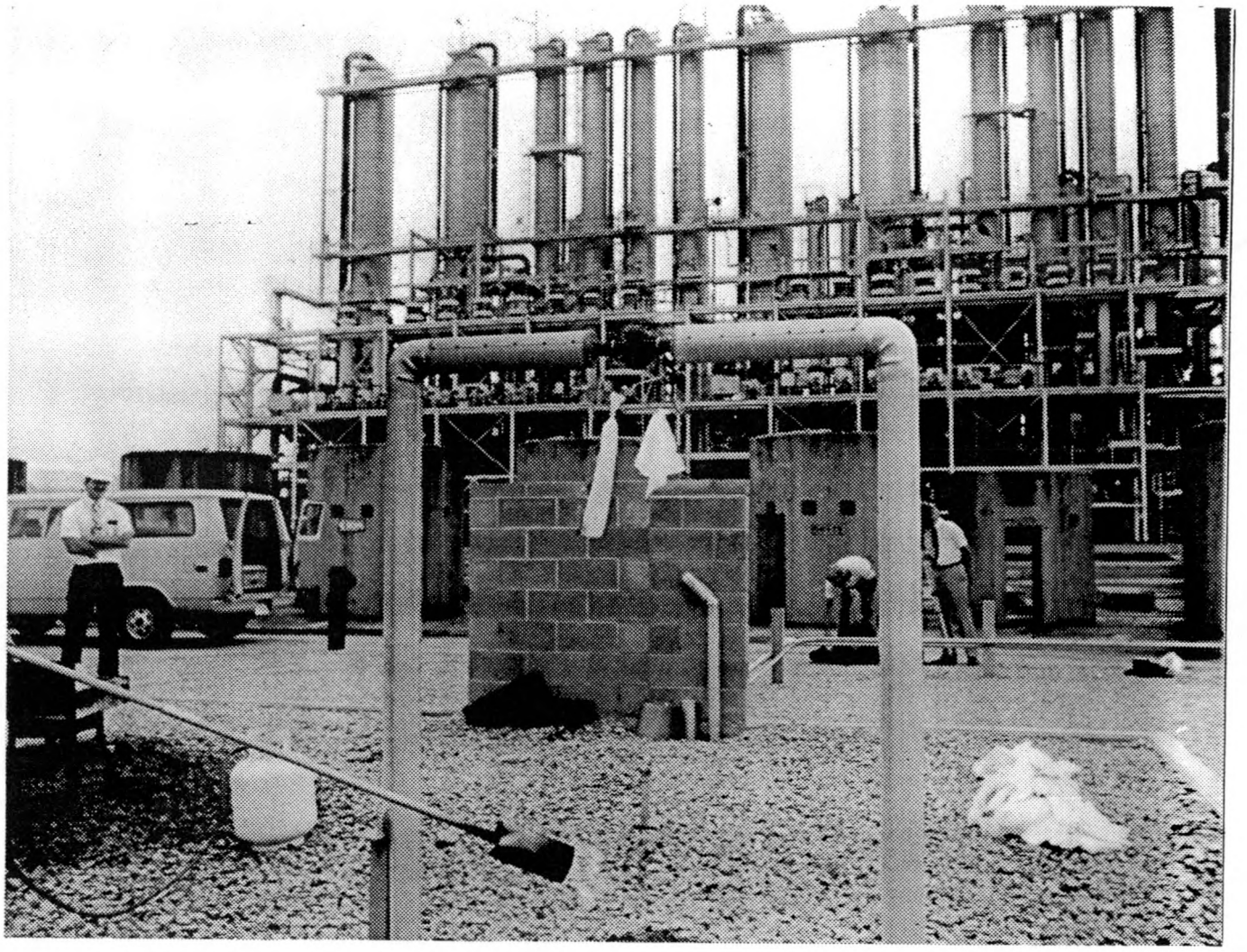

Figure 4. First Fire Test

Figure 5. Second Fire Test