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ONSITE TREATMENT OF VOLATILE ORGANIC COMPOUNDS IN GROUNDWATER

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John L. Steele

E. I. du Pont de Nemours & Co.
Savannah River Plant
Aiken, South Carolina 29808

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John L. Steele, P. E.

E. I. du Pont de Nemours & Co.
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ABSTRACT

Volatile organic compounds (trichloroethylene and tetrachloroethylene) were discovered in a shallow groundwater zone. A three-phase program was implemented to systematically address the problem. Principal sources and location of the contaminants were identified along with appropriate remedial action technology. A pilot air stripping column was installed to evaluate air stripping. A 50-gpm production unit is being built and will be followed by a 400-gpm production unit.

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DISCUSSION

Volatile organic compounds mainly (trichloroethylene and perchloroethylene) were discovered in the groundwater beneath M Area at the Savannah River Plant and a three phase program was implemented to systematically address the problem. The three phases of the program (Slide 1) included:

- Preliminary Assessment
- Groundwater Monitoring Assessment
- Installation of a Remedial Action System.

The preliminary assessment involved the identification of all possible contamination sources, collection of available data, and assessment of the preliminary data.

The second phase of the program involved the installation of a monitor well network and the collection of groundwater quality data quarterly for one year. With the water quality data in hand, remedial action alternatives were evaluated and the optimum one selected.

The third and current phase of the program involves the design and installation of the remedial action facilities.

Aeration, in particular air stripping, was selected as the best treatment option. Basically, it is a system where water flows by gravity over packed material enclosed in a cylindrical structure. This is simply illustrated in Slide 2.

Packed tower air strippers offer improved mass transfer. Their removal efficiencies are quite often greater than 99% with relatively low gas pressure drops. This is possible due to the packing which disrupts the flow of liquid thereby producing and renewing the water/air interface.[1]

Design methodology is based on empirical mass transfer correlations; therefore, pilot studies are highly recommended. This is why a 20-gpm pilot air-stripper column was installed prior to a full scale system. In addition, the pilot column also enabled remedial action to be quickly implemented on a small scale. Recovery well performance was also observed and analyzed during the pilot operation.

The pilot unit became operational in February 1983 (Slide 3). Its first month in operation was devoted to gathering operational data. A TRACOR® 565 gas chromotograph with a Hall detector was

installed at the site to perform the analytical work. The field analytical set-up eliminated delays and permitted rapid turnaround for the samples. Operating parameters were developed and mass transfer correlations verified with the data collected.

The unit has continued to operate during the past months for evaluation of potential pluggage problems, air emissions, and increased efficiency.

Two important points came out of the pilot program (Slide 4). First, the Henry's Law constants were not up to the theoretical values. They were somewhat depressed. As a result, the relative volatilities were less. The theoretical height of a transfer unit (HTU) was also found to be less than the actual HTU. What this implies is that for SRP's application, a column theoretically designed would be undersized. This point was closely considered with the design of a 50-gpm production unit and a 400-gpm production unit. The pilot operation enabled a high degree of confidence in the mass transfer correlations and in turn has permitted more precise designs for the 50-and 400-gpm production units.

The pilot column is a 14-inch-diameter PVC column (Slide 5). It is 34 feet high to the tip of its stack. It has two packed beds each 9 feet high. The packing material is polypropylene Flexirings® (Slide 6). The water is supplied to the top of the column from an 8-inch recovery well (Slide 7). Flow is monitored with a totalizer (Slide 8). Operating time is recorded with an hour meter (Slide 9). The column is remotely located, but is serviced with 240V single phase power (Slide 10). Air is supplied to the base of the column by a Roots Whispair® blower (Slide 11). The blower's speed is controlled by means of an Allen Bradley variable frequency motor drive (Slide 12). The motor drive is located in a weather-tight, temperature-controlled enclosure (Slides 13,14,15). The column will automatically shutdown if the water level in the base gets too high. The unit is easy to operate, requires little attention, operates 24 hours a day and has performed well.

As previously mentioned, a new 50-gpm production air stripper is being fabricated (Slide 16). Its design is based upon the pilot program work. It will be 20 inches in diameter, 46 feet tall and be made of 304 stainless steel. It will have two 14-ft packed beds utilizing polypropylene Flexirings®. The unit will be in operation November, 1983.

A 400-gpm unit is currently being designed for the full-scale remedial action program.

The pilot stripper column has played an important role in the SRP M-Area groundwater program. It has provided valuable design data and enabled early implementation of remedial action measures.

REFERENCES

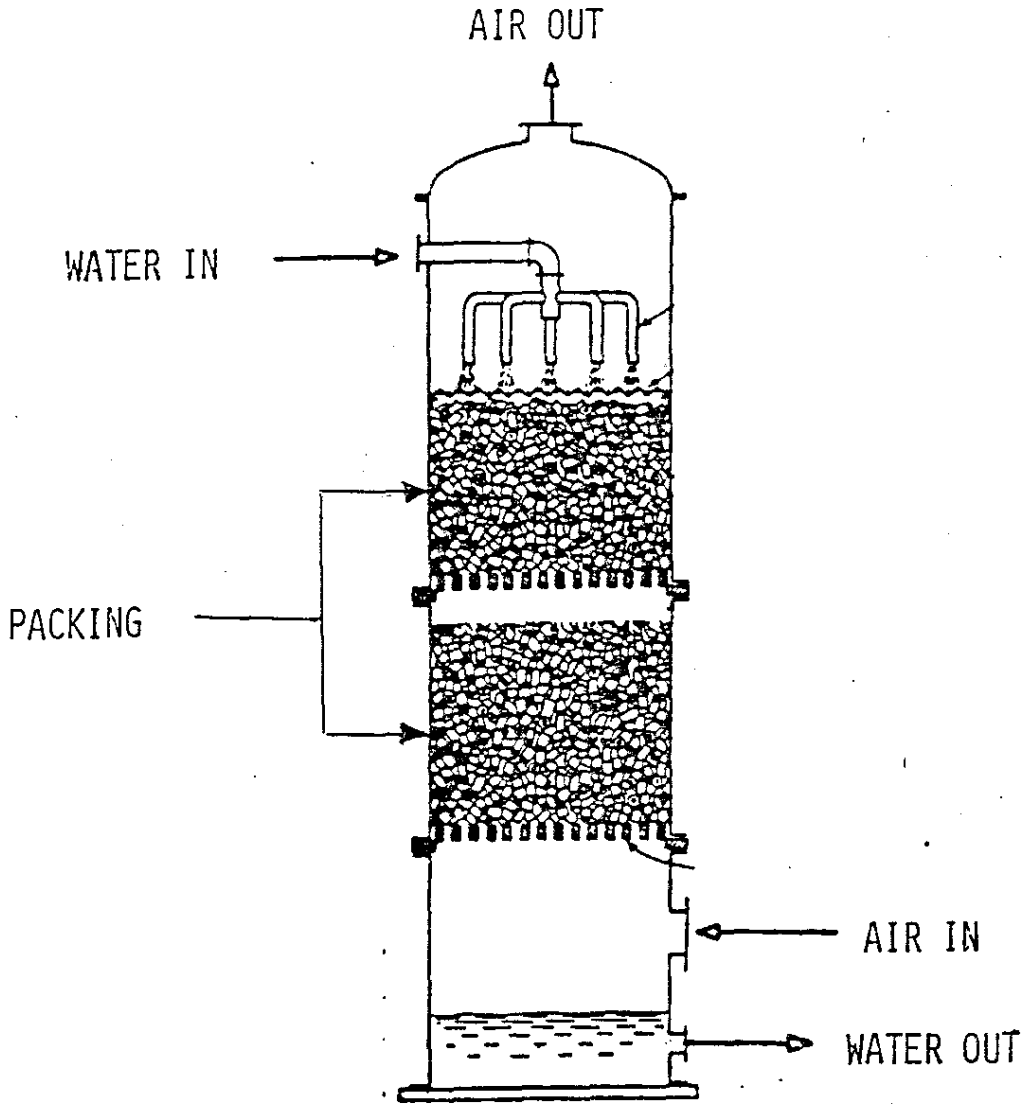
1. M. C. Kavanaugh and R. R. Trussell. "Air Strippping as a Treatment Process." AWWA Seminar Proceedings (June 7, 1981).

- VOLATILE ORGANIC COMPOUNDS (VOC)
  - TRICHLOROETHYLENE
  - PERCHLOROETHYLENE

- THREE PHASE PROGRAM
  - PRELIMINARY ASSESSMENT
  - GROUND WATER MONITORING ASSESSMENT
  - INSTALLATION OF PERMANENT RECOVERY SYSTEM

SLIDE 1

PACKED TOWER AIR STRIPPER



SLIDE 2

- PILOT AIR STRIPPER
  - FEBRUARY, 1983
  - DATA COLLECTION/ANALYSIS
  - OPERATING PARAMETERS
  - MASS TRANSFER CORRELATIONS
  - ONGOING EVALUATION

SLIDE 3

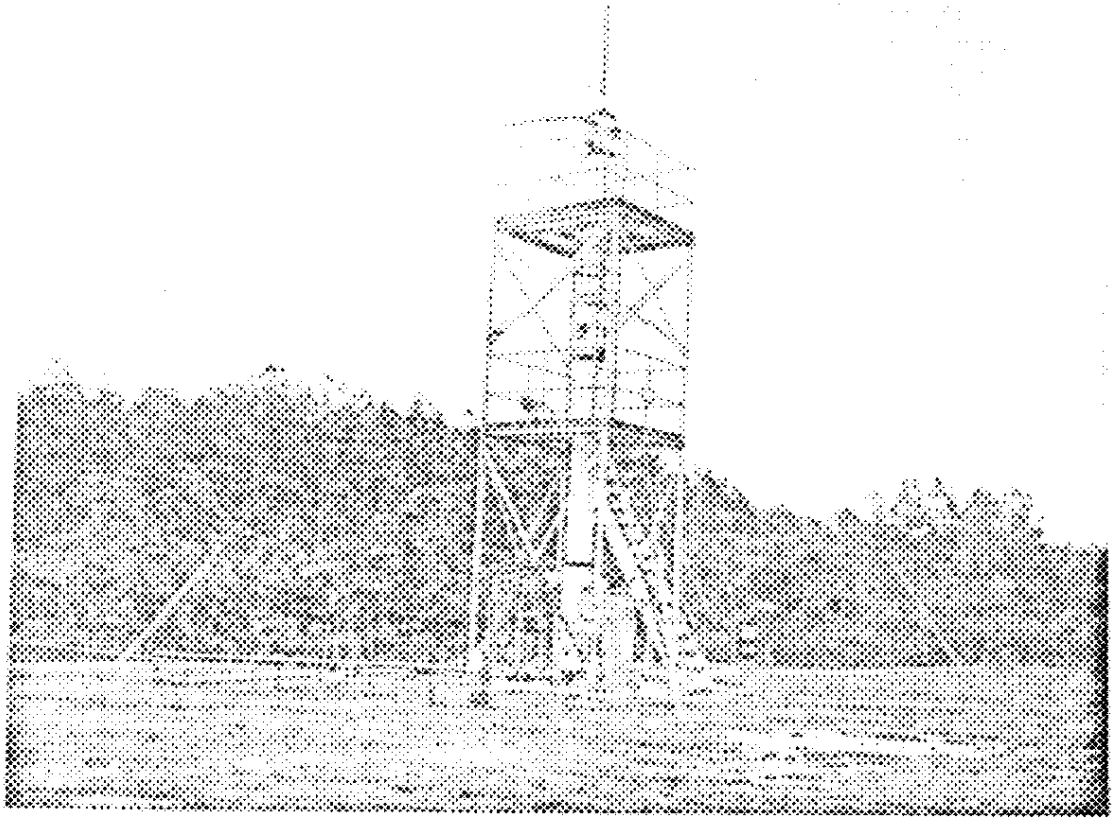
PILOT PROGRAM

- HENRY'S LAW CONSTANTS
  - SOMEWHAT DEPRESSED

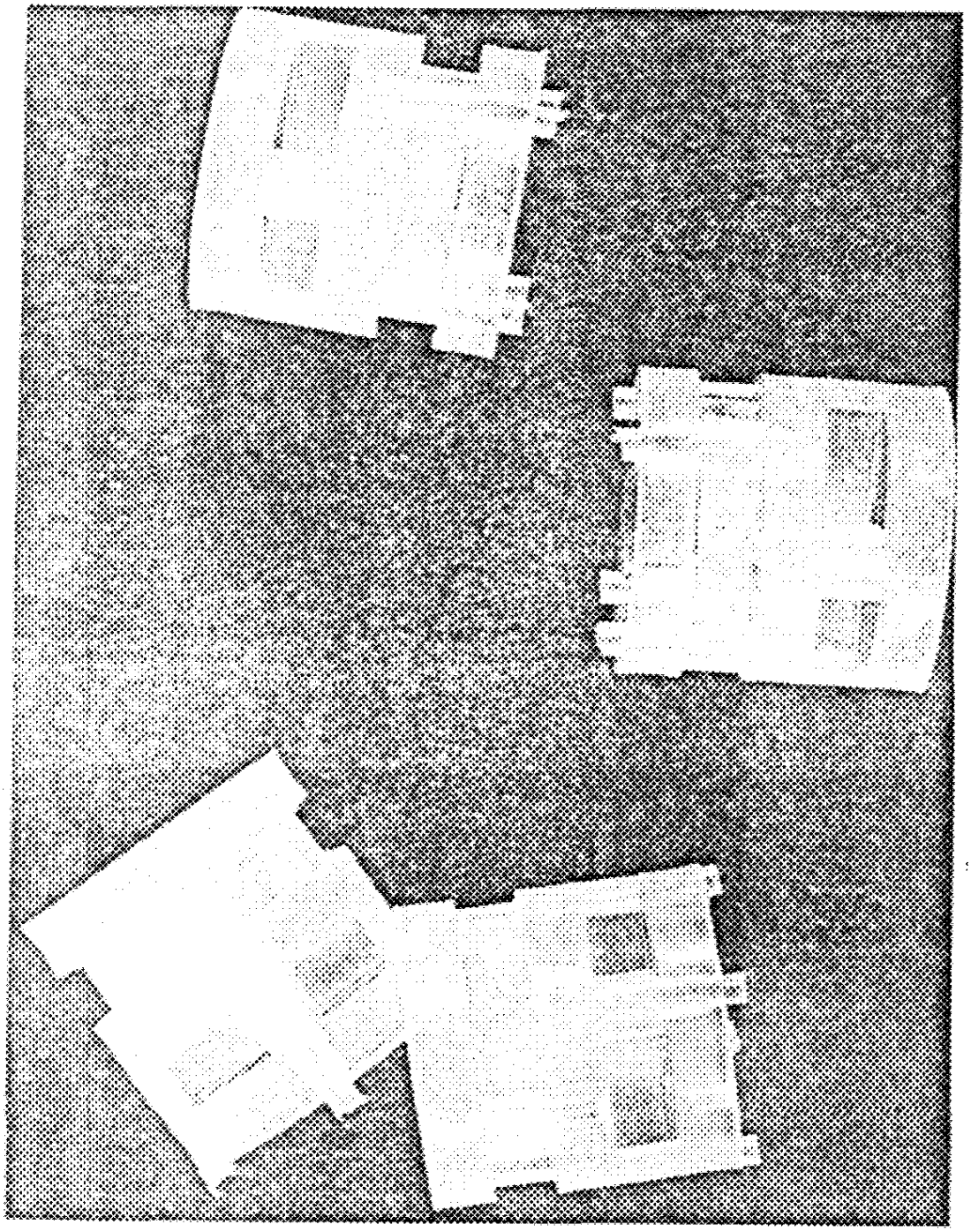
- HEIGHT OF A TRANSFER UNIT (HTU)
  - THEORETICAL < ACTUAL

- CONFIDENCE IN MASS TRANSFER CORRELATIONS

SLIDE 4



SLIDE 5



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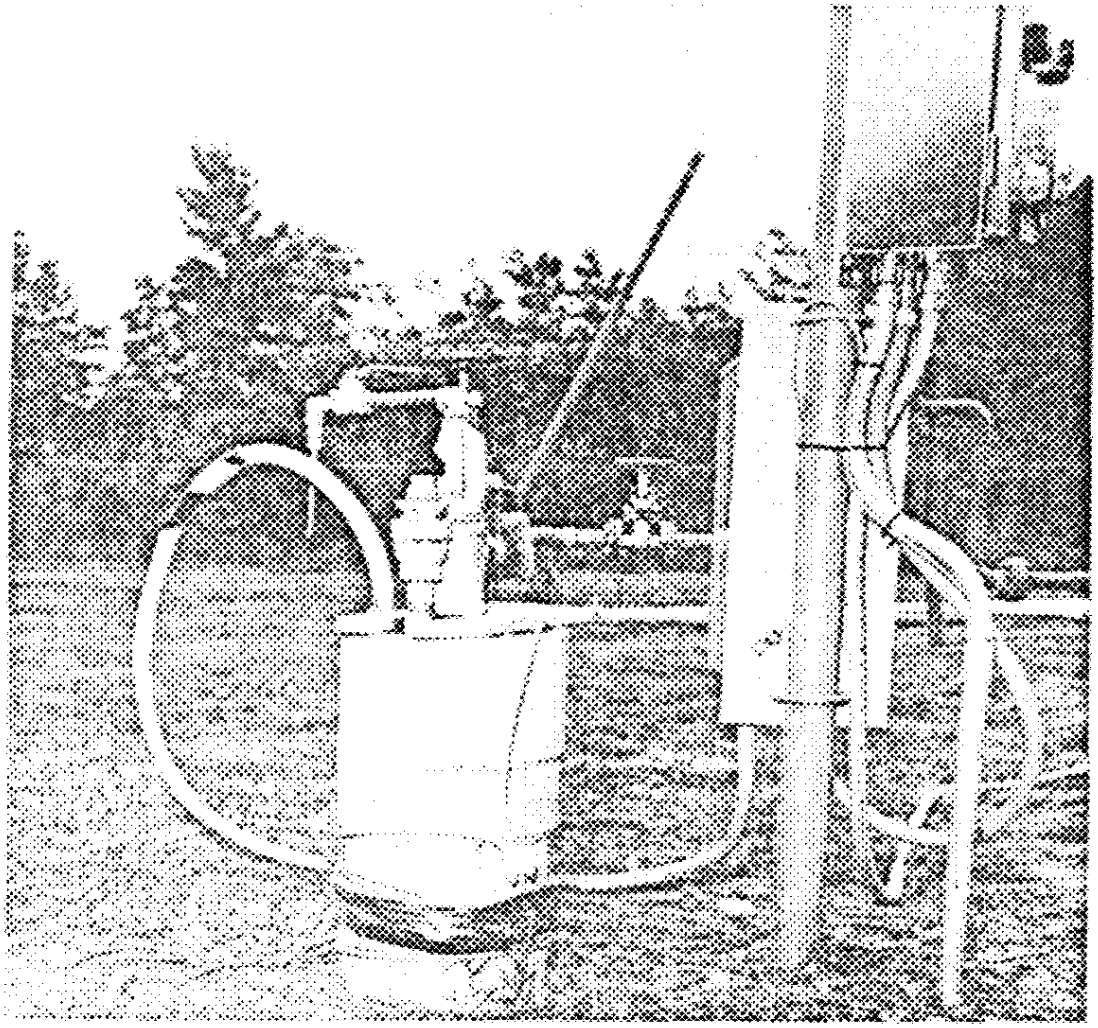
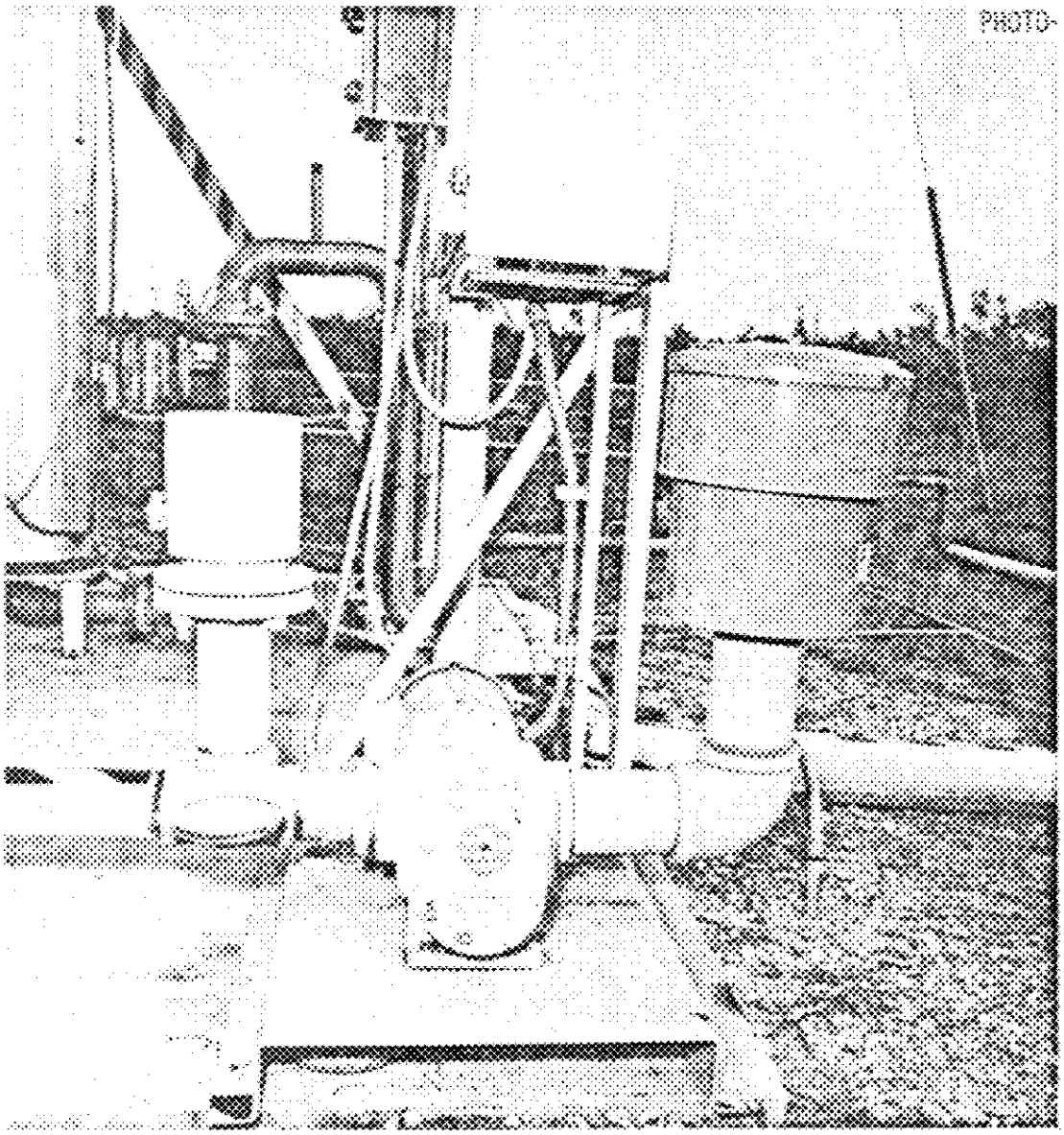


SLIDE 7

SLIDE 8

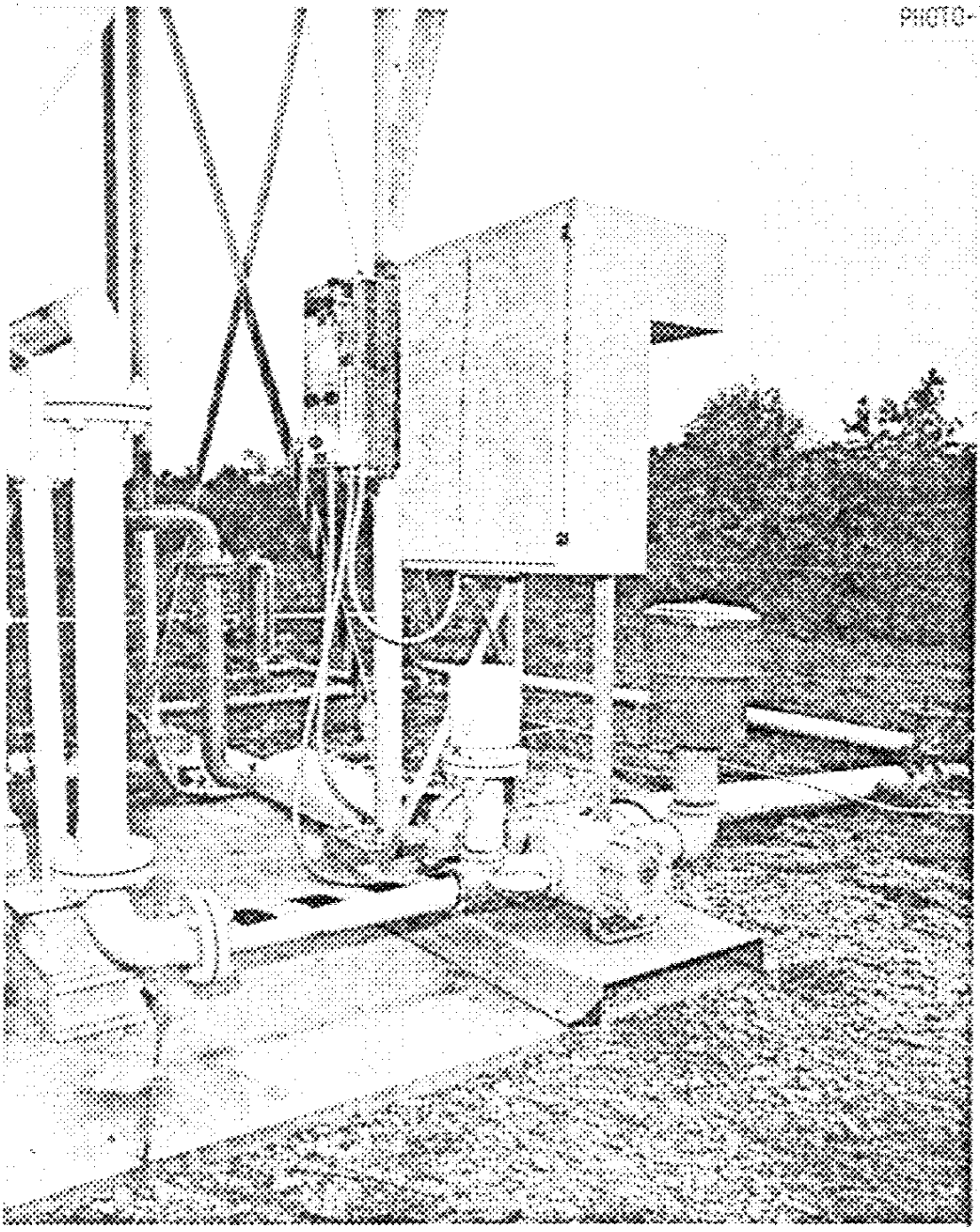
SLIDE 9

SLIDE 10



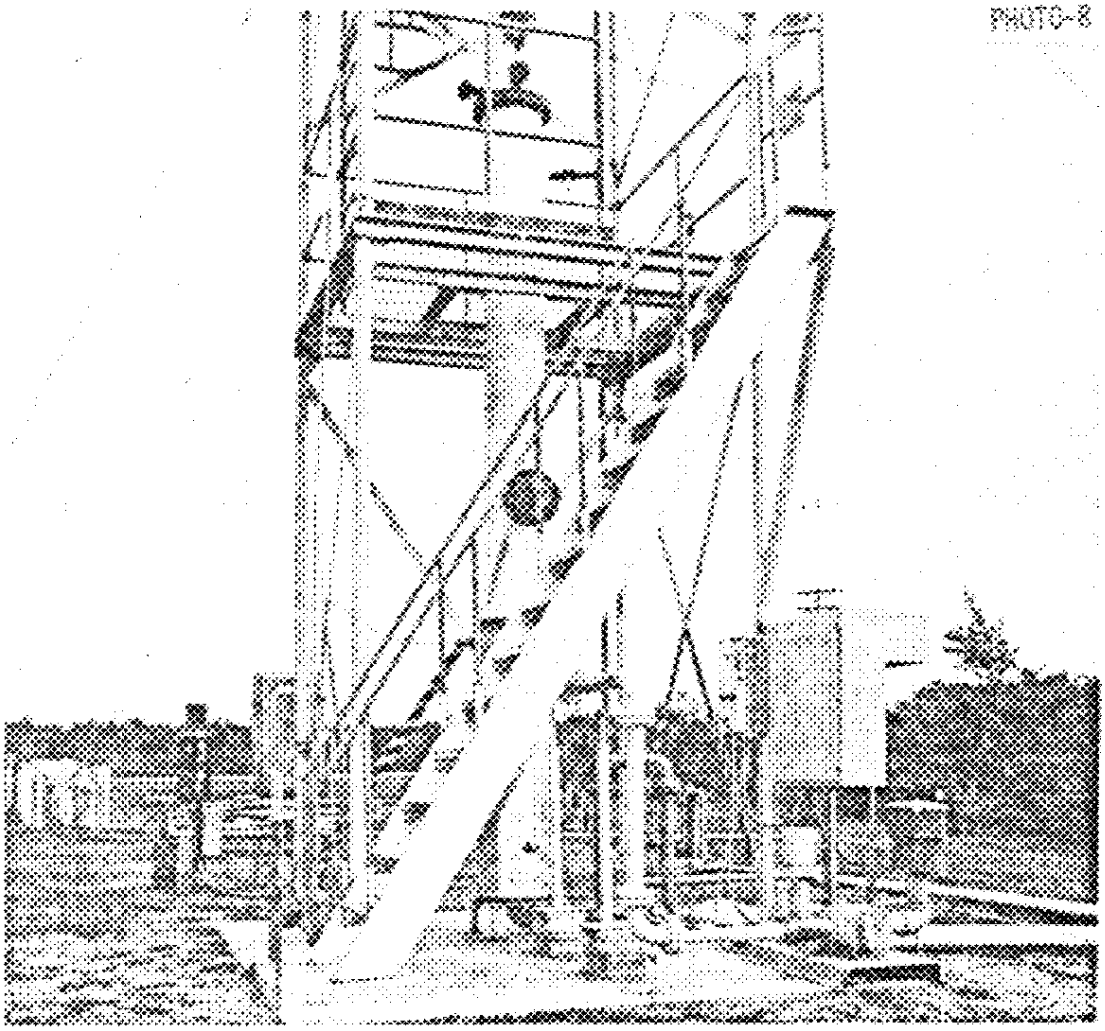
SLIDE 11

PHOTO-

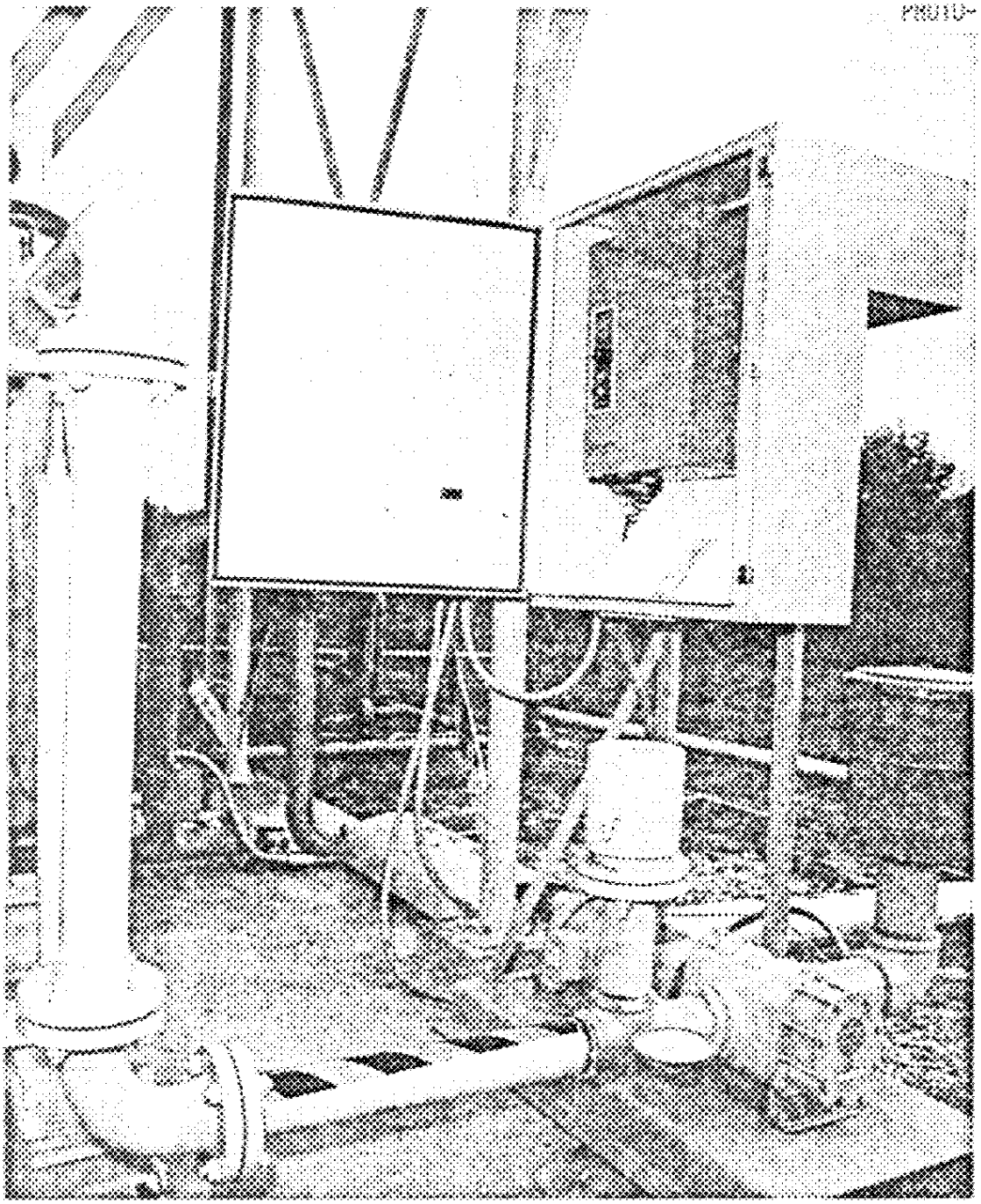


SLIDE 12

PHOTO-8



SLIDE 13



SLIDE 14

SLIDE 15

- 50 GPM PRODUCTION AIR STRIPPER UNIT
  - 20 INCH DIAMETER
  - 46 FEET TALL
  - 304 STAINLESS STEEL
  - TWO 14 FOOT PACKED BEDS
  - PVC FLEXIRINGS

- 400 GPM PRODUCTION UNIT
  - FULL SCALE REMEDIAL ACTION

SLIDE 16