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A LARGE-SCALE HIGH-EFFICIENCY AIR STRIPPER AND RECOVERY WELL NETWORK FOR REMOVING VOLATILE ORGANIC CHLOROCARBONS FROM GROUND WATER

by

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Introduction

The Savannah River Plant (SRP) is located in western South Carolina on the Georgia/South Carolina border. The plant produces special nuclear materials for national defense and is operated for the Department of Energy by E. I. du Pont de Nemours and Company. M Area, located in the northwest quadrant of the plant, manufactures fuel and target assemblies for the site's reactors. Chemical wastes generated by this process containing acids, alkalis, metals, and chlorinated degreasing solvents were discharged to a settling basin from 1958 to July 1985.

In June 1981, during routine monitoring of wells located near the M-Area settling basin, volatile organic chlorocarbons (specifically trichloroethylene and tetrachloroethylene) were discovered in the shallow ground water.

A three-phase program was implemented to systematically address the problem (J. L. Steele, 1983). The three phases of the program included:

- Preliminary Assessment
- Ground Water 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 ground water quality data. Using these water quality data, remedial action alternatives were evaluated and the optimum alternative selected based on the following program objectives:

- Retard the vertical and horizontal migration of contaminated ground water.
- Remove the chlorocarbons from the recovered ground water.

This phase also began to employ a numerical ground water flow model for the hydrological system in the M Area and vicinity. The third phase of the program involved the design and installation of the remedial action facilities.

Ground Water Assessment Program

Following the discovery of contaminated ground water, a thorough background investigation was conducted. This included past usage of solvents, spills, releases, and identification of potential source areas. A monitor well network of approximately 50 wells was installed and ground water quality data was collected to define the vertical and horizontal extent of the the plume. To date, over 200 monitor wells have been installed in and around M Area.

The horizontal area of the plume at the 100 ppb total degreaser solvent contour is estimated at 360 acres, with a total estimated inventory in the saturated zone of approximately 360,000 pounds. The vertical extent of the contaminant plume ranges from the water table, which is approximately 80 to 100 feet below the ground surface, to approximately 200 feet below ground surface.

A ground water flow model was initially employed in 1984 for M Area using a three-dimensional, multi-layered, finite-difference aquifer simulation. Review of the geologic and potentiometric data indicated that the ground water environment beneath M Area could be modeled more accurately by dividing the section into three separate hydrologic units. The two uppermost units are known locally as the Upper and Lower Tertiary aquifer, and the lowermost unit, the Tuscaloosa aquifer. The confining layer between the Tertiary and Tuscaloosa aquifers is called the Ellenton Formation. These hydrologic units were selected to provide adequate detail regarding vertical variation of ground water conditions that exist at the study area. The model is also used to assess the effectiveness of the remedial action system in managing the chlorocarbon plume and to estimate the effects of recovery well operation on the hydrologic system.

Evaluation of Remedial Action Alternatives

Several cleanup technologies for removing volatile organics from ground water were evaluated. Air stripping was chosen as the best overall alternative. This approach was chosen because it met our program objectives and was a cost effective method of treatment. Other methods evaluated included steam stripping, activated carbon adsorption, synthetic resin adsorption, and fuel oil extraction.

Air stripping is used widely in the chemical industry. Air stripping of ground water contaminated by volatile compounds is an effective and economical method of treatment and is one of the techniques recommended by the Environmental Protection Agency for treating drinking water (O. T. Lover and R. G. Eilers, 1981 and EPA Regulations). Effects of atmospheric releases, nonvolatiles, and column pluggage were evaluated before air stripping was selected as a treatment method, but were not significant for the M-Area problem.

Steam stripping is sometimes used as an alternative to air stripping when the organics to be removed are only slightly volatile, or organic recovery is required. Steam stripping shares many of the advantages of air stripping. However, operating costs are higher due to steam usage, and the disposal of the recovered organics. Steam stripping was not justified in this case.

Activated carbon adsorption is used for ground water and drinking water treatment. Activated carbon has greater applicability than air stripping because it can also remove nonvolatile compounds. The principal disadvantage to activated carbon adsorption is that the carbon must be regenerated or disposed of after each use. The regeneration costs and potential generation of solid wastes mitigated against this option.

Synthetic resin adsorption is similar to activated carbon adsorption. The synthetic adsorbents can be selected to give twice the bed life of activated carbon, but the initial cost is 15 to 20 times greater than that for activated carbon. Also, regeneration services for synthetic resins are not typically available.

Fuel oil or solvent extraction is a technology that could be used for removing organic compounds from ground water. However, it was not considered for this case due to the large amount of wastes that would be generated, and the solubility of solvent in the effluent water.

Air-Stripping Technology

The packed tower, as shown in Figure 1, is commonly used in air stripping. It consists of a cylindrical column, with liquid inlet and distributor at the top, and a gas inlet and distributing space at the bottom. Packing material located below each liquid distributing plate is known as the packed bed and is supported by gas injection support plates. It is not uncommon for packed towers to use multiple liquid distributing devices and packed beds. The gas outlet (stripper stack) is located at the top of the column above the entrainment separator. The entrainment separator or demister minimizes liquid in the exhaust air. The liquid outlet is located at the bottom.

The inlet liquid is pumped to the top of the column where it is evenly distributed over the upper packed bed by the distributor plate. The liquid flows by gravity down through the first packed bed, where it is collected and redistributed over the lower packed bed by the redistributor. In an ideal operation, the liquid distribution wets all packing surfaces uniformly. Uniform liquid distribution is essential to high efficiency. Air is fed to the bottom of the column and flows upward through the packing countercurrent to the water flow. The packing provides a large surface area for intimate contact between the liquid and gas phases. The volatile organics in the ground water are vaporized and exhausted through the stack. The clean water is discharged from the bottom of the column.

Randomly dumped packing was used in our case rather than stacked packing. Randomly dumped packings offer better liquid-gas interface due to the frequent change in fluid velocity and direction. Several material characteristics of the packing were considered during the selection process, including: sufficient strength to resist crushing; light weight; chemically inert to the process fluids; adequate flow passages for good contact between the liquid and gas; and reasonable cost.

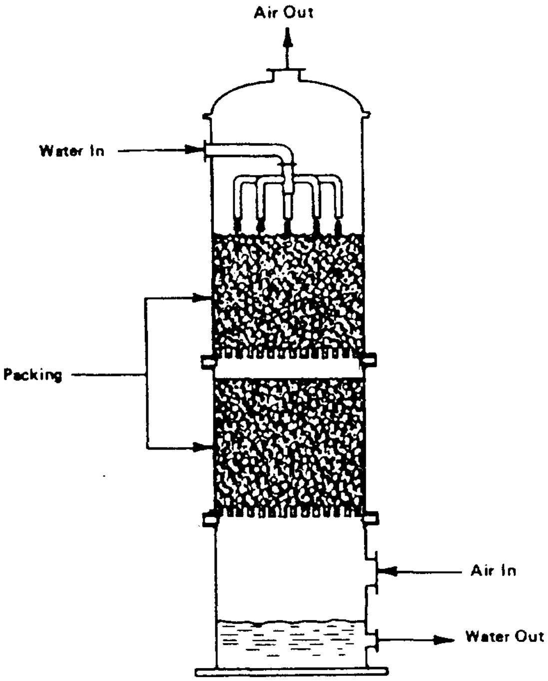

FIGURE 1. Packed Tower Air Stripper

Program Strategy

There were a number of elements required for the successful design, installation, and operation of a major engineering project such as the remedial action facilities described in this paper. Those elements included the plant's engineering project system, various regulatory and permitting requirements, a quality verification program, preparation of operating procedures, operator training, troubleshooting after startup, and evaluation of the system's performance.

The engineering project system involved several stages. The compilation of basic data or description of the problem parameters was developed early in the program. From the basic data, the design process began. Several modifications were made to the original design prior to entering the materials procurement stage. Physical construction started as various portions of the procurement stage were completed.

Several regulatory and permitting requirements were addressed prior to construction. Environmental effects of the remedial action facilities were identified and evaluated, as required by the National Environmental Policy Act (NEPA). The plant's National Pollution Discharge Elimination System (NPDES) permit was modified to include the remedial action facilities discharge. The state regulatory agency, South Carolina Department of Health and Environmental Control (SCDHEC), required construction and operating permits for both air and wastewater discharges. SCDHEC also required that operating personnel be certified by the state.

A quality verification program was instituted during the procurement and construction phases to ensure purchased equipment was built to plant specifications and that it was installed properly. Installation of the remedial action facilities was on an accelerated schedule that allotted no time for major fabrication deficiencies. Therefore, numerous inspections were made onsite and at vendor shops. Several major deficiencies were identified and resolved without impacting the schedule. These efforts minimized the time required for trouble-shooting after startup. Nevertheless, some problems could only have been identified after startup.

Procedures were developed for check out and normal operation of the new equipment. The M-Area remedial action facilities were the first of their kind at SRP, which meant ground-level training of operators of the remedial action facilities was for sanitary wastewater treatment facilities and did not address air stripping.

Design Development

Design Criteria

Design criteria for the full-scale remedial action facilities included the following:

- Removal of chlorocarbons from an influent concentration of 50,000 ppb to a total effluent chlorocarbon concentration of less than the minimum detection limit of 1 ppb (using state-of-the-art techniques).
- Air emissions less than 40 tons per year.
- Design flow rate of 400 gpm (as a result of the above criteria).
- Low maintenance, high operating utility.
- 40-year equipment life.
- Adjustable air and water flow rates.
- System interlocks.
- Convertible to steam stripping in the event abatement was required in the future.

To meet the design criteria, several critical parameters were identified. They included the liquid distribution system, the packing design, and sufficient air supply. The liquid distribution system must provide even liquid distribution across the packed bed. Uneven distribution could lead to channeling, resulting in reduced removal efficiency.

In addition, equipment interlocks were required to prevent discharge of untreated ground water to the NPDES permitted outfall. Materials of construction were to be resistant to the process and meet structural strength requirements while handling high flow rates.

The path chosen to meet these design criteria was to first install a small pilot unit to conduct performance testing, collect operating data and gain operating experience. The second step involved the design and installation of a larger 50-gpm prototype unit. Finally, the full-scale remedial action system would be designed and installed based on data obtained from the smaller units.

Pilot Air Stripper

Stripper design is based on empirical mass transfer correlations; therefore, pilot studies are highly recommended. A 20-gpm pilot air stripper column was installed with one recovery well in February 1983. This unit provided empirical mass transfer data while initiating remedial action on a small scale. The unit was located adjacent to the M-Area settling basin where chlorocarbon concentrations in the ground water were relatively high. Total influent chlorocarbon concentrations of approximately 160,000 ppb were reduced to less than 20 ppb. This demonstrated that our basic goal was achievable.

The column, made of PVC, measured 14 inches in diameter and 34 feet in height. It was designed with two packed beds, each measuring nine feet in height, with a liquid distribution tray above each bed. Packing material was one-inch-diameter pall rings made of polypropylene. An air blower with variable-speed drive was used to supply air to the column at about 200 cubic feet per minute. The treated effluent was discharged by gravity to the nearby settling basin.

Performance tests were conducted at various water and air flow rates. Influent and effluent water samples were collected during each test. Water-filled manometers were used to measure various operating parameters such as the blower air flow rate, and the differential pressure across the packed beds. Thermowells installed along the height of the column were used to measure water temperature at the distributor trays. Water feed rate and total gallons pumped were monitored from a totalizer. Operating time was recorded by an hour meter. Samples were analyzed using a gas chromotograph installed at the site. The field analytical setup eliminated delays and permitted rapid turnaround for the samples.

During the operating life of the pilot air stripper, stack and ambient air emissions were tested. The stack testing studies revealed air emissions at a rate close to those predicted using mass balance calculations from water samples. The ambient air results under normal operating conditions were significantly lower than the worst-case levels predicted by an air emissions model.

SCDHEC was notified of the installation and given a full description of the facility and an assessment of anticipated releases based on modeling prior to operation. Because the pilot stripper was an experimental unit that did not discharge to a permitted outfall, the formal permitting procedure was not required by SCDHEC.

Evaluation of the operating data yielded the conclusion that air stripping was feasible as a treatment method for the M-Area problem. The pilot operation enabled a high degree of confidence in the mass transfer correlations and, in turn, permitted a more precise design for the production prototype air stripper and the full-scale unit.

Production Air Stripper Unit No. 1

This air stripper became operational in January 1984 and served as a prototype production unit for the full-scale model. It was fed by two recovery wells at a total flow rate of 50 gpm. With an influent chlorocarbon concentration of over 120,000 ppb, this unit demonstrated an effluent total chlorocarbon concentration of less than the detectable limit of 1 ppb.

The column measured 20 inches in diameter and 46 feet in height. Two packed beds and liquid distribution trays were utilized, as with the pilot stripper. The packed beds of this unit measured 14 feet in height. More attention was focused on the levelness of the liquid distribution trays. Materials of construction for the column, distributor trays, and above ground piping were upgraded to 304 stainless steel. It was equipped with interlocks to prevent, in case of blower failure, the release of untreated water. This unit utilized pneumatic instrumentation and water flow controllers supplied by a dedicated instrument air system. A discharge pump was used to pump the column effluent to the discharge point.

SCDHEC required air and wastewater construction permits prior to installation of the 50 gpm unit because the effluent would be discharged to a NPDES outfall. A wastewater operating permit was required by SCDHEC prior to operation. Air emissions testing in the stripper stack was required to obtain an air operating permit. The design and operating experience with this unit provided a sound foundation for the design of the full-scale air stripper.

Full-Scale System

System Description

The remedial action project consists of the project air stripper, eleven recovery wells (designated RWM-1 through RWM-11), an air blower with adjustable frequency drive, tails pump, instrument air system, control building, associated piping, instrumentation, and controls (See Figure 2).

The recovery wells were strategically located within the contamination plume to create a desired cone of depression to retard lateral migration (see Figure 3). The wells were designed to fully penetrate the Tertiary aquifer. In each well, four 10-foot sections of well screen were installed opposite the zones of more permeable sands identified during well installation. The wells annuli were filled with a graded filter pack from total depth to the static water table. The wells are approximately 200 feet deep and remove contaminated ground

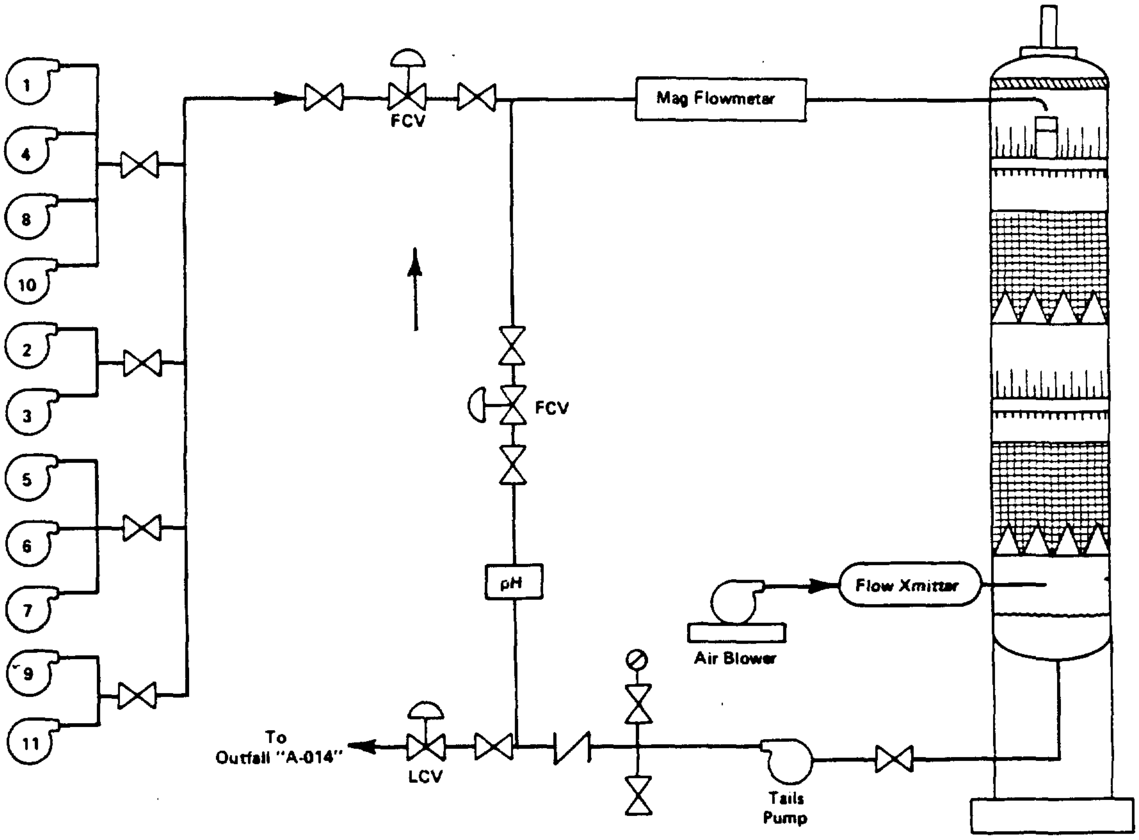

Figure 2. M-Area Remedial Action System Diagram

water from the Upper and Lower Tertiary zones, then pump it to the air stripper for treatment (see Figure 3 for well locations). Geohydrological data obtained from area monitoring wells were used in conjunction with an analytical ground water flow model to strategically locate and size the recovery wells. Two sizes of submersible stainless steel pumps were used. Four recovery wells (RWM-3, 5, 9, and 11) are equipped with 7.5 horsepower (hp) pumps capable of pumping 50 - 75 gpm. The remaining recovery wells use 5.0 hp pumps, which are operated in the 20 - 50 gpm range. Over two miles of thick-walled polyethylene piping were installed to connect the recovery well system to the air stripper.

The stripper column consists of two major components: (1) the cylindrical shell, and (2) the internals. The air stripper column measures 54 inches in diameter, is approximately 70 feet in height, and is designed to process 400 gpm of contaminated ground water. The column wall thickness varies from 5/16- inch at the bottom to 3/16-inch at the top, and is constructed of 304 stainless steel with welded joints. The skirt, slip flanges, manway cover supports, platforms, and ladders are constructed of carbon steel. Nozzles for access, inspection, and instrumentation are located along the column. Barrel ladders provide access to five platforms along the column from which all nozzles can be reached. The column is grounded by means of four 20-foot copper grounding rods, which are connected to grounding clips on the skirt.

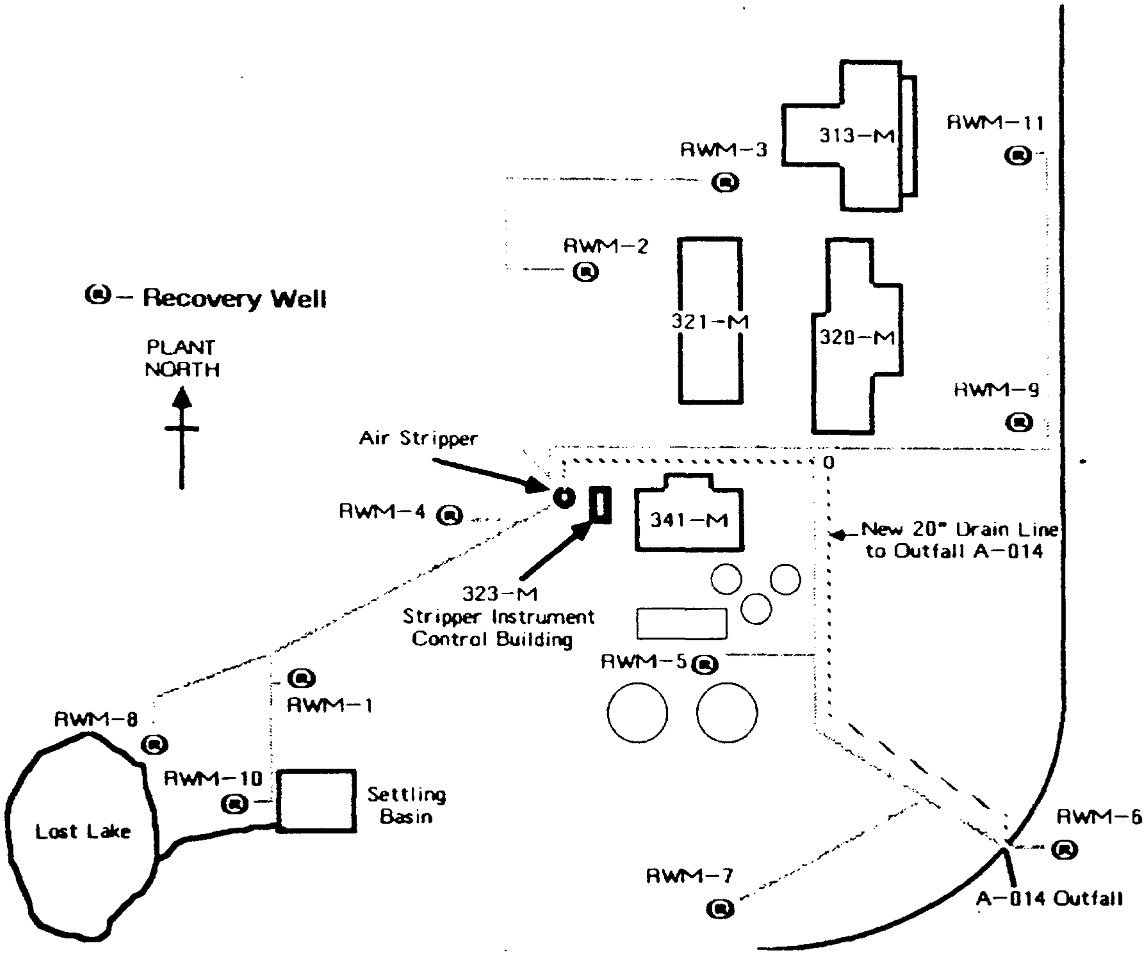

Figure 3. M-Area Remedial Action System Location

The internals consist of one liquid distributor plate, one liquid redistributor plate, two gas-injection support plates (packing supports), 600 cubic feet of packing material, and one entrainment separator (demister). The randomly dumped packing material is one-inch-diameter polypropylene pall rings, with the remainder of the internals constructed of 304 stainless steel. Both the liquid distributor and redistributor plates are of the tubed drip-pan type design with 10 to 12 distribution points per square foot of column area.

The rotary lobe air blower is driven by a 60 hp electric motor and controlled by an adjustable frequency drive. The blower has a maximum capacity of 5000 cubic feet per minute. During normal stripper operation the blower operates at 2000 cubic feet per minute.

The system utilizes a tails pump to recirculate water through the column to wet the packing prior to startup, and then to pump the clean effluent to the NPDES permitted outfall during normal operation. The tails pump is driven by a 15 hp electric motor. It has a pumping capacity range of 60 to 400 gpm with total dynamic head of about 71 feet.

The dedicated instrument air system for the column provides dry air to the pneumatic control valves at a maximum rate of 10 cubic feet per minute at 100 psi. The system consists of an air compressor, air dryer, prefilter, afterfilter, oil separator, and pressure regulator. Without quality instrument air, the pneumatic control system could malfunction, causing complete shutdown of the recovery well/air stripper system.

The air stripper and recovery wells are equipped with instrumentation that provide operating data and automated operation. Operating data must be collected manually at each recovery well and in the stripper control building. Each recovery well has a pressure gauge, sample port, water totalizer, and instantaneous flow rate indicator. The stripper column is equipped with a stripper liquid level indicator, influent water flow rate, differential pressure across each packing bed, influent water pH, and temperature. Air flow rate and air temperature from the blower are also displayed. The tails pump discharge pressure is monitored via a pressure gauge. Water sampling ports are available on both the influent and effluent sides of the stripper.

System Operation

The project air stripper is equipped with several safety interlocks to ensure that only treated water is discharged and to protect personnel and the equipment. Any of the following conditions will cause an automatic system shutdown: (1) high stripper liquid level, (2) low stripper liquid level, (3) high differential pressure across either packing section, (4) low air flow, (5) low water flow, and (6) a high percent deviation between air flow and water flow rates.

Due to the various interlocks, a "Bypass" mode was designed into the control circuitry, which bypasses the interlocks for a period of time while system components are started. A time-delayed relay was incorporated to allow the startup time to be adjusted from 7 to 68 minutes. After the time period expires, the system reverts to the "Auto" mode. When in the "Auto" mode, all conditions must be satisfied or complete system shutdown will occur. Even in the "Bypass" mode, the following startup conditions exist due to the safety interlocks (1) the recovery well pumps cannot be started on stripper high level, (2) the tails pump cannot be started on stripper low level, (3) if the recovery well pumps are started with the stripper influent control valve closed, an alarm will sound in the control room, and (4) all components will be inoperable when there is a high differential pressure across the packing beds.

Starting the system involves many steps. Written procedures with sign-off sheets are used to ensure the proper startup sequence. The startup sequence can be divided into five categories: (1) preparation prior to startup, (2) charging the system with water, (3) recirculation to wet the packing, (4) blower startup and stripping of recirculation water, and (5) transition to normal operation.

During normal operation, recovery well data are collected on a daily basis. Stripper operation data are collected on each shift around the clock. It is very important to know the operational history of the air stripper and recovery wells when assessing the effectiveness of the system on the underlying aquifer.

System Performance

Project construction began in September 1984 with initial startup in April 1985. During the summer of 1985, some problems were encountered that restricted full-scale operation. The two primary problems were: (1) failure of the adjustable frequency drive after being hit by lightning, and (2) improper grounding of the multiplexer system, which controls the automatic operation of the recovery well network. While these problems were being resolved, the air stripper was operated at a reduced capacity in a manual mode to collect hydrologic data from individual recovery wells.

Since September 1985, the air stripper has been processing 375 to 400 gpm with 10 to 11 recovery wells online. The operational reliability of the system has been demonstrated by an average utility of over 90%, including routine maintenance.

Since its startup in April 1985, the stripper influent and effluent have been sampled approximately once per week and analyzed for degreaser solvents, specifically, trichloroethylene, tetrachloroethylene, and 1,1,1-trichloroethane. Monthly average total degreaser concentrations for stripper influent and effluent are presented in Table 1. Although the range in influent concentrations varied widely depending on the total number and specific recovery wells operating, the effluent concentration was always less than the 1 ppb analytical detection limit. A summary of the air stripper performance data is presented in Table 1.

The number of recovery wells online between April and September 1985 varied, depending on operational problems associated with startup.

The wide range in total degreaser concentrations (100-200,000 ppb) reported from June to August 1985 in Table 1 reflects the range of chlorocarbon levels in the individual recovery wells.

Stack-air emission sampling was conducted as part of the final operating permit requirements for the air stripper. These results demonstrated that the total degreaser air emissions from the column were within the permit limits of 7.9 pounds per hour or 35 tons per year, at a maximum flow of 400 gpm.

Current Status

Operation of the pilot unit was terminated in February 1985, with a total of 16,000 pounds of chlorocarbons removed from 17 million gallons of water processed. The recovery well that fed the pilot stripper (RWM-1) was then connected to the project air stripper system.

TABLE 1. Summary of M-Area Project Air Stripper Performance

Date	No. of Wells Operating	Total Degreaser Concentration (ppb)	
		Influent	Effluent
April '85	3	4,900	<1
May '85	5	29,000	<1
June/Aug '85	1*	100 - 200,000	<1
Sept. '85	11	47,100	<1
Oct. '85	11	34,500	<1
Nov. '85	10	32,000	<1
Dec. '85	10	32,100	<1
Jan. '86	11	37,075	<1
Feb. '86	11	30,490	<1
March '86	11	37,600	<1

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*One recovery well operating at a time during individual hydrological testing.

The 50-gpm air stripper was shut down in March 1985, and the two recovery wells (RWM 2 & 3) that fed it were connected to the project air stripper system. The 50-gpm unit processed approximately 22 million gallons of water, removing about 15,500 pounds of degreaser solvents.

The project air stripper system has been in full-scale operation since September 1985. It has been fully permitted by South Carolina Department of Health and Environmental Control. From April 1985 through March 1986, approximately 33,500 pounds of chlorocarbons have been removed by this unit from 115 million gallons of water. Hydrologic data is currently being assessed and will continue to be collected. Locations of recovery wells are being evaluated. Ground water quality data are being monitored and compared to the system operating performance to predict the system effectiveness in meeting the program objectives.

Acknowledgement

The engineering design for each of the air strippers in this case study was done by Mervin E. Meckley of the Engineering Services Division of E. I. du Pont de Nemours and Company, Inc. We, the authors, are grateful for his assistance and recognize that the excellent column performance reflects his contributions.

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Biographical Sketches

Mr. Llewellyn F. Boone received a B.S. in Mechanical Engineering from the University of South Carolina. For the past two years he has worked on the design, development, and construction of air stripper/recovery well systems used to remediate volatile organic ground water contamination at the Savannah River Plant. Prior to his current position, he worked as lead engineer of various mechanical design areas in the renovation of a nuclear production reactor at SRP. E. I. du Pont de Nemours & Co., Savannah River Plant, 320-4M, Aiken, SC 29808.

Mr. Robert Lorenz received an M.S. in Water Resources from the S.U.N.Y. College of Environmental Sciences and Forestry. He is a senior engineer with Du Pont at the Savannah River Plant. During his five-year career with Du Pont he has been involved in long-term studies in gas, particulate matter, and energy exchange with the forest canopy. Other work included developing microcomputer-controlled data acquisition systems and writing software for data analysis and management. He is currently involved in a major ground water remediation program. His responsibilities include data base management, software development, coordinating field sampling, and special programs involving ground water flow and contamination control. E. I. du Pont de Nemours & Co., Savannah River Plant, 320-4M, Aiken, SC 29808.

Dr. Carl F. Muska, received a Ph.D. in Environmental Toxicology from Oregon State University. For the past two years he has worked as a Staff Engineer on a project to assess and remediate a volatile organic ground water contamination problem at the Savannah River Plant. Prior to his current position, he worked for five years as a Research Toxicologist at Du Pont's Haskell Laboratory for Toxicology and Industrial Medicine in Newark, DE. Areas of specialization include hazardous waste management and environmental regulatory issues with an emphasis on water quality standards and criteria. E. I. du Pont de Nemours & Co., Savannah River Plant, 320-4M, Aiken, SC 29808.

Mr. John L. Steele received a B.S. in Mechanical Engineering from the University of Akron. He currently is a Process Staff Engineer coordinating all ground water related activities at the 300-square-mile Savannah River Plant. Prior to his current position, he was directly responsible for the development and design of the large-scale high-efficiency air stripper and recovery well network covered in this presentation. Prior to his assignment at SRP he served as a Departmental Environmental coordinator at Du Pont's corporate office. He is a registered professional engineer and a member of NWWA's Association of Groundwater Scientists and Engineers. E. I. du Pont de Nemours & Co., Savannah River Plant, 703-A, Aiken, SC 29808.

Dr. LeVerne P. Fernandez received a B.S. in Chemistry from the College of Charleston, and his Ph.D. in Physical Chemistry from the University of Virginia. For more than two years, he has been supervisor of a group concerned with environmental activities, including ground water monitoring, ground water cleanup, wastewater treatment for metal finishing processes, and basin closure. Previously, his assignments included fabrication of heat sources for deep space exploration, and nuclear fuel processing and storage. E. I. du Pont de Nemours & Co., Savannah River Plant, 320-3M, Aiken, SC 29808.

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Abstract

The Savannah River Plant (SRP) produces special nuclear materials for the U. S. Government. Since 1958, chemical wastes generated by an aluminum forming/metal finishing process used to manufacture fuel and target assemblies were discharged to a settling basin. This process waste stream contained acids, alkalis, metals, and chlorinated degreasing solvents. In 1981, these solvents, specifically trichloroethylene and tetrachloroethylene, were discovered in monitor wells near the settling basin. A monitor well network was installed to define the vertical and horizontal extent of the plume. The current inventory of total chlorocarbons in the saturated zone is approximately 360,000 pounds within the 100 ppb contour interval.

During 1983, air stripping technology was evaluated to remove these solvents from the ground water. A 20-gpm ground water pilot air stripper with one recovery well was tested. Performance data from this unit were then used to design a 50-gpm production prototype air stripper. This unit demonstrated that degreaser solvent concentrations in ground water could be reduced from 120,000 ppb to less than the detection limit of 1 ppb. Data from these two units were then used to design an air stripper column that would process contaminated ground water at a rate of 400 gpm.

Water is fed to this column from a network of 11 recovery wells. These wells were located in the zone of contamination, as defined by analytical and numerical modeling techniques. This system has been operational since April 1985. To date, over 65,000 pounds of chlorinated degreaser solvents have been removed from an underlying aquifer. The effects of this program on the hydraulic gradient and contamination movement are currently being evaluated. The purpose of this paper is to describe the ground water remediation program at the Savannah River Plant.