MIXED WASTE GROUNDWATER TREATMENT AT IDAHO NATIONAL ENGINEERING LABORATORY

Stuart L. Claggett
ADTECHS Corporation

ABSTRACT

Test Area North (TAN) is located at the Department of Energy's (DOE) Idaho National Engineering Laboratory (INEL). The INEL was listed on the National Priority List (NPL) in 1989 by the Environmental Protection Agency (EPA) for several environmental concerns. Subsequently, A Record of Decision for one area of concern was signed to begin interim remedial action of groundwater at TAN.

ADTECHS was selected to design, procure, construct and operate a 50 gpm groundwater treatment facility to treat radioactive and hazardous contaminants (mixed waste). It is a "pump and treat" system that will undoubtably add to the controversy of their effectiveness in aquifer restoration. The facility will provide information for final remedial action of the Snake River aquifer at TAN.

BACKGROUND

Groundwater treatment units are located throughout the United States. They range from the peculiar shack and rising tower at a local gas station to large treatment plants at industrial sites. At the many Department of Energy (DOE) sites they are not common place, although most sites have been identified as having groundwater contamination.

The Idaho National Engineering Laboratory (INEL) is one facility that has now begun remedial action to cleanup groundwater contamination. The site was added to the Environmental Protection Agency's (EPA) National Priorities List on November 21, 1989 based on environmental investigations. The federal agency subsequently entered into a Federal Facility Agreement and Consent Order (FFA/CO) in December 9, 1991 to proceed with cleanup efforts.

Groundwater contamination has been identified at the Test Area North (TAN) operating site of the INEL. An injection well (TSF-05)(1) at TAN has been identified as the source of the contaminants. This injection well was drilled in 1953 to a depth of 310 feet. Liquid effluents from operations were then introduced into the Snake River Aquifer via this conduit. Subsequent sampling activities identified six contaminants of concern in the groundwater that are listed in Table I. The mixture of hazardous and radioactive contaminants makes this site a novelty in CERCLA activities. A Record of Decision (ROD) was issued to perform remedial action of the groundwater at TAN, also known as Operable Unit (OU) 01-7A.

ADTECHS Corporation, a subsidiary of the JGC Corporation, was selected by the site contractor responsible for environmental restoration, MK-Ferguson of Idaho Company (MK-FIC), to design, construct and operate a 50 gpm groundwater treatment facility (GWTF) at TAN. The operation includes an on-site laboratory.

CONCEPTUAL DESIGN

The record of decision signed by DOE for the interim action selected specific technologies or processes to be incorporated into the GWTF. Changes to the general process philosophy were not allowed. The technologies were proven groundwater/process methods that included:

- Air Stripping
- Filtration
- Activated Carbon Adsorption
- Ion Exchange

Configuration of the process technologies was not restricted by the ROD. This allowed ADTECHS to evaluate several system configurations to meet the effluent discharge requirements shown in Table II. Preliminary designs were narrowed, and enhancement technologies were considered to minimize secondary waste generation, consistent with the EPA and DOE requirements. Minimization of secondary mixed waste were of high priority. The final process flow diagram is illustrated in Fig. 1.

Enhancement technologies included a scale pre-treatment unit and bag filtration system. The scale pre-treatment unit (E-Process) uses a unique oxidation and filtration process. It will minimize secondary waste from buildup in the air stripping unit, treat bacteria, and is expected to assist with stripper efficiency through an oxidation and co-precipitation process. The bag filter works in conjunction with the backwash cycle of the larger filter, cleanup and decommissioning activities. It is expected to minimize waste from the process as a dewatering and concentrating unit. Liquid phase waste from the operation is recycled through the facility.

The GWTF system includes a multimedia filtration (MMF) unit that is expected to minimize loading on the ion-exchange vessel. The MMF unit is backwashable to a bag filter that will reduce overall secondary waste from the process. It has seven media layers that include gravel, garnet, sand and anthracite. The filter is capable of removing solids down to the 10 micron level.

ADTECHS selected a low profile tray type air stripper over a packed tower to remove the hazardous volatile organics from the mixed waste stream. The unit can be assembled in the sea van modular design, is easily maintained and generally creates less waste than typical packed towers. Removal efficiencies are expected to meet or exceed typical packed tower designs.

Off-gas treatment for the air stripper includes an in-line heater and two (2) large adsorber vessels. Each unit contains 1500 pounds of virgin vapor-phase granular activated carbon. The units measure 4 feet by 4 feet by 7 feet high. Breakthrough for TCE at the design flow rate of 350 cfm is estimated to occur at approximately 70 days.

Ion Exchange vessels are incorporated into the design for final polishing of the liquid phase to effluent requirements. A selective cation exchange resin is provided in the vessels to remove metals and associated radionuclides. It is expected that the MMF will remove hazardous metals to levels that will preclude the resin from being a mixed waste.

Mass balance information is included in Fig. 1. It illustrates the expected path of contaminants of concern through the system.

TABLE I
Typical Concentrations of Groundwater Contaminants of Concern

Contaminants	Concentration	Drinking Water Standard
Trans-1,2 Dichloroethylene (DCE)	See Footnote b	100 µg/ℓ
Cis-1,2 Dichloroethylene (DCE)	22-9000 µg/ℓ[b]	70 µg/ℓ
Trichloroethylene (TCE)	2 to 7,800 µg/ℓ	5 µg/ℓ
Tetrachloroethylene (PCE)	2 to 71 µg/ℓ	5 µg/ℓ
Lead (Pb)	3 to 515 µg/ℓ	50 µg/ℓ
Strontium-90 (Sr-90)	2 to 630 pCi/ℓ	8 Pci/ℓ

µg/ℓ = micrograms/liter
pCi/ℓ = picoCuries/liter

[a] Data obtained from sampling a network of 30 wells in the TAN area during late 1989 and 1990. Most of these wells are within 1 mile of the TSF-05 injection well. It also includes 1992 data.
[b] Total for Cis-1,2 and Trans-1,2 Dichloroethylene.

TABLE II
Effluent Water and Air Limits

Contaminants of Concern	*Treated Water Discharge Limits*	*Treated Air Emission Limits*[1]
Trans-1,2 Dichloroethylene (DCE)	100 ug/ℓ	52.7 lb/hr
Cis-1,2 Dichloroethylene (DCE)	70 ug/ℓ	52.7 lb/hr
Trichloroethylene (TCE)	5 ug/ℓ	0.00051 lb/hr
Tetrachloroethylene (PCE)	5 ug/ℓ	0.013 lb/hr
Lead (Pb)	50 ug/ℓ	1.5 ug/m³
Strontium-90 (Sr-90)	300 pCi/ℓ	10 mrem/yr

1 Trans and Cis DCE Combined Air Emission Limit is 52.7 lb/hr.

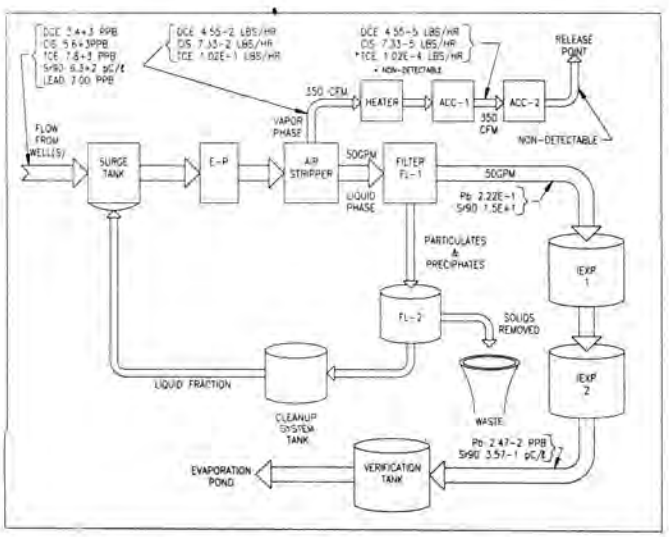

Fig. 1. Material balance flow path.

DESIGN AND FABRICATION

The project includes an eighteen month operation period that weighed considerably in the design. This short operational period concluded that the design should be mobile, have minimum fixed installations, and be easily decontaminated and decommissioned. Based on these criteria, ADTECHS selected commercial sea vans to house plant equipment and operations, a mobile decontamination trailer, double walled above ground storage tanks on precast pads, and a SPRUNG structure for additional protection from the elements. Figure 2 illustrates the general layout of the facility.

The treatment facility was designed to control spills and function automatically during back shift periods. Features included:

- Exterior piping is double walled
- All tanks are double walled
- Process units include drip pans
- Process and waste handling sea vans have built in secondary containment
- Van containment systems have float alarms to shutdown the system at a 1cm level
- External visual alarms indicating power and/or freeze protection device failures.
- Enclosed pump housing

The facility was fabricated at an off-site location as part of the modular concept and to provide high quality control. The GWTF was designed and fabricated under NQA-1 quality levels. This criteria in itself created a critical path for the

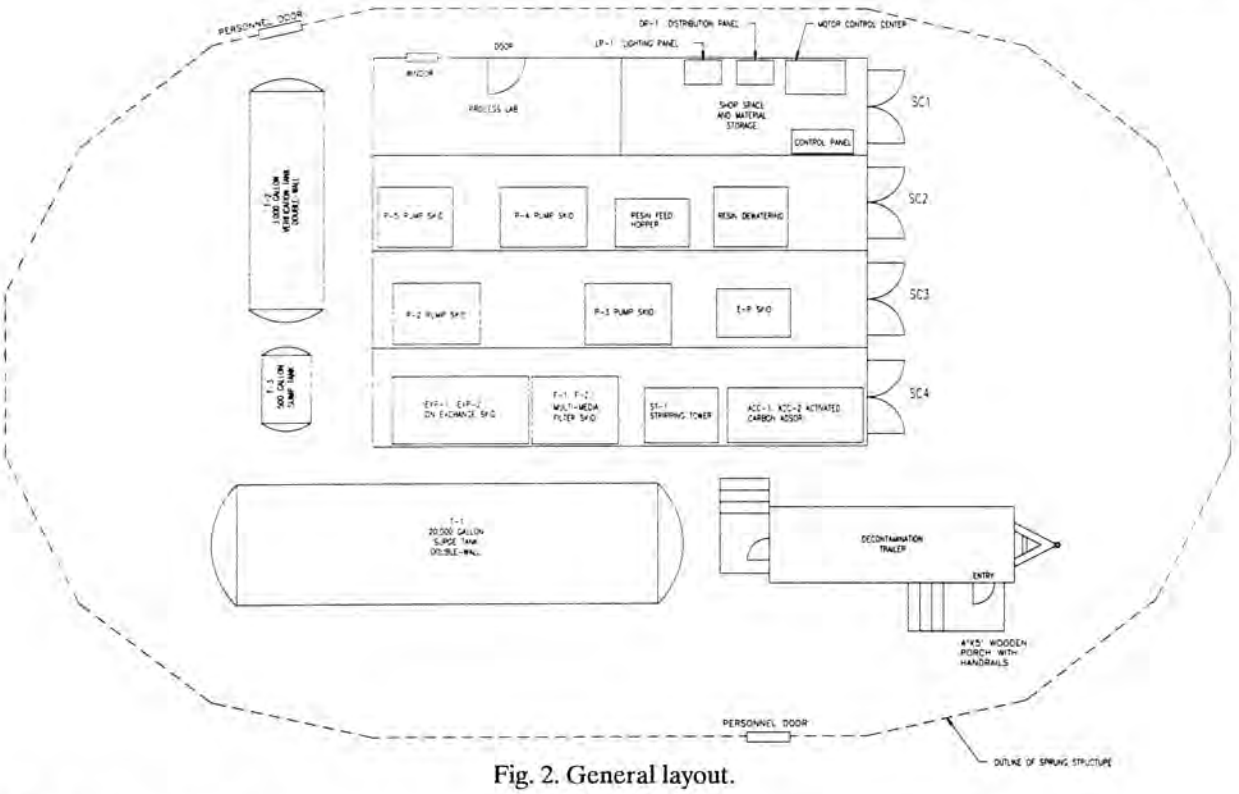

Fig. 2. General layout.

Fig. 3. Modular concept.

project. Ion exchange vessels were Level 2 items and were expected to become critical to meeting the project schedule. The overall process facility was procured, fabricated and tested off-site in a nine week period. This was accomplished by selecting off the shelf ion-exchange vessels that met the level 2 quality criteria.

The sea vans were transported to the project site and installed with the tanks at the site. Final electrical and mechanical connections were made in the field. Clean water startup testing commenced prior to performance testing.

OPERATIONS

Performance testing began in February, 1994. The mobile laboratory provides real-time data to the operators at the site. Sample ports for both gaseous and liquid phase samples are available to monitor compliance with effluent requirements and process equipment efficiencies.

The laboratory is equipped with a Beta Scintillation Detector, Gas Chromatograph (GC), and various wet chemistry items (pH, temperature, conductivity, etc..). Direct air sampling from the system is accomplished with an air pump manifold system directly connected to the GC. This allows real-time breakthrough information on the gaseous effluent.

Upon completion of the performance testing period, the treatment facility will operate 7 days a week, 24 hours a day at 50 gpm. All waste generated at the facility will be packaged and stored in pre-fabricated waste storage unit prior to final disposal.

SUMMARY

The GWTF at TAN is primarily a large scale feasibility study that will provide information for the final action. It is unique in that it will treat a mixed waste stream (Hazardous and Radioactive materials). The modular concept and additional design features illustrate a cost-effective means to expedite delivery while meeting the DOE, EPA and state requirements of the often complicated CERCLA/DOE environmental sector. Results from this action will provide important information to the DOE community in their efforts to begin groundwater remediation at other facilities.

REFERENCES

1. R. JONES, "Auditable Safety Analysis for Test Area North TSF-05 Injection Well and Surrounding Groundwater Contamination Interim Action Groundwater Remediation," MK-Ferguson of Idaho, DOE-ID, (December 1993).