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TREATMENT OF CONTAMINATED WASTE SITE RUNOFF AT THE SEYMOUR RECYCLING SITE, SEYMOUR, INDIANA

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Summary

A case study is presented of treatment of contaminated waste site runoff water at Seymour, Indiana by the Environmental Emergency Response Unit of USEPA. A prototype Mobile Independent Physical/Chemical Wastewater Treatment System was utilized to satisfactorily process up to 50,000 gallons of contaminated water per day over a nine month period.

Introduction

The Environmental Emergency Response Unit (EERU) is the U.S. Environmental Protection Agency's (EPA) hazardous material release response and control organization for situations where the use of complex cleanup equipment and techniques are required. EERU is engaged in the shakedown and field demonstration of prototypical equipment and techniques that have been developed under the direction and sponsorship of EPA's Hazardous Waste Engineering Research Laboratory (HWERL).

The concept of EERU involves a cooperative effort among spill response research personnel at HWERL's Releases Control Branch in Edison, NJ, EPA's Environmental Response Team (of the Hazardous Response Support Division, Washington, DC), and contractor personnel, to provide the most effective use of new technologies under development. EPA efforts through EERU include the use of government-owned equipment during emergency response and hazardous waste site cleanup activities as well as the operation of a pilot plant facility and a mobile analytical chemical laboratory.

During the past several years, the Environmental Emergency Response Unit has supported EPA Regional and Headquarters personnel at a variety of emergency incidents involving contamination of groundwater, surface waters, and potable water supplies by spills of hazardous materials and oils, as well as at emergency response to uncontrolled chemical waste sites.

The cooperative effort between EPA and contractor personnel enables EERU to bridge the gap between research and commercially useable equipment. This effort is intended to inspire enterprising commercial development and application of spill control technology.

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This paper presents an EERU operation which utilized a prototype mobile water treatment system to process contaminated waste site runoff water at the worst uncontrolled waste site in the state of Indiana.

In March 1983 the EERU was requested by the EPA Region V On-Scene-Coordinator to provide an onsite water treatment system at the Seymour Recycling Site, Seymour, Indiana. The system was to be onsite and operational by April, 1983. A few of the limiting factors in choosing a system were speed of mobilization, plus short term and intermittent use.

Seymour, Indiana, a town of approximately 15,000 people located 65 miles south of Indianapolis, has the worst abandoned chemical waste site in the state and the 51st-worst site in the nation. The 13-acre site, located in the middle of corn fields, originally contained 60,000 deterioration drums and 98 bulk storage containers of hazardous chemicals of which just a few of the major identified toxins were: ethers, spent solvents, phenols, cyanides, acids, PCBs, C-56, arsenic, and naphthalene.

The State of Indiana obtained a restraining order in April 1978 that shut down Seymour Recycling, alleging violation of the state's Environmental Management Act. However, a consent decree was reached with the owner, Environmental Processing Corporation, under which Seymour Recycling agreed to reduce its inventories. While the company issued detailing progress, state officials found that the stockpile of drums and waste products continued to grow.

Seymour Recycling abandoned the site in February 1980. In March 1980 a rain storm triggered a violet chemical reaction in the stockpiled drums, sending dark plumes of smoke and fumes into the neighboring residential development, forcing the evacuation of all citizens. Leaking drums and bulk storage tanks mixed with surface runoff resulting in large quantities of heavily contaminated rainfall drainage to both flood the site and migrate off into the surrounding farmland.

A total of 350 companies have been identified as contributors of the abandoned chemical waste site at Seymour. The EPA entered into a consent decree in October 1982 with 24 of the major generators to privately fund and manage the $7.7 million clean-up operation of all surface containers and the removal of the top one foot of contaminated soil over the entire site. The Seymour Generators Committee included such companies such as: IBM, General Motors, DuPont, General Electric, Western Electric, and United Technologies. Following the removal of surface contamination, 175 of the 350 generators were to fund a $3.7 million subsurface cleanup.

The EPA On-Scene-Coordinator, overseeing the cleanup operation, agreed to have the federal government provide an onsite treatment unit for processing contaminated site runoff.

The on-scene requirement was to treat contaminated surface runoff water on an as-needed basis, originally for a six- to eight-week operation, during the rainy spring period. This indicated the need for a temporary mobile system. The general parameters that required attention during treatment operations were reducing suspended and settleable solids and organic chemical concentrations to a low enough level to permit discharge to the municipal sanitary treatment plant.

A number of mobile options were available for an anticipated mobile treatment system, both commercially available and within EERU capabilities. The first step involved the assessment of the applicability, availability, cost, reliability, environmental impacts and plant performance of treatment systems.

Known as Packaged Integrated Control Approach (PICA) treatment systems, these units are engineered as skid mounted, pre-piped, pre-wired systems which contain subsystems such as compressors, filters, clarifiers, pumping stations, chemical contactors, etc. These systems usually have relatively small capacities as compared to larger permanent systems, and can be transported to the site where utilities (fuel, water, electricity can be connected and the unit started up.

Some of the unit operations utilized in the commercially available PICA units for wastewater treatment applications are listed in Table 1.

Table 2 indicates the site-specific operational parameters that would be needed for treating the contaminated site runoff at Seymour Recycling.

Once data on commercially available PICA systems were collected, comparison was made with available EERU treatment units. The EPA systems considered for the Seymour response were:

a. Mobile Flocculation—Sedimentation System

TABLE 1

Unit operation options for PICAs

a.	oxidation, reduction & neutralization	h.	filtration
		i.	biological degradation
b.	flotation	j.	dissolved air flotation
c.	sedimentation	k.	clarification
d.	precipitation	l.	extended aeration
e.	wet air oxidation	m.	physical/chemical
f.	adsorption	n.	flocculation
g.	solids dewatering	o.	activated sludge

TABLE 2

Seymour runoff treatment operational parameters

1. Time from decision to operations	4 weeks
2. Amount of runoff to be treated	up to 50,000 gal/day
3. Length of operation per visit	variable
4. Frequency of start-up	variable
5. Pretreatment needs	solids removal
6. Competing demands for emergency responses	unknown

b. Mobile Reverse Osmosis Treatment System
c. Mobile Physical/Chemical Treatment System (PCT)
d. Mobile Independent Physical/Chemical (IPC) Wastewater Treatment System

The Mobile Flocculation—Sedimentation System

This mobile system is completely enclosed in a 12.2-m (40-ft) long van-type trailer. The major components of the system are a pipe reactor, chemical addition equipment, flocculation chambers, an inclined tube settler, and a tri-media filter. Chemicals, including powdered carbon, lime, aluminum salts, iron salts, clays, polyelectrolytes, acids, and bases can be introduced into the 170-m (560-ft) long, looped pipe reactor at various locations. Adsorbents, coagulants, and polyelectrolytes may be added at the end of the pipe reactor, while pH-adjusting chemicals may be introduced midway in the system. Three positive displacement pumps are provided to feed chemicals into the reactor, and static mixers are located at each chemical addition point to assure rapid and effective mixing.

After the wastewater is chemically treated in the pipe reactor, it flows through gently agitated flocculation chambers. Floc collects in a tube settler and is discharged to a sludge collector. The final treatment phase of the system is the tri-media filter, which insures effective solid removal at the design flow rate of 265 l/min (70 gal/min).

The Mobile Flocculation—Sedimentation System was not ideally suited due to the extremely high solids loading from the surface runoff.

Mobile Reverse Osmosis (RO) Treatment System

When a solution of hazardous material approaches a concentration range greater than 1%, many physical/chemical treatment systems are not effective. An existing technology that can be used to efficiently separate some constituents of concentrated solutions (>10,000 ppm) is reverse osmosis.

A Mobile Reverse Osmosis Treatment System is currently being upgraded for use by EERU. This system, which was originally designed as a pilot plant to test the feasibility of treating acid mine wastewater, is being modified for field use at incidents involving concentrated solutions of hazardous materials (e.g., leachate from uncontrolled hazardous waste sites).

The Reverse Osmosis Treatment System will separate the influent waste into two streams (1) a "purified" stream that can be further treated, if necessary, or directly discharged to the environment, and (2) a concentrated waste stream that will be greatly reduced in volume, thereby facilitating further processing and/or ultimate disposal.

The RO Treatment System was rejected for use at the Seymour site because the required modifications of the system could not be completed within the extremely rigid response schedule. Also, the maximum flowrate of the unit was marginal for this particular operation.

Mobile Physical/Chemical Treatment Trailer (PCT)

One effective approach to onsite cleanup of hazardous material spills is the highly flexible, Mobile Physical/Chemical Treatment Trailer. This unit provides for flocculation, sedimentation, filtration, and carbon adsorption. Contaminated water is pumped into a portable settling tank where flocculation and sedimentation occur. The clarified fluid is passed through mixed media filters before entering the carbon adsorption columns. Sludge is removed from the sedimentation tank and stored for ultimate disposal. Treatment schemes can be varied (i.e., each step in the process may be bypassed) to facilitate the recovery of spilled materials or contaminated waste processing. If required, additional storage tanks are provided for filter backwashing or temporary storage of unprocessed materials.

The PCT system is mounted on a 13.7-m (45-ft) trailer, incorporates three mixed media anthracite and sand filters, three pressure columns containing a total of 8128 kg (18000 lb) of activated carbon (which may be used in parallel or in series), pumps, piping, controls, and a 125-kVA diesel generator. A support trailer is equipped with additional pumps, fittings, and several collapsible rubber tanks which allow the treatment trailer to be located up to 150-m (500-ft) from the spill site. Contaminated fluids can be processed at flow rates between 380 and 2,270 l/min (100 to 600 gal/min).

The extremely high treatment rates of the PCT did not justify the maximum 50,000 gal/day wastestream. This system is also the heart of EERU emergency operations and could not be dedicated at one site for a long duration.

Mobile Independent Physical/Chemical (IPC) Wastewater Treatment System

Emergency response personnel at hazardous materials spills and uncontrolled waste site cleanups are frequently faced with the problem of selecting effective treatment methods for large volumes of complex wastes. When the cleanup is expected to last over an extended time period, such as the Seymour cleanup, wastewater treatment can be both cost and labor intensive. Treatment of the contaminated wastewater in a timely and cost-effective manner can be facilitated by a flexible, automated system that is capable of providing several types of treatment (e.g., clarification, filtration, adsorption, neutralization, disinfection).

The Mobile Independent Physical/Chemical (IPC) Wastewater Treatment System utilizes standard equipment and conventional process flow schemes. Figure 1 shows a schematic of the system. Contaminated water is pumped at a rate of 130 l/min (35 gal/min) from the wastewater source to a flash mix tank where coagulant is added. Chemically treated wastewater and recycled sludge (from the clarifier) are then mixed in a flocculation tank and settleable floc is formed. The wastewater then flows to a clarifier where precipitation and skimming of solids are accomplished. Removal of settled sludge from the clarifier is aided by a slowly rotating rake. A time-con-

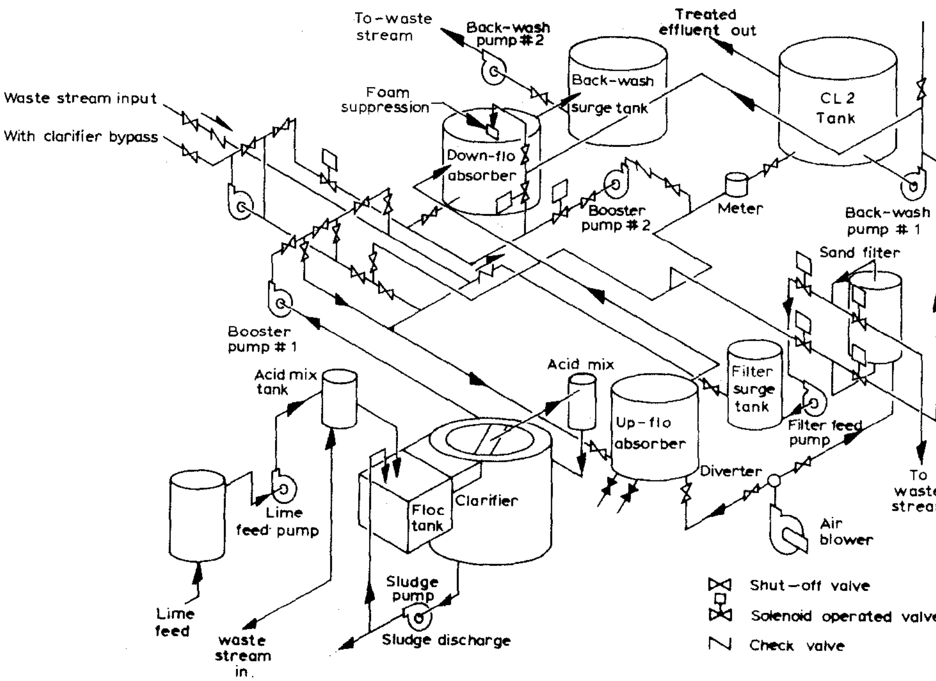

Fig. 1. Schematic of independent physical/chemical treatment system used for contaminated runoff treatment at Seymour, Indiana.

trolled valve regulates the recycling and/or wasting of sludge. Clarified wastewater flows over V-notched weirs to a neutralization mix tank where it is treated with acid or caustic to adjust the pH.

The wastewater then enters a two-stage, upflow and downflow, mixed media anthracite sand filter and granular carbon contact system. Additional treatment stages can be added between the neutralization mix tank and the final holding tank.

This system is ideally suited for long-term cleanup activities which may require several months of effort. Once it has been set up, the IPC system requires only minimal operator time for chemical replenishment, sludge disposal, and periodic maintenance prior to system restart.

After evaluating various system capabilities, it was decided that the IPC would be the most appropriate choice. The overriding factors in making the decision were the amount of water to be treated daily (up to 50,000 gal/day) and the need for solids removal during pretreatment.

Field operations

Field operations were divided into four phases, all distinct but overlapping. The phases included site preparation, set-up, operations, and demobilization. Site preparation and set-up were distinct and different from mobilization.

Prior to the mobilization of any package treatment systems, it is critical that major logistical support details are identified. This can only be accomplished by a site "walk" to assess operation conditions such as:

1. Location of power supplies
2. Availability of water/sewer ties
3. Site accessibility of large/oversized trailers
4. Site level of personnel protection
5. Site location of waste stream to be handled

Following the site inspection, a location for the treatment system was chosen adjacent to the 50,000 gallon contaminated runoff storage lagoon. This location allowed the system to be brought in on the "clean" uncontaminated gravel road which was contructed for the clean-up contractor's trucks.

Prior to bringing the IPC onsite, the central Indiana area received torrential rainfall, causing the onsite runoff lagoon to fill and overflow, along with approximately 80% of the 13 acre site being flooded out. EERU received an emergency request from the OSC to bring the PCT to Seymour Recycling to relieve the onsite flooding condition and stem the threat of further offsite contamination while the IPC was still undergoing mobilization preparation. The PCT arrived and was set-up on April 11, 1983, and began filtration and carbon contacting of the contaminated site runoff.

The IPC arrived in Seymour on the night of April 12, 1983, was set up onsite the next day and was operational on April 14th. Physical preparation of the site consisted of emplacing gravel adjacent to the road to form a stable base for the IPC. The treatment unit was kept on the Lo-Boy transport trailer after taking into account the limited space onsite, the cost of rigging, and the originally anticipated limited onsite time.

The activated carbon columns were loaded prior to bringing the unit onsite, although additional carbon was added once the unit was positioned. After the unit was in place, screw jacks were positioned along each side of the trailer to help stabilize and support the unit. This was deemed a necessity because the unit extended one foot beyond either side of the trailer, allowing for a considerably large overturning moment to be created once all tanks were filled. During setup and filling of the IPC main clarifer, the level was checked frequently, using a four-foot carpenter's level, to prevent short circuiting of unclarified effluent over the weir plate. Figure 2 shows the location of the IPC at Seymour following an extended rainfall event which flooded the entire site.

The treated effluent discharge was fed into an onsite manhole leading directly to the municipal sewage treatment plant. The clarifier sludge underflow was discharged back into the lower portion of the lagoon in which contaminated runoff was being collected. The final site cleanup task was to include the excavation and disposal of the first one foot of contaminated

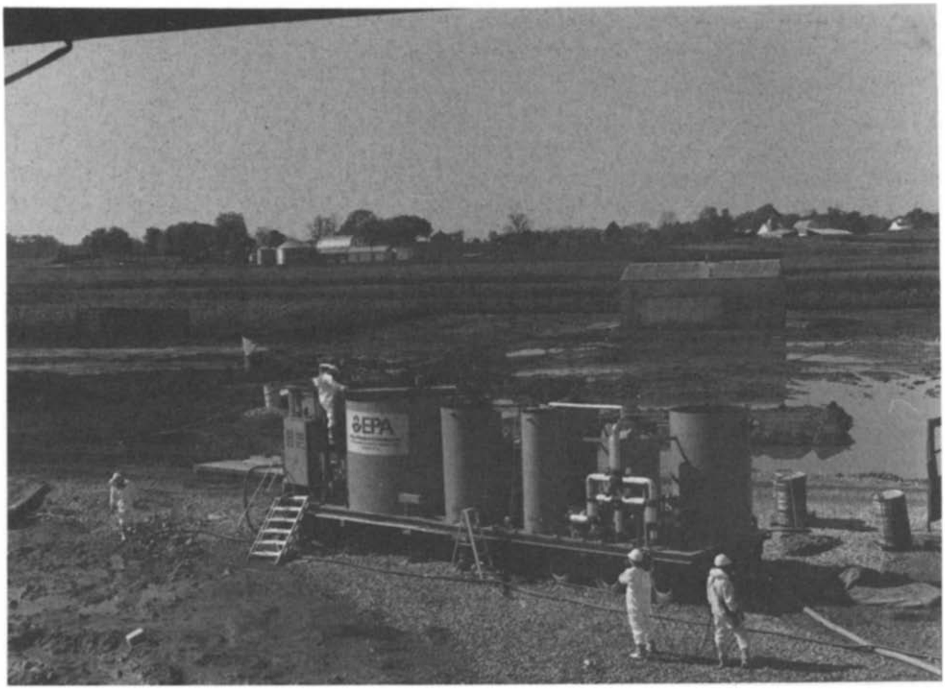

Fig. 2. Photograph of independent physical/chemical treatment unit used for contaminated runoff treatment at Seymour, Indiana.

soil. The clarifier sludge was ultimately to be handled by this operation when the runoff storage lagoon was drained and excavated. The influent stream to the IPC was supplied by a submersible pump secured to a foot bridge which spanned the lagoon. Flow from the pump was adjusted by the use of a bypass valve.

Much of the first full day of operation was used to adjust the flowrate and correct other minor operational problems. Power to the IPC was initially provided by the generator aboard the PCT. Indiana Power and Light later furnished line service to the site perimeter, which was extended to the unit.

During the initial operations, the unit performed satisfactorily. The single major problem was that the chemical feed pump was damaged during transit, so that alum, used as a chemical flocculant, was fed into the flash mix tank manually. This continued until repairs were made to the pump. The only other problem, although not significant, was the skimmer continually coming off the track guide in the clarifier due to misalignment.

Following the gross dewatering of the site by the PCT, the initial 50,000 gallon lagoon drawdown operation by the IPC was completed on April 16. The IPC performed satisfactorily in significantly reducing settleable and suspended solids along with COD concentrations to acceptable levels to permit direct discharge to the Seymour sanitary sewer system for further processing at the publically owned treatment plant.

During the period from April to December 1983, the IPC was utilized on nine separate occasions. Between operational responses the IPC was shut down, drained and was unattended. The unit was finally demobilized on December 2, 1983. The two major reasons for demobilization were: (a) the extremely cold weather, which could result in freezing conditions in the IPC's pipes and tanks; and (b) the surface water remaining onsite was scattered in small pools and no longer centrally collected as a result of changes in the local contours made during the site cleanup. At the time of shutdown, any further treatment functions were to be reassumed by the PCT, and all site work by the cleanup contractor was ultimately completed in January 1984.

Operations analysis

Throughout the nine months the IPC was onsite, there were no major mechanical or operational problems. The most significant repair work was the replacement of the air blower used for backwashing of the carbon and sand filter columns. From an operational standpoint, the deficiencies which became apparent were relatively minor and were easily corrected. The most noticeable was the need for improved operator training dealing with understanding the IPC subsystem functions, flowrate controls and chemical flocculant addition.

A review of all the encountered unforeseen problems seems to be associated with the need for periodic intermittent use of the IPC. A procedure is being established for such use. The final portion of the Seymour response was conducted during the cold weather months. The unit was exposed to the weather where freezing became an ever-present problem. Even though the piping was heat traced and insulated, the numerous shutdowns aggravated this freeze-up problem.

The only difficulty encountered during demobilization was with the unloading and cleaning of the interior of the carbon and sand filters. Removal of the contaminated sand and carbon was accomplished using a truck-mounted Super Sucker vacuum system and a great deal of labor. A system modification is being made to the unit to facilitate column unloading if vacuum truck services are not available.

Conclusion

The IPC provided satisfactory treatment of the contaminated runoff water at the Seymour Recycling Site. It provided both good flexibility and reliability for periodic operation over an extended response. The system is currently undergoing retrofit to allow for operation ease and is currently on a "stand-by" status for any immediate response, emergency or long-term remedial action. Any inquiries should be directed to Richard P. Traver, US Environmental Protection Agency, Releases Control Branch, Edison, NJ 08837-3679, FTS-340-6677, (201) 321-6677.