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EMERGENCY RESPONSE TO A MAJOR AGRICULTURAL CHEMICAL WAREHOUSE FIRE

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The purpose of this chapter is to review an emergency response to a major agricultural chemical warehouse fire that was directed by the Illinois Environmental Protection Agency (ILL EPA) with assistance from an environmental crisis engineering firm, REACT. The principal elements, including emergency response management systems; risk assessment; isolation and containment procedures; recovery, treatment and disposal practices; cost vs liability tradeoffs; and available emergency response resources will be presented to assist industry and regulatory agencies in coping with hazardous material emergencies that pose life safety and environmental threats in a rational and cost effective manner.

BACKGROUND

To minimize public and environmental risks from spills of pollutants and hazardous materials, the ILL EPA maintains and Emergency Action Reporting Center. The center assures quick field investigation response by appropriate field personnel who make on-scene risk assessments, and to assure adequate cleanup by those responsible for the material spilled.

The center is staffed by technical personnel who receive and log all spill reports throughout the state. The center functions as an operations control headquarters during spill incidents. Based on the spill report information first received, a decision is quickly made whether to dispatch one of the ILL EPA's field office staff to the scene of the spill for verification and on-scene assessment. The various divisions of the ILL EPA have numerous field office locations around the state from which personnel respond to these spill reports. The Division of Water Pollution Control has seven regional offices strategically located so that response time is usually not over 1.5 hours to any point in the regional office service area. Most spill reports result in an investigation by ILL EPA field personnel.

The field staff's first on-scene actions include:

1. verification of the type and quantity of materials invovled;
2. determination of owner or responsible agent;
3. assessment of risk to the public and environment;
4. assurance of quick containment of toxic and hazardous liquid and solid materials that could pose public exposure, air, land or water pollution threats;

5. reporting facts and observations back to the ILL EPA Emergency Action Center so that a multidisciplinary team of technical personnel can review incoming information, make decisions and relay instructions back to the field person for implementation; and
6. assures that adequate cleanup actions are completed by the responsible agent.

On large scale and major incidents a panel of ILL EPA technical staff members remain in the Action Center to receive field information, and to research and devise possible control alternatives. The center then relays instructions to the ILL EPA on-scene personnel for implementation. The technical panel uses watershed maps and computes times of travel to plan downstream water sampling surveys. Panel members locate downstream water intakes and, if necessary, issue warning and advisories to public water supplies and industrial users.

THE HILLSBORO WAREHOUSE FIRE

On April 23, 1980, the Emergency Action Center received a report relayed from the Illinois Emergency Services and Disaster Agency (ESDA) that an agricultural warehouse fire had occurred in Hillsboro, IL, at the Hewitt-Ware Feed & Supply Company. Because of past experience with agricultural warehouse fires, it was determined that this incident could involve substantial threats to the public and environment. J. Renkes, Manager of the Agency's Emergency Response Unit, departed immediately for the site to make an on-scene risk assessment and initiate on-scene actions to contain spilled products.

Risk Assessment and Immediate Response

The on-scene assessment revealed that people downwind from the fire scene should be evacuated because of the potential formation of toxic gases, including cyanide, phosgene, chlorine, fluorine, oxides of nitrogen and isocyanates (Figure 1). Several hundred people were evacuated from a 1000-foot toxic corridor formed downwind from the fire, and the Hillsboro schools were closed for the day. It was learned that Hillsboro city personnel had taken quick action to block drainage channels and dig pits to minimize runoff of the 250,000 gallons of fire water used to extinguish the fire (Figure 2). This quick action substantially reduced the water pollution potential of the highly contaminated fire water.

Figure 1. Hewitt-Ware Feed and Supply undamaged grain elevator and burned agricultural chemical warehouse.

Figure 2. Containment Pits 1 and 2 collect concentrated pesticide runoff from firefighting operations.

After the fire was extinguished, Mr. Renkes' assessment was that a massive hazardous materials cleanup action was necessary to eliminate public hazards from the remaining unburned pesticides and water pollution problems caused by the highly contaminated water pooled on-scene. Two drinking water valve stations contained contaminated runoff and collapsed distribution lines in the city of Schram posed an imminent direct cross-connection problem. The valve pits were immediately pumped off and water supplies were monitored by the state for contamination. Cleanup of a nearby stream was also necessary because some contaminated runoff had reached the stream. City forces had dammed this stream to prevent the contaminated water from flowing downstream and causing a fish kill or threat to livestock. This work would require the services of a specialized cleanup contractor. The Hewitts were advised of the quick action needed to bring in a specialized contractor for cleanup to minimize further public and environment exposure. In response to this, the Hewitts quickly contacted REACT.

When REACT engineers and scientists arrived on-scene, the ILL EPA role switched to technical advisor to the owners and contractor on state environmental standards for air, water and land pollution control parameters. The ILL EPA on-scene personnel and technical panel working in the Action Center at ILL EPA headquarters also acted to ensure quick review and approval of clean-up alternatives proposed by REACT. These actions are taken by the ILL EPA in all spill incidents to expedite cleanup work and to minimize project costs, while facilitating adequate cleanup. ILL EPA approvals of hauling uncontaminated fire debris to a sanitary area landfill was expedited. A hazardous waste site was located and a special permit for disposition of the highly contaminated materials was issued. The ILL EPA also collected land and water samples and expedited analysis by ILL EPA's lab in order to assist the contractor in monitoring the cleanup work.

Isolation and Containment

Contaminated stream waters were isolated and transferred into a 300,000-gal polyethylene-lined lagoon (Figure 3). The interceptor trench collection network was enhanced using bentonite/sand-filled sandbags and activated carbon. The primary collection pit at the burn site was drawn down using floating pumps, and the concentrated liquid residues were staged in 55-gal drums pending the results of on-going treatability investigations being conducted

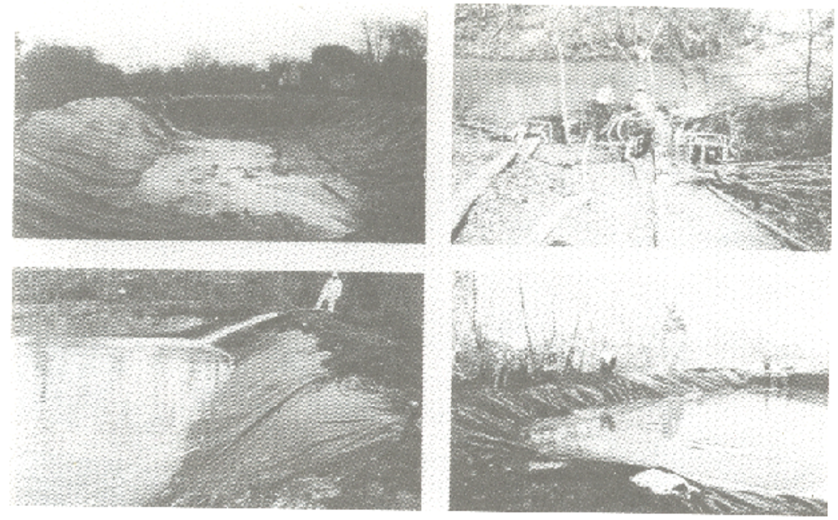

Figure 3. 300,000-gal treatment lagoon contains contaminated runoff from the creek. The lagoon was lined with 24-mil Visqueen with side slopes of 1.5 to 1. Pumping station transferring creek to treatment lagoon. Final grade lagoon apron.

at REACT's Corporate Response Center in St. Louis, MO (Figure 4). Swales were constructed to divert the uncontaminated portion of the watershed around the contaminated burn site. A plastic canopy was available to cover the entire burn site to prevent vertical contaminant transport into the soil matrix with impending thunderstorms.

Recovery, Treatment and Disposal

Twenty-one pesticides, including 11,000 lb of granular chemicals and 3465 gal of liquid chemicals, were involved in the fire. Since these products had been subject to high temperatures, the exact physicochemical and toxicological properties were unknown. The known chemicals, quantities, and toxicological and physicochemical properties are presented in Table I.

The presence of numerous known and unknown complex organics required a pragmatic selection of physical/chemical and biological indicator decontamination yardsticks. Five pesticides (presented in Table II) were selected, based on their high aquatic and mammalian toxicities and water solubilities. Gas chromatography was used to measure these five pesticides. Aquatic bioassays were performed to determine the presence of any unknown contaminants and to confirm detoxification operations. Five waste streams were identified, and alternative recovery, treatment and disposal methodologies were considered. Ultimate disposition selection criteria was based on bench-scale tests showing the best disposition efficiencies and cost effectiveness. The five waste streams were identified as follows: (1) contaminated stream waters; (2) concentrated leachates at burn site; (3) soil matrices at burn site; (4) contaminated and uncontaminated building materials; and (5) contaminated product residues.

Contaminated Stream Waters

Bentonite and activated carbon were added at the stream pumping station prior to pumping into the 300,000-gal lagoon to facilitate immediate odor control and pesticide degradation via solar oxidation, aeration, evaporation and sorption. Powdered activated carbon was selected (Table III) and injected into the lagoon at a self-flocculating concentration of 1000 mg/l. A carbon contact period of 4 hr was employed, followed by a 48-hr clarification period. The treated contents of the lagoon was then pumped behind a sandbag

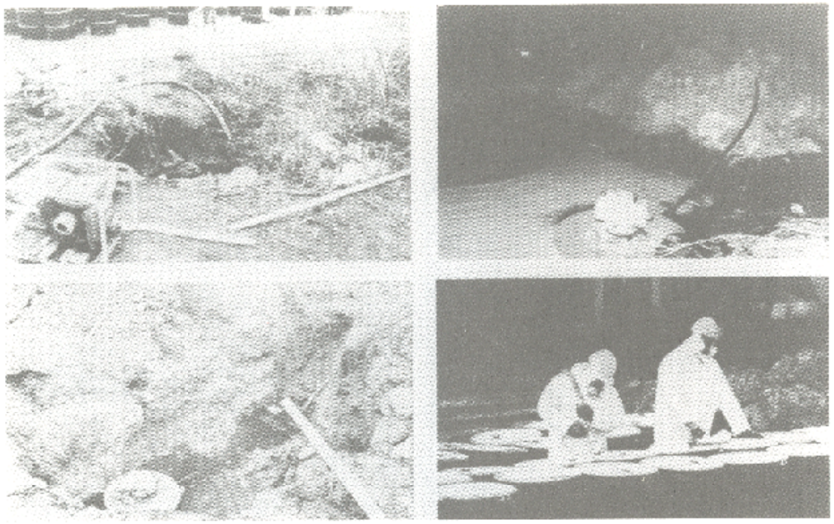

Figure 4. Concentrated pesticide runoff collected in interceptor pits at burn site. Residues from pit 1 transferred to pit 2. Floating pump used to transfer runoff into 17H drums by personnel wearing full protective clothing.

carbon/bentonite impoundment constructed in the stream. The treated water was released after confirming tests indicated that all concentrations of contaminants had been reduced below established decontamination yardsticks (Figure 5, Table IV).

Concentrated carbon/bentonite slurry (2300 gal) was pumped from the lagoon bottom into epoxy-lined 17-H drums for disposal. Unpumpable residues (500 gal) were treated with soda ash for alkaline hydrolysis with subsequent pesticide half-life reduction. Activated carbon was blended into the remaining lagoon bottom sludge and the 24-mil lagoon liner was folded in to entomb the treated residue and the lagoon was filled in.

Concentrated Leachates and Soil Matrices at Burn Site

A total of 26,675 gal of highly concentrated pesticide leachates and soil matrices were transferred into epoxy-lined drums by personnel wearing full protective clothing (Figures 6 and 7). Bench-scale evaluations determined that the cost of treatment (including incineration or deep-well injection) greatly exceeded the cost of disposition at an EPA approved hazardous waste landfill. Consequently, these waste streams were disposed of accordingly. Heavy duty mechanical earth moving equipment was not used because of the potential to increase runoff coefficients and to minimize the volume of contaminated soil matrices handled.

Altogether, 26,000 ft^2 of soils containing traces of agricultural chemicals at the burn site were treated with activated carbon for odor control and soda ash for alkaline hydrolysis half-life reduction. This procedure was repeated several times to accelerate the destruction of pesticide residues.

Contaminated and Uncontaminated Building Materials

Personnel wearing full protective clothing carefully segregated uncontaminated building materials from contaminated building materials and staged these materials where conventional high lifts and open bed trucks could be used for loading and transportation to an approved sanitary landfill. Emphasis was placed on confining the use of heavy-duty equip-

Table I. Chemical Quantities, and Toxicological and Physicochemical Properties of Products

Pesticide		Quantities		Solubility @ 25°C		TLV	LD_{50} (mg/kg)		TL_M
Trade Name	Chemical Class	(gal)	(lb)	Water (mg/l)	Solvent	(mg/m^3)	Oral (rat)	Dermal (rabbit)	96-hr (mg/l)
Treflan	Dinitroaniline	530			Xylene		3,700		0.02
Sutan	Thiocarbamate	140		E			3,690–4,500	4,640	
Surflan	Dinitroaniline		80	NS	Ethanol		10,000		
Paraquat	Pyridilium	56		S	NS[a]	0.1	150		10.0
N-Serve	Pyridine	75		NS	Xylene	10.0	2,140	5,000	
Lorsban	Organophosphate	310	1,100	2	Methanol	0.2	2,000	4,000	
Lasso	Acetanilide	70		DISP	Monochlorobenzene	0.75	1,800		
Eradicane	Thiocarbamate	40		NS			2,000	3,830	
Furloe-Chloro IPC	Phenylcarbamate	10		NS	Xylene	100.0	3,800	10,200	10.0
Furadan	Carbamate		1,100	700	N	0.1	11	10,200	0.11
Lorox	Phenyurea		2,000	75	Xylene		1,500–4,000		
Lexone	s-Triazine		1,500	1,200	Ethanol		4,000	2,000	
Bladex	s-Triazine		200	NS		0.5	334	7,200	
Amiben	Benzoic acid	190	4,000	S	Alcohol		3,400–5,620	3,160	
Dyanap	Phthalic acid	370		S	Ethanol		232	400	0.10
Aatrex	s-Triazine	1,355	850	70	18,000 Methanol		3,080	10,200	1.0
Alfa-tox	Chlor. Hydrocarbon & organophosphorus	60		40	S Alcohol		2,000	8,000	
B 1088		4							
Banvel K	Benzoic acid	55		SS	Xylene		2,500	2,000	
Bassagran	Benzothiadiazin	200		620,000	Ethanol		1,480	2,500	
Randox	Acetamide		250	N			750		
Total		3,465	11,080						

[a]DISP = dispersible; N = negligible; NS = not soluble; S = soluble; SS = slightly soluble; E = forms emulsion.

Table II. Initial Contaminant Levels by Location and Decontamination Yardsticks

Sample Location & Date	pH	TOC (mg/l)	Alkalinity	Oil & Grease	Suspended Solids	Atrazine (mg/l)	Dyanap (μg/l)	Treflan (μg/l)	Amiben (μg/l)	Paraquat (mg/l)
Burn Site Collection Pit No. 2, 4/29/80	7.1	400	160	108	18	40	24,034	1,629	894	3.1
Lagoon, 4/29/80 (Note: 4-days treated)	4.4	30	0	10	156	7.4	<5	5	15.1	0.260
Creek, Station 4, 4/29/80 (Note: 4-days treated)	7.1	22	150	5	34	4.9	121.7	7.5	16.9	0.340
Decontamination Yardsticks	4.0[a]	10	0–100	5	20	<0.1	<100	<100	<100	<0.1

[a]Low pH due to strip mine waters in area.

Table III. Treatability Alternatives Resulting in Selection of Powdered Activated Carbon Addition for Water Treatment

Treatment Method	Dosage Level	Atrazine (mg/l)	Treflan (μg/l)	Contact Time (hr)	Sludge Volume (% volume)
Untreated Lagoon Sample		7.4	5.0		
PAC[a]	24,500 mg/l	<0.1	<0.1	10.5	13
PAC	1,000 mg/l	<0.1	<0.1	0.5	0.5
PAC	5,000 mg/l	<0.1	<0.1	0.5	3
PAC	15,000 mg/l	<0.1	<0.1	0.5	8
H_2O_2[b]	0.03%	<0.1	0.18	15.0	4
H_2O_2	0.3 %	<0.1	<0.1	15.0	4
H_2O_2	3.0 %	0.11	<0.1	15.0	4
Na_2CO_3[c]	5 ml/l saturated solution	0.26	<0.1	24.0	20

[a]Aqua Nuchar powdered activated carbon, particle size 2 microns.

[b]Hydrogen peroxide—rejected because of potential formation of oxidized toxic by-products and high sludge volume.

[c]Soda ash—rejected because of inadequate treatment and high sludge volume.

Figure 5. Short term bioassay tests run on treated lagoon and pool 1 samples resulted in perch fingerlings surviving the 96-hr TLM (Median Tolerance Limit).

ment outside of contaminated areas at the burn site to minimize the transport of contaminants. Consequently, out of a total of 131 yd^3 of contaminated and uncontaminated building materials, only 29 yd^3 of materials had to be treated and disposed at an approved hazardous waste landfill facility. Special arrangements were made with the ILL EPA to haul these materials in bulk contained in a 24-mil polyethylene capsule thereby minimizing packaging, transport and disposal costs.

Contaminated Product Residues

A total of 500 gal of product were recovered in original containers. Due to obvious potential third-party liability problems, these materials were disposed of at a hazardous waste disposal facility.

CLEANUP COSTS VS LIABILITY TRADEOFFS

The degree of decontamination required should reduce potential life safety threats and environmental and property impacts to acceptable limits. From the experience of the authors, cleanup costs for hazardous material incidents posing imminent life safety threats, property and environmental impacts generally range from 1 to 10% of litigation costs, health impairment claims and property damage claims. Consequently, it becomes imperative that responsible parties have access to reliable cost estimates for corrective action and reliable risk assessment information to make practical decisions on the appropriate cleanup action required.

Other elements enter into the decision criteria for determining the extent of cleanup, including:

- available financial resources,
- government regulations,
- local media and public hazard perception, and
- local political/regulatory interpretation of laws and subsequent corrective actions required.

Because of the potential multimillion-dollar liabilities associated with this incident, pesticide levels in soils and waters were decontaminated below acceptable environmental health limits and below background concentrations typical of the watershed.

Total REACT resources committed to this project involved round-the-clock emergency operaions for 21 days and involved over 60 engineers, scientists and engineering technicians. Total losses incurred by the Hewitts including chemicals, buildings and this cleanup totaled nearly $500,000. Fortunately, all losses were fully insured, and the Hewitts were reimbursed by their insurance company. In addition, because the site was adequately decontaminated, no legal actions have been filed.

SUMMARY

Liabilities, cleanup costs and life safety hazards can be reduced by using experienced personnel who are able to evaluate rapidly the risks at hand, and select and implement

Table IV. Final Pesticide Concentrations and Fish Bioassays Used to Confirm Decontamination below Established Yardsticks

Sample Description	Atrazine (mg/l)	Treflan (µg/l)	Dyanap (µg/l)	Furidan (mg/l)	pH	Number of Fingerlings Tested	Perch Fingerling Survival Times (hr)
Control					7.0	20	> 96
Creek prior to treatment	4.9	7.5	121.7	15	7.1	1	1.8
Treated lagoon waters	0.06	0.17	<0.5	<0.1	6.5	5	>336
Treated creek impoundment No. 1 waters	<0.01	<0.1	<0.5	<0.1	6.7	5	>336

Figure 6. REACT personnel packaging Dyanap soil residues. Treflan residues and white Atrazine residues contaminated soil. Packaging operations of Atrazine and Treflan residues using polyethylene bags placed in 17H epoxy lined drums.

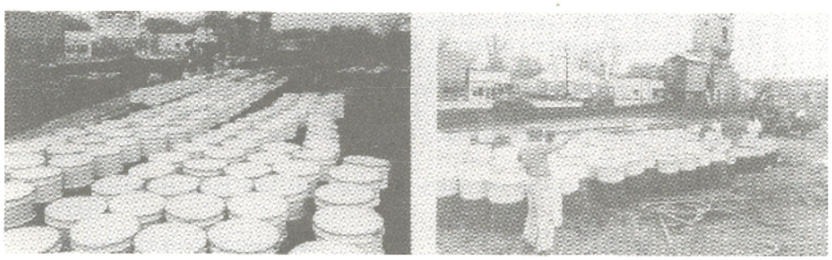

Figure 7. Contaminated residues packaged in 17H drums. 485 drums were loaded using front-end loaders and transported by covered trucks for ultimate disposition.

"engineered" isolation, containment, recovery, treatment and disposal procedures. The coordination of existing resources on this agricultural chemical incident resulted in:

- no injuries or significant impacts to the public health and welfare,
- no significant impacts to the environment,
- decontamination of over 250,000 gal of contaminated surface waters using a new single-stage powdered activated carbon in situ injection process that did not require post-filtration for suspended solids removal,
- an innovative decontamination program that resulted in substantial cost savings (over $180,000) as compared to conventional treatment methods such as granular carbon filtration,
- project completion in accordance with good environmental engineering practices,

- the owner's insurance company assuming financial responsibility for this decontamination program on the basis that all risks and potential liabilities had been mitigated,
- project completion in full compliance with regulatory requirements,
- no legal claims or litigation costs because imminent risks and potential liabilities were mitigated through the timely completion of this decontamination program.

It is the profound hope of the authors that this case history will provide insight to assist others to cope better with hazardous material emergencies.

Resources available to assist on hazardous material incidents include:

1. National Response Center, U.S. Coast Guard and U.S. EPA;
2. Environmental Health State Agencies, e.g., Illinois EPA;
3. industrial technical assistance accessed through CHEMTREC;
4. regional poison centers;
5. private hazardous material engineering contractors, e.g., REACT;
6. local metropolitan sanitary districts and waterworks districts;
7. civil defense agencies, e.g., Illinois Emergency Services & Disaster Agency;
8. trained hazardous material state highway patrol teams;
9. Army and Air Force technical assistance teams; and
10. trained fire departments.

The type of assistance available through these organizations include technical assistance, financial assistance, manpower, equipment, supplies and facilities to deal with hazardous materials spills.

ACKNOWLEDGMENTS

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