Hazardous Materials Spills Handbook

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Preface

Hazardous materials have been and will continue to be articles of commerce which, when properly used and converted, provide some of the materials that are an everyday part of our standard of living. When properly handled, they pose no threat or danger. Unfortunately, no matter how careful the planning and how great the care, accidents can and do occur. It is then critical that we negate or minimize the effects of such accidents on the population and the environment.

Work to contain spilled hazardous materials and minimize damage has been carried out for many years on an individual, seat-of-the-pants basis. It is only since 1970 that work in developing methodologies for containment and mitigation has been carried out on a planned basis. At the same time, the public has demanded stricter rules for shipping and handling hazardous materials. This effort is now providing systems and methodologies for the sound handling of hazardous materials and the unfortunate accidents that may occur in their transport. These then serve as a basis for developing regulations to guide the transporters.

The editors of the *Hazardous Materials Spills Handbook* have been leaders in this field since 1970. They have been active in the field and have seen it grow and mature. They bring to the *Handbook* a unique insight into the advances and an appreciation the problems because of their long leadership in the area.

The material presented in the *Handbook* provides a basis for anyone to manage hazardous materials movement and develop plans for the prevention of accidents and for the mitigation of spills and other incidents that may occur. The authors of the various chapters and parts are all in the forefront of their respective fields and are all intimately acquainted with the management of hazardous materials.

As an early worker in this exciting field, I consider it a pleasure to see this compendium, whose time and need is now, available for use by those who are now active and

will be active in the future in ensuring that we can continue to handle, as articles of commerce, those hazardous materials which are so necessary to support the lifestyle which we have and aspire to.

Peter B. Lederman, Ph.D., P.E.
Vice President,
Roy F. Weston

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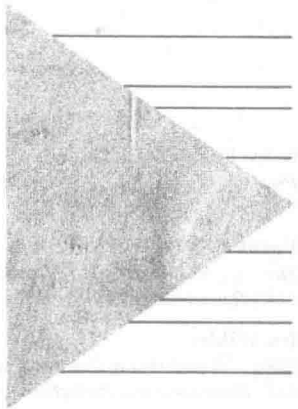
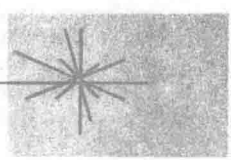


Introduction



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The wrecking of the *Torrey Canyon* in 1967 on the Seven Stones Rocks in the English Channel, with the loss of 117,000 metric tons of Kuwait crude oil, focused worldwide attention on the increasing problem faced by even major water bodies because of oil spills. As a result of widespread awareness of the magnitude of the oil spill problem, governmental activities began in the 1970s in Britain, with research on oil removal techniques at the Warren Spring Laboratories, while in the United States, Congress expressed concern in 1970 in Public Law 91-224, the Water Quality Improvement Act. As a result, the U.S. Environmental Protection Agency (U.S. EPA) published its requirements for oil spill prevention control and countermeasure (SPCC) plans on December 11, 1973.

The problems of hazardous materials, though known, were not addressed until later in the 1970s. In the United States, one of the first steps taken by the U.S. EPA was to form a research laboratory at Edison, New Jersey, to address the urgent problems of prevention, control, and cleanup of hazardous materials spills. In the United Kingdom, the Hazardous Materials Service at Harwell was set up with similar objectives.

Little guidance was available to these early workers, and indeed there was not even widespread realization or acceptance that the problem was severe. An initial action was to sponsor a National Conference on Control of Hazardous Material Spills in Houston in March 1972[1] to define the problem and suggest solutions. The papers presented at this conference clearly demonstrated the need for development of hazardous material spills control technology.

The U.S. Congress addressed the problem of hazardous material spills in Public Law 92-500, the Water Quality Improvement Act of 1972. In the preamble to Sec. 311, Congress stated its intention that no hazardous materials be spilled into any navigable body

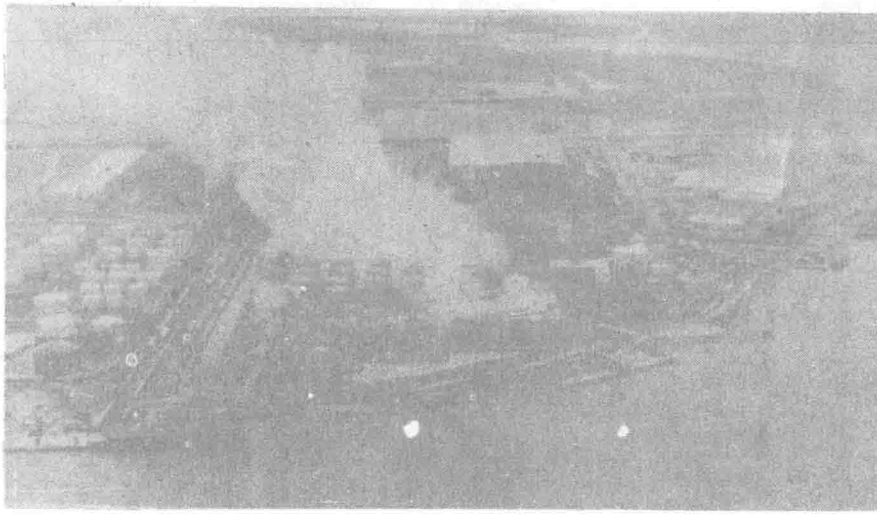

Fig. 1 Fire in 1974 at the Bulk Terminal Co. in Calumet Harbor. [*Photograph courtesy Illinois Department of Transportation.*]

of water of the United States. To this end, it directed the U.S. EPA to develop a list of hazardous chemicals, specifying penalties for spilling and determining reportable quantities and removability. However, it was not until 1979 that these regulations were finally in place, covering almost 300 chemicals. The tortuous path taken by the U.S. EPA to promulgate its regulations is described in detail by Bennett and Wilder.[2] The Superfund law, the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (see Chap. 2, Part 1, and Chap. 15), will result in new regulations designating additional hazardous chemicals and establishing reportable quantities for their release not only into navigable waters but also into groundwaters, soils, sediments, and the atmosphere.

In the United Kingdom, the Deposit of Poisonous Wastes Act of 1972 and the Control of Pollution Act of 1976 had the same goals as Sec. 311 of Public Law 92-500.

MAGNITUDE OF THE PROBLEM

Worldwide, billions of kilograms of hazardous chemicals are produced daily. According to data published in *Chemical and Engineering News*[3] for 1979, production of the 50 most prolific chemicals totals almost 266 billion kg a year (Table 1). Almost one-half of the 50 most common chemicals are deemed hazardous (Table 2) according to the U.S. EPA. In 1979 their production totaled almost 138 billion kg (about 377 million kg a day) and was growing at an annual rate of 7.6 percent.

Of course, not all chemicals are hazardous, nor do all hazardous chemicals have the same degree of toxicity. The U.S. EPA has categorized chemicals according to toxicity criteria: X is the most toxic and D the least, with A, B, and C being intermediate. If 1 lb (0.45 kg) of a chemical in Category X is spilled into a watercourse, federal authorities must be notified, but it is not until 5000 lb (2268 kg) of Category D chemicals reaches a watercourse that notification is required.[4]

It is inevitable that when chemicals are produced, stored, or shipped, they will be

TABLE 1 1979 Production Rate of the 50 Top Chemicals in the United States

Rank, 1979		Production, 1979 (billion kg)	Average annual change, 1978–1979 (percent)	Hazardous chemical category list*
1	Sulfuric acid	38.07	2.2	C
2	Lime	17.59	0.0	
3	Ammonia	16.44	5.4	B
4	Oxygen	16.03	−0.2	
5	Nitrogen	13.57	5.4	
6	Ethylene	13.24	12.5	
7	Sodium hydroxide	11.24	15.7	C
8	Chlorine	10.99	9.6	A
9	Phosphoric acid	9.19	8.3	D
10	Nitric acid	7.77	7.9	C
11	Sodium carbonate	7.49	−0.4	
12	Ammonium nitrate	7.08	8.2	
13	Propylene	6.49	9.9	
14	Urea	6.14	24.2	
15	Benzene	5.77	16.3	C
16	Toluene	5.38	55.2	C
17	Ethylene dichloride	5.36	7.5	D
18	Ethyl benzene	3.87	1.7	C
19	Vinyl chloride	3.42	8.6	
20	Styrene	3.39	4.0	C
21	Methanol	3.36	15.1	
22	Terephthalic acid	3.29	22.0	
23	Carbon dioxide	3.21	5.7	
24	Xylene	3.13	12.4	C
25	Formaldehyde	2.93	1.1	C
26	Hydrochloric acid	2.70	6.6	D
27	Ethylene oxide	2.39	5.4	
28	Ethylene glycol	2.09	17.9	
29	*p*-Xylene	1.90	18.8	C
30	Cumene	1.81	18.3	
31	Ammonium sulfate	1.79	1.8	
32	1,3-Butadiene	1.61	0.9	
33	Acetic acid	1.51	19.8	C
34	Carbon black	1.51	−0.6	
35	Phenol	1.34	10.1	C
36	Acetone	1.13	−0.8	
37	Aluminum sulfate	1.12	−5.9	D
38	Cyclohexane	1.09	3.4	C
39	Sodium sulfate	1.06	0.4	
40	Propylene oxide	1.02	9.8	D
41	Calcium chloride	0.92	−1.5	
42	Acrylonitrile	0.92	15.4	B
43	Vinyl acetate	0.90	18.6	C
44	Isopropyl alcohol	0.89	13.9	
45	Adipic acid	0.82	11.1	D
46	Sodium silicate	0.70	−3.1	
47	Sodium tripolyphosphate	0.68	2.3	
48	Acetic anhydride	0.68	0.7	C
49	Titanium dioxide	0.67	5.7	
50	Ethanol	0.59	3.1	
	Total	265.94	7.6	

*Hazardous material category defined by the U.S. Environmental Protection Agency under Sec. 311 of the Water Quality Improvement Act (Public Law 92-500) of 1972. See G. F. Bennett and I. Wilder, "Evolution of Hazardous Material Spills Regulations in the United States," *Journal of Hazardous Materials*, vol. 4, January 1981, p. 257; U.S. Environmental Protection Agency, "Hazardous Substances: Definition, Designation, Revocation of Regulations, Proposed Expansion of Criteria of Designation and Proposed Determination of Reportable Quantities," *Federal Register*, vol. 44, Feb. 16, 1979, pp. 10266–10284.

SOURCE: "Top 50 Chemicals," *Chemical and Engineering News*, vol. 58, June 11, 1980, p. 36.