United States
Environmental Protection
Agency

Risk Reduction
Engineering Laboratory
Cincinnati OH 45268

Research and Development

EPA/600/S2-91/037 Sept. 1991

EPA **Project Summary**

Chemicals Stored in USTs: Characteristics and Leak Detection

Joseph W. Maresca, Jr., and Robert W. Hillger

The regulations issued by the U. S. Environmental Protection Agency (EPA) in 1988 require, with several exceptions, that the integrity of underground storage tank (UST) systems containing petroleum fuels and hazardous chemicals be routinely tested. The regulatory standards for leak detection in tanks containing hazardous chemicals are more stringent than for those containing petroleum motor fuels. The report summarized here describes (1) the regulatory standards for leak detection in tanks containing hazardous chemicals, (2) the types of chemicals being stored, (3) the characteristics of the tanks in which these chemicals are stored, (4) the effectiveness of tank tightness tests and automatic tank gauging systems for detection of leaks in tanks containing chemicals other than petroleum, and (5) the approaches to leak detection that are being implemented by tank owners and operators.

This Project Summary was developed by EPA's Risk Reduction Engineering Laboratory, Cincinnati, OH, to announce key findings of the research project that is fully documented in a separate report of the same title (see Project Report ordering information at back).

Introduction

On September 23, 1989, EPA issued technical standards and corrective action requirements (40 CFR 280) for owners and operators of USTs that are used for petroleum products and hazardous chemical substances. (A hazardous chemical is any substance defined by the Comprehensive Environmental Response, Compensation, and Liability Act.) Section 280.42 of the regulations presents the requirements for storing hazardous substances. There are five options for release detection in new tank and pipeline systems used to store hazardous substances. Four of these options require some form of secondary containment and periodic monitoring or leak detection within the secondary containment. The fifth option allows for leak detection without secondary containment safeguards providing that (1) the method or system is at least as effective as the ones allowed for use in petroleum USTs in Section 280.43 (b) through (h) of the regulations; (2) information is provided about the chemical and physical properties of the stored substance, the health risks associated with the substance, the characteristics of the site, and corrective action technologies that can be used in case of a release; and (3) approval from the implementing agency is received before installation and operation of the UST system. Existing USTs do not have to meet these requirements until 1998. Until that date, existing USTs need only meet the requirements for petroleum UST systems given in Section 280.41. After 1998, all existing USTs containing hazardous substances will be subject to the same requirements as new tanks.

Tank tightness tests and automatic tank gauges (ATGs) are the two most frequently used release detection methods for petroleum USTs. Either one, when used in conjunction with monthly inventory reconciliation, is acceptable as the

fifth option and thus will satisfy the requirements delineated in the regulations. (This option should not be used, however, if an accidental release cannot be environmentally tolerated even though detection may be immediate). The release detection requirements for tank tightness tests and ATGs are given in Section 280.43 (c) and (d) of the regulations. Tank tightness tests must be capable of detecting a 0.1-gal/hr leak with a probability of detection of 0.95 and a probability of false alarm of 0.05, and ATGs must be capable of detecting a leak of 0.2 gal/hr with the same probabilities of detection and false alarm as a tank tightness test. Because an ATG conducts tests more frequently, its performance requirement is not as stringent as that of a tank tightness test.

Over the next 8 yr, owners and operators of existing hazardous-substance USTs will be using volumetric leak detection systems (for example, tank tightness tests) that were developed primarily for use with petroleum products. As noted above, owners/operators may continue to use these systems after 1998 if the requirements specified in the fifth option are met. It is therefore critical to determine whether volumetric leak detection systems can be relied on when used on tanks containing nonpetroleum chemicals. The performance requirements that were developed for tank tightness tests and ATGs were based on extensive measurements in underground storage tanks containing petroleum motor fuels such as gasoline and diesel. Hazardous substances can differ from these fuels in density, coefficient of thermal expansion, viscosity, and vapor pressure. Moreover, since the list of hazardous substances is extensive, the variability of these properties is expected to extend over a broad range. The effects of these properties on volumetric testing, and therefore on the performance of tank tightness tests and ATGs, have not been fully assessed. Such assessment must be done if the owners and operators of existing hazardous substance USTs are to have any assurance that they can depend on tank tightness tests and ATGs to guard against accidental releases.

Objectives

The objectives of this project were (1) to identify the chemicals being stored in USTs and the characteristics of the tank systems used to store these chemicals; (2) to assess the influence of the physical properties of the stored products on the performance of volumetric leak detection systems; and (3) to identify, as well as determine the effectiveness of, the approaches to release detection that owners and operators of tanks containing hazardous chemicals are taking to achieve compliance with the regulations.

Report Organization

The work done in fulfilling these objectives was presented in three technical papers [1-3]. These are included as Appendices A, B, and C of the full report summarized here. Each paper addressed one objective of the project. The main conclusions and recommendations derived from this work are summarized below.

Conclusions

Characteristics of Tanks Containing Nonpetroleum Chemicals

A survey of the registered tanks containing chemicals other than petroleum was conducted [1]. The following states participated in the survey: California, Delaware, Florida, Illinois, Indiana, Maine, Massachusetts, Minnesota, Missouri, Montana, New York, Ohio, Texas, Virginia, and Wisconsin. This survey enlarged on earlier work [4] analyzing data provided by New York, California, and the Chemical Manufacturers Association (CMA).

The results of the present survey suggest that tanks containing hazardous and nonhazardous chemicals comprise up to 2% of the total UST population nationwide. Of the chemical tanks surveyed, approximately 50% contained hazardous substances and the remaining 50% contained chemicals that are not regulated. The most striking feature to emerge from the survey of chemical tanks is the wide variety of substances that are stored. Analysis of the survey data indicates, however, that roughly 80% to 90% of the stored hazardous chemicals are organic solvents, and, of these, the most common are acetone, toluene, xylene, methanol, and methyl-ethyl ketone. These five chemicals account for the contents of approximately 49% of the tanks containing hazardous materials.

Not only were the most commonly stored substances assessed, but also the ranges of tank capacity, age, and construction materials. The average tank capacity was approximately 7,200 gal, with over 27% of the tanks having capacities of 10,000 gal or more. The mean age of the tanks was roughly 18 yr, and over 86% were fabricated from steel. In view of the survey's findings, it can be expected that substantial upgrading of tank installations will occur over the next 8 yr.

Analysis of the Applicability of Volumetric Leak Detection Systems to Tanks Containing Hazardous Chemicals

The performance of volumetric leak detection systems that could be used to meet the tank tightness testing and the ATG release detection option was analyzed [2]. The results show that (1) how well the volumetric leak detection system works is directly related to the coefficient of thermal expansion of the stored product and (2) the waiting period required for the effects of structural deformation to subside is essentially the same for all values of density of the stored fluid (even though higher densities produce greater deformation-induced volume changes immediately after any product-level change). When a leak detection system is used with a chemical having a coefficient of thermal expansion higher than that of the product used in the evaluation of the system, the system's performance will be lower than it was in the evaluation. Because gasoline has a higher coefficient of thermal expansion than that of many chemicals, a system evaluated with a gasoline product can be used with such chemicals and still maintain a similar level of performance. (This may not be true, however, if the system was evaluated with diesel, which has a coefficient of thermal expansion 35% less than that of gasoline.)

For a large portion of the tank population, internal leak detection methods such as tank tightness tests and ATGs are a viable approach to testing tank integrity. The physical properties of the most commonly stored chemicals are generally similar to those of unleaded gasoline, upon which the quantitative performance standards in the regulations are based. In addition, the size and construction of a majority of chemical tanks closely approximate those from which the data used to support the regulations were developed. Assuming, therefore, that practical details of material compatibility and safety have been addressed, it would seem that only minimal extrapolations of current knowledge are needed for volumetric leak detection systems to be applied to storage tanks containing chemicals.

Currently Used Approaches to Leak Detection

Two types of organizations were informally surveyed by telephone: those that own and operate tank systems containing hazardous substances and those that provide tank testing services to such organizations [3]. The object of the survey was to

determine the type and effectiveness of the leak detection systems and the inventory control practices being used to test tank systems.

Even though a diverse cross section of organizations was contacted, the responses obtained during the telephone survey should not be interpreted quantitatively. Because the number of organizations was very limited and the survey was not statistically designed or statistically analyzed, the results should be interpreted cautiously. The temptation to generalize, particularly about the status of regulatory compliance, should be avoided unless additional data are gathered. The following observations are noteworthy, however, either because the response was overwhelming or because it was ambiguous.

Based on the discussions conducted during the course of the survey, one would tend to conclude that most owners and operators of chemical tanks are actively involved in upgrading their tank systems to minimize the liability associated with any accidental releases. Most organizations said that they were replacing their underground storage tanks with aboveground tanks whenever possible. When this was not possible, tank and piping systems with secondary containment, primarily double-wall tanks and piping, were being used; none of the organizations contacted was considering the use of single-wall tanks or piping in conjunction with the release detection option. What is not clear from the survey is how much time will be required for those organizations currently upgrading their tank systems to complete the process. If the time required for upgrading a tank system exceeds 1 yr, the regulations require that the tank system be tested in the interim by means of methods commonly used on tanks containing petroleum.

None of these organizations used inventory control as a means of leak detection. It also appears that this method of leak detection would be difficult to apply because of the lack of metering devices or the lack of accuracy in the metering devices being used.

The tank testing firms indicated that approximately 5% of their tests were conducted on tanks containing hazardous chemicals, a figure that is slightly higher than the estimated percentage of such tanks in the United States. This response is inconsistent with that obtained from the 13 tank-owning organizations responding to the survey; none of these indicated that they were using or planning to use such services. This inconsistency is probably due to the small size of the survey.

Recommendations

Although the number and volume of UST systems containing hazardous chemicals is small, it is important to ensure that good leak detection practices—ones that are in compliance with state and federal regulations—are being used.

This project made no attempt to assess the status of regulatory compliance by owners and operators of UST systems containing hazardous chemicals.

The principal recommendation of this project is that a survey be conducted (1) to assess the level of compliance on the part of owners and operators and (2) to determine whether guidance documents in support of compliance efforts are needed and would be effective.

The full report was submitted in fulfillment of Contract No. 68-03-3409 by Vista Research under the sponsorship of the U.S. Environmental Protection Agency.

References

1. R. W. Hillger, J. W. Starr, and M. P. MacArthur. Characteristics of Underground Storage Tanks Containing Chemicals. Accepted for publication by ASTM, April 1991.
2. J. W. Starr, R. F. Wise, J. W. Maresca, Jr., R. W. Hillger, and A. N. Tafuri. Volumetric Leak Detection in Underground Storage Tanks Containing Chemicals. Accepted for publication in Proceedings of the 84th Annual Meeting and Exhibition of the Air and Waste Management Association, Vancouver, B.C., Canada (15-17 June 1991).
3. R. F. Wise, J. W. Starr, J. W. Maresca, Jr., R. W. Hillger, and A. N. Tafuri. Leak Detection in Underground Storage Tanks Containing Hazardous Chemicals. Accepted for publication in Proceedings of the 17th Annual Research Symposium, Risk Reduction Engineering Laboratory, Office of Research and Development, U.S. Environmental Protection Agency, Cincinnati, Ohio (3-5 April 1991).
4. I. Lysyj, R. W. Hillger, J. S. Farlow, and R. Field. A Preliminary Analysis of Underground Storage Tanks Used for CERCLA Chemical Storage. Proceedings of the Thirteenth Annual Research Symposium, Hazardous Waste Engineering Research Laboratory, Office of Research and Development, U.S. Environmental Protection Agency, Cincinnati, Ohio (July 1987).

☆U.S. GOVERNMENT PRINTING OFFICE: 1991 - 548-028/40068

Joseph W. Maresca, Jr., is with Vista Research, Inc., Mountain View, CA 94042; and the EPA author ***Robert W. Hillger*** *(also the EPA Project Officer, see below) is with the Risk Reduction Engineering Laboratory, Edison, NJ 08837.*
The complete report, entitled "Chemicals Stored in USTs: Characteristics and Leak Detection," (Order No. PB91-219592/AS; Cost: $17.00, subject to change) will be available only from:
National Technical Information Service
5285 Port Royal Road
Springfield, VA 22161
Telephone: 703-487-4650
The EPA Project Officer can be contacted at:
Risk Reduction Engineering Laboratory
U.S. Environmental Protection Agency
Edison, NJ 08837

United States
Environmental Protection
Agency

Center for Environmental Research
Information
Cincinnati, OH 45268

BULK RATE
POSTAGE & FEES PAID
EPA PERMIT NO. G-35

Official Business
Penalty for Private Use $300

EPA/600/S2-91/037