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Project Summary

Underground Tank Leak Detection Methods: A State-of-the-Art Review

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The full report is a state-of-the-art review of available and developing methods for finding small leaks in underground storage tanks used primarily for gasoline and other liquid petroleum fuels. It describes (based on information provided by the manufacturers or practitioners) a total of 36 volumetric, nonvolumetric, inventory monitoring, and leak effects monitoring detection methods; provides general engineering comments on each volumetric and nonvolumetric leak detection method; and discusses variables which may affect the accuracy of detection methods. The emphasis throughout is on volumetric and nonvolumetric leak detection methods.

This Project Summary was developed by EPA's Hazardous Waste Engineering Research 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

Statement of the Problem

In recent years, the increase in leaks from underground gasoline storage tanks has had a significant adverse environmental impact on the United States. Current estimates from governmental and industrial sources are that between 1.5 to 3.5 million underground storage tanks exist in the nation. Estimates of the number of leaking tanks range from 75,000 to 100,000; and 350,000 others may develop leaks within the next five years. (Conference Report on H.R. 2867 Hazardous and Solid Waste Amendments of 1984, Congressional Record-House, H11140, October 3, 1984.) The 1983 National Petroleum News Factbook Issue forecasts the existence of approximately 140,000 gasoline service stations in the United States at the end of 1983. New York State estimates that 19 percent of its 83,000 active underground gasoline tanks are now leaking. Maine estimates that 25 percent of its 1,600 retail gasoline underground tanks are leaking approximately 11 million gallons yearly. In Michigan 39 percent of groundwater contamination incidents are attributed to storage tanks.

One of the primary causes of tank leakage is corrosion of the storage tanks. Product loss from leaking tanks may cause an adverse effect on the environment, endanger lives, reduce income, and require the expenditure of millions of dollars for cleanup. To prevent or reduce the adverse effects of gasoline leakage, an accurate method must be used to determine whether or not an underground tank is leaking.

The 1984 Resource Conservation and Recovery Act (RCRA) amendments regulate underground storage tanks containing petroleum products and substances defined in Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). RCRA regulations specify release detection, prevention, and corrections and require a leak detection system, an inventory control system, and a tank testing (or equivalent) system. States are also passing legislation and writing regulations requiring both staged replacement of existing underground tanks and installation of monitoring wells to detect leaks. Performance standards for new tanks will be specified under

RCRA and included in various state regulations.

Objective

The objective of the full report is to identify existing and developing techniques to detect leaks in underground fuel storage tanks. This objective is accomplished by a review of the manufacturer's description of each method, its capabilities, and its,claimed precision and accuracy.

The variables affecting leak detection methods are introduced in Section 5 of the report. This information should give the reader an understanding of the major variables and their effects on the accuracy of various leak detection methods. Section 6 presents a description of each detection method based on the available literature from the manufacturer or practitioner. The descriptions in Section 6 of the manufacturer's techniques for offsetting the effects on each detection method of these major variables are based on information from the manufacturer's literature, reports, and/or verbal communications between the authors and the staff of the manufacturer. This information was reviewed for correctness by most of the manufacturers, practitioners, or developers of the detection methods (instruments). Independent engineering evaluations of error sources for each detection method are provided by the authors. Finally, Tables 1 through 9 in Section 2 summarize the capabilities of the leak detection methods. Information in these tables is primarily from each manufacturer's description and, where noted, from the engineering comments in Section 6. Table 1 provides the phone number and contact name of the manufacturer/practitioner for each manufactured leak detection method.

Summary

Existing and developing leak detection methods were reviewed, and techniques for offsetting the effects of variables which affect accuracy were evaluated. In Tables 1 through 9 of the report, general information, general operational capabilities, and compensation for effects of variables discussed in this text are summarized for volumetric, nonvolumetric and other leak detection methods for underground storage tanks. Wherever it is appropriate, in these summary tables, the information furnished is based on engineering comments and not on the manufacturer's claim.

Table 1. *Leak Detection Methods: Manufacture or Practitioner Phone Numbers*

Leak Detection Testing Methods	*Phone Number*	*Contact Name*
Volumetric (Quantitative) Leak Testing Methods		
1. Ainlay Tank Tegrity Testing (TTT)	*(312) 328-6119*	*Mr. John Ainlay*
2. ARCO HTC Underground Tank Leak Detector	*(312) 333-3000*	*Mr. Gary L. Everett*
3. Certi-Tec Testing	*(612) 487-1484*	*Mr. Jonathan Nedved*
4. "Ethyl" Tank Sentry Testing	*(609) 452-8600*	*Mr. A.V. Morschauser*
5. EZY-CHEK Leak Detector	*(517) 684-7180*	*Mr. John Horner*
6. Fluid-Static (Standpipe) Testing	*Method is used by different contractors*	
7. Health Petro Tite Tank and Line Testing (Kent-Moore Testing)	*(617) 344-1400*	*Mr. Jack Stillwagon*
8. Helium Differential Pressure Testing	*(415) 228-8400*	*Mr. John Schweizer*
9. Leak Lokator Test (Hunter Sunmark Leak Detection)	*(215) 296-7380*	*Mrs. Donna Hymes*
10. Mooney Tank Test Detector	*(504) 241-0453*	*Mr. Joseph Mooney*
*11. *PACE Tank Tester*	*(416) 443-7032*	*Mr. Jack Witherspoon*
*12. *PALD-2 Leak Detector*	*(Not Available) 3425 W. 30th Ave. Vancouver, B.C., V6S1W3 CANADA*	*Mr. Werner Grundmann*
13. Pneumatic Testing	*Method is used by different contractors*	
14. Tank Auditor	*(617) 740-1717*	*Mr. William E. Baird*
*15. *Two-Tube Laser Interferometer System*	*(415) 424-1251*	*Mr. Joseph W. Maresca*
Nonvolumetric (Qualitative) Leak Testing Methods		
*1. *Acoustical Monitoring System (AMS)*	*(615) 966-4773*	*Mr. Charles B. Oh*
2. Leybold-Heraeus Helium Detector, Ultratest M2	*(412) 327-5700*	*Mr. Wm. C. Worthington*
3. Smith & Denison Helium Test	*(415) 782-9788*	*Mr. Wm. H. Burkhart*
4. TRC Rapid Leak Detector for Underground Tanks and Pipes	*(602) 623-0200*	*Mr. Glenn Thompson*
*5. *Ultrasonic Leak Detector, Ultrasound*	*(914) 592-1220*	*Mr. Mark A. Goodman*
6. VacuTect (Tanknology)	*(403) 483-3506*	*Mr. Edward Adams*
7. Varian Leak Detector	*(617) 935-5185*	*Mr. Roger Schneider*
Inventory Monitoring		
1. Gage Stick	*Method is used by different contractors*	
2. MFP-414 Leak Detector	*(617) 238-6911*	*Mr. Stanley Hayes*

Table 1. (continued)

Leak Detection Testing Methods	*Phone Number*	*Contact Name*
3. TLS-150 Tank Level Sensor (Veeder-Root)	*(203) 527-7201*	*Mr. Tony Spera*
Leak Effects Monitoring		
1. Collection Sumps	*Method is used by different contractors*	
2. Dye Method	*Method is used by different contractors*	
3. Ground Water or Soil Core Sampling	*Method is used by different contractors*	
4. Interstitial Monitoring in Double-Walled Tanks	*Method is used by different contractors*	
5. L.A.S.P. Monitoring System	*(214) 271-2561*	*Industrial System Marketing*
6. Observation Wells	*Method is used by different contractors*	
7. Pollulert and Leak-X Detection Systems	*(317) 261-1130* *(212) 822-6767*	*Mrs. Joyce Rizzo (Pollulert)* *Mr. John Gelles (Leak-X)*
8. Remote Infrared Sensing	*Method is used by different contractors*	
9. Surface Geophysical Methods	*Method is used by different contractors*	
10. U-Tubes	*Method is used by different contractors*	
11. Vapor Wells	*Method is used by different contractors*	

To conduct this survey, the American Petroleum Institute (API), and the Petroleum Equipment Institute (PEI) were contacted for assistance in developing a comprehensive list of available detection methods. A limited patent search was performed to identify methods currently being developed, but not yet available commercially. In all, fifteen volumetric leak testing, seven non-volumetric leak testing, three inventory monitoring, and eleven leak effects monitoring methods were found.

The information in the report is based almost entirely on information provided by the manufacturers and practitioners of the detection methods.

Conclusions

The conclusions listed below are based on the review of leak detection methods described in this report.

1. Variables affect the testing results of available or developing volumetric, nonvolumetric, and in-tank monitoring methods used for leak detection of underground tank systems. These variables are potential sources of errors in using the detection methods successfully. The importance of each variable may vary due to the characteristics of the tank being tested and to such test conditions as the temperature of additional product used to fill a tank prior to testing, depth of the water table, tank deformation, random variation of ambient temperature or pressure, tank inclination, product vapor pressure, and tank age.
2. The 36 methods identified include 15 volumetric leak detection, 7 nonvolumetric leak detection, 3 in-tank monitoring, and 11 leak effects monitoring methods.
3. Detection methods attempt to compensate for variables affecting accuracy in various ways.
4. Available data on the performance evaluation of the leak detection methods reviewed were not adequate to determine their relative accuracy.

Recommendations

The accuracy and precision of volumetric leak detection methods (at least) should be determined in order to permit selection of the ones appropriate to any specific need. A cost-effective procedure is to make use of signal/noise theory and a high quality data base to estimate the likely performance of each method under a variety of representative conditions, and to verify performance by evaluating the method under a few selected, controlled conditions in a full-scale test apparatus.

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The complete report, entitled "Underground Tank Leak Detection Methods: A State-of-the-Art Review," (Order No. PB 86-137 155/AS; Cost: $16.95, subject to change) will be available only from:
National Technical Information Service
5285 Port Royal Road
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