IDENTIFICATION AND CONTROL OF ORGANIC CHEMICALS IN SOLE SOURCE AQUIFERS ON LONG ISLAND, NEW YORK

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INTRODUCTION

Widespread contamination of groundwater, the sole source of drinking water for 2.8 million people on Long Island, New York, by industrial solvent discharges and underground gasoline spills has created unique public health and environmental protection problems.

The experience and knowledge gained, the organization and procedures developed for various aspects of the investigation, and the data collected, may be useful in guiding other communities which may encounter similar situations. The probability of such occurrences are high considering that organic chemicals are an intrinsic part of our industrialized society. The water of most urban and suburban areas are probably already contaminated with these substances to some degree.

Identification of trace organic chemicals in the drinking water source in Nassau County presented initial difficulties because gas chromatography/mass spectrometry (GC/MS) methodologies required have been scarce and expensive considering the need to test over 400 public wells. Health risks associated with exposure to volatile halogenated organic chemicals are not clearly established. Restriction in use of contaminated public wells have to be weighed against the threat of insufficient water and low distribution water pressure. Staff resources have been inadequate to mount a comprehensive well monitoring program and concurrently perform a comprehensive field survey to identify and abate sources of these chemicals.

Groundwater contamination by leaking of buried gasoline storage tanks has presented a series of technical problems including determining the spatial extent of aquifer contamination, notably from benzene, marshaling the best available technology for clean-up of spills, disposition of contaminated groundwater pumped from recovery wells, development of field equipment for treatment of contaminated water, and determination of an appropriate standard or end point for restoration of groundwater quality.

Administrative problems have included determining the extent of liability of perpetrators of spills and enforcement of discharge standards of State Environmental Conservation law. Other issues involve health risks associated with exposure to gasoline fumes in residential environments and the development and promulgation of legislation to minimize future failures of underground gasoline tanks.

HYDROGEOLOGY OF LONG ISLAND

The sole source aquifer system of Long Island constitutes the terminal moraine of two major glaciers and consists of three major interconnected aquifers consisting of sand and clay deposits from 200 to 1,400 feet in total thickness resting on bedrock. Groundwater, replenished entirely by precipitation, flows generally northerly and southerly respectively toward the Long Island Sound and the south shore bays bordering the Atlantic Ocean.

Movement of groundwater varies from 0.5 to 2.5 feet per day and there is a greater vertical component in vicinity of the divide which causes more direct recharge to deep aquifers in the center of the island as compared to the areas near the north and south shores. A vicinity map and a hydrogeological cross-section are shown in Figures 1 and 2.

GROUNDWATER DEVELOPMENT

Public water supply serving virtually the entire 1.42 million residents of Nassau County is provided by 48 community and 23 non-community public water supply systems with collective facilities totaling 434 wells and an average daily pumpage of 181 million gallons per day (MGD). Public wells extend from 28 to more than 1,200 feet in depth.

Wells are spatially distributed generally in proportion to demand except along the southern fringe of the island mainland where wells are not authorized in order to prevent salt water intrusion from the sea. The water table aquifer (Glacial) is generally not used for public water supply because of extensive sewage pollution from cesspools generated during the early post World War II years of country development. The second (Magothy) aquifer provides 88 percent of the public water while the third (Lloyd) aquifer is reserved for barrier island communities because of salting of the other two aquifers in these areas.

NASSAU COUNTY PROFILE

Nassau County serves as a bedroom community for adjacent New York City and increasingly supports both a service and predominantly dry light manufacturing industry. Significant local industrial and commercial facilities include aerospace manufacturing, printing and publishing, metal fabrication,machine and electronic equipment manufacturing, and textile production.

Residences are primarily of the one family type in suburban type development with urban centers primarily in the southwest quadrant and rural characteristics in the northeast portions. Automobiles are the primary transportation mode, although the Long Island Railroad provides train service mainly on three east-west routes. Freight volume is handled mostly by truck with some service by rail.

Industrial and commercial operations are fairly uniformly distributed with concentrations generally along the center of the County near main railroad and expressway routes and in the City of Glen Cove located in the north central part of the County.

Sewage disposal in the County before rapid land development in the 1950's was by cesspool and leaching field systems serving industrial lots, except for sewer systems serving the two cities and several populated hamlets. A major sewerage system serving the southwestern quadrant was constructed in the 1950's and one serving the southeastern portion has been under construction during the 1970's and is expected to be completed by 1985. At the present time more than 68 percent of the population is served by municipal sewers.

CONTAMINATION OF GROUNDWATER BY INDUSTRIAL SOLVENTS

The first indication of contamination of groundwater by organic chemicals grew out of an investigation starting in 1972 of a sweet paint taste and odor in wells serving the Grumman Aerospace Corporation plant in the southeastern area of Nassau. After exhaustive wet chemical analyses could not identify the cause, the Region II office of the U.S. Environmental Protection Agency agreed to perform GC/MS tests in 1974 of two wells and nearby industrial waste sumps of the Grumman plant as well as that of the Hooker Chemical Company then engaged in the manufacture of PVC. Vinyl chloride and chloroethylenes were found in the sumps but not in the wells at a detection limit of 100 micrograms per liter (ug/l). Further qualitative, then quantitative tests were made by the N.Y. State Health Department laboratories of Grumman Corporation wells over the next two years until in late 1976, organic chemical contamination of municipal wells was demonstrated.

During December of 1976, municipal wells were first tested for the same volatile halogenated organic chemicals (VHOC) which had been identified in the industry wells and waste sumps consisting of the following:

- 1,1,2 trichloroethylene
- tetrachloroethylene
- chloraform
- 1,1,1 and 1,1,2 trichloroethane
- carbon tetrachloride
- trifluorotrichloroethane
- bromodi chloromethane
- vinyl chloride

Analytical work was performed by laboratories of Region II of the USEPA and the State Health Department. In all, 98 tests were performed of 21 public wells of 11 water districts. Ten of these wells were restricted from use by the County Health Department as a prudent public health measure due to appreciable concentrations of one or more of these chemicals, based on the sparse toxicological data then available.

A comprehensive testing program of all public wells in the County was then launched. During 1977, all of the operating public wells were tested with priority to shallow wells and proximity to industrial areas, incinerators, landfills, and inland sewage treatment plants. By September 1978, 425 of the 434 public supply wells had been tested, 418 of them at least twice, and 1,262 samples analyzed. In addition, 259 monitoring wells (303 samples) had been tested.

During 1977 the laboratory work was performed primarily by the State Health Department at a rate of 15 samples per week. Laboratory capability for GC/MS work was acquired by the Nassau County Department of Health in late 1977. In 1978, public water purveyors were requested to test for organic pesticides and herbicides listed in drinking water standards and in 1979, for volatile halogenated organic compounds on an annual basis for each well matching the routine monitoring of the State and local health departments.

The monitoring program for VHOCs included routine tests for the original group of nine compounds except for vinyl chloride which was not found in any municipal wells and tested sporadically. Limited testing was also performed for 1,2 dichloroethylene, methylene chloride, and bromoform.

The overall extent of contamination of drinking water sources is demonstrated by the proportion of total wells at various ranges in levels of organic chemicals. Based on data representing 425 public wells analyzed as of September 1978, 301 (70 percent) are not contaminated, 84 (20 percent) contain less than 10 ug/l of organic chemicals, 24 wells (6 percent) contain between 10 and 50 ug/l, and 16 wells (4 percent) exhibit concentrations equal to or greater than 50 ug/l. This data represents the total of organic constituents in the most recent laboratory analysis.

A similar analysis of the same wells grouped by aquifer reveals a distribution of organic contaminants in decreasing levels for the progressively lower aquifers. Of the 50 Glacial wells tested, 17 (34 percent) are contaminated. Of the 338 Magothy wells,105 (31 percent) reveal these substances. The Lloyd aquifer has the lowest percentile, 2 of 37 wells tested or 6 percent positive. The data is summarized in Table 1.

Distribution of individual organic contaminants in public wells provides another informative summary of the data. The most common organic constituents in community wells are chloroform, tetrachloroethylene, 1,1,2 trichloroethylene, 1,1,1 trichloroethane, carbon tetrachloride, and trifluorotrichloroethane listed by decreasing numbers of wells in which detected. The frequency of occurrence of 14 individual constituents and maximum levels detected is shown in Table 2.

Monitoring wells exhibit a greater variety of constituents detected in a significantly larger proportion of wells with highest concentrations for individual contaminants generally greater than for water supply wells. This is attributed to generally more shallow well depths than water supply wells and the predominant locations of these wells in industrial areas.

Glacial wells account for 61 percent of monitoring wells compared to only 12 percent for public supply wells. Monitoring wells are 60 percent positive compared to 30 percent for public supply wells and 14 percent are contaminated in excess of 50 ug/l compared to 4 percent for public wells.

HEALTH RISK ASSESSMENT

In late 1976, little information was available concerning the toxicity of organic chemicals, particularly through exposure in drinking water, although at the time the National Academy of Science was performing such studies for the USEPA as a basis for establishing national organic chemical standards required by the 1974 Safe Drinking Water Act. The State Health Department interceding in these studies was able in early 1977 to provide, "Interim Guidelines" for use by local health departments in evaluating the potential health risk in the data being collected and take appropriate measures to prevent public exposure.

The guidelines specified a maximum level in drinking water of 10 ug/l for vinyl chloride, 50 ug/l for other individual VHOCs and a total concentration of organic chemicals not to exceed 100 ug/l. The informal standards were predicated on a lifetime human exposure (70 years) in drinking water (2 liters/day) which would cause on additional cancer death per year in from 100,000 to 1 million people compared to the absence of such exposure.

The Nassau Health Department decided to restrict well use where the interim guidelines were violated in order to minimize public health risk. In all, 16 public water supply wells have been restricted of which 13 are community wells.

Halogenated hydrocarbons found in public water supply wells in Nassau County include none which have been listed by the National Academy of Science as "known" human carcinogens or as "suspected" human carcinogens. Three compounds detected however, have been identified by the NAS as animal carcinogens. These are listed below together with their associated cancer risk:

Compound	Upper 95% Confidence Estimate of Lifetime Cancer Risk per ug/l
Chloroform	3.7×10^{-7}
Carbon tetrachloride	1.5×10^{-7}
Trichloroethylene	1.3×10^{-7}

CRITERIA FOR RESTRICTING WELLS

The implementation of the Interim Guidelines posed difficulties due to the variability in reported levels of contamination in successive tests of the same well and the concern that restriction of several wells in a particular water system could result in sufficient loss of supply capability to cause a significant pressure drop in the system leading to a backsyphonage threat which could contaminate the water supply due to bacterial or toxic chemical agents.

A criteria was developed which provides a prudent public health protocol for regulating well use. Successive tests for organic chemicals exceeding guideline levels are required before a well is formally restricted. Restricted wells are not to be used except when all of the following conditions are satisfied:

1. All non-contaminated wells in the system are in use.
2. Interconnections with adjacent public water supply distribution systems are fully utilized to augment the supply.
3. A water emergency is declared to curtail non-essential uses of water such as lawn sprinkling, car washing, etc.
4. Distribution system pressure threatens to fall below 20 psi at any point.
5. Consumers are notified of proposed use of contaminated well before the well is placed into service.

Where contaminated wells are required to be placed in service, the least contaminated well is to be utilized first, followed where needed by wells with progressively higher levels of organic chemicals.

LABORATORY CERTIFICATION

A key factor in the interpretation of laboratory analyses reported by several governmental and commercial laboratories was the wide variation in organic compounds and concentrations reported from well to well and in successive tests of the same well. While these variations could be attributed to changes in the sources tested, there were sufficient occurrences of unusual laboratory findings to suggest the need for a formal certification process for analytical laboratories. The State Health Department undertook the responsibility and did develop by May 1977, an approval procedure for analytical laboratories performing tests for organic chemicals. The USEPA-II in a cooperative role agreed to inspect out-of-state laboratories for the State Health Department using the State criteria.

The process was slow because of the rapidly developing technology in gas chromatography/mass spectrometry equipment and analytical techniques. Approved laboratories were also required to retain highly qualified directors and to expend a significant percentage of their time in quality assurance procedures and checks. By June 1977 only one analytical laboratory was approved. As of June 1978 however, five additional laboratories were certified.

The lack of early development of the laboratory approval system unfortunately cast doubt on the validity of results of 192 analyses which were contracted for by public water supply officials and others in a sincere effort to cooperate with the Department in the expeditious identification of the extent of well contamination during 1977.

IDENTIFICATION AND ABATEMENT OF SOURCES

While the first priority in the investigation of organic compounds was to identify the extent of the problem by assessing the public water supply wells,the need was recognized to identify and abate the sources of organic compounds. These were categorized as industrial and commercial sources, consumer products, and community facilities, the latter to include stormwater recharge, sewage treatment plants, incinerator discharges, and landfill leachate.

Industrial and Commercial Sources

Industrial and commercial sources were the first to be addressed. A plan was developed to perform on-site surveys of each of 3,500 establishments in the County considered to be potential sources and the field phase was initiated in December, 1976.

The survey procedure for each establishment was to determine through interview of plant officials and direct observation, the use by the facility of organic chemicals, the identification of specific compounds and quantities used, and the disposition of these chemicals either as a component of the wastewater effluent or by batch disposal either on or off the site.

Identification of a potential discharge of organic chemicals to the groundwater at a plant triggered a regularization procedure to identify constituents of concern as well as their concentrations and to cause either an immediate cessation of the discharge of organic chemicals or the institution of permitting procedures under the State Pollution Discharge Elimination System (SPDES) calling for an engineering evaluation and an abatement plan on a reasonable compliance schedule.

A $100,000 one-year C.E.T.A. project was approved in June of 1977, which enabled the recruitment of a staff of nine technical personnel (bachelors degree with major in chemistry or biology) and one clerk-typist to augment the permanent staff. $7,200 was allocated for commercial laboratory analyses of industrial wastes.

It was learned that in many establishments the use of organic solvents is in a manner such that relatively small quantities of waste containing organic chemicals are collected and dumped into sumps or cesspool systems or flushed into drains. These include equipment cleaning operations such as by printers, machine shops, and automobile service stations. Drycleaners, too, in typical solvent recovery operations generate several gallons of condensed steam containing the unrecoverable fraction of solvents.

While the individual contribution of organic chemicals to the water environment by these processes is small, the overall adverse impact is appreciable because of the large number of such operations and the public health significance of only trace quantities of organic chemicals. Chemical analyses of three drycleaning plants revealed a waste loading of between 1,800 and 200,000 ug/l. A typical discharge is eight gallons per week. There are 400 drycleaning plants in the County.

In most instances, small batches of waste can be effectively controlled through the use of "Store and Remove" permits. In many other instances, changes in products and use enabled corrections to be made at the time of the plant survey.

By June 1978, 3,097 plants were inspected of which 1,014 were found to be using chemicals. Of these, 379 facilities were identified as using chemicals of concern. Immediate abatement efforts were feasible in 82 establishments and SPDES permits indicated for 227 other plants. At 124 sites, sampling and testing of plant effluent was considered appropriate and 59 such tests have been completed. Remaining establishments to be surveyed are primarily 400 drycleaners and 1,400 automotive service stations.

The data generated by the Industrial Organic Chemical Waste Survey has been evaluated in several ways. An ADP "Symap" System was used to plot data on chemical usage by constituent and by quantities on a map of the County. Resulting maps were superimposed on similarly prepared "Symaps" on which were printed the concentration of the same constituent in water supply wells. Usage of industrial solvents by constituent and by industry is shown in Table 3, groundwater values in Figure 3.

Generally the comparison of chemical usage and concentration in wells demonstrates a significant cause-effect relationship with consideration of the temporal and spatial lag between chemical discharge and appearance in a well,caused by:slow groundwater movement (1 1/2 to 2 1/2 feet/day), varying lateral flow components of groundwater throughout the aquifer system, changes in chemical usage by industry, and influence of other sources of the same chemicals.

Consumer Product Assessment

A second major source of synthetic organic chemicals in the groundwater which was investigated was the consumer products containing those substances which through use and disposal would contribute to contamination of the groundwater.

Identification of consumer products of concern consisted of a survey of 25 percent of the County's retail hardware and department stores, supermarkets, sanitary supply companies, and automotive supply stores. Letters of inquiry were also sent to the manufacturers of over 500 products of concern to ascertain more complete ingredient information and yearly sales volumes in the County.

Based on the information gathered, each product was evaluated using the following three criteria:

1. The product contains or is suspected of containing harmful organic chemicals.
2. The product has the potential of entering the groundwater through its usage or disposal.
3. The product is used in significant quantities in Nassau County.

This evaluation yielded 250 products which may have the potential of contributing to groundwater degradation. A breakdown of the product categories is shown in Table 4.

The single most significant products requiring control are cesspool and drain cleaners which constituents total 85 percent of methylene chloride, 1,1,1 trichloroethylene, ortho dichloro benzene, and other aromatic and halogenated compounds. Total usage annually of these products in the County in 1978 was 67,500 gallons. These products are generally applied directly into plumbing drains and in unsewered areas are recharged to the groundwater through cesspools and leaching fields.

The State Attorney General instituted a successful effort to gain voluntary removal of these products from sale on Long Island on the basis that their use represented a contravention of State water discharge standards and constituted a public health nuisance. A State ban is proposed.

Community Source Identification

Sporadic testing of sewage treatment plant effluents discharged to groundwater, incinerator discharges, stormwater runoff, and landfill leachate, have identified the presence of organic chemicals of concern, but not in quantities to elicit priority concern at this time.

Three sewage treatment plants have been sampled and analyzed indicating small amounts of chlorinated hydrocarbons. These can be attributed to background levels in the associated groundwater and/or compounds created by chlorination of the sewage.

Recharge basins sampled in industrial areas have been negative for organic chemicals. Two landfill leachates have been analyzed - one test was negative and the other chemicals only slightly above interim drinking water guidelines. The one incinerator sampled (cooling water) contained 75 ug/l of bromoform.

GASOLINE CONTAMINATION OF GROUNDWATER

History

Concurrent with the contamination of groundwater by industrial solvents, another threat has been experienced from the leaking of gasoline from the rupture of increasing numbers of underground gasoline storage tanks, primarily at automobile service stations. Since May 1976, 43 incidents of such leaks have been verified in Nassau County alone. Eighteen sites are presently in various stages of recovering petroleum products. Quantities of product spilled in each incident have varied from small amounts to as much as an estimated 51,000 gallons.

The rather sudden and increasing frequency of tank failures in the County is attributed to the very rapid land development immediately following World War II. From 1940 to 1960, the population increased from 407,000 to 1,308,000. The heavy dependency on the automobile for transporation stimulated rapid construction of automobile service stations reaching 1,400 gas stations with 5, 600 tanks, as well as 500 non-public facilities with an additional 750 tanks.

The average life expectancy of the steel tanks generally in place is 25 years. The earliest record of a tank leak is in 1969 and the Department of Health has been involved since May 1976 when gasoline fumes in a residence were first encountered.

Spill Identification and Recovery Procedures

Coping with leaks of underground gasoline storage tanks presents a series of both technical and administrative problems spanning the discovery and reporting of tank failures, identification of the extent of product excursion and groundwater contamination, product recovery, restoration of groundwater quality, and public health implications relating to drinking water quality and exposure to gasoline fumes in interior air.

Delay in discovery of tank leaks is caused first by generally poor product inventory practices at service stations, although procedures are available and encouraged. There is further, no effective program in place for routine monitoring of tank integrity. Small leaks may go undetected indefinitely. Appearance of gas fumes at a utility manhole, stormwater recharge basin, or at a construction excavation is usually the first indication of a leak which may be years after its onset.

Usual recovery operations in permeable soil conditions begin with the installation of observation wells to determine the spatial extent of product migration in the groundwater and the depth of product floating on the water table. Product recovery involves the installation of a drawdown well which creates a conical depression in the groundwater table sufficient to allow the product to gravitate to a central location where it can be pumped through an oil-water separator and recovered. The water discharge from the drawdown well, amounting to from 100 to 500 gpm, is usually discharged to a stream or a stormwater drain or basin. A residual amount of spilled product remains absorbed on the soil particles and cannot be recovered by mechanical means. The quantity involved depends on the depth of unsaturated soil, the physical parameters of the soil, as well as the amount and type of petroleum products spilled.

Threat from Dissolved Toxicants

A new dimension to underground gasoline spills on Long Island was the recognition in late 1978, that benzene and several other constituents of gasoline, although soluble in water to a very small extent, are nevertheless, sufficiently dissolved to pose a significant threat to groundwater quality in terms of drinking water impairment.

Gasoline products contain varying amounts of benzene, toluene, xylene, tetra ethyl lead, and methyl ethyl ketone (M.E.K.), all of which are known or suspected toxicants in drinking water. Benzene is a known carcinogen and banned from consumer products by the Consumer Product Safety Commission. A level of benzene in drinking water of only 1 ug/l is estimated to produce one additional cancer in a million people after a lifetime (70 years) exposure.

The Nassau Health Department has demonstrated that these chemicals can and do dissolve in the groundwater. Benzene concentrations in the groundwater at a 51,000 gallon gasoline spill in the East Meadow area have been sporadically reported as high as 80,000 ug/l at a point one-third of a mile southwest of the spill. Groundwater pumped at the spill site has contained levels as high as 19,100 ug/l. Other consituents - lead, toluene, and xylene - have also been detected in limited testing of groundwater at levels exceeding standards or informal guidelines for drinking water. A summary of data and comparison with applicable standards is shown in Table 5.

There are several aspects of the gasoline threat to public water supply sources. First is the inability to remove all of the spilled product in recovery operations which provides the opportunity for subsequent stormwater recharge to continually dissolve soluble toxic constituents from the residual product in the soil and conduct the contaminants into water supply aquifers, particularly since the water table aquifer is itself the source of the lower Magothy aquifer which supplies 88 percent of the County public water supply.

A second concern is the possibility that constituents of gasoline may be precursor chemicals in the formation of carcinogenic trihalomethanes when the contaminated raw groundwater is chlorinated as part of the water treatment process.

The third problem is the mechanics of pollution. Isolated point sources from gasoline spills infiltrate the aquifer system by means of contaminant plumes with unpredictable dimensions, directions, and rate of travel due to the complex natural hydrology, coupled with the superimposed effect of an irregular pumping regimen of a large number of wells. Interception of one or more of these plumes by the zone of influence of a water supply well generally could compromise the safe quality of the supply because of the extremely low contaminant concentrations which are health significant. The presence and levels of toxicants is variable except where steady state conditions exist between a source and a well intercepting the contaminant plume.

Water quality monitoring for toxic gasoline constituents at individual wells is not feasible at the frequency which would be required to properly identify contaminants which may be present in order to prevent human exposure. Gas chromatography and wet chemical tests required for testing soluble toxic gasoline constituents in one sample may cost over $100.00. Scarcity of laboratory capability is another constraint.

Groundwater Restoration

One appropriate countermeasure to the infiltration of groundwater by toxic gasoline constituents is to restore the quality of the contaminated water. Valuable experience has been gained in this respect from a 51,000 gallon gasoline spill in East Meadow, Nassau County, of an Exxon service station tank. The discovery of significant benzene in the drawdown well discharge generated two approaches, the first to dispose of the drawdown well water in an environmentally satisfactory manner; the second, to devise a field water treatment system to remove benzene from the discharged water.

While the feasibility of treatment was being explored, environmental assessment was made of alternatives to the original unsatisfactory disposition of drawdown well discharge which was into a local stormwater recharge basin. Discharge to a nearby brook was explored and found unacceptable because the stream was partially recharged to groundwater at a downstream reach and because benzene concentrations anticipated might interfere with the spawning and reproduction as well as edibility of trout.

Removal of the tainted water by tank truck was found to be logistically and economically unfeasible requiring 73 trips daily of tankers of 10,000 gallons capacity. Discharge to a sanitary sewer trunk line was decided to be the most feasible solution after the hydraulic sufficiency of the sewer was assured, appropriate user fees established, and responsibility accepted for any unforeseen damage which might occur to the physical structures and the biochemical treatment process of the sewerage system.

Exploration of the feasibility of water treatment to remove benzene included a request by the County Health Department to the USEPA Region II Emergency Response and Hazardous Materials Inspection Branch for technical assistance. Their bench scale studies on water from the East Meadow spill site demonstrated nonfeasibility of conventional tractor-trailer mounted GAC units because the carbon capacity would be exhausted in less than two days, but might be useful as a polishing treatment. Air stripping was determined to be 85 percent effective in removing benzene using an air-water ratio of 20:1.

The Exxon Company had meanwhile fabricated a treatment unit at the spill site consisting of two vertical cylindrical tanks 64 inches in diameter and 24 feet high. Drawdown water sprayed into the tanks operated in parallel achieved a benzene removal efficiency of 30 percent. Later addition of compressed air units, a third tank, and arrangements for operation in series, succeeded in achieving an effluent with a benzene concentration of less than 10 ug/l.

An ironical twist in the operation of the air stripping unit was encountered when nearby residents complained of benzene odors in the ambient air. While subsequent air testing showed benzene concentrations at residential properties to be commensurate with the ambient air background, the operation of the unit was found to violate State air emission regulations which require 99 percent removal of benzene generated.

Extent of groundwater degradation in an individual spill site has not been achieved nor have methodologies been demonstrated to completely restore groundwater quality to pre-spill conditions. Some consideration has been given however, to the installation of recovery wells at one or more locations downgradient from the spill to pump, treat, and recharge the effluent through stormwater recharge basins.

GASOLINE IMPACT ON INTERIOR AIR QUALITY

Exposure to gasoline fumes in an interior environment has presented problems such as to reliably sample and test for the constituents present, to make an appropriate toxicological assessment, to reduce human exposure, and to purge the contaminants from building interiors which have been permeated by the fumes.

Recent contamination by gasoline fumes of 24 homes adjacent to the gasoline spill in East Meadow provided an apparently unprecedented experience for public health officials. Reports of gasoline odors and varied symptoms of illness prompted evacuation of the homes in January 1979 after sealing of basement wall and floor openings and installation of forced ventilation systems were successful in correcting explosion hazards, but not complete dissapation of vapors.

Samples of the first floor and basements for benzene and other hydrocarbons showed variable results from laboratories using different procedures and wide variations from home to home and from day to day.

Average benzene levels in the impacted homes have varied from 26 to 29 ug/l in the basement areas and from 24 to 26 ug/l on the first floor level. These compared with average levels in the control homes of 17 ug/l in basements and 10 ug/l on the first floor level. There has been no discernable trend in benzene levels during the five month testing period (April to August 1979). It should be noted that valid test readings were not conducted until April 24, although the original complaint of gasoline odors was in December of 1978.

Toxicological assessment and epidemiological investigation by the State Health Department, including medical examination of the exposed residents and exhaustive laboratory tests, showed no evidence of somatic effects. There was insufficient basis to conclude however, that some residual injury may not have been experienced by exposed personnel.

A characteristic odor has persisted in the affected homes to the present time in spite of efforts to prevent entry of vapors and to ventilate the buildings. It has been suggested that the fumes originally may have penetrated textiles in drapes, carpets, and upholstered furniture which account for the continued odor.

CONCLUSION

Organic chemicals discharged to the environment and significant to public health in only trace quantities have created formidable challenges to assess health risks and to clearly identify as well as correct environmental degradation. With constantly improving analytical methodologies more and more contaminants will be identified, initially in isolated investigations. It behooves the regulatory agencies at all levels of government, as well as the scientific community to share the information being gathered so that the pioneering experiences in one community are available to others with the same potential problems.

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