AGRICULTURAL CHEMICAL NEWS

by Stuart Cohen

Arsenic in the Ogallala Aquifer

The Texas Department of Agriculture recently released a report concerning arsenic levels in Texas soil and ground water, with particular emphasis on elevated arsenic concentrations in the southern region of the Ogallala Aquifer. Fifty-three of the 101 wells sampled in the area around Knott, Texas, were found to contain detectable arsenic concentrations; 34 of these wells contained arsenic concentrations that exceeded EPA's 50 ppb maximum contaminant level (MCL). Wells sampled elsewhere in the state generally had low or non-detectable levels of arsenic.

The investigation was launched in December 1983, following the poisoning of 11 head of cattle by arsenic. Initially, the suspected source of poisoning was arsenic-contaminated ground water. It was later determined that the deaths occurred after the cattle were fed arsenic-contaminated cotton gin trash. Meanwhile, wells in the general area were found to contain high levels of arsenic. Subsequent investigations during 1984 and 1985 indicated that the two findings could be linked.

Calcium arsenate was applied to cotton in the area as an insecticide from the 1930s to the 1960s. Arsenic acid has been applied to cotton in the area as a defoliant since the 1950s.

It has been a common practice in the Texas High Plains to return cotton gin trash to the fields as a soil amendment since 1954. This agronomic practice was probably given a boost in 1972 when the Texas Air Control Board banned the burning of this waste. Thus, the cotton fields were receiving direct applications of arsenical insecticides and defoliants, as well as indirect arsenic applications via arsenic-contaminated cotton gin trash. Pesticide application rates were 3–15 lb/acre (3.4-16.8 kg/ha) and total arsenic concentrations in the gin waste ranged from 0.78-450 mg/kg (ppm). Thus, total arsenic applications to the fields were very high over a period of time.

Arsenic compounds are fairly water soluble compared to most organic pesticides but they are readily bound to soils with low pH, high clay content, and/or high organic matter content. As a result, scientists were puzzled at the initial arsenic findings in wells and there was a big push to look for contamination mechanisms that would 'short circuit' the normal leaching process, such as disposal pits, use of gin trash to insulate uncemented or uncased wells, and interflow along caliche layers until macropores are encountered. Evidence of all of these contamination sources, including normal leaching through soil, was found.

Soils in the area are neutral to moderately alkaline—a phenomenon that tends to increase arsenic mobility.

The soils are sandy loam to sandy clay loam and overlie a clay loam and sandy clay loam caliche layer. Depth to ground water was apparently not measured in the study but was suspected to be 6 to 40 feet (1.8-12.2m). High levels of tritium and nitrate were found in the affected area, indicating significant recharge. (However, a recent report on the Southern High Plains region estimated the average recharge rate to be 0.5-3.24 in/yr (Nativ & Smith, Bureau of Economic Geology Open File Report 85-34, 1985).)

The highest arsenic concentration in top soil samples collected directly under gin trash piles and from fields where gin trash was added to the soil were 20.15 and 12.82 mg/kg, respectively. Results from a related 26-well study showed that 45 percent of the 20 wells that exceeded the arsenic MCL also exceeded the nitrate MCL. The two wells with the highest arsenic concentrations—585 ppb and 500 ppb—were located adjacent to an abandoned cotton gin and also had the highest nitrate concentrations—255 ppm and 432 ppm, respectively.

Low ppm concentrations of arsenic were found in deep soil cores (>8 feet) under four plowed fields. Adsorption coefficients (K_d values) measured with the native soils were typically 30 to 200 mL/gm following 85 days of equilibration and they were typically 10 to 60 mL/gm following seven days of equilibration. These K_d values are much higher than usually would be found for pesticides that leach to ground water.

The investigations could not distinguish between the potential sources of arsenic contamination and suggested that all sources—pesticide applications, soil amendments, point sources—may have contributed to the problem.

The Texas Department of Agriculture plans to begin further investigations soon that will expand the list of analytes to more than 82 pesticides. Copies of the 1988 report "Investigation of Arsenic Contamination of Ground Water Occurring Near Knott, Texas," can be obtained from the Texas Department of Agriculture, Stephen F. Austin State Office Building, 17th & North Congress

Ave., Austin, TX 78701.

EDB and Infiltration Rates on Oahu

In 1983, soil fumigation uses of the nematicide ethylene dibromide (EDB) were banned by EPA in an imminent hazard/emergency suspension order due to ground water contamination. In subsequent years, the state of Hawaii, the pineapple industry, and the USGS/WRD conducted investigations of EDB in soil and ground water on Oahu. EDB was found in the Waipahu wells, which tap the Pearl Harbor Aquifer, but it could not be definitively determined whether the contamination source was use on pineapple plantations or leakage from fuel pipelines (Oki and Giambelluca, *Ground Water*, v. 25, pp. 693-702, 1987). EDB has been used as a lead scavenger in leaded fuels.

Recently, the USGS published a report that used EDB soil core data to help estimate irrigation water infiltration rates on Oahu (Eyre, P.A.; *Sources of Salts in the Waianae Part of the Pearl Harbor Aquifer Near Barbers Point Water Tunnel, Oahu, Hawaii,* Water Resources Investigations Report 87-4247 1987). The most interesting and relevant part of this report is that it estimates 'real world' infiltration rates based on empirical data obtained from a system of complex hydrogeology. Through this work, one is able to infer a retardation factor for EDB in this environment. Too often, retardation factors are estimated based on the classic analytic equation using equilibrium batch adsorption isotherms.

The purpose of the report was to determine the reason for the marked increase in salinity in Barbers Point shaft water since 1983. In volcanic islands, the fresh water lens floats on top of denser salt water in accordance with the Ghyben-Herzberg principle; thus, salt water intrusion was feared. Instead, it was determined that the salinity increase was most probably the result of saltier irrigation recharge water reaching the water table.

The water infiltration rate was estimated three ways, one of which used EDB soil core data collected in approximately 1-foot intervals down

to 60 feet (18.3m). This interval includes soil and saprolite (chemically weathered rock) material.

The Hawaii vadose zone is atypical of the rest of the United States and these results should not necessarily be extrapolated. Copies of the report can be obtained from the USGS Reports Section, Federal Center, Building 810, Box 25425, Denver, CO 80225.

Legislative Update

If you are confused about all of the bills before Congress that address ground water contamination, you are not alone. One reason for this is multiple jurisdictions. For example, there are 11 House committees with some jurisdiction over ground water. There are more than 50 Congressional committees with some jurisdiction over EPA. EPA senior managers have been called on to testify before these various committees more than 200 times within the last two years. Obviously, there are many 'fingers in the pie' and the potential exists for multiple pieces of legislation.

Following is this author's attempt to list the various pieces of legislation that contain at least some language addressing agricultural chemicals in ground water. No claim is made that this list is complete. An attempt has been made to distinguish between regulatory bills and research and education bills.

Please note that, at this writing, all of these bills are dormant. Congress has adjourned and many of the bills' authors are up for reelection. One can only wait and see which bills will be resurrected in 1989.

Ideas for future columns may be sent to the author at Biospherics Inc., 12051 Indian Creek Court, Beltsville, MD 20705.

Regulatory

S. 1419	Durenberger: pesticides in ground water (*GWMR* Fall 1987, p. 25, and Summer 1988, p. 53)
S. 2035	Heflin: pesticides in ground water, less restrictive than the Durenberger bill; this language was incorporated into the revised pesticide law (FIFRA), S. 1516.
S. 20	Moynihan: comprehensive (pesticides, USTs, etc.)
H.R. 3174	Oberstar: pesticides in ground water; similar to S. 1419

Research and Education

H.R. 791	Brown: see S. 1105
S. 1105	(Env. & Pub. Works version of H.R. 791); EPA must publish and update a list of ground water contaminants; nationwide contaminant source assessments; national ground water information clearinghouse