Results of NAWQA studies show that pesticides are widespread in streams and ground water sampled within agricultural and urban areas of the Nation. As expected, the most heavily used compounds are found most often, occurring in geographic and seasonal patterns that mainly correspond to distributions of land use and associated pesticide use.

The frequency of pesticide contamination, however, is greater than expected. At least one pesticide was found in almost every water and fish sample collected from streams and in about one-half of all wells
sampled. Moreover, individual pesticides seldom were found alone— almost every water and fish sample
from streams and about one-half of samples from wells with a detected pesticide contained two or more
pesticides.

For individual pesticides in drinking water, NAWQA results are generally good news relative to current water-quality standards and guidelines. Average concentrations in streams and wells rarely exceeded standards and guidelines established to protect human health. For aquatic life and wildlife, however, NAWQA results indicate a high potential for problems in many streams, particularly in urban areas, where concentrations of more than one pesticide often approached or exceeded established water-quality
guidelines.



Important questions remain unanswered about potential risks of pesticide contamination to humans and the environment. Currently, standards and guidelines are available only for a limited number of individual pesticides, do not account for mixtures of pesticides or for pesticide breakdown products, and are based on tests that have assessed a limited range of potential health and ecological effects. Long-term exposure to low-level mixtures of pesticide compounds, punctuated with seasonal pulses of higher concentrations, is the most common pattern of exposure, but the effects of this pattern are not yet well understood.

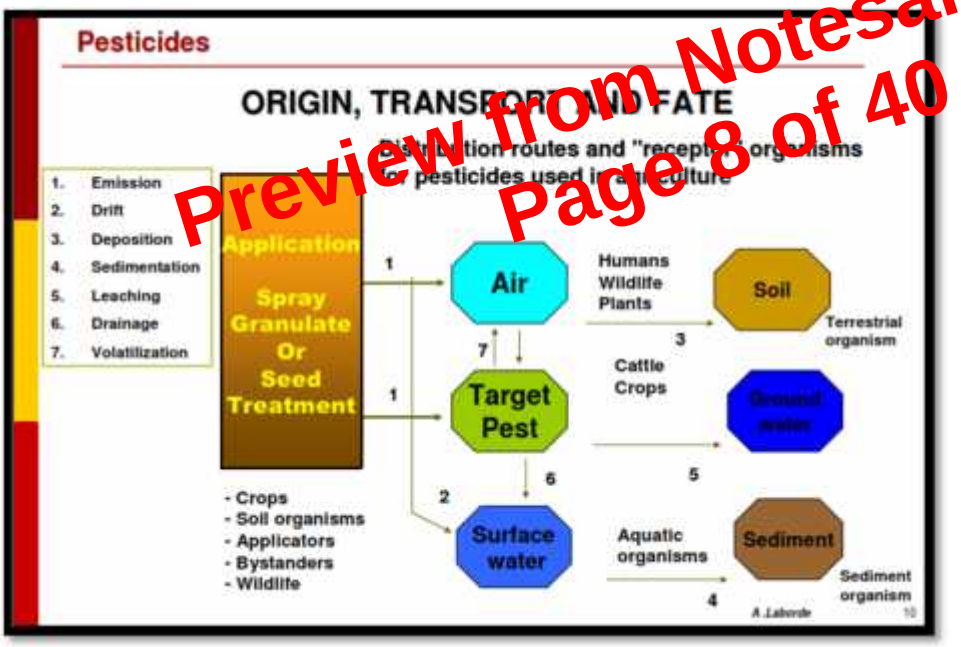
The uncertainty about whether present-day levels of pesticide contamination are a threat to human health or the environment makes it imperative that we document and understand the nature of pesticide exposure, the causes of contamination, and the actions we can take to reduce pesticide levels in streams and ground water.

Pesticides have numerous beneficial effects. These include crop protection, preservation of food and materials and prevention of vector-borne diseases.

physical properties,rapid environmental dissemination and human or animal absorption (examples include cyanide, aluminium phosphate and methyl bromide).

Some domestic, agricultural or veterinary products may contain more than one chemical belonging to the sameor a different chemical group.
Exposure or emission into the environment can occur from on-site exposure through spraying or application of solid formulations to different targets. For example exposure can occur in children during:
- agricultural use (spraying fields) or seed treatment;
- use in cattle dips and in animal husbandry;
- use as household insecticide (indoor), or in gardens;
- sanitary indoor use in schools, offices, hospitals and other institutions;
- public health use (outdoor or indoor): in parks and urban areas and for vector control (e.g. malaria, Chagas
disease, dengue and onchocercasis); - medical human use: to treat head lice or scabies; and - veterinary products for pets (e.g. to treat infestations with fleas or ticks).






Pesticides have different distribution and persistence patterns in the environment, even if all of them are distributed in some way through air, soil and water. This should be addressed to gain an understanding of how acute and chronic exposure may occur because air, water and soil are the media of exposure.This scheme illustrates the routes followed by an agricultural chemical (spray, granulate or seed treatment)
that is applied to a given site, representing a risk to applicators, bystanders and wildlife.
When a pesticide is applied directly to a target pest (plant or animal) the whole site is affected including crop
plants, soil organisms and, potentially, humans and wildlife in the immediate area. In addition, part of it goes to the air or to surface waters, due to emission (1) or drift (2). Once on the target

DDT and Organochlorine Insecticides

Chlorinated hydrocarbon or organochlorine insecticides are hydrocarbon com- pounds in which various numbers of hydrogen atoms have been replaced by Cl atoms. The structural formulas of several chlorinated hydrocarbon insecticides are shown in Figure 7.6. It can be seen that the structural formulas of many of these insecticides are very similar; dieldrin and endrin are stereoisomers.

The most commonly used insecticides in the 1960s, these compounds have been largely phased out of general use because of their toxicities, and particularly their accum- ulation and persistence in food chains. They are discussed briefly here, largely because of their historical interest, and because their residues in soils and sediments still contribute to water pollution.

Of the organochlorine insecticides, the most notable has been DDT (dichlorodi- phenyltrichloroethane or 1,1,1-trichloro-2,2-bis(4-chlorophenyl)ethane), which was used in massive quantities following World War II. It has a low acute toxicity to mammals, although there is some evidence that it might be carcinogenic. It is a very persistent insecticide and accumulates in food chains. It has been banned in the U.S. since 1971.



For some time, methoxychlor was a popular DDT substitute, reasonably biodegradable, and with a low toxicity to mammals. Structurally similar chlordane, aldrin, dieldrin/endrin, and heptachlor, all now banned for application in the U.S., share common characteristics of high persistence and suspicions of potential carcinogenicity.

Toxaphene is a mixture of up to 177 individual compounds pro- duced by chlorination of camphene, a terpene isolated from pine trees, to give a material that contains about 68% Cl and has an empirical formula of $C_{10}H_{10}Cl_8$.

This compound had the widest use of any agricultural insecticide, particularly on cotton. It was employed to augment other insecticides, especially DDT, and in later years methyl parathion. A mixture of five isomers, 1,2,3,4,5,6-hexachlorocyclohexane has been widely produced for insecticidal use. Only the gamma isomer is effective as an insecticide, whereas the other isomers give the product a musty odor and tend to undergo bioaccumulation. A formulation of the

Many large cities and towns will provide municipal trash pickup. If such a service is not available, a company can search locally for certified providers available privately.

Non-certified parties may be disposing of waste through processes such as incineration or landfill, which can be harmful to public health and the environment if not carefully controlled and approved by third parties.

Municipal and certified providers ensure that proper regulatory and environmental protocols are followed, and that waste is ultimately disposed of at safe and controlled locations.

If a company is located in a rural area without a certified provider, it can identify the nearest town with a municipal or certified provider. It may be possible to make arrangements for periodic pickup or drop-off.

Methods for Storage and Disposal: Hazardous Waste

If a company uses hazardous materials, proper precautions must be taken in the storage and disposal of these materials. Many common materials, such as paint, fertilizer and other chemicals, are considered hazardous. If such materials are not stored and disposed of properly, they could create health risks for employees, the community or the public at large.



Any hazardous materials purchased should include a Material Safety Data Sheet (MSDS), otherwise known as a Safety Data Sheet (SDS) or Product Safety Data Sheet (PSDS). By mandate of the World Health Organization's Inter-Organization Programme for the Sound Management of Chemicals (IOMC), all manufacturers of hazardous materials are required to provide a MSDS so that end users can treat the materials properly.

If an MSDS is unavailable for a hazardous material that a business has on site, manufacturer should be able to provide a copy or it may be available on the online MSDS catalog for common products and chemicals MSDS sheets tell if the material is in fact hazardous, as well as provide critical information on the specific hazard, how to store the material, and how to prevent and handle unintended exposure to the material. These sheets should be made readily available to all employees who come into contact with hazardous materials.

If a company uses hazardous materials on site, the below guidelines should be followed for as long as the materials are present on the premises:

- Employees should be trained in the storage and disposal of hazardous materials. A manual for the storage and disposal of wastes should be available in the local language.

- Materials should be stored in sealed containers, in appropriate temperatures, and separate from regular business activities. They should be monitored once a week to ensure no spillage or damage to the container.

- Materials should be labeled with the following7 (which can be found on the MSDS):
    - Standardized pictograms and/or words indicating the type of hazard
    - Product identifier disclosing the chemical identity of the substance
    - Precautionary statements covering prevention, response in case of exposure, storage and disposal
    - All words written in the language understood by employees and handlers



- Materials stored should be recorded and documented. The records should be reviewed periodically to identify trends in the use of hazardous materials on site and potential ways to reduce the level of such materials.

Hazardous waste must be disposed of through a certified third party. Contact the local government or search through private sources for information on pickup or drop-off.

REFERENCES:


- Schreiber, Lukas, and Jörg Schönherr, "Uptake of Organic Chemicals in Conifer Needles: Surface Adsorption and Permeability of Cuticles," Environmental Science and Technology 26, 153-159 (1992).
- Ockenden, Wendy A., Andrew J. Sweetman, Harry F. Prest, Eiliv Steinnes, and Kevin C. Jones, "Toward an Understanding of the Global Atmospheric Distribution of Persistent Atmospheric Pollutants: The Use of Semipermeable Membrane Devices as Time-Integrated Passive Samplers," Environmental Science and Technology, 32, 2795–2803 (1998).
- Graedel, T. E., Chemical Compounds in the Atmosphere, Academic Press, San Diego, 1978.
- Shu, Yonghui, Erik S. C. Kwok, Ernesto C. Tuazon, Roger Atkinson, and Janet Arey, "Products of the Gas-Phase Reactions of Linalool with OH Radicals, NO Radicals, and O ," Environmental Science and Technology, 31, 896-904 (1997).
- Hallquist, Mattias, Ingvar Wängberg, Evert Ljungström, Ian Barnes, and Karl-3 Heinz Becker, "Aerosol and Product Yields from NO Radical Initiated Oxidation of Selected Monoterpenes," Environmental Science and Technology 33, 553-559 (1999).
- Yu, Jianzhen, Richard C. Flagan, and John H. Seinfeld, "Identification of Products Containing –COOH, –OH, and –C=O in Atmospheric Oxidation of Hydrocarbons," Environmental Science and Technology 32, 2357–2370 (1998).
- Odum, J. R., T. P. W. Jungkamp, Richard C. Flagan, and John H. Seinfeld, "The Atmospheric Aerosol-Forming Potential of Whole Gasoline Vapor," Science,276, 96-99 (1997).
- Grimvall, Anders and Ed W. B. deLeer, Naturally Produced Organohalogens, Kluwer Academic Publishers, Dordrecht, The Netherlands, 1995.
- Butler, James H., Stephen A. Montzka, Andrew D. Clarke, Jurgen M. Lobert, and James W. Elkins, "Growth and Distribution of Halons in the Atmosphere," Journal of Geophysical Research, 103, 1503-1511 (1998).
- Molina, Mario. J. and F. Sherwood Rowland, "Stratospheric Sink for Chlorofluoromethanes," Nature, 249, 810-12 (1974).
- Madronich, S., R. L. McKenzie, L. O. Bjorn, and M. M. Caldwell, "Changes in Biologically Active Ultraviolet Radiation Reaching the Earth's Surface," Journal of