How Safe Is Your Bait?

Pesticides May Be Labeled as "Nonvolatile," But Still Release Poisons into the Air

Editors Note: The issue of volatility (chemical evaporation into the air) is confusing because the classical definition of this chemical characteristic disregards very low level emissions, often referred to as "negligible," that escape into the air. We are aware of volatility when we see and/or smell a pesticide being applied as a spray or aerosol. However, this may not be the case with pesticides in bait formulations that are commonly placed throughout buildings in bait stations, or as gels, pastes or granules in cracks and crevices, or behind walls, cabinets, and appliances. While many of the chemical bait products may be characterized as nonvolatile because old technology could not measure the low level vapors, their use may actually result in exposure in indoor environments, particularly those areas that are sealed tightly. These low level exposures resulting from the use of baits have not been evaluated by the regulatory agency, EPA. This piece provides an overview of the pesticide bait volatility issue and reinforces the notion that the best precautionary approach is to adopt practices (cultural, mechanical and biological) that prevent insects and rodents from entering structures. Door sweeps, sealing cracks and crevices, moisture control (including proper drainage and dry conditions) and sanitation management all go a long way in reducing the need for chemical products. -- Jay Feldman

By Raymond Koytcheff

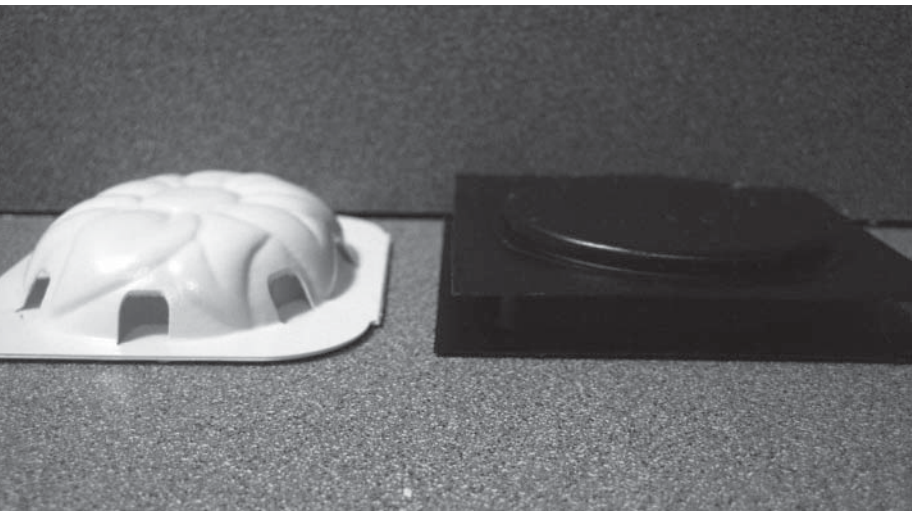
Open up your local Integrated Pest Management (IPM) plan, and you may see baits mentioned often. Touted as the preferred method of application by pest control operators and pest management officials, many people assume baits are safe and do not release dangerous chemicals into the surroundings. But really how hazardous are these products and how much does one get exposed to harmful pesticides from supposedly contained baits?

Baits refer to products that combine an active ingredient(s) with an attractant(s), such as flour or sugar. Popular active ingredients in baits include abamectin/avermectin, acetamiprid, boric acid, disodium octaborate tetrahydrate, fipronil, hydramethylnon, oxypurinol and xanthine, propoxur, sodium tetraborate decahydrate, and sulfluramid. All these chemicals are intended to kill the target organism, which means that baits are inherently poisonous. By definition, however, there is no guarantee that the bait is sealed, secure, or that exposure does not present a health risk.

Some baits are contained so as to minimize exposure, and, all else equal, using these baits as part of a targeted treatment is preferable to applying aerosols or sprays over a larger area. Also, one does not need to locate a nest if using baits, as the formulation either attracts pests or is put in a place where the organisms will find it and consume the contents. While baits may provide some

Table 1. Classical Definitions of Volatility

Non-volatile	Less than 10-7 mm Hg (millimeters of mercury)
Slightly volatile	10-7 to 10-4 mm Hg
Volatile	10-4 to 10-2 mm Hg
Highly volatile	Greater than 0.01 mm Hg



All baits are not created equal. The bait on the left contains avermectin and the one on the right contains boric acid. See Table 2 to compare the relative volatilities.

advantages to other pesticide options, they should by no means be assumed to be a non-toxic, problem-free solutions.

Modernizing the Bait Debate

Given the frequency that baits are used in homes and other buildings—especially in kitchens, gardens, food-storage and processing areas and facilities, and refuse disposal areas—the conventional wisdom about baits needs to be retooled to properly take account of the hazards where they are identified. Children and pets may be attracted to baits and improperly handle them if the bait is not properly placed or not contained in a sealed bait station. Regardless of the exact type of bait used, baits need to be used with caution. All substances evaporate into the air, at least to some degree, so poisonous vapors from baits may very well enter and linger in the ambient air. The clear exception to this is boric acid, which does not volatilize under normal conditions.

Defining Volatility

A key question to ask is how volatile is a bait formulation, and this, along with the toxicity of and the level of exposure to the pesticide, needs to be considered to determine how likely a product is to be harmful. Volatility gives at a first glance a measure of the likelihood of coming into contact with a pesticide that is not already present in the air. The *Basic Guide to Pesticides* defines volatility as "the capacity of a substance to evaporate, thus moving through the air, being easily inhaled, and moving widely as its persistence permits." Volatility is commonly quantified by the vapor pressure (typically measured in millimeters of mercury [mm Hg]) and measures the tendency of a liquid or a solid to turn into a gaseous form. The lower the vapor pressure, the less a pesticide vaporizes into the air after application.

Classical Volatility Definitions

There are different ways of classifying volatility of pesticides. Generally, a substance with a vapor pressure of less than 10^{-7} mm Hg is identified in scientific texts as nonvolatile. The *Basic Guide to Pesticides* rates volatile substances, those with a vapor pressure above 10^{-7} mm Hg, in three categories: slightly volatile, volatile, and highly volatile (see Table 1 for details). The National Pesticide Telecommunications Network (NPTN) agrees on the threshold for nonvolatile chemicals, but only ranks volatile substances as slightly volatile (vapor pressure between 10^{-7} and 10^{-3} mm Hg) or volatile (vapor pressure greater than 10^{-3} mm Hg). These definitions, however, do not suggest that a nonvolatile rating (unless zero volatility) does not result in movement of the chemical into the air. With new technology, vapors that would not be measured are now detectable. In sealed rooms and buildings there can be build up over time. Table 2 lists vapor pressure for active ingredients that are commonly used in baits.

Factors Affecting Volatility

Despite the certainty in measuring vapor pressure of chemicals in a controlled setting, volatility is affected by many variables, even in the indoor environment. Scientists have found that temperature and humidity are significant factors influencing pesticide volatility. High temperature and low humidity increase volatility, and UV radiation and the types of microorganisms present affect how quickly a substance vaporizes and enters the air. Also, air flow plays a role in determining air quality and the levels of pesticide

Table 2. Vapor pressure & health effects of commonly used active ingredients

Boric acid	Not measurable (below detection)	RD
Indoxacarb	1.9 x 10-10	EN, N
Abamectin/ avermectin	1.5 x 10-9	ED, EN, N, RD
Fipronil	2.8 x 10-9	C, ED, EN, N
Isoxaben	4.13 x 10-9	C, EN
Hydramethylnon	2.0 x 10-8	C, EN, RD
Sulfluramid	4.3 x 10-7	EN, RD
Propoxur	9.68X10-6	C, EN, N
Acetamiprid	4.4 x 10-5	EN, N, RD
Water	23.8	--

Key: C = associated carcinogenicity; ED = endocrine disruption; EN = environmental effects; N – associated neurotoxicity; RD = reproductive/developmental effects

residues present indoors. "We conclude that to maintain good air quality, ventilation is important and special care must be taken when spraying insecticides on different surfaces," write Hsien-Wen Kuo and Hsin-Mou Lee, authors of *Volatility of Propoxur from Different Surface Materials Commonly Found in Home*s. Building characteristics—such as volume and surface area of building, products and materials used in structure and furnishing, and mechanical air movement system—also change the distribution and level of pesticide residues.

Under any conditions, all substances will volatilize, albeit to different degrees, so one cannot claim that a pesticide is safe because it is nonvolatile. The toxicity of the pesticide and the level of exposure, both length and frequency, need to be determined to properly gauge the hazard of the pesticide. In the case of most bait applications, exposure is constant, as pesticides remain in the vicinity indefinitely. Exposure to pesticides through inhalation of fumes from baits has not been studied. So for now, think twice before you place some bait packs in your cupboard against those pesky ants or reach for some roach bait to slide under your fridge. Those baits may not even be effective if there are other more accessible or desirable food sources available.

How to choose a pesticide residue-testing lab

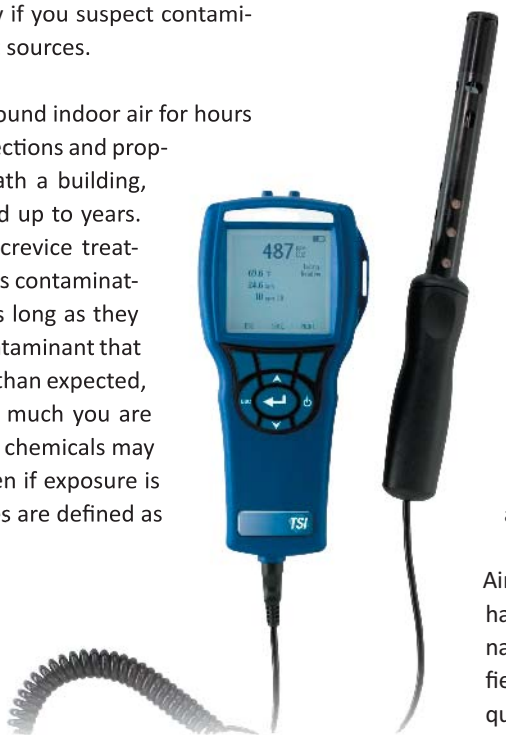
Testing may detect the presence of a chemical in the physical environment and may involve soil, water, air, surface swabs, wood scrapings, carpet samples, etc. A reputable lab should be using validated methods of analysis for the particular pesticide, such as those published in the Pesticide Analytical Manual, in the Association of Official Analytical Chemists Manual, or by EPA. Numerical data should be reported in clearly identifiable units, for example, milligrams per liter, parts-per-million, etc. Results should also include the adequacy of the method chosen for analysis, including percent recovery of spiked samples, results of a standard curve, and results of assay blanks. Before testing, it is best to have a consultation with the lab scientist, either a toxicologist or an analytical chemist, to determine how sensitive the method of analysis must be to be useful.

Indoor Air Quality Testing

Did you know that the air inside your home may be more polluted than the air you breathe outside? That is to say that many times there are more contaminants and greater concentrations of these substances present indoors than outdoors. Given that most people spend 65 to 90 percent of their time indoors, indoor air pollution is more likely to have an impact on human health than outdoor air pollution. Living or working in a "sick" building can lead to respiratory complications or other illnesses, so it may be helpful to measure the indoor air quality if you suspect contamination from one or a number of different sources.

Pesticide and solvent vapors can hang around indoor air for hours even when applied according to label directions and properly ventilated. Pesticides applied beneath a building, can contaminate inside air for weeks and up to years. Baits used indoors and even crack and crevice treatment around a room can result in residues contaminating the air following application or for as long as they are around. Pesticides are one type of contaminant that may be present at concentrations higher than expected, and air testing can help determine how much you are being exposed to toxic substances. Some chemicals may be present at measurable quantities, even if exposure is assumed to be nil because the substances are defined as nonvolatile.

Any air sampling should be part of an overall evaluation of the building and not the first step to addressing a problem with indoor air quality.



Testing usually finds measurable quantities of some sort of contaminant, but it is difficult to determine what level should be flagged as a reason for concern. No standards for indoor air quality exist for schools and residences, and different guidelines have been set for other types of buildings. For instance, the Occupational Safety and Health Administration (OSHA) and the American Industrial Hygiene Association (AIHA) have different guidelines for indoor air quality, which should be treated as such, recommendations rather than firm levels.

Before deciding on air testing, you should use your senses to detect obvious problems in the building. This begins with determining people who are affected, their location inside the building, and the timing of their symptoms. You can then perform an inventory of potential sources of environmental agents that may be related to indoor air quality problems; look for locations and sources of moisture intrusion or water damage; and investigate heating, ventilating and air conditioning (HVAC) system problems and air movement pathways.

Air sampling is useful after all practical steps have been completed and a particular contaminant or contamination source has been identified. Then testing can be done to document quantitatively the degree of the effects of this

contaminant. Although home-testing kits are available, it is advisable to hire an air quality consultant to focus on a particular issue and provide a thorough analysis. You should be sure to verify that a consultant has the proper training and project experience and be as specific as possible in defining project expectations when looking for a consultant.

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Commonly Used Baits and Active Ingredients

FC Professional Insect Control Ant Bait Stations (fipronil), Drax Liquidator Ant Bait (boric acid), Gourmet Ant Bait Gel (disodium octaborate tetrahydrate), Niban-FG Fine Granular Bait (boric acid), Terro-PCO Liquid Ant Bait (sodium tetraborate decahydrate), Prescription Treatment® brand Advance® 360A Dual Choice® Ant Bait Stations (abamectin), Transport™ Ant Bait (acetamiprid), Combat® Ant Products (fipronil), Hasta La Vista, Ant!™ (boric acid), Prescription Treatment® brand Advance™ Dual Choice® Ant Bait Stations (Formula 1) (sulfluramid), Maxforce Professional Insect Control Roach Bait Stations (fipronil), Advion Cockroach Gel Bait (indoxacarb), Prescription Treatment® brand Avert® Cockroach Bait Stations Formula 1 (abamectin), Cleary Roach Terminal (a.k.a.Ecologix Roach Bait) (oxypurinol & xanthine), Focus® Termite Attractant (corn oil), Firstline® GT Plus Termite Bait Station (sulfluramid), Firstline® Termite Bait Station (sulfluramid), Advance® Compressed Termite Bait System (diflubenzuron), Recruit™ IV Termite Bait (noviflumuron), Requiem® Termite Bait (chlorfluazuron), Subterfuge® Termite Bait (hydramethylnon)

These five baits available for over the counter purchase contain the following active ingredients (clockwise from top left): sodium tetraborate pentahydrate & boric acid, avermectin, sodium tetraborate decahydrate, propoxur, and hydramethylnon.

Endnotes

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