Date: February 19, 2008

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Subject: **Field Screening Tests of Zinc Phosphide Based Rodenticide**

Summary

Field screening tests were performed to determine the potential for phosphine gas generation from a zinc phosphide rodenticide, ZP Bait, historically used to control rodents around closed ponds at FMC. Those tests demonstrated that ZP Bait has a very small potential to release phosphine gas (PH3) above 0.3 ppm – a concentration limit applicable to any environmental release from RCRA Pond 16S that is also the OSHA 8-hr Permissible Exposure Limit. Under conditions most representative of field conditions – ZP Bait wetted with tap water and ZP Bait placed in a simulated vole burrow in moist soil - phosphine concentrations were usually not detected (at a minimum detection of 0.01 ppm PH3). Only when the ZP Bait pellets were saturated with an acidic commercial bathroom cleaner containing 9.5% hydrochloric acid were significant concentrations of PH3 gas released.

Background

FMC has historically used a zinc phosphide-based rodenticide (ZP Bait) to control rodents, primarily voles, around the closed RCRA ponds. The toxic action of ZP Bait results from the liberation of phosphine gas after ingestion of the bait by rodents. Phosphide baits generating phosphine are widely used to protect stored grain intended for human consumption from rodent damage.

Phosphine generation is of concern because FMC received a Unilateral Administrative Order from EPA Region 10 in December 2006 requiring that phosphine gas from Pond 16S be removed and treated. Subsequent negotiations resulted in a phosphine concentration limit of 0.3 ppm applicable to any environmental release. FMC has also agreed to monitor the cap surface of Pond 16S for phosphine releases as well as subsurface concentrations of phosphine at the perimeter of Pond 16S. Thus, phosphine gas generation at the soil surface or in a rodent burrow in the soil subsurface attributable to off gassing from ZP Bait might be mistaken as evidence of a release from a closed pond. OSHA also limits worker exposures to 0.3 ppm as a time-weighted average exposure over 8 hours.

Therefore, FMC requested that the licensed rodenticide applicator – Bestway Pest Control – contact rodent bait manufacturers to determine if there were any non-phosphide rodent bait alternatives that would not generate phosphine gas. Bestway determined that the only non-phosphide alternative to ZP Bait was warfarin-based baits.

ZP Bait is a one-time feeding application that has been highly successful for rodent control in the past. The ZP Bait is typically applied to the RCRA Ponds twice per year - Spring and Fall. Warfarin bait requires multiple feedings because the warfarin bait becomes unattractive over time. A single application of a warfarin bait will decrease the rodent population but does not eliminate the population like ZP Bait. Thus, warfarin bait will likely need to be repeated about every 6 weeks, according to JD Johnston of Bestway Pest Control, or about 8 or 9 times per year. Thus, warfarin bait may not provide acceptable control of the rodent population and the cost of using warfarin bait may be about 4 to 5 times higher compared to ZP Bait.

Purpose and Test Methodology

The purpose of this field screening was to determine the likelihood that the ZP Bait used for rodent control in the RCRA pond area could cause a measurable release of phosphine gas. All phosphine measurements for all tests were made using a calibrated low-range Draeger Pac III phosphine monitor. Testing was performed on February 13, 2008 by J.D. Johnston (Bestway), Mark Smith (KW) and Jim Sieverson (FMC).

Five different screening tests were completed. These tests were:

1. Phosphine in the head space of a ZP Bait container.
2. Phosphine from a typical bait sample (one teaspoon) under dry conditions.
3. Phosphine from typical sample (one teaspoon) after the bait was wetted with tap water.
4. Phosphine from typical sample (one teaspoon) after the bait was wetted with an acidic cleaning solution - SparCling containing 9.5% HCl.
5. Phosphine from typical sample (one teaspoon) placed in an outdoor simulated vole burrow.

Test Results

The results for the screening tests are discussed below:

1. Head Space Test

This test consisted of measuring the phosphine levels in the head space of a one-gallon container which was about 50% full of ZP Bait pellets. This container had been closed for at least 3 months. First a phosphine meter was held directly above the ZP Bait container about 6” from the pellets. The highest reading measured over a 5 minute period was 0.50 ppm which was measured soon after the container was opened.

The phosphine meter was then held inside the container about 1” to 2” from the pellets. Over a 3 minute period the phosphine measurements ranged from 0.40 to 1.20 ppm. At the 3 minute time the reading was 0.60 ppm, likely reflecting dilution by ambient air.

2. Typical Bait Sample – Dry Conditions

This test consisted of setting out the typical amount of ZP Bait that is placed in a vole burrow, one teaspoon, and measuring the phosphine released. The bait was held in a disposal plastic spoon placed on an empty work surface at the FMC Training Center bay. The phosphine monitor was held 1 to 2 inches above the pellets. This test did not show any measurable phosphine above the one teaspoon of ZP Bait.

3. Typical Bait Sample – Bait Wetted with Tap Water

For this test, the one teaspoon sample described above was wetted to saturation with tap water. The phosphine levels were again measure over a 5 minute period. Generally the readings were always 0.00 ppm although there were 3 brief (less than 10 seconds) readings at 0.02 ppm.

4. Typical Bait Sample – Bait Wetted with Acidic Cleaning Solution

For this test, a one teaspoon sample of the ZP Bait pellets was wetted with several drops of Spartan SparCling bathroom cleaner. The label on this cleaner indicated that it contained 9.5% hydrochloric acid. This cleaner was selected because it was readily available at the Training Center as a cleaning agent, because phosphine generation is enhanced in a highly acidic or highly basic pH environment, and finally because it would simulate the acid environment present in the stomach of rodents.

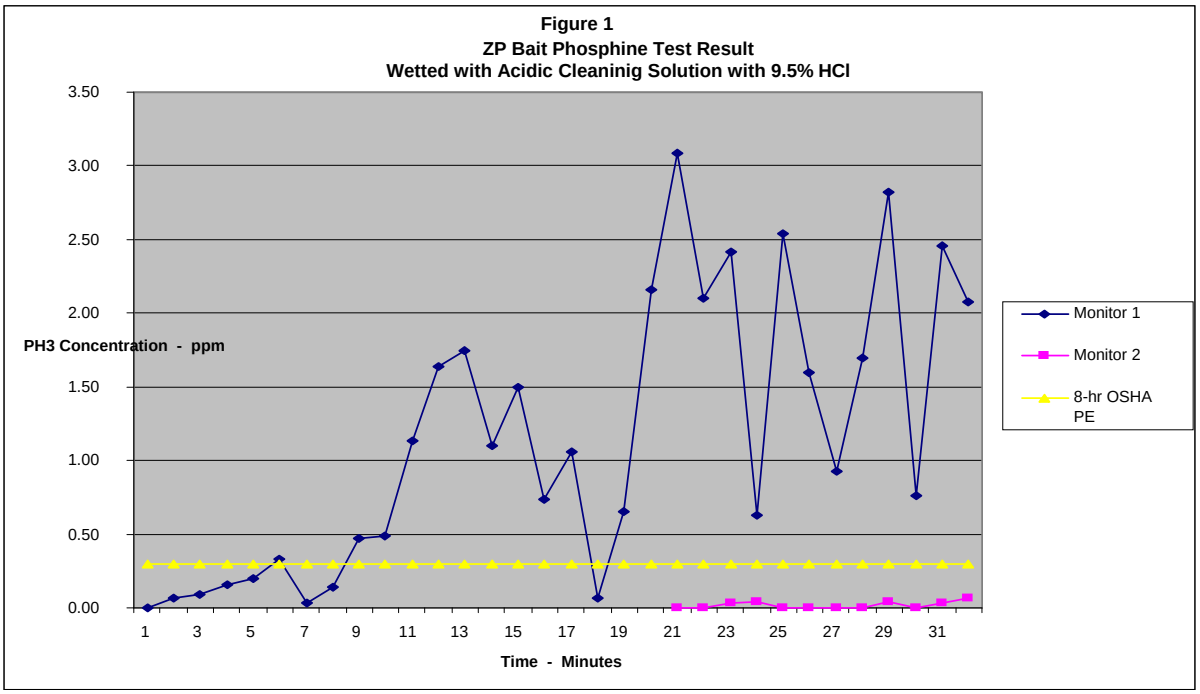
A phosphine monitor (Monitor #1) directly next to the pellets (within $^1/_2$") began measuring phosphine within 30 seconds after the bait was wetted with the acidic cleaning solution. The phosphine levels were measured about every minute over a total time of 40 minutes.

In addition to the measurements taken directly next to the pellets, phosphine concentrations were also taken with a second monitor (Monitor #2) located about 2" from the pellets.

Figure 1 shows the phosphine levels measured during the 40 minute test.

5. Typical Bait Sample – Placement in a Simulated Vole Burrow

For this test, a small hole was dug in moist, snow-covered ground outside the Training Center. The typical amount of ZP Bait, one teaspoon, was placed in the mouth of the simulated burrow. Phosphine measurements were taken at the ground surface (within 2") of the ZP Bait pellets. No phosphine was measured for 3 minutes at which time the pellets were wetted with tap water. No phosphine was measured at the mouth of the hole after wetting of the ZP Bait.



Conclusions

The ZP Bait used for rodent control around the RCRA ponds has a very low potential to release phosphine at levels of concern to human health or above the concentrations negotiated under the EPA Unilateral Administrative Order. Under conditions most representative of field conditions – ZP Bait wetted with water and ZP Bait placed in a simulated vole burrow in moist soil - phosphine concentrations were usually not detected (at a minimum detection of 0.01 ppm PH3) with a few scattered readings around 0.02 ppm PH3. The only condition which emitted a concentration greater than 0.3 ppm PH3 was when the ZP Bait pellets were wetted with an acidic cleaning solution containing 9.5% HCl – a highly acidic environment.

Future Work

A full-scale test is planned using ZP Bait around the Phase IV ponds because these ponds are located some distance away from Pond 16S. Phosphine levels will be measured downwind of the Phase IV ponds on a daily basis. If possible, actual vole burrows will be located and sampled for phosphine at the ground surface post-baiting. This test is planned to begin during the week of February 18-22.

A full-scale test comparing warfarin bait vs. ZP Bait on two different ponds will be planned for later this Spring because warfarin-based baits are not particularly effective during cold, wet winter months.

Appendix A

Data Table for Test 4
ZP Bait Wetted with an Acidic Cleaning Solution

Time, min	Monitor 1 PH3 PPM	Monitor 2 PH3 PPM	8 Hour OSHA PEL	Comment
0	0.00		0.30	
0.5	0.07		0.30	
1	0.09		0.30	
1.5	0.16		0.30	
2	0.20		0.30	
2.25	0.33		0.30	Monitor #1 - First reading above 0.3 ppm
3	0.03		0.30	
4	0.14		0.30	
5	0.47		0.30	
6	0.49		0.30	
7	1.13		0.30	
8	1.64		0.30	
9	1.75		0.30	
10	1.10		0.30	
11	1.50		0.30	
12	0.74		0.30	
13	1.06		0.30	
14	0.07		0.30	Used paper to fan area for 1 min toward monitor
15	0.65		0.30	
16	2.16		0.30	
17	3.09	0.00	0.30	2nd monitor in place downwind about 2”
18	2.10	0.00	0.30	
19	2.42	0.03	0.30	
20	0.63	0.04	0.30	
21	2.54	0.00	0.30	
22	1.60	0.00	0.30	
35	0.93	0.00	0.30	
36	1.70	0.00	0.30	
37	2.82	0.04	0.30	
38	0.76	0.00	0.30	
39	2.46	0.03	0.30	Pellets observed starting to breakdown
40	2.08	0.07	0.30	