

Solution to Maigret's zinc phosphide challenge

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Accepted: 10 February 2023 / Published online: 9 April 2023
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The winner of Maigret's zinc phosphide challenge (published in volume 414 issue 24) is: Thomas Mühlenbernd, 69126 Heidelberg, Germany.

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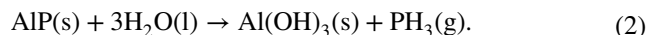
Our Congratulations!

Zinc phosphide or trizinc diphosphide (Zn_3P_2) — to use its systematic name — is indeed toxic, as it reacts violently with water to generate extremely poisonous phosphine gas (trihydrogen phosphide), and zinc dihydroxide in a reaction that is facilitated by the presence of acids:



As correctly stated by both Dr. Pardon and Madame Marton [1], this compound (Fig. 1) is widely used to control rodents, such as rats, mice, voles, gophers, and moles. It can be administered in two ways. For indoor rats and mice, it is mixed with food of some sort. Upon ingestion, it hydrolyzes in the animal's stomach to generate the poisonous phosphine gas. In the case of outdoor burrowing animals, such as gophers, moles, and voles, pellets of the compound are sprinkled down the entrance to their burrows and water added using a garden hose or some other convenient source.

In some products, aluminium phosphide (AIP) has been used as an alternative for the zinc compound. It has the same property of hydrolyzing in the presence of water to generate aluminium trihydroxide and phosphine gas:



I was once told an amusing story about this compound by my late colleague, John J. Alexander [2]. He had hired a teenage

boy to deal with several problems in his backyard, including a mole infestation. For this latter problem, he gave the boy a can of aluminium phosphide pellets and instructions on how to use them. This had a commercial name of some sort on the can, as well as a chemical formula indicating that the active ingredient was AIP. When John came home from the university over the lunch hour to check on how the boy was doing, he asked him if he had administered the aluminium phosphide to the mole burrows as instructed. The boy replied that he knew nothing about any aluminium phosphide, but assured John that he had administered a healthy dose of "Alp" (which he pronounced like the mountain range) to each burrow. It took a few minutes for John to realize that the boy knew no chemistry and had mistaken the chemical formula on the can for the product's name.

The errors

There are numerous chemical errors in Simenon's otherwise entertaining novella. To begin with, zinc phosphide is not a dirty white, almost colorless, powder. It is dark gray when pure, and in most commercial-grade products may be dark brown or black in appearance. The most serious error, however, is Simenon's belief that zinc phosphide is an accumulative poison, like arsenic, that can be gradually administered to the victim over time through food or drinks. Any attempt to add it to a cup of hot herbal tea would result in a violent release of poisonous phosphine gas that is more likely to prove fatal to the would-be poisoner than to the intended victim.

Simenon's use of chemistry may be compared with that of one of his 19th-century predecessors — the French author, Guy de Maupassant. As I have described in greater detail elsewhere [3], in a short story entitled *The Practical Joke*, Maupassant made use of the chemistry of calcium phosphide, which is a direct analog of zinc phosphide, and which also generates phosphine on contact with water:



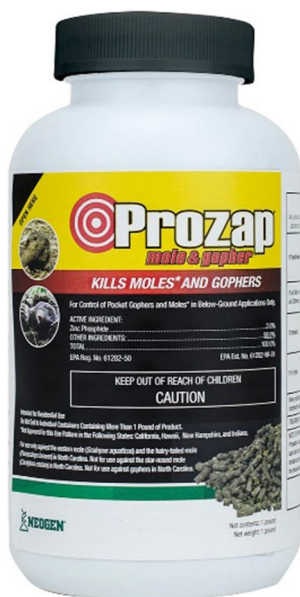
In this tale, Maupassant describes the result of placing some of this compound in the dry chamber pot of a nasty

This article is the solution to the Analytical Challenge to be found at <https://doi.org/10.1007/s00216-022-04195-0>

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Fig. 1 A bottle of Prozap for control of gophers and moles



old lady that the narrator particularly loathes. Not only is the resulting “reaction” when the pot is used accurately described, the physiological after-effects of mild phosphine exposure are also accurately described.

At the opposite end of the spectrum is a 1976 adaptation of the Maigret novella as a radio play for the BBC under the more literal title of *Maigret has Scruples*. Here, the script writer eliminates Marton’s careful distinction between zinc phosphide and zinc phosphate and uses the latter, rather than the former, to kill both the rats in the Marton home and Xavier himself. This is unlikely in the extreme as zinc phosphate is not used as a rat poison but rather as a coating to prevent the rusting of metal objects and as a dental cement.

Declarations

Conflict of interest The author declares no competing interests.

References

1. Jensen WB. Maigret’s zinc phosphide challenge. *Anal Bioanal Chem.* 2022;414:7001–2.
2. Anon. Obituaries. *Chem Eng News.* 2003;81(3):54.
3. Jensen WB (1983) Monsieur de Maupassant and Phosphure de Calcium, *Chem 13 News* (University of Waterloo) 139, 4–5; reprinted with revisions in *HIST Newsletter* 1986;18:5–8.

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