

## FAQ

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### **Aluminium phosphide: highly toxic pesticide No health impairments are expected when used properly**

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Aluminium phosphide is a pesticide used mainly indoors, for example in containers or grain silos, as an insecticide, and outdoors as a rodenticide to control rodents. When combined with moisture, the substance releases phosphine gas, which is highly toxic even in very small amounts. In Germany, the substance may only be used by trained specialists (i.e. trained professional users) and its use is subject to strict safety regulations. In recent years, the BfR has received reports of a number of mostly minor cases of poisoning and suspected cases, mainly caused by occupational exposure to phosphide. However, when the chemical is used properly by the trained specialists, no risk of poisoning in humans is expected.

#### **What is aluminium phosphide?**

Aluminium phosphide is a grey powder with a fishy or garlic-like odour. When combined with moisture (e.g. air or soil moisture), it forms the toxic gas hydrogen phosphide, also known as phosphine. This gas acts as a powerful insecticide and rodenticide (biocidal products for the control of rodents), which, when used in high concentrations, prevents cell respiration in both vertebrates and insects, leading to their rapid death.

#### **What is aluminium phosphide used for?**

Aluminium phosphide is used both as an insecticide indoors and as a rodenticide for controlling brown rats and voles outdoors.

Indoor applications include fumigation of silos, flat storage areas, stacks of sacks, storage rooms, containers and other gas-tight rooms or buildings, as well as fumigation of ship cargo holds to protect the goods stored there from insects. The application takes place in closed and sealed rooms or buildings, both empty and containing stored goods.

Outdoors, aluminium phosphide is used in fumigation to control brown rats and voles in clearly localisable rat burrows that are separated from other rodent burrows and building structures. It is also used in all types of non-agricultural domains where rodent burrows can cause damage, for example on railways (embankments, tracks, ballast edges, boundary paths), dams and flood defences, sports facilities (e.g. golf courses), gardens and parks, port traffic areas, aerodromes and other types of technical domains.

### **What is the hazard potential of aluminium phosphide?**

Aluminium phosphide has a very high acute toxicity. However, it is not the solid aluminium phosphide itself that is toxic, but the gas phosphine (hydrogen phosphide, PH<sub>3</sub>) formed when exposed to air humidity. The toxic effect occurs both following the uptake of aluminium phosphide through the skin and following swallowing or inhalation of phosphine. Animal experiments show that even very small amounts are sufficient to cause serious damage to health. A single oral dose of 10 mg/kg body weight of aluminium phosphide led to death in half of the laboratory animals. When phosphine gas is inhaled, the lethal concentration is less than 0.1 mg/l of air. Accordingly, aluminium phosphide is classified in the highest hazard category, Acute Tox. 1, and must therefore be labelled in the EU with the hazard statement "Fatal if inhaled".

In humans, the first symptoms of poisoning have been reported after just half an hour at a concentration of 1.4 mg of phosphine per cubic metre of air. This corresponds to a phosphine concentration in the air of 1:1 million (1 ppm).

### **What are the symptoms of aluminium phosphide poisoning?**

Aluminium phosphide poisoning can cause a wide range of symptoms. These include general clinical symptoms, gastrointestinal problems, headaches, dizziness, nausea, vomiting and diarrhoea. Other symptoms include muscle twitching and numbness or tingling in the limbs, disorientation and lethargy. A garlic-like odour on the breath has also been described. In severe cases of poisoning, organ damage with kidney failure, cardiac arrest, pulmonary oedema (water accumulation in the lungs), respiratory arrest and coma may occur. After oral intake of aluminium phosphide, death occurred in approximately 70% of reported cases.

### **What should be considered when using products containing aluminium phosphide?**

Aluminium phosphide may only be used by trained specialists, i.e. trained professional users. The expertise required for fumigation is regulated in Germany by TRGS 512 (Technical Rules for Hazardous Substances, Fumigation). It also contains important requirements for the protection of both the persons using the product and uninvolved third parties.

The following relevant requirements apply to the general public (uninvolved third parties). These are specified in the authorisations for the respective biocidal products and require compliance by the trained specialists:

Indoor areas:

- A safety zone must be established and clearly cordoned off around the area to be fumigated. No measurable amounts of the gas may occur outside this danger zone. If necessary, the safety zone must be enlarged accordingly.
- The treated rooms/objects and the danger zone must be labelled with warning signs (skull and crossbones symbol, warning of hazard due to fumigation and prohibition of entry, name of the biocidal product, time and date of fumigation, address and telephone number of the responsible person/company and the authorisation holder, emergency number).
- Users or experts must regularly check the concentration of the fumigant in the ambient air until the area is released. This is to ensure that there is no occurrence of concentrations above the limit of detection (LOD) ( $\geq 0.01$  ppm) outside the specified danger zone.
- Once fumigation has started in rooms or warehouses, these must be vacated immediately and sealed sufficiently gas-tight. The rooms must not be entered until they have been released.
- The person in charge of fumigation may only release rooms, furnishings and fumigated goods once suitable measurement methods have ensured that there is no longer any risk from the fumigant.
- The air concentration in rooms and in the vicinity of treated goods and facilities must be below 0.01 ppm phosphine. The measurements must be carried out with devices that enable precise compliance with the reference value. The measurements must be carried out near the floor and in domains where the highest concentrations of the fumigant are to be expected.

Similar safety rules apply to outdoor use (rodenticides) as to indoor use. In addition, residents must be informed at least three days before fumigation begins. Furthermore, additional cordoning-off measures and an additional safety zone of 25 metres must be established.

### **Are there limit values for phosphine residues after fumigation?**

The Biocidal Products Regulation applies throughout the EU to the supply and use of biocides. Its aim is to ensure the protection of human health, animal health and the environment in all Member States. The individual authorisations for biocidal products specify relevant requirements for the protection of the general public (uninvolved third parties), which require compliance with them by the trained professional users. In the case of phosphine, the air concentration in rooms and in the vicinity of treated goods and facilities must be below 0.01 ppm phosphine.

In the opinion of the BfR, this limit value is sufficient. The mechanism of action of phosphine is well known (inhibition of energy production in cells). No harmful effects on health have been observed below a value of 1 ppm. The limit value of 0.01 ppm phosphine includes a 100-fold safety factor for this value.

### **Is aluminium phosphide freely available in Germany?**

Two biocidal products that release phosphine are currently authorised in Germany:

Rodenticide with aluminium phosphide:

<https://echa.europa.eu/documents/10162/a20d741d-083c-bc52-0453-ef0ef472d98c>

Insecticide with magnesium phosphide:

<https://echa.europa.eu/documents/10162/82b8bd0a-5c9c-5187-5a7b-57617b4fce4c>

It is irrelevant for the effect whether phosphine is released from aluminium or magnesium phosphide. Both biocidal products may only be used in Germany by trained professional users. These are pest controllers who have expertise in fumigants in accordance with TRGS 512. These products can only be purchased in shops upon presentation of proof of expertise. This means that products containing aluminium and magnesium phosphide are not freely available for sale in Germany and should therefore not fall into the hands of private individuals.

### **Are there legal regulations governing the use of aluminium phosphide?**

Yes, the use of aluminium phosphide is regulated by law in Germany in TRGS 512. This states that only trained professional users may use aluminium phosphide and contains regulations for the protection of the users and uninvolved third parties. Please also refer to the answer to the question: “What should be considered when using products containing aluminium phosphide?”

### **What is the risk posed by aluminium phosphide when transporting fumigated cargo?**

To protect transported goods from infestation by pests and mould, containers, cargoes or empty spaces on seagoing vessels (bulk carriers) are fumigated. Port and warehouse workers may come into contact with residues of the fumigants. In the past, despite the relevant labelling requirements, there have been reports of minor health problems in connection with the opening of fumigated containers (FAQ on fumigated containers). For inland waterway vessels that transport previously fumigated bulk goods, the BfR has identified a need for further regulation and has worked within the designated Committees for the transport of dangerous goods to introduce mandatory measurements of the cargo and the crew quarters on board the vessels. These measurements serve to ensure compliance with the limit values for phosphine applicable in Europe in the transport sector as well, in order to protect the crew, which also includes family members and usually spends more than eight working hours a day on board.

### **Could a case of poisoning such as the one in Turkey, where a family is believed to have died in a hotel room in 2025 as a result of the previous use of aluminium phosphide, also occur in Germany?**

No. In Germany, aluminium phosphide is used almost exclusively in warehousing, for example for fumigating stock. In addition, strict safety regulations apply to the use of aluminium phosphide in Germany (TRGS 512). If the application is carried out by competent specialist personnel in accordance with the legal regulations, there is no risk of such a poisoning accident. The existing safety regulations ensure that rooms in which fumigation for pest control is carried out are sealed gas-tight and may only be reopened when the concentration of the agent in the air is no longer detectable. In addition, the treated room and the adjacent danger area must be adequately labelled with warning signs.

## **Is it possible to distinguish between phosphine poisoning and food infection or food poisoning?**

The symptoms of phosphine poisoning and food infection or food poisoning are similar and cannot be distinguished by laypeople.

In the case of infections caused by pathogens in food, the symptoms are usually limited to the gastrointestinal tract and general symptoms such as fever and weakness. Symptoms usually begin between 12 hours and 3 days after the meal. In cases of food poisoning caused by bacterial toxins, the occurrence of symptoms often occurs more quickly than in infections, within a few hours, and produces a wider range of symptoms, which can be very similar to those of phosphine poisoning. As with phosphine poisoning, symptoms can include gastrointestinal complaints such as nausea and vomiting, as well as breathing difficulties, neurological complaints (movement disorders, abnormal sensations, agitation or drowsiness) or cardiovascular symptoms (e.g. drop in blood pressure, cardiac arrhythmia). Phosphine poisoning is potentially life-threatening. Therefore, if poisoning is suspected, a poison information centre should be contacted and, in the event of severe symptoms (such as shortness of breath), the emergency services should be called immediately.

Further information on food poisoning can also be found in our FAQ Acute food poisoning: What are the possible causes and how can they be avoided (<https://www.bfr.bund.de/fragen-und-antworten/thema/akute-lebensmittelvergiftungen-was-sind-moegliche-ursachen-und-wie-lassen-sie-sich-vermeiden/>).

List of German Poison Centres:

<https://www.bfr.bund.de/chemikaliensicherheit/nationales-produktregister/giftinformationszentren/>

## **How many cases of aluminium phosphide poisoning have there been in Germany to date?**

The BfR receives communications about poisoning cases in accordance with Section 16e of the German Chemicals Act. These communications currently mainly cover occupational exposures, which are submitted to the BfR by the competent statutory accident insurers.

Between 2019 and 2024, 109 cases involving phosphide/phosphine were communicated to the BfR. Almost all of the reported cases occurred in an occupational setting. The poisonings and suspected cases mostly resulted in mild symptoms at most. However, two deaths were also reported during this period. These involved the accidental poisoning of two small children by rodenticides containing aluminium phosphide.

The BfR is currently setting up a national poisoning register. In the future, this will bring together data from the seven German Poison Centres. This will improve the overview of poisoning incidents in Germany.

An additional source of data on poisoning cases are the annual reports of the Poison Centres (PC) in Germany. The Poison Centre North, for example, publishes detailed annual reports every year (<https://www.giz-nord.de/cms/index.php/ueber-uns/Jahresberichte>). In 2024, 13 cases involving rodenticides containing phosphine were reported there (including one serious case, no fatalities). The Poison Centre North handles roughly 1/7 of all enquiries to German Poison Centres.

**Are health impairments to be expected with the proper use of aluminium phosphide?**

No, if the substance is used properly for pest control indoors or outdoors by the trained specialists and in compliance with legal regulations, no health impairments are to be expected for consumers.

**Can foods, such as grain, that have been fumigated with phosphide be safely consumed?**

There are clear regulations for food. Compliance with the legal requirements of the EU Maximum Residue Level Regulation is required.

According to an information leaflet on the control of storage pests with phosphine from the former Federal Biological Research Centre for Agriculture and Forestry, the phosphide used for fumigation in grain silos does not affect the taste or smell of the grain. The baking properties are also not impaired. Only very small residues remain in the grain, and even with repeated fumigation of the same grain the legal maximum residue level is not exceeded. Any residues are further broken down during subsequent processing of the grain.

**Further information is available on the BfR website**

Questions and answers about fumigated containers (only in German available)  
<https://www.bfr.bund.de/fragen-und-antworten/thema/fragen-und-antworten-zu-begasten-containern/>

Health risks from fumigated cargo (only in German available)  
<https://www.bfr.bund.de/chemikaliensicherheit/transport-gefaehrlicher-gueter/transport-von-verpackten-guetern-auf-see/gesundheitsrisiken-durch-begaste-ladung/>

## About the BfR

The German Federal Institute for Risk Assessment (BfR) is a scientifically independent institution within the portfolio of the German Federal Ministry of Agriculture, Food and Regional Identity (BMLEH). It protects people's health preventively in the fields of public health and veterinary public health. The BfR provides advice to the Federal Government as well as the Federal States ('Laender') on questions related to food, feed, chemical and product safety. The BfR conducts its own research on topics closely related to its assessment tasks.

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