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Responsible Care®
OUR COMMITMENT TO SUSTAINABILITY

Fumigation of non gas-tight buildings and horizontal structures using continuous phosphine injection.

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Stored Product Protection: Fumigants

Lack chemical, cost effective and practical methods for fumigation of stored products and food processing facilities worldwide.

Available alternatives are limited basically to a few gases.

Optimization of use and application of currently available fumigants is critical, in order to maintain them functional and available for the future.

Stored Product Protection: Fumigants

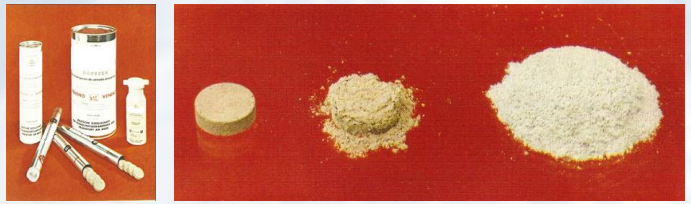
- **Methyl bromide**: - Ozone depleting substance.
  - Use limited to CUE´s and pre shipment quarantine.
  - Listed for phase out by Montreal protocol

- **Sulfuryl fluoride**: - Fluoride residues.
  - Strong global warming potential
  - Temperature critical for eggs control.

Stored Product Protection: Fumigants

- Phosphine:
  - Most widely used fumigant today.
  - Effective to control insects in all life stages.
  - No environmental issues.

There are two ways to obtain phosphine:

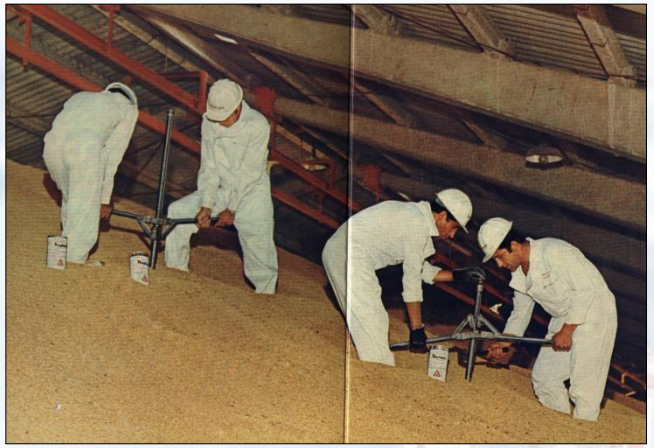


Metal phosphides

Horn Diluphos System + pure phosphine

Phosphine: Metal phosphides

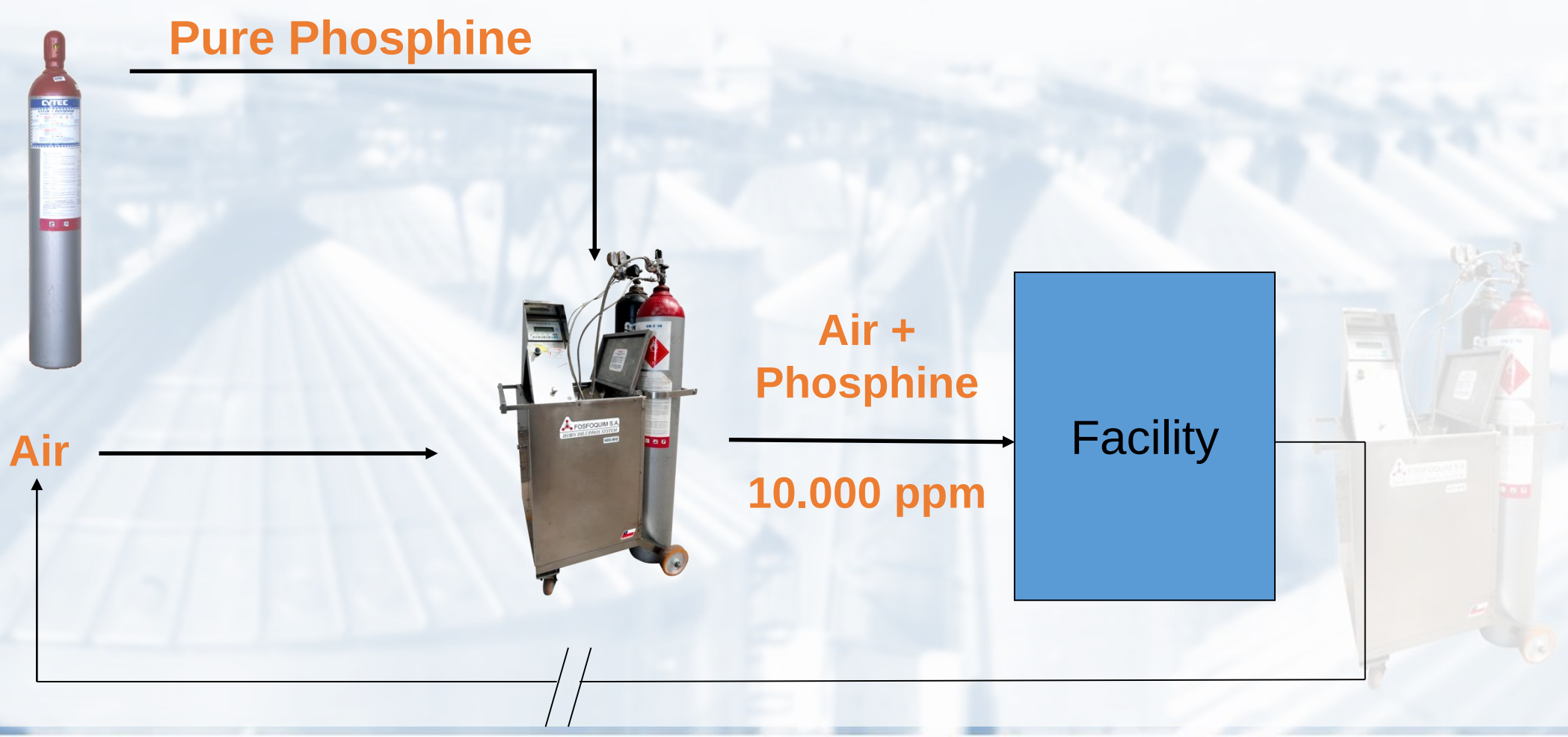
- Aluminum phosphide or magnesium phosphide
- Hydrolysis reaction dependent in moisture and temperature.
- Residue generation.
- Workers exposure.
- Confined space entry.
- Risk of fire.



Phosphine: Horn Diluphos System

- Technology developed and patented by Fosfoquim in Chile
- Only technology available worldwide to dilute pure phosphine from cylinders directly with air.
- Wide range of fumigation capacity, ranging from 0,2 up to 200 gr/min.

Pure phosphine dilution with air



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Fumigation of Food Processing Facilities

- Some of these structures, such as mills or warehouses, has not been conceived to be fumigated.
- Fumigation is required just occasionally in some cases.
- Difficult to justify investment in permanent sealing of the structures.
- Corrosion might be a problem in some cases.

The use of the Horn Diluphos System allows performing quality fumigations using pure phosphine on non gas-tight facilities through continuous phosphine injection.

Practical Cases

The following two cases are presented:

- Non gas-tight warehouse fumigated using continuous phosphine injection.
- Flour mill fumigated using automated phosphine injection.

Case 1. Non gas-tight warehouse fumigated using continuous phosphine injection.

- 1260 cubic meters metal sheet warehouse.
- End product warehouse.
- Product located in racks in different packaging materials

Preparation for fumigation: Sealing, Fumigant injection

Sealing:

- Polyethylene sheeting.
- Polyurethane foam.
- PVC Tape

Fumigant Injection:

- Injection hose.
- Perforated pipe.

Fumigation: Injection Strategy, Fumigation Control

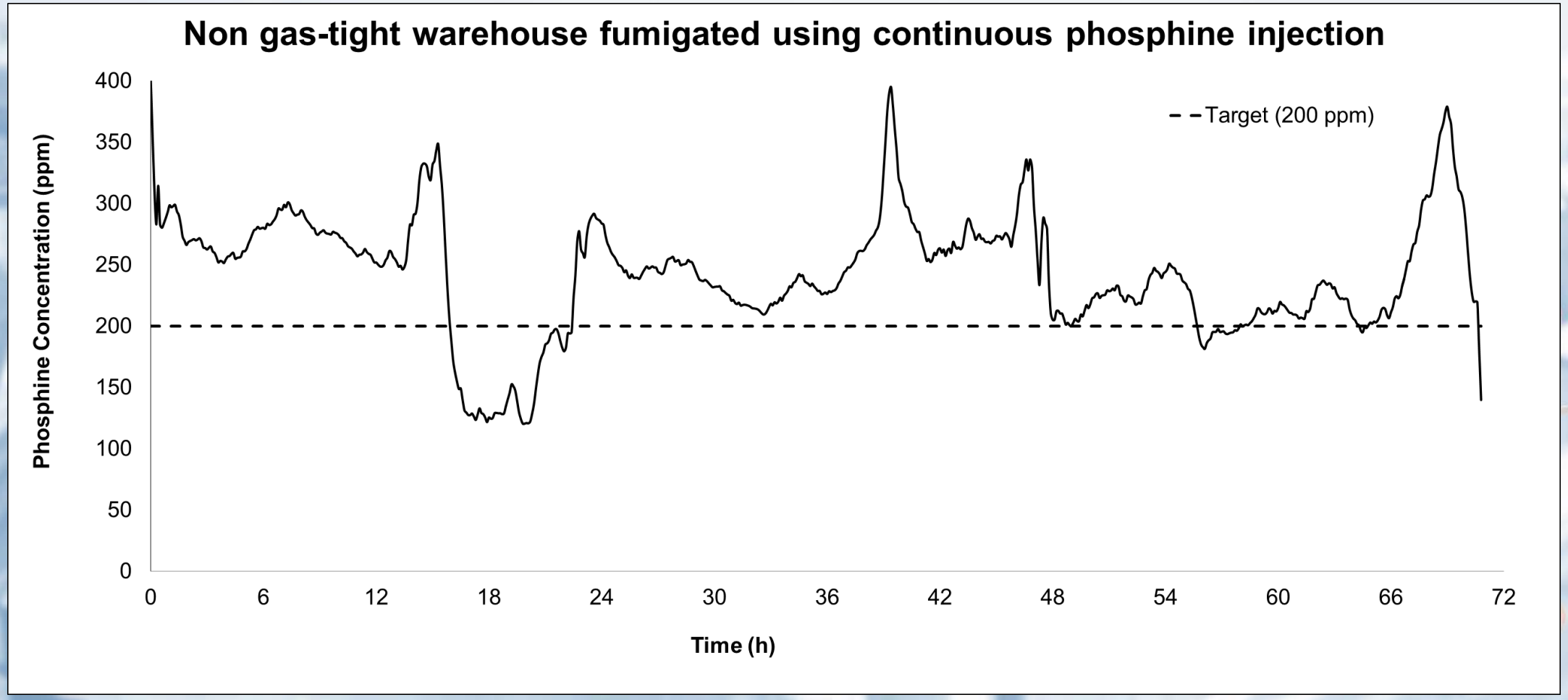
Injection Strategy:

- Initial Injection using HDS 200.
- Continuous phosphine injection using HDS 30.
- Injection Rate: 3 gr/min.

Fumigation Control:

- CertiPH_3os Monitor.
- 3 Zones.
- Site visits during exposure time.

Non gas-tight warehouse: fumigation results



Case 2. Flour mill fumigated using automated phosphine injection

- Constructed in 1960´s
- Volume: 12.000 cubic meters.
- Seven floors.
- Corrosion is a concern.

Preparation for fumigation: Sealing

Permanent Sealing:

- Geotextile fabrics.
- Elastomeric paints.

Non-permanent Sealing

- Polyethylene sheeting.
- PVC Tape
- Craft paper stripes
- Wall paper glue

Polyethylene sheeting of control panels.

Fresh air injection lines.

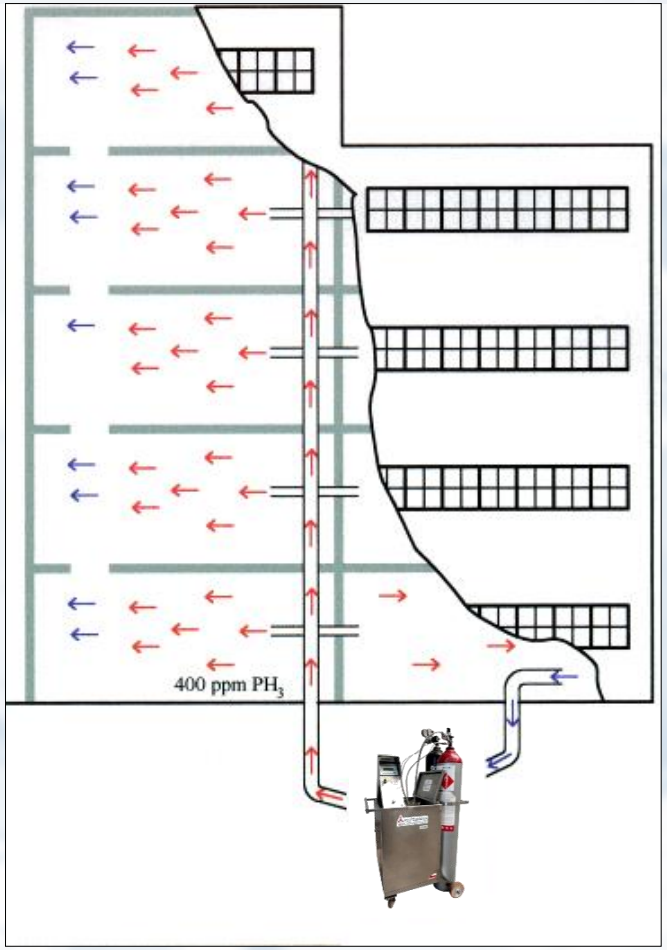
Preparation for fumigation: Fumigant Distribution, Corrosion protection

Fumigant Distribution:

- PCV Pipes
- Fumigant release in every floor.

Corrosion protection.

- Sealing of electronic and electric equipment inside the mill.
- Fresh air injection in electronic equipment to generate over pressure.
- Painting of exposed copper.



Fumigation: Injection Strategy, Fumigation Control

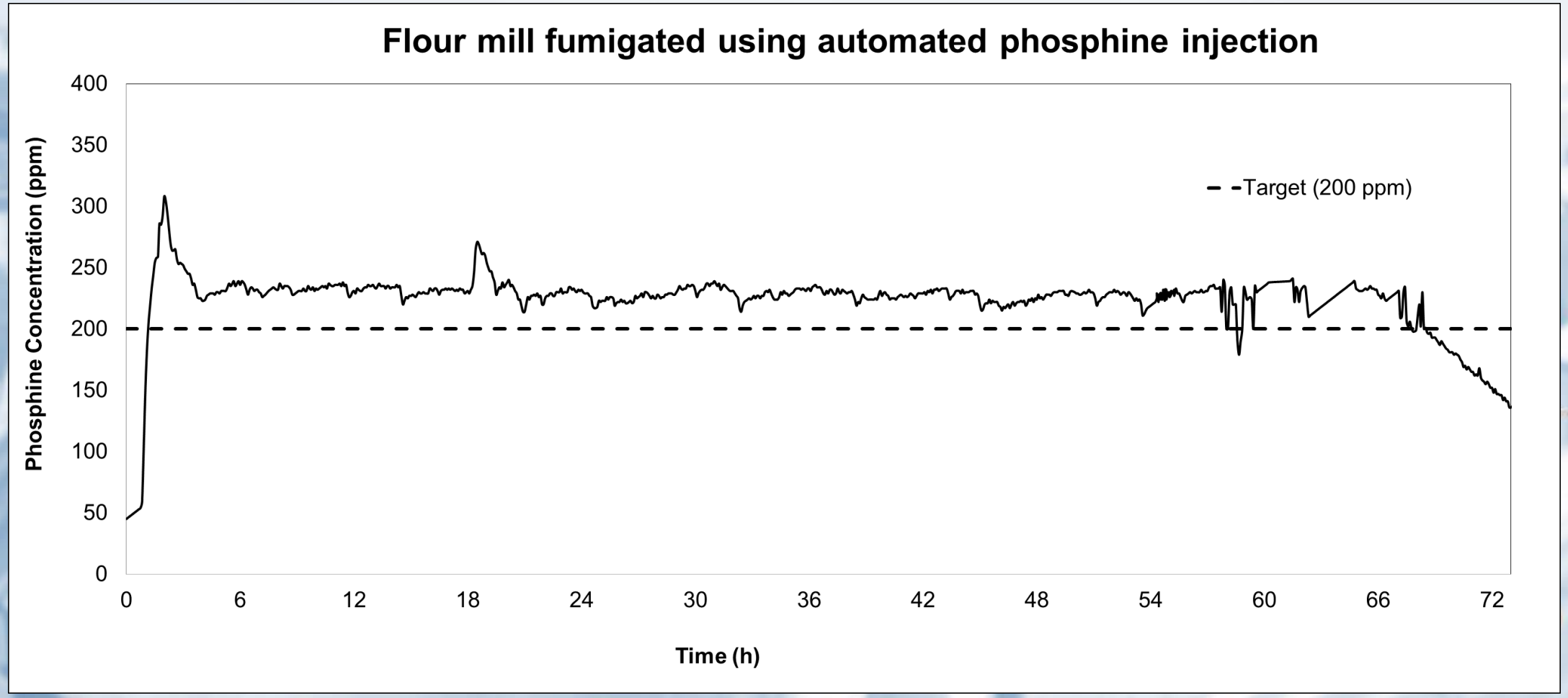
Injection Strategy:

- Initial Injection using HDS 200.
- Automatic top-up using an HDS 30 modulated with a CertiPH_3os Monitor.
- Target: 200 – 250 ppm for 72 hours.

Fumigation Control:

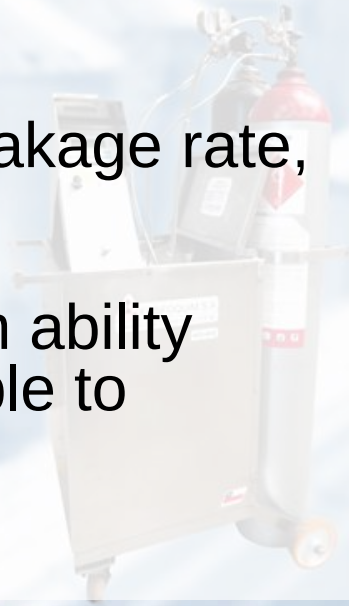
- 4 CertiPH_3os Monitor.
- Web monitoring.
- Automated top-up using HDS 30.

Flour mill: fumigation results



Conclusions: Non gas-tight warehouse fumigated using continuous phosphine injection.

- Phosphine concentrations can be established early during the fumigation period, not depending on temperature or moisture.
- It is possible to overcome natural leakage of non gas-tight structures by using a continuous phosphine injection, being able to maintain lethal phosphine concentrations over a fumigation period.
- Winds and other weather conditions can affect the structural leakage rate, affecting the concentrations in the facility.
- Using electronic real time phosphine monitor with GSM modem ability allow the fumigators to verify concentrations remotely, being able to anticipate problems throughout the fumigation.



Conclusions: Flour mill fumigated using automated phosphine injection.

- Through the use of the HDS system, it is possible to control the phosphine concentration in a narrow range, enough to control insects, but as low as possible to minimize corrosion problems.
- In the event of weather condition changes, such as strong winds, the interconnection between the HDS and the CertiPH3os monitor offers the ability to control the phosphine injection, to maintain the concentration within specified values.
- The use of automated phosphine injection allows to optimize the amount of phosphine required for the fumigation process.
- As pure phosphine is free from corrosive ammonia (present as by-products in metal phosphides) corrosion is minimized when using the HDS system.

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THANKS

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