AUTOMATED STRUCTURAL FUMIGATIONS WITH PHOSPHINE USING THE HORN DILUPHOS SYSTEM

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Abstract

Applying the Horn Diluphos System for the blending of pure cylindered phosphine with air allows developing new methods and applications for the control of insects in process plants and storages.

Phosphine has been used for more than 70 years, and today it is the most widely used fumigant for control of all stages of insects in storages and process plants all over the world.

Phosphine has a series of great advantages to other fumigants. Some of them are:

- It does not leave residues in the treated commodity
- It decomposes rapidly into phosphoric acid once released to the atmosphere.
- It does not damage the ozone layer,
- It has no effect in global warming

Therefore phosphine seems to be the best available tool as replacement to CH_3Br.

But on the other hand, phosphine has the known disadvantage compared to other fumigants which is the corrosive effect of phosphine for some metals like copper, brass, silver and other alloys.

In Argentina and Chile, flour mills have been fumigated successfully in the past years using pure cylindered phosphine together with the Horn Diluphos System, equipment developed in Chile for the direct blending of phosphine with air without risk of ignition starting from pure cylindered phosphine.

This equipment and method allowed carrying out large scale fumigations for structures like flour mills or pasta factories.

The Horn Diluphos System allows phosphine injection and top up from outside of the facility to be fumigated, maintaining a reduced concentration in the ambient which reduces the corrosion levels in the electronic and electrical equipment.

Pure cylindered phosphine is less corrosive than other phosphine formulations, since, different than in other phosphine formulations, no ammonia is present in the product, which is known to increase corrosion effects of phosphine.

In the year 2008 a new model of phosphine blending equipment was developed by Fosfoquim, adding the fourths model to the three existing models. The philosophy of this new equipment, the HDS 30, is the same that in the other units, but with some differences such as:

- The new model can be left alone more than 30 days during the gas injection.
- It applies very small amounts of phosphine. This equipment applies 1-6 grams/minute while the other models apply up to 200 grams/minute of phosphine
- The phosphine dispensing process can be controlled electronically with an external digital signal.
- The unit has the ability to control an additional blower.
- The unit has the ability to send electronic alarm signals.

In addition, Fosfoquim, together with PPM Messtechnik, a German company, has developed a new monitoring equipment, the Fosfoquim CERTIPH_3OS Monitor, that thru a photo-acoustic method, measures phosphine concentration in different points in the facility. The fumigator can set a minimum and a maximum phosphine concentration and the equipment gives electrical signals as phosphine maximum concentration exceeded and phosphine minimum concentration undershot.

With the new Horn Diluphos System, HDS 30 and the Fosfoquim CERTIPH_3OS Monitor, the Fosfoquim team (Fosfoquim is the manufacturer of the phosphine dispensing equipment) came up with a new method for large structural fumigations.

The idea was to control the injection process automatically using these new tools.

After an initial injection of a 12,000 cubic meter flour mill using the traditional HDS equipments (HDS 80, HDS 200 or HDS 800) a HDS 30 unit was installed, shooting gas into the facility and connected to the Fosfoquim CERTIPH_3OS Monitor which was set with two alarm levels, a low level to start the phosphine dispensing and a high level to stop the phosphine injection.

As normally, these big buildings and process plants have irregular shapes, a large fan with a 3 phase induction motor was installed inside of the building to help accelerate the phosphine distribution inside the building. A polyethylene sleeve

tubing at the outlet of the blower was used for distribution of the gas in the different stores of the building.

The phosphine gas coming from the HDS 30 was released close to the inlet of the blower allowing in that way a quick distribution of the gas and therefore a quick reaction of the monitor for the control of the phosphine blending equipment.

The blower used for the recirculation and distribution of the air phosphine mixture during the fumigation had a capacity of one complete air change per hour.

In order to reduce the risk of corrosion, and in the same way normally the flour mill phosphine fumigations are being carried out in Chile with Horn Diluphos System, all the electronic equipment were sealed and compressed clean air from the outside was injected slowly into the electrical cabinets to maintain a positive pressure in the inside and avoid the entry of phosphine.

Results and Conclusions

The results were surprising. The concentration in the entire building could be maintained constant during the whole fumigation period, even though it is extremely difficult to seal this type of building because of the size, architecture and construction materials (see Graph 1).

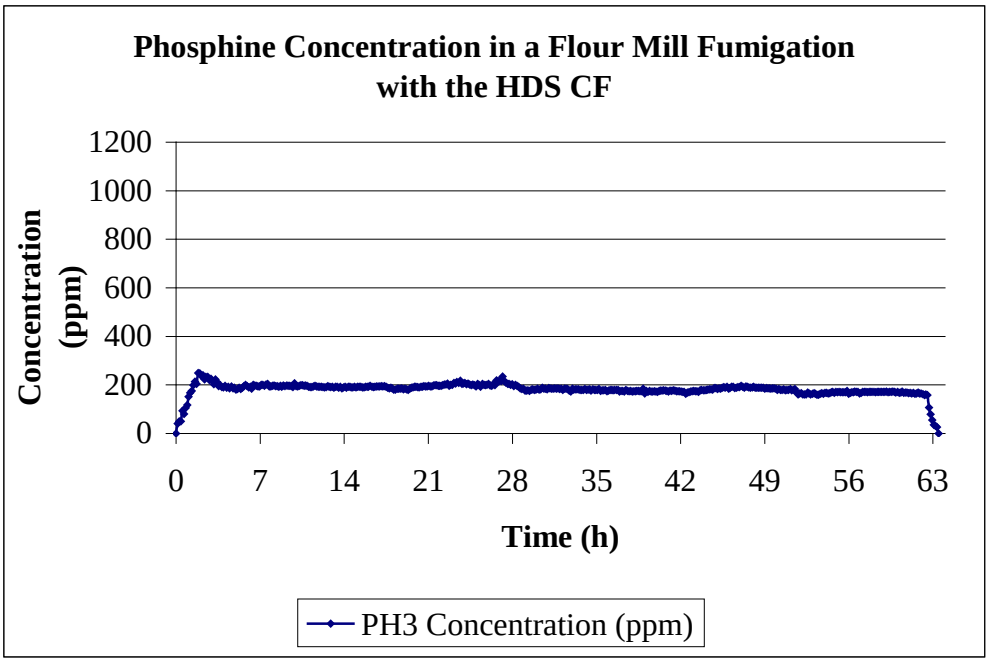
In addition, the amount of gas used for the entire fumigation was less than with the traditional method, where normally the gas had to be redosed from outside about every 12 to 24 hours.

Under normal conditions (see Graph 2), a very unstable concentration and several points with higher concentrations caused by re-injection of gas would be expected. Using the present method a very stable concentration was maintained during the whole fumigation, and no period with higher concentration was observed, achieving better results in corrosion control, exposure of insects to the gas, and efficiency in the use of the gas.

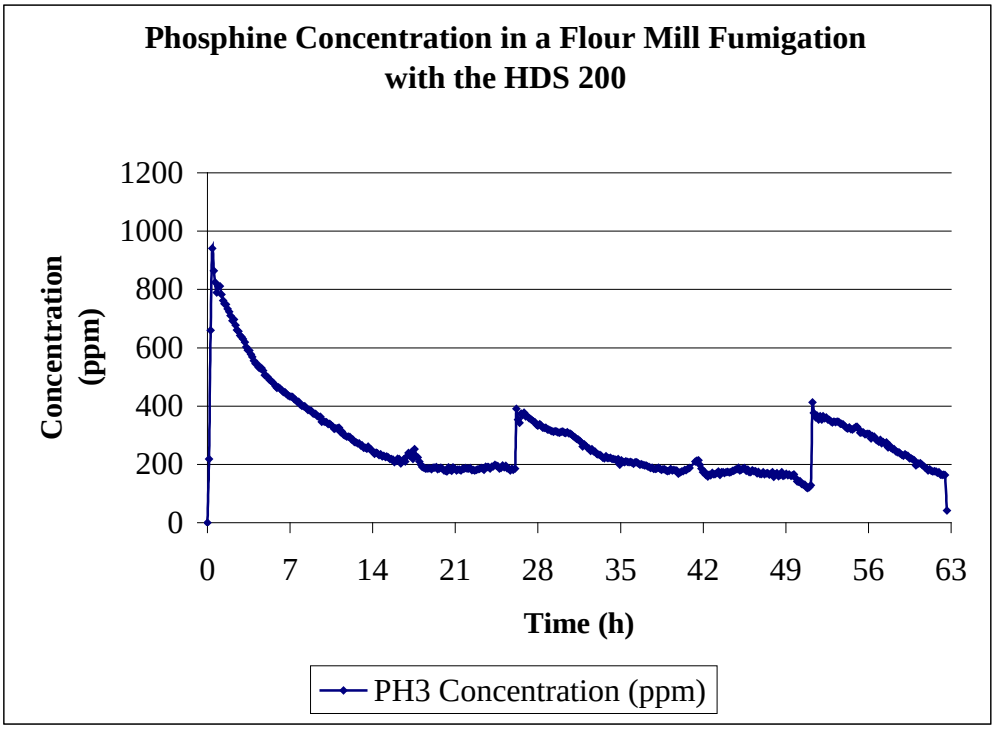
In addition, the fumigation team had no need to return to the fumigation site until the fumigation was finished.

The main advantages of this method can be summarized as follows:

- Less labor required for fumigation.
- Less sealing required
- Less gas applied
- As concentration is kept low, lower risk of corrosion in electrical and electronic equipment.



Graph 1: Phosphine concentration graph during phosphine fumigation using a continuous injection of gas at low concentration.



Graph 2: Phosphine concentration graph during phosphine fumigation using traditional injection with top up every 24 hours.

Picture 1: Carozzi flour mill, located in Santiago, Chile, where the HDS 30 was used for the continuous phosphine injection fumigations. Total Vol: 16,000 cubic meters.

Picture 2: Fosfoquim's latest phosphine dispensing equipment, the HDS 30 used for the continuous phosphine injection fumigations.

Picture 3: Fosfoquim CertiPH_3os Monitor used together with the HDS 30 for the continuous phosphine injection fumigations.

Picture 4: Horn Diluphos System Model HDS 200 used for initial phosphine injection in large scale structural fumigations.