

# Active fumigation process improvement

*B.W. Bridgeman*

Forsure Pty Ltd, 6 Clive Crescent, Withcott, Queensland 4352

**Abstract.** Fumigation must be regarded as a science. It is a process that can be described, scheduled and audited. Fumigation by necessity involves the use of highly toxic chemicals in a gaseous form and requires appropriately trained, specialised operators to ensure the safe application and achievement of effective results.

Training courses for fumigators need to reflect the need for continuous review of processes and results attained as well as the need for improvement in the processes used. One way of achieving this continual improvement is 'progressive weakest link elimination'. This method encourages fumigation practitioners to regard their efforts as dynamic processes that can be modified to improve their effectiveness and success. This back-to-basics concept is simple to implement and provides an excellent method of trouble-shooting breakdowns and failures in various fumigation and grain protection activities.

This paper discusses 'the weakest link' concept as it applies to fumigation training and application.

## Introduction

Traditionally, fumigation has been regarded as an art—as such, the fumigation process tends to be something that is constructed on the go. It tends to be based on the 'gut feelings' of experienced fumigators who appear to have all the knowledge. In recent times, there has been some evidence of a degree of acceptance of the benefits of a scientific approach to fumigation practice, however complete compliance with a described, scheduled and audited process in the fumigation is a considerable way off. In practice, it is rare that fumigations are reviewed in terms of their process and results, and detailed audits of the process are generally unknown. There is little dissent from the management as they have complete faith in the fumigator to do the task without a problem, as on previous occasions. Thus, there is a lack of acceptance by management that there is a problem and this has, to a large extent, resulted in the situation as is. In many cases, it is a conscious decision to rely on contractors or operators who can get the work done for a reasonable price, even though they know the process is flawed. The compliance sought is merely the acquisition of the fumigation certificate. The actual results are of much less importance than the certification and the cost of having the job done.

Many of the fumigators who find themselves in this position are aware of the compromises, but even more are not. The consensus of opinion in many of these cases is that if there are no pests found at the marketplace, then the work must have been a complete success. It is difficult to describe the operators of many of these fumigations as

'fumigators'. A more apt description would be a 'fumigant applicator'.

The assistants—fumigators in training—are usually licensed by the relevant authority, which has tested them on the basic safety considerations. The fumigation licence they receive is indistinguishable from that held by the experienced operator. It is of no relevance in assessing the competence of the fumigator or his ability to conduct effective fumigation process. When relevant training is provided, it is generally a one-way relationship with little behavioural change in those trained. The philosophy is that if it worked last time, it is okay. You do not fix things that are not broken.

Quality assurance of the fumigation process is a must if the process is to be improved.

Recent moves towards a national accreditation system for fumigators that is based on competence will go a long way to addressing this deficiency. Unfortunately, existing fumigators will be able to be 'recognised for prior learning' (RPL) and their experience.

The fumigation process described in this paper is designed to engineer a change in the current practice of existing fumigators as well as to provide a sound structure for training new staff. The concept is a very basic system of procedures, documentation and review. The results of this system on the professionalism of fumigators and fumigation effectiveness are usually immediate and obvious.

This active fumigation improvement process (progressive weakest link elimination) is a system that introduces fumigation as a dynamic process which is tested each time. In practice, the process allows the fumigator to continue to develop opportunities to improve the system used.

## Documentation of the process

Most fumigators are currently maintaining some documentation. It is a requirement under the legislation and their licensing. The adequacy and detail varies from rudimentary to excellent. The traditional fumigators or 'artists' are in the former group. While there are some data being kept, they are rarely analysed unless there is a problem. Even then, the analysis is usually not recorded.

When we consider fumigation as a scientific process, everything is documented—the processes involved, staff training, the planning, the fumigation and clearance activity, disposal, and the review or analysis of the results. Any changes to be implemented from the analysis of the data need to be verified and documented. The general comment about this level of monitoring is that there is too much paperwork. If the paperwork is an issue then it may be it is redundant, the staff is unaware of its importance, or it is not being used to improve the process. All these reasons are sure signs that a scientific process is absent.

During the planning of a fumigation process, details on the site, produce and environment are assessed. The details on equipment, staffing, fumigant type and dose required are calculated. The process is identified and all this is documented. Traditionally, this is recorded initially in the fumigator's diary or personal records. The location of the documentation during the process is not the major issue. It is more important to ensure all the details are recorded. In a truly scientific sense, a notebook is essential. It is also essential to report or transcribe this information formally at some stage. The presence of the notebook and the data collected at the fumigation is the start of a scientific process. The quality and quantity of information recorded is the next step. This requires some thought about what is to be reviewed and what information is of value. The addition of thought into the data collection at a planning phase would indicate that there is a scientific process in place.

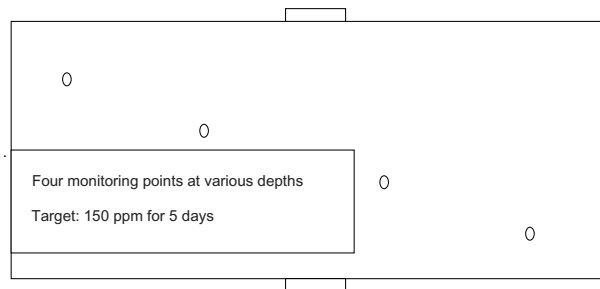
## Review and analysis of process

The construction of a formal review or debriefing process for each fumigation would enhance any benefits or highlight the areas where change would be an advantage. It is for this stage that the term 'weakest link elimination' is coined. The fumigation is only as good as its weakest link. The review process should highlight where these weak links are and allow a serious fumigation practitioner to effect a change that not only eliminates the weak links, but provides improvement to the fumigation's effectiveness.

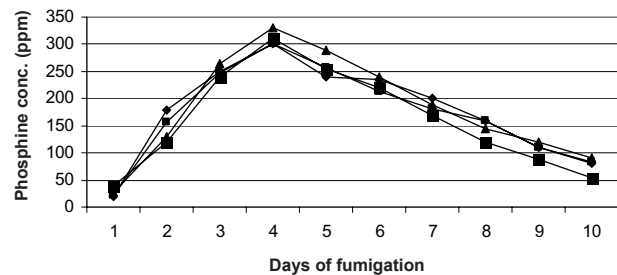
To explain the system in operation, I will discuss an actual investigation of a fumigation failure. The location of this storage is irrelevant to the process and although this particular scenario may be a little obvious to some, it demonstrates clearly the value of a structured scientific process.

## The example

This storage is a 12,000 t sealed, recirculated shed of wheat. There were two access doors directly opposite each other in the centre of the longer walls of the rectangular storage. A fumigation with phosphine had been carried out, but had failed. Resistance to phosphine in the surviving target pests was not present. The fumigator had recorded a great deal of data from several points within the storage (Figure 1). These data indicated that the target dose of 150 ppm of phosphine for 5 days had been achieved and for all purposes the fumigation appeared to be a success (Figure 2).



**Figure 1.** Plan of the sealed grain storage shed (not to scale) indicating the location of the doorways and the monitoring points used in the initial fumigation.



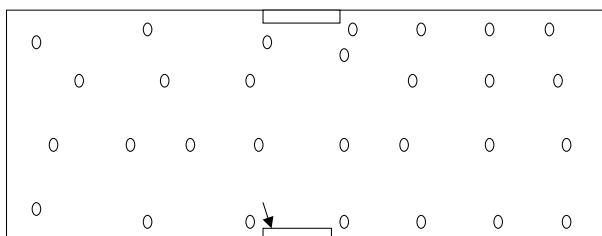
**Figure 2.** Analysis of the fumigator's original data indicated that the fumigation was a success. The target rate of 150 ppm of phosphine was achieved. The fact that insects were detected within a fortnight of the fumigation clearance indicated that the fumigation had actually failed.

The fumigation site was inspected in some detail. The seal integrity testing was analysed as were the application of the fumigant and the monitoring of the process.

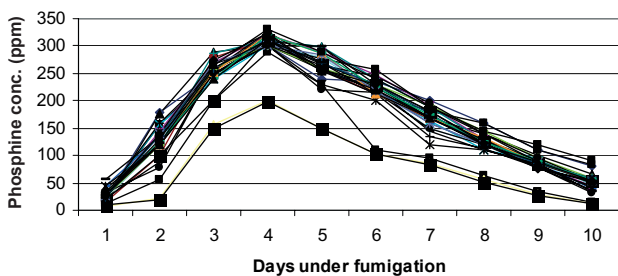
During inspection of the monitoring sites, the location of the monitoring points was discussed. The fumigator indicated that, as was usually the case, the monitoring was done in areas where the grain was thickest—reasoning that this would indicate that the bulk of the grain was fumigated to the standard prescribed. The target dose was 150 ppm for 5 days. The fumigator was asked, if there was one, where a leak point would be in the fumigation, i.e. was there any point in the fumigation where he thought that the fumigant concentration may not reach the mean of the storage. The fumigator chose several points near the doorways.

The storage was then re-fumigated with the number of monitoring points increased from 4 to 30. The 30 points were scattered throughout the grain mass at various depths and included the points identified by the fumigator at the site inspection as the areas where he felt the fumigation was likely to be weakest (Figure 3).

Analysis of data gathered from the second fumigation carried out in almost identical circumstances as the first showed quite a different picture. The readings taken from the area where the fumigator thought that there may have been a problem—the weakest link—showed clearly that there was definitely a lower fumigant presence throughout the fumigation (Figure 4). Further analysis of the readings revealed that when measured from the area where the fumigation was most likely to fail the fumigant was not present in high enough quantities to control the target pests.



**Figure 3.** After analysing the data, the storage was re-fumigated using three monitoring points located throughout the storage. There was a monitoring point placed at the position where the fumigator believed the readings were most likely to be poor (arrow) compared to the mean of the readings in the storage.

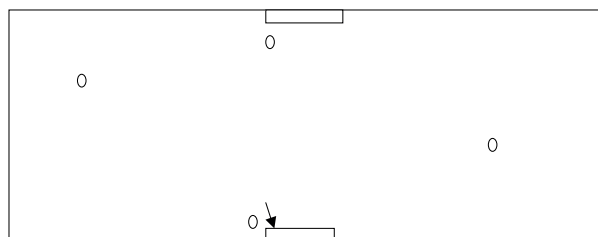


**Figure 4.** Data collected during the second fumigation show that there were areas within the fumigation area where the fumigation was likely to fail. The target dose of 150 ppm phosphine was present for only two days at the 'weakest link' monitoring point.

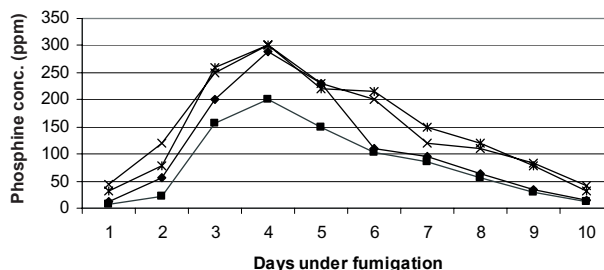
Using these data, the positioning of monitoring points was revised (Figure 5), and consequently provided improved data (Figure 6). In future, the fumigator could use this information to adjust the fumigation as it progressed to achieve the control doses of fumigant—i.e. by adjusting the fumigation period, increasing the dose rate, or modifying the recirculation process to ensure that the fumigant reached all points in the storage evenly. In addition, the results of the study also brought into

question the quality of the seal in the enclosed area and the target dose, which appeared to be on the low side.

While seemingly a simple issue at this stage, this was a case where an experienced fumigator had all the answers in front of him but failure to analyse them had resulted in a frustrating fumigation failure. In hindsight, the results make sense.



**Figure 5.** New monitoring points based on the results of the 'weakest link' identification process.



**Figure 6.** The analysis of the reading points in the fumigation using the weakest link concept. This fumigation of the storage was clearly inadequate to control the target pests. The question of the next step is then an issue.

This simple site analysis is just an example. There is still a long way to go with this storage system. It is hoped that the simple application of weakest link elimination in this example has convinced the management and the fumigators that there is better way.

The immediate focus in this example would obviously be in the maintenance of an adequate dose and distribution throughout the storage via a high dose of fumigant, more effective recirculation, and better sealing. It would also be necessary to confirm that the target dose would actually control the target pests.

## Conclusions

Fumigation is a highly specialised process in pest control. Fumigators or 'pest control technicians' are held in high regard for their ability to provide timely solutions to costly problems. The methods currently used in most areas are still largely artworks. The basis of a scientific process is already in place as data are already collected, but this information is not utilised by the majority of fumigators. The system outlined in this paper indicates the benefits of documenting and analysing each fumigation. The results are more effective fumigations, a more professional service, and less resistance development in target

pests. At the very least, it will increase the level of control and understanding each fumigator has over the fumigation process.

The efforts in instruction with this system have so far had mixed results. For the newer trainee fumigators, the response has been excellent, however the response from 'experienced' fumigators has been poor. There appears to be a real hurdle in changing entrenched habits once established. There is also a minority who believe that if they followed a scientific process as described, their costs would blow out and they would suffer losses of custom. Why bother to change it if it appears to be working adequately? Such opinions are detrimental to the industry

as a whole. It is difficult to discourage this kind of thinking. However, the industry can ill-afford poor practice which will eventually lead to accidents, failures and tighter regulatory controls.

The new emphasis on competency assessment to obtain accreditation is likely to test only a few of the poorer operators. It is unlikely to influence any real and permanent changes. The change will come only when management insists on these tasks being carried out properly. When this occurs and the fumigators are externally assessed regularly for their performance the standards will improve. The 'weakest links' will be systematically eliminated. This refers to the fumigators as well as the process.