Properties and uses of inert dusts

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Abstract

Use of inert dusts within the bulk handling system in Australia has extended beyond structural treatments and now includes spot treatments, application to grain surfaces (50–100 g m⁻²) and admixture with the top 10–50 cm of grain. Other applications such as admixture at low doses to control low density populations and admixture of dusts impregnated with insecticide (removable insecticides) are possible. Such applications are potentially useful components of integrated pest management. Commercial and laboratory scale studies on inert dusts applied in and on grain have shown:

1. virtually complete (99.5%) removal during wheat cleaning in a mill with no effects on the end products such as bread, sponge cake and noodles;
2. quantification of the effect of Dryacide® and grain dust on factors causing gas loss in open structures under fumigation;
3. the effects of Dryacide® on grain flow, bulk density and resistance to airflow;
4. the effect of admixture with Dryacide® in control and prevention of reinfestation; and
5. the relative importance of both amount and type of dust (e.g. grain dust, dirt and inert dust) for worker safety, grain flow, bulk density and acceptability.

The following is a history of the relatively recent introduction and use of inert dusts in the bulk handling system in Australia and an overview of interactions between industry and research organisations. No experimental details are provided as information is drawn from either published, unpublished or about to be published data.

Industry and research organisation interactions

The use of inert dusts in the bulk handling system started in Australia during 1988 with structural treatments using dry blown Dryacide® (2 g m⁻²) in empty silo storages, both capped and open top. It was recommended jointly by both the Stored Grain Research Laboratory (SGRL) and GrainCorp that the application was not suitable for use in sheds. This recommendation was made on worker safety grounds. The aqueous slurry method was introduced later that year in order to treat storage sheds safely.

In 1989, trial treatments to the surface of wheat were carried out. These were based on laboratory data (S.E. Allen, unpublished data) that demonstrated significant population reduction from this type of treatment. The most effective treatment, admixture to the top 30–50 cm grain, was difficult to implement, whereas applying a dry blown covering (100 g m⁻²) was relatively simple. Unfortunately, this covering does not prevent invasion via the surface into the grain bulk by any species, whereas a depth of 30–50 cm of admixture prevents most species from penetrating and reinfesting the grain below. This work will be detailed in a subsequent publication.

GrainCorp staff applied dry blown Dryacide® (100 g m⁻²) to the surface of wheat in silos under Siroflo® fumigation to provide some protection to the surface layers where phosphine concentrations were low. GrainCorp staff monitoring phosphine concentrations noticed an increase in concentrations near the surface after application of the dry blown layer. Following this observation Siroflo® was introduced to sheds and the use of Dryacide® as a treatment to the surface of wheat bulks became widespread. Dryacide® is now used in this manner by almost all Australian Bulk Handling Companies.

For the extensive use of Dryacide® in this manner to continue and to comply with agreements between the Aus-
Australian Wheat Board and the Flour Millers' Council of Australia, commercial scale milling trials evaluating the removal of the product and the milling characteristics of the wheat were required. These were carried out in 1993 (Desmarchelier et al. 1996). Milling trials on an insecticide retentive inert dust were carried out during 1997 (Allen and Moss 1998).

Methods for the determination of inert dust content in the presence of grain dust were developed as a preliminary study to milling trials (Allen and Desmarchelier 1997). The development and use of these methods have provided a more detailed understanding of the nature of grain dust, the variation in type and distribution within grain bulks.

The effect of dry blown Dryacide® in maintaining gas concentrations near the grain surface has been verified and quantified. This report is in draft form and it is intended for publication within scientific literature.

Since the introduction of inert dust use in the bulk handling system back in 1988, uses and application techniques have developed and been refined. Also analytical and theoretical knowledge has accumulated. It is now time to look back on use patterns and the accumulated knowledge and assess performance and ask the question 'Are we using dusts as effectively and thoughtfully as possible?'

The future

The current use of inert dusts is encouraging in an industry committed to using less chemical where possible. However, inert dusts have not been utilised to their potential. Admixture to the top 30–50 cm of grain bulks has become commonplace only at storage for The Unite Tobys Company Limited (Nickson et al. 1994).

Admixture of inert dust with the whole bulk of grain has been taboo (for grain passing through the central handling system) due to the changes in physical properties of the grain such as bulk density, flowability and angle of repose. Yet these problems are not insurmountable and the benefits may be real. Dusts, both natural or intentionally added, which are distributed unevenly in grain have been known to create grain flow stoppages. The manner in which an inert dust is applied to grain can influence flowability and the possibility of stoppages. A dust (up to about 700 g m⁻²) which is applied uniformly and mixed homogeneously will definitely slow the grain flow but may not necessarily create stoppages. It is possible that localised, high concentrations, e.g. on the grain surface, where it is not completely mixed into the grain during the outloading process (e.g. core flow from silo bins) may block machinery. Although, during trials on outloading wheat surface treated with Dryacide® about 200 g m⁻² no problems with grain handling machinery were experienced and samples taken at the point of delivery into rail trucks had dust concentrations no different to control samples.

The greatest change in physical characteristics, with admixture of Dryacide® occurring between 60 and 125 g m⁻² yet in practice addition of 100 g m⁻² has not created any problems with grain flow and had been judged by country elevator operators as being 'no different to normal'. The benefits of adding less than the recommended dose to bulk wheat are part anecdotal and part actual. There is anecdotal evidence that low doses may control low density populations but this requires verification. There is a demonstrated decrease in resistance to airflow from low dose admixtures and this may well lead to faster movement of aeration fronts.

Another potentially valuable use of inert dusts is in the admixture of dusts, impregnated with insecticide, with grain. For the same effectiveness, insecticide concentrations can be significantly reduced in this form compared with material applied as a spray and the insecticides then become partly removable (Desmarchelier, unpublished data).

It has been shown above that inert dusts can have an important role in an integrated pest (commodity) management plan. Some of the applications towards this role are already implemented and others remain as available or potential applications awaiting sufficient impetus for industry adoption.

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