*Donahaye, E.J., Navarro, S., Bell, C., Jayas, D., Noyes, R., Phillips, T.W. [Eds.] (2007) Proc. Int. Conf. Controlled Atmosphere and Fumigation in Stored Products, Gold-Coast Australia***.** 8-13th August 2004. *FTIC Ltd. Publishing, Israel. pp 9-15.*

"CAF '83 - '04 …FROM CONCEPT TO MISSION CRITICAL…"

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Good morning/afternoon/evening distinguished guests, ladies and gentlemen. My name is David Fienberg and I am the Manager of Grain Technology at The CBH Group of Companies.

For those of you who are unfamiliar with who CBH is, we were formally known as Co-operative Bulk Handling Limited, but with the merger with the grains marketer The Grain Pool of Western Australia and the creation of a manufacturing and logistics management arm, Bulkwest Pty Ltd, we have grown into the 5th largest Corporate entity in Western Australia. We are charged with the management and protection of 90% of Western Australia's grain crop which for the 2003 – 2004 harvest, totaled some 14.7 million tones.

Just briefly, a little about myself; I am from a farming background in the Northern Wheat Belt of Western Australia having worked the family property consisting of around 10,000 hectares of predominantly broad acre wheat production.

I have been employed at the CBH group for around 20 years in various operational and technical management roles. My combined exposure to the systems surrounding the storage and handling of grain is in excess of thirty years and hopefully I will today be able to pass on the benefits of some of my experience.

Traditionally the operations people within our organisation have two main requirements of grain storages. That is, to get the grain into the storage as fast as possible and then, surprisingly enough, to get the grain out of the storage as fast as possible. It's my team's responsibility to ensure that during the intervening period, the grain quality is maintained and that the grain is shipped with no introduced grain pests.

Our grain storage network fall into three main categories, these being horizontal sheds, vertical silos and emergency bunker type storages;

Effective use of our sealed storage infrastructure or network is critical to achieve this mammoth task. As mentioned previously, we received in the vicinity of 14.7 million tonnes of grain into the system during the last harvest. We are currently shipping in excess of one million tonnes a month from our four shipping terminals. None of this grain is exported using contact pesticide.

I have called this presentation, “from Concept to Mission Critical”. Prior to 1983 and the CAF Symposium we hosted in Perth, Western Australia, grain protection via "Controlled Atmosphere Fumigation" was a **concept** that was still very much in it’s infancy.

So let’s take a step back here…

Prior to the introduction of "Controlled Atmosphere Fumigation", grain protection, or pest control as we used to call it then, consisted primarily of the application of contact pesticides such as malathion and fenitrothion via spray equipment attached directly to conveyors or elevators at the receival or inloading times. In addition, to protect the grain in store, a barrier treatment such as fenitrothion dust would be applied to the surface of the grain stack.

With the advent of increasing consumer and market demands for chemical or pesticide free grain, there was an urgent push for alternative grain protection strategies, hence the adoption of "Controlled Atmosphere Fumigation".

The initial trials of this new system of caring for grain, were carried out in 1982 by completely covering an existing grain storage using tarpaulins and introducing a fumigant. This proved successful and a further trial of three storages was approved for the following year, the year of CAF ’83.

By the mid 80’s we had approximately 25 storages sealed with grain capable of being fumigated, which represented around 8% of the company’s entire storage and handling capacity.

These early developments of "Controlled Atmosphere Fumigation Ready Storages" (which in CBH parlance are “Sealed Storages”) were amongst the first and certainly the most numerous in Australia and this was a source of much pride exhibited during CAF 83, also our 50th year of existence. Those here that attended CAF 83 would remember the trip to the Eastern Wheat belt and the storages along the way.

After the success of CAF 83, it was full steam ahead. Considerable effort was made to retro fit various types of “traditional” horizontal and vertical grain storages so that they could retain Phosphine (our fumigant of choice) to an acceptable level.

With some assistance from CSIRO's division of Entomology, a basic fumigation protocol was developed and adhered to where possible, given the varied logistical requirements of customers, both domestic and export…

Traditionally, the "sealing" method of choice at CBH has been the application of a waterborne elastomeric acrylic membrane over internal and/or external mating surfaces at varying thickness ranging from 150 microns up to 1500 microns. Large apertures were sealed using a combination of polystyrene foam blocks with a coating of polyurethane foam. Some types of storages have had fitted to them, flat galvanized sheeting which then have a bead of polyurethane foam applied at the joints.

This method of "sealing" storages has been both cost effective as well as reasonably long lasting when applied to those storages that were in the main, constructed prior to 1983. These "pre" 1983 storages were of an extremely robust nature, almost to the extent we considered using them as nuclear fallout shelters had the Berlin Wall not come down and the Cold War still be on.

The robustness of these storages had one benefiting factor. They were or are extremely rigid (and expensive by the way). This rigidity minimized movement and enabled the use of a fairly simple acrylic membrane formulation, by today's standards anyway. The main source of movement on our horizontal storages or sheds was in the roof sheeting area and the materials applied were in the main adequate to ensure the integrity of the seal, well in excess of the five year warranty required of the applicators of the day.

Where storages had walls of concrete, a coating of the acrylic membrane was applied internally with special attention being paid to cracks and expansion joints in the wall structure. This was also the accepted methodology of sealing concrete vertical silos.

Storage floors which were constructed of either concrete or a bituminous coating had an application of an inert clear penetrating sealer. This sealer when fully cured, presented a glassy like hard surface to the grain and facilitated easier cleaning of the facility.

These methods were in the main extremely effective in providing us with storages that effectively and safely permitted the use of Phosphine as a fumigant. There are however other external influences that combine to ensure that maintenance to sealed storages is an ongoing and necessary part of our business.

So let's examine some of the types of problems we encountered with these sealed storages.

Firstly and most importantly, as the seal was extremely effective, the internal pressures of these storages fluctuated between positive and negative depending upon the time of day. If we received a shower of rain in the late afternoon when the negative pressure inside the storage was at its greatest, rain would find its way inside via even the smallest holes on the surface. In an unsealed storage, the rain would simply flow off the roof and into the gutters.

Secondly, the sealing process would often make the storage very dark inside. This necessitated the fitting of additional skylights, thereby creating even more opportunities for water ingress should the seal surrounding these fail.

Another problem that is fast becoming a major source of maintenance expenditure is damage to the storage seal caused by rodents and birds. Rodents in particular seem to consider our sealed storages some Mickey Mouse version of the Hilton Hotel. Polyurethane foam in particular is the perfect source of burrowing material for these animals. It has excellent insulating properties and if one end of their burrow is blocked off via the repair process, they simply chew their way out somewhere else.

Some birds, in particular the white corella (a type of cockatoo) are particularly destructive. While the problem is localized (meaning specific areas in the state), the abundance of food in the form of sweeps and embedded grain provides these natural vandals with plenty of opportunity to keep boredom at bay. It is difficult to dislodge a flock once they establish their presence. The fact that these birds are often a protected species also limits what we can do to minimise the damage they cause.

Other more common sources of damage include rising salt water tables, termites and over zealous front end loader drivers, all contributing to ongoing work for our maintenance teams.

So that in a nutshell is what we are faced with when maintaining the majority of our fixed machinery horizontal grain storages.

I would now like to spend a little time discussing what we have tried to do to engineer out in new storages, some of the problems we created when we retro-fitted unsealed storages to be capable of carrying out a fumigation.

The first thing we did was re-establish a “Sealed Storage” department. The initial Sealed Storage department was progressively dismantled until the function became absorbed under the umbrella of Civil Engineering Maintenance.

With the creation of our subsidiary, Bulkwest Engineering Pty Ltd, and their responsibility for ensuring appropriate maintenance, the opportunity to re-establish a dedicated Sealed Storage maintenance unit was made. Personnel with

vast experience in grain handling, grain protection, controlled atmosphere fumigation and industrial coatings filled key positions

This unit carries out both an administrative function managing and administering contracts with external service providers as well as an operational function carrying out maintenance to Sealed Storages and applying a first time seal to newly constructed storages.

This group has been actively involved in the research and development into better methods of sealing existing storages as well as providing consultancy services to various groups involved in the development and construction of new services. I will provide examples shortly.

CBH continually invests in its infrastructure via the construction of new storages. The creation of the Sealed Storage department provides an ideal interface between my department and those responsible for the design and construction. Given that the majority of our non seaboard storages are concrete walled, steel roofed horizontal shed type structures, the sealing process is more complex than the sealing of simple vertical circular cells.

Our newer grain storages have structures that benefit from the latest construction materials and methodology such as hollow cored and pre formed tilt wall technology. Roof trusses and sheeting are usually lighter in gauge for given spans and all these factors combine to make these modern storages very flexible thereby moving more. Flexible in form rather than function!

While this flexibility is an end result of the drive to lower costs and improve returns, it also makes the process of sealing storages more complicated. In the first instance, the traditional waterborne elastomeric acrylic membrane used, no longer has the performance characteristics to deal with the greater amounts of movement mentioned previously.

Critical to the resolution of the problem of increased movement was the development of a new protocol for the approval of membranes used in the sealing process. This new protocol involves tests that will ensure the materials used will be more suitable for the task at hand. Several additional tests require the materials to perform over a greater range of conditions more consistently for longer. A separate protocol is being developed for materials used to seal bunker storage covers.

Creating the protocols fulfilled only one part of the solution. The testing of the materials, application and applicators is equally important for the whole system to work. To this end a detailed and rigorous testing and inspection regime has been implemented and administered by the sealed storage team.

Secondly, the integration of aeration systems, larger doors to accommodate larger out-loading devices, gas recirculation systems and pressure relief all create apertures within the storages which all require sealing methods that are effective and operationally appropriate.

To resolve these and other design and integration issues members of the sealed storage team work closely with the designers, fabricators and builders of our storages. Within the last eighteen months there have been changes in the design of exhaust fan dampers, main doors, conveyor entry points and door sealing panels which have resulted in quicker turn around times in the sealing process and more effective fumigations.

Another area that is a major component of the "Controlled Atmosphere Fumigation" environment at CBH is the bunker or bulkhead storage. This steel walled, tarpaulin covered emergency storage type, forms an increasingly important and large percentage of CBH's infrastructure, currently around 50%. This type of storage has its own unique set of operational challenges in terms of our ability to cover grain as well as fumigate and clear gas.

We are continually evaluating new methodologies to seal covering tarpaulins, methods for introducing fumigants under the tarpaulins as well as methods to clear the fumigant. The traditional methods of introducing fumigants into the tarpaulin covered storage have been time consuming and has had potential safety issues to contend with. The mere fact that this process requires the opening of a tarpaulin seam, impacts on the integrity of the seal and the grain within during future fumigations.

Extensive trials have enabled the development of infrastructure to facilitate the process from the ground, thereby eliminating many previous problems.

There are also strict protocols for the supply and testing of the tarpaulin materials themselves.

So where do we go from here? There are a number of unresolved issues that require analysis and a comprehensive research and development effort. These include effective protection against feral animals including some birds and rodents, dealing with highly corrosive salt laden ocean front environments and their effects on various substrates and membranes and finally the development of cost effective self sealing main grain load bearing doors.

There are many new materials that are being evaluated to augment the performance of the existing materials. These could be used to either entirely replace or selectively replace the acrylics currently used. As always the cost of

implementation versus the enhanced serviceability of the solution is foremost in our analysis and decision-making. The current specification and required film thicknesses of membranes and other sealing materials are under constant review with the assistance of suppliers and manufacturers.

The development of grain protection staff to utilize new equipment, care for grain and innovate within the "Controlled Atmosphere Fumigation" environment is a major challenge in the current era of increasing customer scrutiny. The implementation of quality assurance systems such as the ISO and HACCP variety means that there is greater focus on the maintenance and serviceability of all storages within the network….

To conclude… The journey from 1983 to the present moment has been one of continual improvement and discovery. The foresight of the CBH Board has provided the organisation, advantages that far outweigh the capital cost of implementation of the program. This has enabled the Company to provide an unrivalled source of reliable and consistent pest and pesticide free grain from any location within the Grain Storage and handling network in Western Australia.