

## **Engineering — Session Summary**

**Conveners: J. Ford and D.E. Maier**

The Engineering Session consisted of an all day session that included 15 oral paper presentations and over 20 posters, which covered the following areas of interest:

- I. Pest prevention and management through aeration (7 oral papers)
- II. Modelling and analysis of storage and drying (4 oral papers)
- III. Design and management of structure, and equipment (4 oral papers)

The stage for the session was set by the keynote address of Dr. Allan Roberts, which reviewed succinctly the challenges facing engineers when designing silo bulk handling facilities. The presentation was well received by the predominantly non-engineering audience. The engineering session enjoyed a good attendance with an audience high of 60. Participants took full advantage of the 30–45 minute discussion periods following each of the three topic areas.

Highlights of the aeration paper included U.S. work on chilled aeration and conditioning. Specifically, as it is beginning to be implemented for some of the higher value commodities for both pest prevention and product quality preservation in the U.S. grain industry. British research highlighted the effectiveness of ambient aeration cooling as part of an integrated storage strategy. British, Australian, Moroccan, Chinese and U.S. work on the utilisation and development of fan control strategies illustrated the fact that a proper understanding of aeration management is critical for automatic systems to succeed. Much of the discussion centred around whether aeration control strategies should be based on dry bulb or wet bulb temperatures, or relative humidity. Although no consensus developed, agreement did exist that aeration strategies must take into account regional if not local climatic conditions for aeration to be a successful tool in an integrated bulk storage management system.

Australian research on programmable fan controllers pointed the way to the future where computer-based systems will provide managers remote, on-line and real-time decision support, as well as extensive flexibility to optimise strategies. During the discussion period it was pointed out that a prototype commercial system was recently introduced in the U.S. grain industry. In the future, aeration cooling using ambient and/or chilled air will become every storage managers number one preventive pest management tool. Engineers, entomologists and mycologists need to cooperate in promoting this alternative, non-chemical product protection technology as the primary line of defence against quality deterioration!

Another key to improved product quality is a better understanding of the influence of various parameters on the drying and storage of bulk commodities. Because of the complexity of the physical, chemical and biological ecosystem at hand, numerical modelling provides a powerful tool for analysis of optimum strategies and limiting constraints. Work from Australia, China and Thailand highlighted the effectiveness and powerfulness of modelling. The discussion period pointed out the continuing need to refine the numerical approach, and the trade offs between numerical accuracy and field applicability.

Finally, an engineering session would not be complete without looking at the design of the equipment and structures that are necessary to make drying, storage and handling of bulk crops possible. Work from India presented an update on design improvements of on-farm storage's in that vast country. British research highlighted product quality differences observed in large-scale outdoor sack storage's in Zimbabwe when different bagging materials were used. U.S. work presented a summary on the design of dosed-loop fumigation systems in concrete and steel storage structures at commercial elevators in the U.S. wheat belt. Australian engineering ingenuity was

demonstrated with the design of a new high-capacity stacker for filling and emptying of large-scale grain bunkers.

Unfortunately, this particular Australian presentation represented the only contribution by an industry representative in the Engineering session. In the discussion sessions it was emphasised that future session organisers and participants should make a more concerted effort to increase industry participation in oral and poster presentations. Engineers working outside the academic and research community need to be invited to become involved, and hopefully provide an important reality check as to feasibility, costs, economic incentives, appropriateness and transferability of technology. This would add an invaluable dimension to any working conference!

Last but not least, it must be pointed out that engineers and engineering solutions were essentially part of all sessions at this conference. Thus, future conferences should consider using a session title less broad than 'Engineering'. This would hopefully eliminate some confusion as to submitting a paper to what session, and attract a broader range of papers from which to select oral presentations from. Finally, discussions among the participants of the engineering session suggested the following three engineering-related topics for the next conference:

- (1) Sealing procedures and technology for new and existing structural designs of storage and processing facilities.
- (2) Advances in sensor technology used for monitoring and detecting gases, dusts, noise, odours, product quality, and product damage due to insects or fungi.
- (3) Preventive stored commodity management techniques including the utilisation and control of aeration cooling.