COMPILED BY BOB JACKSON

The lead article discusses some recent advances in bulk solids handling and conveying. Also featured are reports on a conveyer upgrade at Loy Yang open-cut mine, an x-ray ore sorting system for scheelite, some innovative conveying applications and a preview of an international particulate solids handling conference, to be held in Brisbane next year.

Simulation modelling helps develop new systems

By Peter Wypych

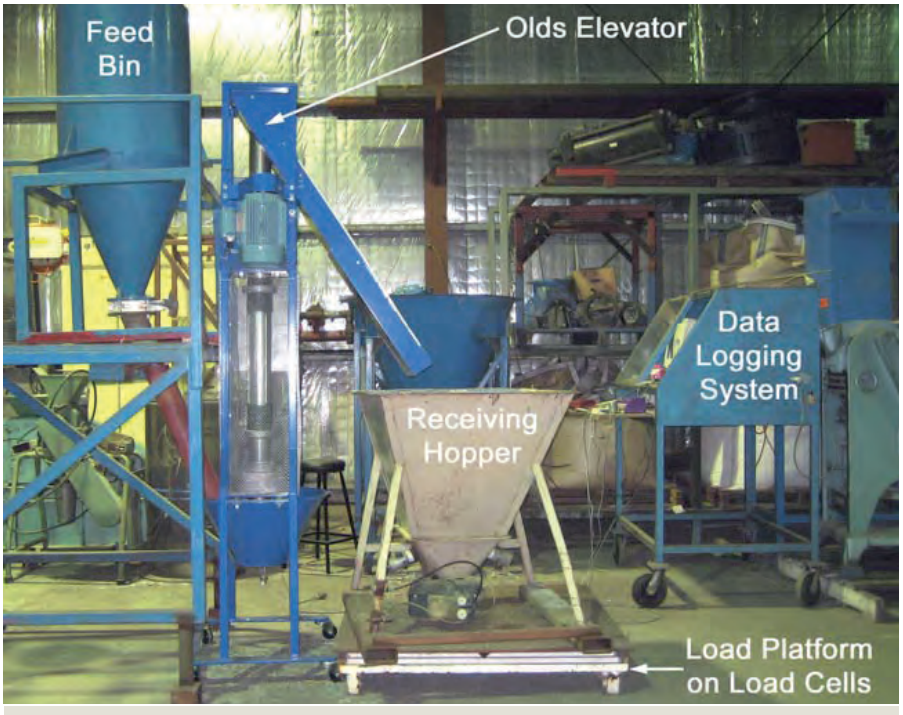
One of the most significant developments in pneumatic conveying technology in recent times has been the application and fundamental modelling of the low-velocity slug-flow (LVSF) of bulk materials.

This mode of flow has been successful in avoiding particle damage and/or segregation problems for a wide range of fragile/granular bulk materials, such as granulated sugar, grain, rice, skim milk powder, poly pellets, peanuts, milled grain, semolina, muesli, powdered and granulated coffee, dry pet food and granular catalyst. Significant advances in the fundamental modelling of this mode of flow have also been achieved.

The most common feeder used in bulk materials handling plants is the rotary valve. Despite their widespread use and popularity, many rotary valves still experience two major problems – particle and valve damage due to excessive particle chopping and inadequate system capacity – due to air leakage.

Flood-fed rotary valve feeders can easily chop or damage the coarse particles that are caught between the advancing rotor blade and the housing. This can lead to immediate failure of the rotor drive or eventual failure of the drive and/or housing due to fatigue. The force impulses generated during the chopping operation can be significant. One option to avoid such problems is to select a rotary valve with a built-in anti-chopping inlet. However, in existing plants, it may be too expensive to replace all the rotary valves with new anti-chopping models. An anti-chopping insert has been developed at the University of Wollongong specifically for this purpose and has been found to be quite effective.

Rotary valves feeding positive-pressure conveying systems can leak as much as 50% of the total amount of air supplied to a system. Hence, it is essential to estimate leakage as accurately as possible. The few leakage models that exist have been found to be inaccurate and also contradictory (in terms of expected trends). The predictions from a new theoretical model I have developed display surprisingly good agreement with experimental data from conventional and high-pressure rotary valves. When air leakage is found to provide an operational problem (eg: inadequate feed rate), it is recommended to employ an efficient method of venting, such as the new centrifugal vent hopper developed by the University of Wollongong. In many cases, such a vent hopper has been found to double the feed rate capacity of rotary valves handling powders.



This new test rig, to assess the performance of an Olds Elevator, has been set up at Wollongong University.

Bulk material elevation

Current methods of elevation can experience a range of problems and limitations, such as:

- pneumatic conveyers/lifters; which have relatively high operating cost, excessive product velocities and wear rates (especially for dilute-phase conveying)
- screw conveyers; which have relatively high operating speeds (due to slippage between the screw flight and particles and the back-flow of material through the screw flight and casing clearance), increased particle attrition and undesirable casing/screw contact
- bucket elevators; which have relatively high capital and maintenance costs, mis-tracking of belt/chain, damage to belt/chain, buckets and casing and increased risk of fire from dust explosion.

A new type of elevator, called the Olds

Elevator, has been developed recently to overcome many of these problems. The unique design and operating features of this elevator include:

- stationary screw and rotating casing
- external drive and bearings
- high volumetric efficiency
- full-bore mode of flow avoiding high particle slippage and back-flow of material
- low particle damage and dust generation
- zero risk of dust explosions and propagation
- accurate feed rate control and excellent turndown ratio (in excess of 20:1).

To investigate in more detail the performance characteristics of the Olds Elevator, a new test rig has been designed and installed at the University of Wollongong (see opposite). Two modes of operation are possible with this new research facility. The first is recirculation mode with a sight glass to demonstrate the mode of flow. The second is a performance test mode, where a separate feed bin is used to supply material to the Olds Elevator feed hopper. Here, a separate receiving bin, sitting on load cells, is used to collect the conveyed material and confirm the actual throughput. Electrical power and rotational speed are also measured. This research facility is being employed to investigate particular design and operating issues (eg: bulk materials subjected to various rotational speeds, wall friction effects, in-feed scoop designs and screw flight designs).

Computer simulation modelling

With the advent of more powerful computers, the discrete or distinct element modelling of particle flows and mechanisms is proving to be an increasingly important tool for the designers of bulk materials handling plants and processes.

The low-velocity slug-flow of granular materials eliminates/minimises particle damage and segregation problems. The accurate prediction of pressure drop for low-velocity slug-flow is possible using appropriate test-design and modelling procedures. The development of the centrifugal vent hopper and also the insertable anti-chopping insert can solve rotary valve problems related to air leakage and the flood-feeding of granular materials. The Olds Elevator avoids many of the problems being experienced by traditional bucket elevators, screw conveyors and pneumatic conveyors. Due to its full-bore mode of flow, transport efficiency is greatly improved and dust explosion ignition and propagation hazards are inherently avoided. The new research facility at the University of Wollongong is being used to investigate in more detail the performance characteristics of the Olds Elevator. With these developments and several others, including the recent advances in validated computer simulation modelling, it is possible now to design, optimise and/or uprate conveying and handling systems with increasingly good accuracy and confidence. ■

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