SOLID NEWS

Issue 4 — *The newsletter of AJAX EQUIPMENT - the BULK SOLID performer* — Issue 4

Clariant Increases Production with Innovative Ajax Conveyor

An innovative twin screw feeder developed by solids handling equipment specialists Ajax Equipment is set to significantly boost Leather Process Chemical productivity at Clariant Chemicals, Selby plant.

The new twin screw conveyor replaces a reversible screw conveyor first installed by Ajax Equipment in the 1980s. It is used in the manufacture of a range of Leather Processing Products. The conveyor takes wet slurry cake from a belt filter and discharges it into either a dryer for subsequent packaging or a storage keg where it is used as an intermediate in another process. However with increasing demand for the intermediate, the existing set up was causing a bottleneck as the flow of wet cake had to be disrupted to divert cake to the keg.

Working within the same space occupied by the original unit, Ajax is installing a twin screw conveyor featuring two independent screws each driven by their own motor mounted at both ends of the conveyor. With a single inlet chute allowing wet cake to be fed into both screws, the two screws can exclusively feed to either the dryer or a new packaging machine. Crucially Ajax has designed the conveyor such that both screws can operate simultaneously in opposite directions, allowing continuous transfer of the product to the dryer while being able to convey cake to the packaging machine. The new Ajax twin conveyor also gives Clariant an energy saving. Until now the company often had to use some of the dried product instead of the wet cake intermediate to ensure sufficient quantity to satisfy internal production demand.

"Ajax Equipment has come up with an elegant solution to our problem. It will enable us to increase production of the dried product by up to 2 tonnes per day, while still maintaining production of the wet intermediate." said Stephen Pywell, process technologist, Clariant Chemicals. ❖

Eddie McGee appointed Technical Director

We are delighted to report that Dr Eddie McGee has been appointed Ajax Equipment's Technical Director. This has been a busy past few months for Eddie. In November 2005 he received his PhD from Glasgow Caledonian University for developing a new approach to predicting powder flow.

"Since Eddie first joined Ajax Equipment in 1992 he has played a valuable role in many of our most technically demanding projects. I am delighted that he has accepted the position of Technical Director," said Lyn Bates, Managing Director, Ajax Equipment.❖

SEE THE LATEST AJAX INNOVATIONS 'IN ACTION' AT www.ajax.co.uk

Powder Handling - Meeting the Pharmaceutical Manufacturing Challenge

The demands of processing increasingly potent active pharmaceutical ingredients leaves manufacturers of pharmaceutical equipment with a difficult balancing act to meet.

On the one hand there is the need to provide very high levels of containment. While on the other the equipment also has to offer reliable, on demand, discharge of materials that often have poor flow characteristics. *See page 2 for the full story.*❖

Also inside…

Innovative Sack Tip Station… Lyn Bates answers your questions…Ajax investing in skills and technology.

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Pharmaceutical Manufacturing - Powder Handling

Ajax Equipment has designed and manufactured a hopper and screw feeder for leading powder processing equipment supplier Hosokawa Micron. In addition to clean-in-place and steam sterilisation-in-place, the equipment meets the combined requirements of ATEX and the Pressure Equipment Directive (PED).

Ajax's approach was to treat the hopper and screw feeder as a single construction from which, in this case, powder is fed to a jet mill for further processing. Independent testing of a variety of milled and unmilled powders for their wall friction, bridging and bulk density characteristics indicated that agitation of the powder produced the best material condition for handling. Drawing on its expertise in powder handling, **Ajax Equipment** also interpreted the flow characteristics of the material to design an agitator to sweep close to the walls of the hopper, eliminating the risk of bridging, and ensuring smooth, reliable powder flow to give stable in-feed to the mill.

Using the powder handling analysis data, **Ajax** was able to overcome the poor flow characteristics of the powder to ensure a reliable and controlled feed from the agitator via the screw to the client's milling machine. The screw feeder meters pharmaceutical powder out of the hopper at a variable rate of between 20 to 100 Kg / hour.

Screw Feeder Design

It uses a state-of-the-art volumetric screw feeder with a stepped shaft and variable pitch, to pick up material progressively from the full length of the agitated hopper outlet, to provide a consistent feed rate to the mill. The agitator and screw feeder drives are controlled by separate invertors to maximise co-ordination between agitation and screw feed for optimum powder discharge.

SSIP and CIP

To meet the stringent demands of steam-sterilisation in place, both the hopper and screw feeder are cleaned by steam at 1.5 bar at 128^{O}C. The equipment is also designed to operate at a maximum operating temperature of 140 ^{O}C and withstand an internal pressure of 4 bar, as well as able to sustain a full vacuum.

Ultra Hygienic Construction

All parts of the hopper and screw feeder are constructed of 316L stainless steel with internal surfaces mechanically polished and then electro polished to a finish of 0.3 microns. The hopper has a jacketed construction for insulation ensuring minimal heat loss to maintain temperature during the steam sterilisation procedure. To meet hygienic processing requirements, all internal surfaces are crack and crevice free. In addition all joints feature a modified 'O' ring flange joint profile which was specifically engineered by Ajax. This joint arrangement uses a combination of FDA compliant aseptic seals in PTFE, and silicone and encapsulated FEP for all access points and joints.

ATEX Rated

ATEX rating for manufacturing equipment is commonplace. However in this case it is the vessel's internal zone, which demands ATEX compliance with the equipment itself being positioned in a safe area. The hopper's internal pressurised processing atmosphere is classed as hazardous and rated ATEX Zone 21 to a maximum surface temperature of 160^{o}C. This meant careful consideration of the mechanical features such as clearances between rotating parts and relative velocities.

"Ajax Equipment's knowledge of powder processing has given us a well designed agitated feeder to meet the demands of our pharmaceutical customer." Iain Crosley, Director, Hosakowa Micron Ltd.

Validation of Cleanability

During the pre-commissioning stage the hopper and feeder assembly was exposed to acid and alkali reagents and cleaned with pharmaceutical quality water. The unit was then stripped down and swab tested to validate the cleanliness of the hopper and feeder after cleaning. After this the vessel is then used for a number of manufacturing campaigns using many different APIs without disassembly for cleaning between campaigns.

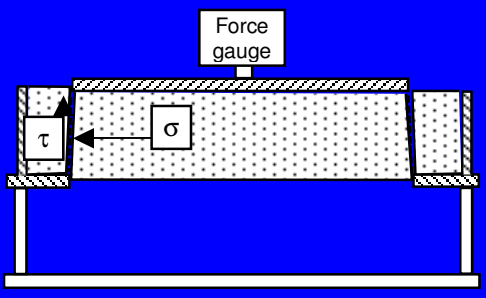
To assist with the validation, **Ajax Equipment** used a triclover clamp fitting at the top of the agitator's ceramic coated shaft with PTFE lip seals and o-ring seal assembly. This allows the agitator to be dismantled without removing the drive shaft. Similarly the screw feeder contains a bespoke seal assembly such that the auger can be removed without disturbing the seals. The seals in both the hopper and feeder are fulfilling an important role in both preserving the pressure during cleaning as well as eliminating the risk of leaks.❖

SOLIDS HANDLING PROBLEM? AJAX M.D. LYN BATES IS HAPPY TO OBLIGE WITH SOME EXPERT HELP

Q. **Lyn, How do I size the outlet of a hopper so that flow will be reliable?**

A. **This depends on the bulk density of the material and its shear strength. These are measurable properties. They both vary according to consolidation conditions, so the weight acting to compact the material and how long it remains undisturbed are important. The conditions for testing should reflect those anticipated during storage and flow.**

There are two options. The Jenike test method is well documented and a good model for conditions where flow has previously been established from a hopper. An alternative is the Vertical Shear Cell (VSC), which replicates starting conditions for flow. The VSC test process is shown below during the shearing stage of the test.



AJAX vertical shear cell test – shearing stage

Analysis is presented in the reference (1) but essentially the calculation is based on the weight of unsupported material over an open outlet generating a shear stress in excess of the strength that the material attains in storage. This indicates that the outlet diameter, *D*, can be given by: -

$$D > 4 * \tau / \gamma \qquad \textit{Equation 1}$$

In Eq.1 τ is the measured shear strength and γ is the specific weight (measured bulk density * g). The shape of the outlet and the hopper construction must then be considered because these influence the minimum orifice dimension. As a rough guide, mass flow will take place through an opening half the size of one in a non-mass flow hopper. Moreover, the slot width half the diameter of a circular opening, provided the slot length is more than three times its width and flow takes place over the total outlet area.

A feeder with progressive extraction is needed to secure the benefits of a mass flow slot, which also provides headroom saving and positive feed rate control. Of course the total 'package' value has to be assessed in a design evaluation. For very difficult flow materials or where headroom is a premium, multiple screws can be employed to secure a larger outlet.❖

Ref: (1) McGee, E: PhD Thesis, Glasgow Caledonian University, 2005

Innovative Sack Tip Station

Improved Safety and Productivity

Having problems handling sacks? **Ajax Equipment** has developed an innovative Sack Tip Station for the opening, discharging and disposal of sacks containing process ingredients. It provides manufacturers with an easy-to-use method of safely cutting and emptying sacks without the need for operators to handle sharp knives.

The Sack Tip Station is ergonomically designed for single man operation and can typically handle 25kg bags. Opening the hinged cover reveals a horizontal, centrally hinged internal platen featuring a number of bag holding spikes. The operator places the bag onto these spikes; the weight of the contents holds the bag in position. As the operator pulls down the hinged station lid to cover the sack, a locking mechanism is engaged to release the sack cutting device. The operator can safely cut the bag centrally in a single operation before returning the knife mechanism to its safe position. The operator now lifts the hinged internal platen to expand open the slit in the bag and in so doing also disturb and agitate the bag to allow complete discharge of its contents.

Ajax sack tip station improves productivity and safety.

Once the bag is satisfactorily discharged, and with the knife safely docked the locking mechanism can be disengaged allowing the hinged cover to be lifted open. The empty sack is then removed from the spikes for safe disposal. Some models feature a chute at the back of the sack tip station to allow bags to be dropped into an **Ajax** bag compactor.

For handling fine, dusty and hazardous materials the **Ajax** Sack Tip Station can be fitted with a dust extraction or glove box cabinet with laminar flow extraction.❖

Manufacturing – Focus on Skills

Efficient solids and powder handling is at the heart of many successful process industries. Just as UK manufacturing has recognised that in many areas mass manufacture has given way to highly customer-centric manufacture, so the solids handling industry faces the same challenge. For Bill Waters, co-founder of **Ajax Equipment** this development was neither new nor unexpected, "We recognised at the outset back in 1971 that every solids handling application is unique and that a 'one-size fits-all' approach is at best a compromise and at worst a serious impediment to maximising plant productivity."

A combination of knowledge of solid and powder flow characteristics and skilled engineering manufacture is central to **Ajax Equipment**. Keeping pace with the changes in solids handling and engineering practice has been achieved by investing in new skills and technology. Bill Waters again, "Time-to-manufacture and conformance to industry and legislative specifications characterises today's manufacturing environment. Laser cutting of sheet metal together with developments in CAD technology have enabled us to cut manufacture times and improve build quality. Of course the skill comes in knowing how to form the metal and interpret the design which is why we've maintained our commitment to apprenticeships."

Ajax Equipment Works Manager, Dave Macdonald has the responsibility of ensuring projects are completed on time. "In common with most manufacturing companies we are having to produce more products with less people, the skill comes in employing skilled workers who take a pride in their work" he notes. Quality is not simply a commitment to meeting the customer's specification; it underpins **Ajax Equipment's** approach to manufacturing. As Dave explained, "Over many years we've found that getting the quality right in every aspect of manufacture actually speeds up the build leaving us more time to focus on the more technical issues we expect when working on bespoke projects."

Every solids handling application is unique, a 'one-size fits-all' approach is at best a compromise and at worst a serious impediment to maximising plant productivity.

Looking to the future, **Ajax Equipment** will continue to specialise in 'design-for-manufacture' where its expertise in powder handling gives a real performance edge to solids handling. Bill Waters doesn't expect the speed of change to slow down and welcomes the challenge; "Investing in new technology will ensure we continue to develop, but it's our ability to find and train skilled people that will ultimately ensure we're able to continue delivering solids handling equipment that is well built, reliable and 'fit for purpose'."❖

❖ Forthcoming Events ❖

August 27-31, 2006 **5th International Conference For Conveying and Handling Of Particulate Solids (CHoPS),** Sorrento, Italy, www.ortra.com/solids/. **Eddie McGee** is presenting two papers entitled *'A novel approach to describing the flow related aspects of bulk solids'* and *'Using data from vertical shear cell tests to define the flowability of bulk solids'*. Both papers report work by E McGee and D McGlinchey, Glasgow Caledonian University.

October 16-17, 2006 **Bulk Europe 2006,** Barcelona, Spain, www.bulkeurope2006.com/. **Lyn Bates** is chairing the session on silo technology, and presenting a paper on *'The need for Industrial Education in Bulk Technology'*.

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