SOLID NEWS

Issue 2 ***The newsletter of AJAX EQUIPMENT - the BULK SOLID performer*** *Autumn 2004*

Ajax Equipment awarded DuPontSA screw conveyor contract

Ajax Equipment is supplying screw conveyors to engineering company Aker Kvaerner, as part of expansion of the DuPontSA pure terephthalic acid production facility at Wilton, Cleveland, in a contract worth over £250,000.

The DuPontSA Wilton Site is a world scale and world class facility for manufacturing over 550ktpa of pure terephthalic acid (PTA) - a key intermediate in the production of polyester. PTA is a fine white powder manufactured by reacting paraxylene in air. This reaction produces a crude terephthalic acid powder, which is purified at high temperatures and pressures in water to form PTA.

In total Ajax Equipment is supplying six, high capacity, screw conveyors ranging from 400 to 850 mm screw diameters to transport wet PTA cake and dry PTA powder between processes. The screw conveyors have been designed by Ajax to fit within the space constraints of the existing PTA production plant. The 850 mm diameter unit is ATEX compliant to Zone 22 and offers enhanced production capacity. Associated plant including inlet and outlet pipework and swinging bucket divertor valves for switching feed to the conveyor offers greater plant flexibility.❖

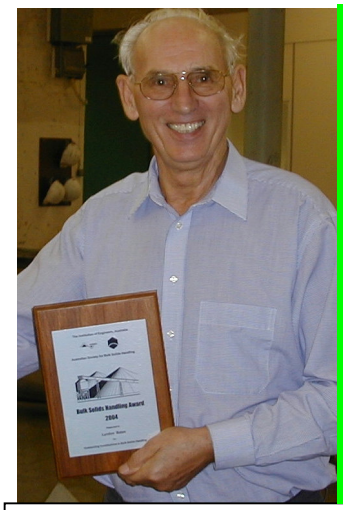
GETTING AGITATED!

The AJAX agitated screw feeder - setting the standard for hygienic processing of active pharmaceutical ingredients.

The AJAX agitated screw feeder - combines expert powder handling with high quality stainless steel construction.

Mechanically polished, electropolished and passivated finish, the feeder is Pressure Equipment Directive compliant and suitable for 'Clean in Place' (CIP) and 'Steam in Place' (SIP) cleaning with machined joints fitted with aseptic seals. Agitators and variable pitch screw ensure precision feeding of Pharmaceutical powder!

ATEX Compliant



'DOWN UNDER' AWARD FOR LYN

Managing Director, Lyn Bates has received international recognition for his contribution to materials handling.

Announcing the award during the recent International Conference on Bulk Solids Handling held in Wollongong, Australia, Mark Jones the Head of the Key Centre for Bulk Solids & Particulate Technologies in Newcastle, New South Wales, acknowledged the many activities and contributions that Lyn Bates has made in this field. Apart from establishing Ajax Equipment as a leading solids handling company, these include international consulting, securing various patents and innovative developments, advising as expert witness and designing various powder test devices.

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GO WITH THE FLOW Part 2

Get the right hopper slope. Using wall friction test data to design reliable hoppers

Angles are important to bulk solids. Perhaps the most important is the Wall Friction Angle, w. There are many circumstances when powders are expected to slip against a contact surface - the wall of a hopper or chute, the blade of a screw conveyor or mixer - if plant is to work well.

The apparatus shown in figure 1 can be used to measure how a powder's friction varies with load and contact surface.

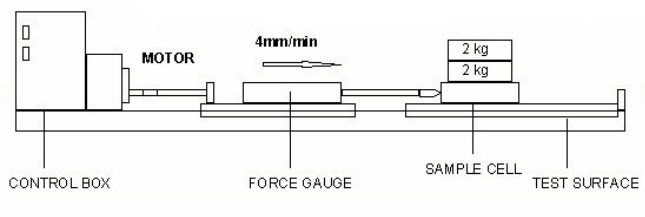


Figure 1: The AJAX wall friction tester

Typical data gathered from the wall friction test is presented in figure 2.

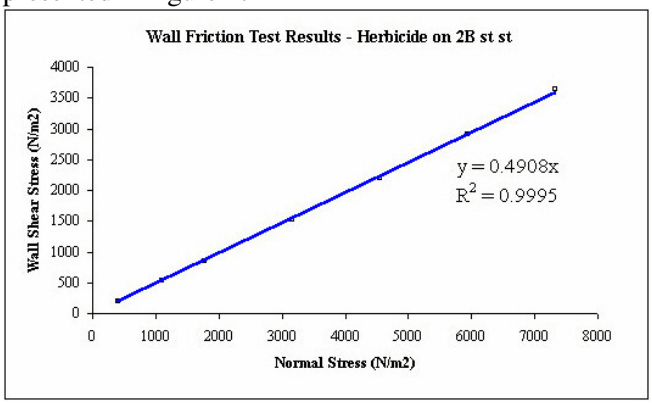


Figure 2: Wall friction of herbicide on 2B stainless

The slope of this line is usually converted to an angle, φ_w using eq. 1:

$$\varphi_w = \tan^{-1} (\tau / \varphi_n) \qquad \text{Eq.(1)}$$

where τ is the measured shear stress and φ_n is the applied normal stress. Using this information the angles required for mass flow in conical and 'V' shaped hoppers. Charts are available for establishing the critical angle at which material will slip at the walls, alternatively the following equation can be used:

$$\beta_c = 1.2\ \varphi_w + 43 \qquad \text{Eq.(2)}$$

Eq. 2 gives conical wall angles, β_c, to the horizontal. 'V' shaped hoppers tend to mass flow at approx. 10 degrees shallower wall angles because the material only converges in one plane.

In the case shown in Figure 2 the wall friction angle is a constant single value (26 degrees) and so the predicted wall angle for a conical hopper is 74 degrees to the horizontal.

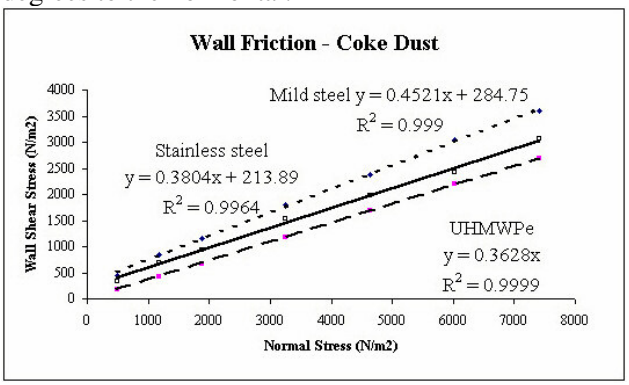


Figure 3: Coal on various surfaces

Figure 3 confirms two other features of interest. Firstly the wall friction coefficient is contingent on the surface and secondly that it is possible for the values to lie on a line that does not pass through the origin. Whilst it may seem obvious that the friction characteristics should be dependent on the wall surface the author notes that values or equipment are often supplied without specific reference to the finish of the surface.

Wall friction testing gives best powder slip

The values in this instance for mild steel and stainless steel surfaces have a significant intercept, which represents a resistance to slip at zero contact pressure.

This intercept is referred to as 'wall adhesion' and is an extra attractive force between the bulk and the wall. Adhesive build up of powder occurs where the mass of material is small in relation to the surface area it is in contact with e.g. corners of square section hoppers or where screw flights attach to support shafts. This tendency to hang up can be countered with the use of generous radii in the hopper or ribbon flights for the screw.

In a review of the measurements of over two hundred different bulks solids against a variety of wall surfaces the average wall friction angle was found to be about 26 degrees. This means that a cone with a wall angle of 75 degrees to the horizontal will only mass flow with about half of the materials tested. So if mass flow is to be achieved very steep hoppers or alternative geometry will have to be used. Whilst the nature and the finish of the wall surface can have a major effect on the wall friction angle there is unfortunately no ubiquitous low friction liner - only wall friction testing can verify what wall material gives the best slip with your powder.

Our next issue will examine another measured flow property - shear strength - and how it is used to establish the correct hopper outlet size.❖

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

Q I have recently installed a sophisticated feeder control but am not getting the results expected. What should I do?

A There are two main classes of poor feeder performance that cannot be addressed by a control system, however sophisticated. One is fluctuations due to the feeder discharge characteristics; the other is unreliable flow from the feed hopper that causes dynamic instabilities of flow and bulk density.

In the case of discharge fluctuations these may be the result of unstable avalanching of the product or cyclic undulations because of the feeder geometry. Each of these can be mitigated by good design, however design detail and an understanding of the technology are crucial to secure the best results. Irregular stoppages due to 'arching' or piping and intermittent phenomenon such as 'flushing' are commonly due to inadequate hopper design and poor feeder interfacing.

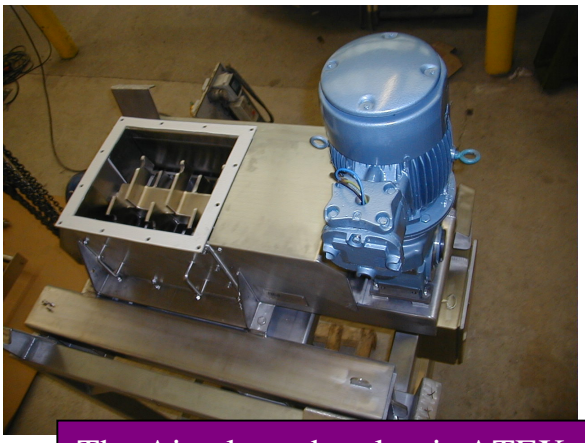
These features make flow uncertain and the extent of the problem is invariably linked to the properties of the bulk material. Quantified measurements of wall friction, bulk density and shear strength will both identify the potential for flow problems and provide data for designing a reliable and consistent mass flow system. Mass flow is usually essential for consistent 'bulk state control'.

The bottom line is that a powder feed system is an integrated installation comprising a storage facility, dispensing mechanism and a control method. The controller requires a predictable feed back so it is essential that the hardware perform reliably. This means the hopper and feeder should accommodate the behavioural nature of the product. ❖

AJAX Puts the Bite on Lumpy Raw Materials

Ajax Equipment Ltd has developed a range of heavy duty lump breakers for breaking up raw materials, previously held in drums and sacks, ahead of processing. The lump breaker can be readily integrated within chemical, food and pharmaceutical processing plant above a hopper or chute feeder, ensuring a more consistent powder quality for the materials.

Raw materials stored in drums and sacks are often prone to aggregating into lumps during transportation and storage. Changes in temperature and moisture can result in material arriving for processing which is part powder and part lumps. The presence of lumps can lead to charge chutes becoming blocked, reaction vessel stirrers being damaged and process reaction times extended.



The Ajax lump breaker is ATEX compliant. It comprises steel shafts and blades that quickly reduce lumps to powder.

It comprises steel shafts and blades that quickly reduce lumps to powder by wedging and crushing the lumps against the breaker's casing and grill. The residual lumps are forced through the grill by means of a sliding and crushing action of the blade edges. Low and high speed lump breakers are available. The low speed efficiently crushes brittle products without excessive dust.

Capable of processing lumps up to 350 mm diameter (football size), the Ajax Lump Breaker measures 400 mm x 800 mm and is available in single and twin shaft arrangements. The twin shaft machine's contra-rotate to draw lumps into the central breaking zone, permitting the breaker to smash larger and denser lumps without either bridging or clogging. ❖

Focus on ……Design

Kevin Gillibrand, Design Director, co-ordinates the Ajax Equipment design team to produce cost-effective solutions to materials handling problems. "The team takes a holistic approach to design. This involves ensuring that all relevant design considerations are taken into account to meet processing operational parameters and to link with associated equipment."

'Attention to Detail' is our design team's constant aim

Ajax Equipment's membership of various industry powder handling advisory committees means we are up-to-speed with all European Directives. "We are able to supply equipment designs that are compliant with ATEX, PED etc, where applicable." All design drawings are produced using AutoCAD, with arrangement drawings sent for client approval and detailed drawings used for profile development and laser cutting.

Great emphasis is given to Health and Safety regulation in all Ajax designs with safety interlocks used to meet processing regulations and individual clients working practices. Recent developments in the pharmaceutical industry in the use of aseptic seals for use with 'Clean in Place' (CIP) and 'Steam in Place' (SIP) systems, has lead to the Ajax design tem producing unique designs for these application.❖

SO WHO DOES WHAT AT AJAX? MEET RICHARD NEWBY - DESIGN DRAUGHTSMAN

With over 27 years experience in engineering and solids handling, Richard Newby is a key member of the Ajax Equipment design team. He is responsible for developing equipment designs using the latest CAD software and a sound knowledge of shop floor production techniques.

"The majority of equipment supplied by Ajax is unique," says Richard. "This means that more careful attention than usual has to be given to design features, ensuring optimum equipment performance for the application." Developing a close working relationship with customers is important in refining designs to take into account ATEX and Pressure Equipment Directive (PED) requirements. "Often there is a tendency to over specify ATEX requirements for solids handling with significant consequences on the design and cost. Our experience allows us to advise customers on the best approach," notes Richard.

A recent project undertaken by Richard and his colleagues concerned a high quality agitated screw feeder for a pharmaceutical company. This machine was required to be CIP and SIP. A hygienic aseptic seal was developed and tested at Ajax for this application. Not only was the machine to meet all the exacting requirements of the pharmaceutical industry, but had also to comply with the PED and ATEX rective. And, of course, the powder was poor flowing as well! ❖

What can AJAX help you with?

- ❑ Please send me your technical sales literature
- ❑ I'd like to know more about 'Flow in hoppers'
- ❑ I'd like to know more about Ajax lump breakers
- ❑ My interest is ……..
- ❑ Contact me, I have an application to discuss!

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