# SOLID NEWS

ISSUE 19

The newsletter of **AJAX EQUIPMENT** - the **BULK SOLID** performer


## BIOCHAR RESEARCH FLOWS WITH NEW HANDLING SYSTEM


The UK Biochar Research Centre (UKBRC) has installed an Ajax mobile twin screw feeder and hopper for biomass handling as part of a pyrolysis system. Based at the University of Edinburgh, the UKBRC investigates how biochar can be sustainably used in resource management, soil improvement and energy production. ***"Since commissioning Ajax Equipment's screw feeder and hopper, the equipment has performed exactly as expected, handling the material very well,"*** said Christian Wurzer, researcher at the UKBRC.

The UKBRC works with many different materials including miscanthus grass. These types of materials are low density with extreme particle shapes and are very prone to 'bird nesting' and hence reluctant to flow. Ajax's technical and design engineers were pleased to provide a great working solution that is adept at handling many different variants of biomass.

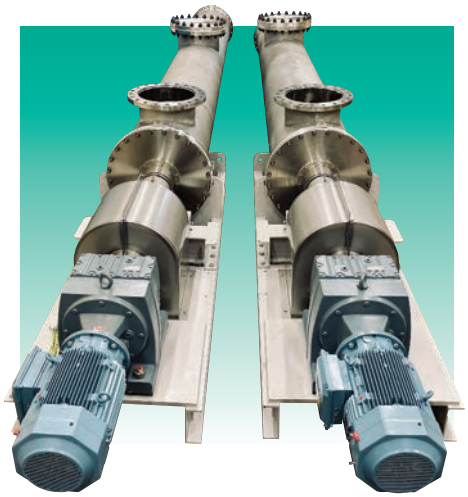
## TWO-STAGE HOPPERS MEET TRIPLE SCREW FEEDERS

Ajax has worked again with material transfer specialists, Coveya, supplying two retractable stainless steel triple screw feeders with hoppers for powder handling. The hoppers feature two stage plane flow symmetry to encourage mass flow of the powder. These are matched with triple screw feeders which promote the flow of powder by providing active extraction from the entire length and width of the hopper's outlet, delivering a controlled discharge and feed rate. Using a triple screw feeder also means the product can be distributed evenly across the width of a belt conveyor handling another bulk product.

***"Ajax worked closely with us to ensure that the screw feeders were manufactured with our unique application in mind and conducted tests on the material to determine the optimal shape of the screw feeders receiving hopper,"*** said Winston Herbert, sales executive, Coveya.

## CE CHEMICAL CONVEYORS FOR CÁDIZ

Leading chemical producer, Indorama Ventures Quimica, is successfully handling semicrystalline polymers using two stainless steel horizontal screw conveyors and a discharge chute from Ajax Equipment at its Cádiz production site in Spain.



***"Ajax's conveyors are fulfilling all project expectations; including capacity, reliability, sustainability and energy efficiency demands. More importantly, our operations team is very happy with the equipment's powder handling performance and how well they work with the other equipment in the line,"*** commented Francisco Fernandez Gato, project engineer, Indorama Ventures Quimica.

The complex production process demanded the equipment be designed to ASME 8 and PED category 4 – module G, and therefore design and manufacture was under the authority of a EU Notified Body. The screw conveyors utilise LynFlow™ ribbon flights, designed to provide excellent powder transfer and prevent product build-up. This unique flight form also allows for process gas flow through the system.

# WHAT TO KNOW IF YOU WANT FLOW

When handling materials there is no one perfect solution that works for all bulk solids. Whether you are working with pharmaceutical or metal powders, carbon fibre, ash, cereals, minerals, waste or anything else, knowing the material is the only way to ensure that the equipment will perform well with that bulk solid.

## What are the Benefits of Knowing the Material?

Knowing your material brings assured performance, a longer useable life, and a far lower total cost of ownership than if the material is not properly considered. For example, if you need a hopper and cost is the primary factor, a conical hopper would be the obvious choice as they are fairly easy to make. However, a cone is often not the best shape for material flow, whilst defining its slope and outlet size is haphazard if material properties have not been used in design.

A conical hopper forces a bulk solid to converge simultaneously in two planes which can mean no flow issues or residual material that is reluctant to discharge. This reduces both usable volume and plant performance, and requires manual interventions to encourage flow, exposing operators to hazards and leads to hammer rash which can make matters worse.

To establish the hopper shapes, wall angles and outlet sizes needed you must spend time material testing. Investing in that research will pay for itself many times from the get-go and over the service life of the equipment.

### *Wall Friction*

During solids handling there are many situations where materials are required to slip against a contact surface, eg the wall of a hopper, the flights of a screw conveyor or mixer blades.

A material's resistance to sliding can be established using a wall friction tester.

Ajax's tester measures the force needed to push the bulk solid across a wall surface for a variety of contact loads. The data can be presented in a graph of normal stress ($\sigma_n$) against wall shear stress ($\tau$), usually in N/m2. The slope of the line is the characteristic wall friction angle, ($\phi_w$) see equation below.

$$\phi_w = \tan^{-1}(\tau/\sigma_n)$$

### *Bulk Density*

Bulk density is used to size hoppers and screw conveyors but it's also useful for assessing flowability. Whilst it is simple to measure by establishing the volume occupied by a known mass of bulk solid, it is rarely a single invariant value. Variability in the bulk density tends to indicate a sensitivity to handling and storage.

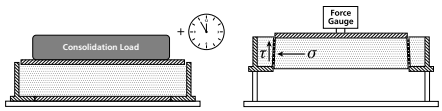
When flowing the material tends to be in its loosest condition. When stored volume falls as the material settles, compacts under its own weight and de-aerates. Low bulk density tends to indicate poor flow. A material's flowability can be characterised by changes in bulk density using the Hausner Ratio (HR), calculated by comparing a material's tapped bulk density against its loose bulk density and ranked as the table below:

| Hausner Ratio | Material 'Flowability' |
|---|---|
| 1.0 - 1.1 | Free Flowing |
| 1.1 - 1.25 | Medium Flowing |
| 1.25 - 1.4 | Poor Flowing |
| Over 1.4 | Very Poor Flowing |

### *Shear Strength*

Shear strength indicates how cohesive a solid is and how much resistance it offers to deformation and flow. This is the key parameter for establishing a reliable outlet size for gravity flow.

**VERTICAL SHEAR CELL TEST**




This figure indicates the stages of testing; once the shear strength ($\tau_s$) and bulk density ($\rho_b$) are known a simple force balance helps determine the minimum outlet diameter ($D_{crit}$) required to destabilise a rat hole or an arch, see equation:

$$D_{crit} = \frac{4 * \tau_s}{\rho_b * g}$$

For slot outlets this minimum outlet size can be halved if an outlet 3 x longer than the width is used.

## From Data to Design

Once you know your material's characteristics it is possible to confidently produce an appropriate design. Understanding the results is just as important as having them. For example, data can help design a hopper but it won't tell you that using a screw feeder below it could reduce the headroom needed, increase storage capacity and improve material flow. Innovation is often key to using the data to produce a practical working solution.

Note testing should always be representative of actual process material and conditions, often it is wise to consider the worst case.

# BARDYKE IMPROVES **CAPACITY & QUALITY**

As part of copper chemicals producer Bardyke Chemicals' latest project to increase production capacity and quality at its factory in Blantyre, Ajax has supplied an agitated screw feeder, screw feeder and hopper.

***"Bardyke Chemicals and Ajax have an established history of collaboration in the development of practical and reliable solutions to a variety of solids handling challenges faced onsite. The latest equipment provided is a culmination of these years of work, incorporating solids handling techniques and design solutions best suited to process our product. Once commissioned, the new feeder will provide a more consistent feed of product to our drying plant, resulting in improved drying throughput and product quality, both critical aspects of our process,"*** said Ross Finlay, site engineer, Bardyke Chemicals Ltd.


# **MOBILE ATEX FEEDER** FOR IRISH PHARMA PLANT

Ajax Equipment has supplied a leading pharmaceuticals producer with a stainless steel mobile feeder comprising hopper and cantilevered screw feeder. The ATEX Zone 1/21 compliant feeder receives pharmaceutical powder from tipped drums and then discharges to a central outlet under gravity flow.

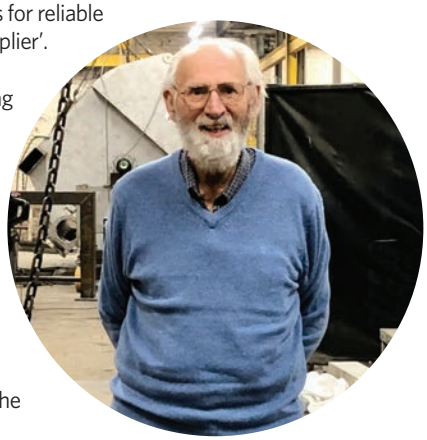
***"Ajax has a long history of designing and manufacturing pharmaceutical standard handling equipment. For the same producer, Ajax recently supplied a fully passivated mobile loading hopper and transition chute,"*** says Eddie McGee, managing director, Ajax Equipment.

Ajax conducted powder testing onsite in Ireland to examine how flow could be improved from the existing system. With the site's space restraints, the tests indicated that flow could best be improved by a steep vee-shaped hopper with a slot outlet and screw feeder extraction. The powder flow is promoted by the auger's left and right hand flights towards a central outlet ensuring that subsequent plant layout was not disrupted.

# ASK **LYN...**

**Q What value is an 'experienced supplier' when buying new solids handling equipment?**

**A** Any user of solids handling equipment looks for reliable performance and seeks an 'experienced supplier'. Practical experience should go beyond the application of latest technology and best manufacturing practice to also understand the fundamental nature of the product to be handled and selection of the most appropriate form of equipment to suit the application.



This not only involves a deep knowledge of powder technology but requires an understanding of the relevance of features of equipment that may be used. This is particularly important in the case of helical screw equipment where the relationship between the physical properties of the product handled and the construction and finish have an important bearing on the way in which the material is promoted to move.

Measured values of contact (wall) friction, bulk density and shear strength are therefore important in relation to flow behaviour and product state. An 'experienced supplier' must therefore use that data to provide equipment that is selected to work well to deliver product that is in the best condition that is of interest to the user. That does require capability and 'Experience'.

# **DIARY** DATE

Institution of MECHANICAL ENGINEERS

## Compliance in Bulk Materials Handling 2023

**10 October 2023, Sheffield**

Many regulatory frameworks govern the handling of bulk solids, including machinery safety, ATEX, DSEAR & other essential health and safety requirements, but a lack of formal training and the limited information available mean best practice is not always followed.

Chaired by Ajax Equipment's Eddie McGee, this seminar aims to address this gap by providing practical guidance for engineers from end-users and equipment manufacturers. The event will use practical examples to aid compliance with regulation and fostering best practice in procurement, design, operation, and maintenance of solids handling equipment.

Get Your Ticket: **bit.ly/3PNMpML**

# LUMP BREAKER SPURS SARACEN HORSE FEEDS

The Ajax lump breaker is helping Saracen Horse Feeds, equine nutrition specialists, reduce the size of caked sugar beet pulp from big bags

***"From the initial conversations to completing the installation, Ajax understood our manufacturing brief and have delivered to expectation. As a premium horse feed manufacturer it is imperative that our stringent manufacturing processes are met at every stage of production and the new installation supports the use of complex ingredients designed to support the nutritional needs of horses and ponies,"*** commented Joe Lydiate, senior operations manager, Saracen Horse Feeds.


# AJAX MADE SMARTER

Supported by the Made Smarter programme, Ajax is working to take advantage of the benefits that digital tools and innovation can bring to design and manufacture with director Mark Waters taking the lead. Technical sales and production are represented by Lewis and Josh as they become digital champions for this initiative.

***"Ajax's leadership team is focused on becoming global leaders in screw equipment design. Key to that vision is innovation in the design and manufacture our customer centric solutions. The Made Smarter programme has been hugely beneficial to Ajax's development and adoption of technology, helping to create a stronger company for our customers and employees,"*** said Mark Waters.

# KEEPING THE SKILLS PIPELINE FLOWING

After four years, two students on Ajax's apprenticeship programme are ready to graduate to skilled craftsmen, having demonstrated their practical skills and abilities.

***"Congratulations to Robbie and Josh on your apprenticeships. We're delighted to continue our successful apprentice programme that has contributed so much to Ajax over the years,"*** commented Mark Waters.

As we build for the future, we welcome George and Joe (pictured) to Ajax. George, a mechanical engineering graduate from Manchester Metropolitan University, will join our Design Office after completing a six-month introduction on the production floor. While Joe will follow a four-year modern apprenticeship programme to become one of Ajax's skilled metal workers.

# AJAX ACHIEVES NEBOSH CERTIFICATION

Ajax continues to prioritise employee health and safety with production manager Matt Barnes successfully completing the National Examination Board in Occupational Safety and Health's general certificate. Congratulations Matt!

***"When given the responsibility of ensuring the high standard of health & safety expected at Ajax Equipment I decided to take NEBOSH's globally recognised qualification to expand on my experience and ensure we were working to the latest best practice. The welfare of our team and customers is of paramount importance to Ajax whether they are on the production floor or on site,"*** said Matt.


We hope you find our newsletter informative and interesting. To provide feedback or find out more about Ajax's equipment and services contact Ajax today.

AJAX
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