SOLID NEWS

ISSUE 12

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

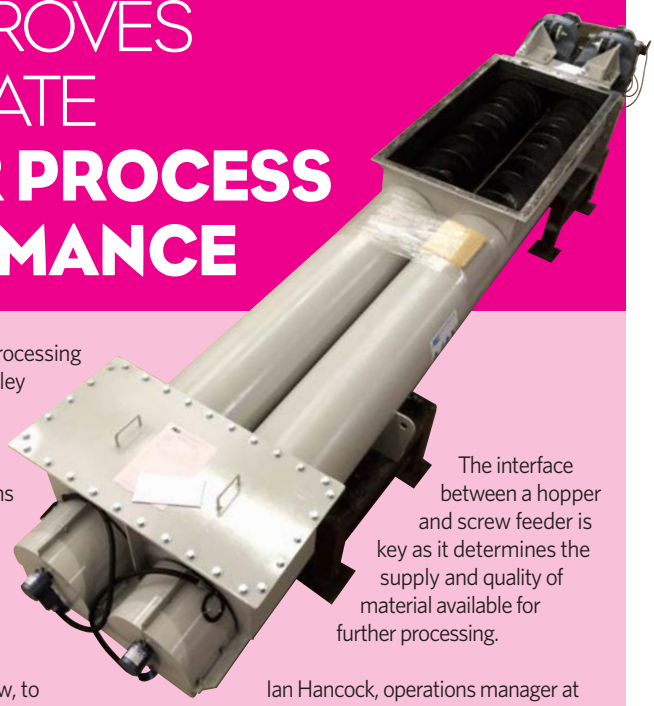
PYROLYSIS PROJECT UTILISES AJAX EQUIPMENT

Hydrocarbon reclamation firm, Recycling Technologies, has utilised Ajax waste handling equipment for the company's waste-to-resource pyrolysis system. Ajax provided a combined screw feeder and elevator, an agitated screw feeder featuring plug screw and a hopper.

Waste material held in the hopper is transferred into the pyrolysis chamber using a plug screw feeder. As the pyrolysis process creates gases that react with oxygen to form unwanted by-products a plug is required. The stainless steel screw elevator recycles sand from the fluidised bed back into the pyrolysis process.

Matt Green, Recycling Technologies commented on the project *"Ajax's plug screw technology is well matched for pyrolysis as it allows continuous production and prevents by-products forming. Ajax has worked on several pyrolysis projects giving them valuable insight on solids handling for pyrolysis, making them the ideal supplier for Recycling Technologies."*

AJAX IMPROVES PHOSPHATE POWDER PROCESS PERFORMANCE



Ajax has supplied mineral processing equipment company, Bradley Pulverizer, with a twin screw feeder for phosphate handling at an Egyptian processing plant. Ajax also supplied designs for a hopper and flow insert to prevent 'ratholes', and encourage mass flow.

Utilising powder testing Ajax determined the hopper wall inclination needed for mass flow, to increase the mean residence time of hopper contents, and enhance de-aeration. Ajax recommended replacing the hopper's bottom section, and introducing a hopper insert and twin screw feeder to promote flow. The twin screw feeder's specifically designed extraction geometry ensures material is drawn from the full width and length of the new hopper outlet.

The interface between a hopper and screw feeder is key as it determines the supply and quality of material available for further processing.

Ian Hancock, operations manager at Bradley Pulverizer, commented *"From the high standard of equipment supplied it's clear Ajax understood the process and what we wanted to achieve. Since the equipment was installed process performance has significantly improved; by providing complete control over the flow of phosphate powder Ajax's equipment has allowed production of the high quality product desired."*

CHEMICALS MAKER INCREASES PRODUCTIVITY

William Blythe, an advanced manufacturer of inorganic speciality chemicals, has worked with Ajax to improve powder handling at the company's Lancashire factory.

"Ajax's knowledge of powder handling has enabled us to streamline those processing areas where we had previously experienced problems. As a result, Ajax's solids handling equipment has boosted our packing rate and overall plant productivity," said Russell Iveson, Projects & Infrastructure Manager, William Blythe.

Find out more on page 3...

PARTICLE VOYAGES THROUGH AN **AJAX SCREW MIXER**

AJAX Continuous Twin Screw Mixer is the primary mixing technology used in Project Chariot's research into the processing of fine powders. Here we review the insights into continuous mixing emerging from using **'Positron Emission Particle Tracking'** techniques.

A twin screw continuous mixer comprises two rotating intermeshing screws enclosed within a profiled casing. The screw arrangement consists of a series of paddles adjusted to resemble a discontinuous double helix, which mix and drive material axially as the shafts rotate. The mixer offers a great deal of flexibility in the degree of mixing through changes to the operating parameters such as speed loading as well as the screw design: ribbons and custom profile paddles, and changes to paddle frictional characteristics and angles.

The way in which material moves through a twin screw continuous mixer has been investigated using 'Positron Emission Particle Tracking' (PEPT). Radioactive tracers of a similar size and density to the powder particles were passed through the system and observed in time and space to chart the movement of particles. Limitations on the size of radiation sensing area meant only the final quarter of the length of the mixer was used.

The trials consisted of mixing dry sulphate powder whilst two variables, feed rate and screw rotation speed, were set at either high or low levels. Four experiments were needed to capture every permutation of variable condition: high/high, high/low, low/high and low/low. The high/low feed rates were operated at 450 and 240 kg/hr respectively, and the high/low screw rotation speed at 150 and 72 RPM (0.6 and 0.3 m/s tip speed).

The radioactive particles were recycled through the system multiple times in order to achieve between 80-100 passes per experiment and capture the various particle paths that may be taken during transit through the system.

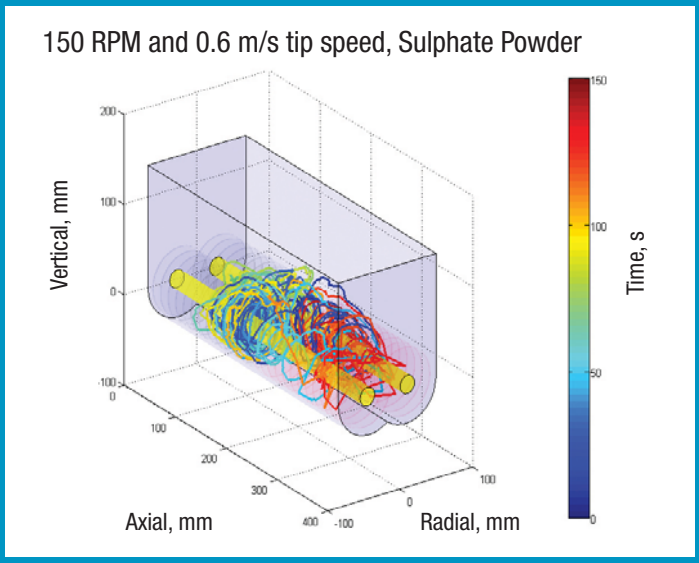


Figure 1

Figure 1 shows a three dimensional plot of tracer particles; the colour of the path changes with respect to time spent in the system. Through analysis of hundreds of particle paths, a complete qualitative description of how powder flows within the continuous mixer is as follows:

- Particle pathways for all regimes flowed mainly in an axial fashion. No backflow was observed
- Particles stayed loosely bound to the motions of paddles on a particular shaft, usually as they flowed smoothly with the bulk. When struck by a paddle, the particles were lifted across the centre of the z axis, and subsequently influenced by the other shaft's paddle motions. A consequent study proved these events happened often enough to ensure sufficient re-ordering of the bulk to achieve mixing of an excellent standard.

In addition, moving from shaft to shaft illustrates a far reaching radial effect which differentiates twin screw from single screw mixing. For example, in food processing with granular materials and liquors to combine, the twin screw provides both squashing and shear of the bulk which encourages good combining and dispersion of the ingredients.

- Particle motion became much slower at the walls of the mixer due to frictional forces
- There is an even spread of particle journey lengths between a minimum and maximum time (the minimum and maximum time changed depending on the variable settings and powder used). Crucially, no two particle journeys were ever exactly the same
- A certain fill level in the mixer is needed for particles to be lifted over the screw shafts by the paddles
- The average residence time of the particles could be decreased by increasing either the powder feed rate, screw speed, or both. This indicated the axial flow became more efficient when there was more bulk solid for the paddles to push against; also proving that high screw speeds push the bulk powder along more quickly.

As only the last quarter of system's axial length could be observed the overall mixing quality for the continuous mixer should, in theory, be many times greater. Mixing was also observed to be excellent even under low feed conditions, indicating the machine may be operated at wide degrees of fill, without drastically affecting product quality overall.

This article represents just a small flavour of useful data being generated by Project Chariot. The insights into continuous mixing will assist Ajax in fine tuning the mixer design to offer more customised systems.

With thanks: Sean Clifford, Newcastle University; Mr. Jerome M. Castro and Mr. Nigel S. Roberts, Procter & Gamble; Prof. Serafim Bakalis, University of Birmingham; Prof. David York, Dr. Mohamed S. Manga and Dr. Dimitrios Kontziampasis, University of Leeds & Simon Fields and Eddie McGee, Ajax.

As part of Project Chariot, Ajax is collaborating with Procter & Gamble, CPI and the universities of Birmingham, Durham, Leeds and Cranfield to develop a novel particle system for fine particles based on Ajax's continuous screw mixing technology. Chariot is a three year project partly funded by the government's Advanced Manufacturing Supply Chain Initiative which aims to help existing UK supply chains grow and achieve World Class standards, while encouraging and retaining quality manufacturing in the UK.

CHARIOT

CHEMICALS MAKER **INCREASES PRODUCTIVITY...** CONTINUED

William Blythe contacted Ajax when undertaking a recent plant upgrade. For the plant's flame retardant grade product, William Blythe was looking for a way of providing buffer capacity while replacing a filter sieve. Powder was taken from a calcination unit by a vertical elevator and discharged into a vibratory filter unit connected to a hopper and associated bagging unit. *"The filter sieve was often blocking, disrupting the process as the vertical elevator continued to discharge powder while changing the filter - the calcination process cannot be stopped at short notice,"* explained Iveson.

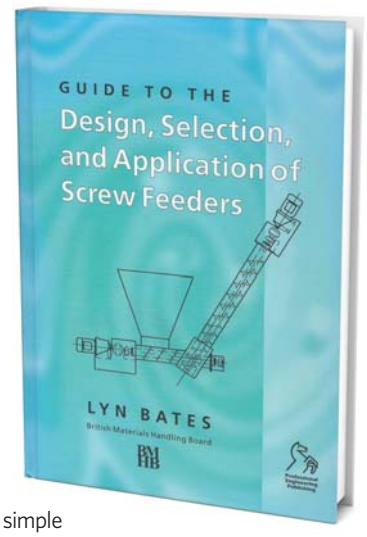
Ajax's solution inserted a hopper and agitated screw feeder between the vertical elevator and filter unit. While the filter is changed the hopper collects powder from the vertical elevator. Since installing the new equipment the sieve blocks less often, providing a stable more consistent feed rate.

In the past William Blythe had a problem on the Copper plant when discharging into a big bag unit. *"After powder testing, Ajax put in place a new hopper and screw feeder more sympathetic to the powder's flow characteristics. The screw feeder draws along the complete length of the hopper outlet and is slightly inclined away from the big bag discharger, preventing the powder flushing into the big bag and has given us over 15 years' trouble-free service,"* Iveson again.

ASK **LYN...**

Q I'm told the filling ratio of screw conveyors should not exceed 30 - 40%, depending on material and inclination angle of the screw. Can this be exceeded?

A A limit is given as above 45% fill material tends to spill into the prior pitch space; fall back is even greater with inclined screws. This back-spill increases the loading, altering conveying from 'Gravity' to 'Flood' mode. In 'Gravity' mode material moves forward by sliding down the screw flight's surface, advancing an axial distance of one pitch per rotation. In 'Flood' mode, the screw behaves like a feeder and material follows a helical path related to the angle of wall friction between the material and blade. As the helix angle varies along the flight face the behaviour is more complicated than a conveying screw. For simple conveying, stick to the limit and only exceed if using as a feeder.



For further guidance Lyn Bates' 'Guide to the Design, Selection and Application of Screw Feeders' is available from Ajax.

DIARY DATE

Institution of MECHANICAL ENGINEERS

IMechE Compliance in Bulk Materials Handling 2016: Successful strategies to stay compliant and to avoid pitfalls in bulk materials handling

22 September 2016, IMechE Engineering Training Centre, Sheffield.

This interactive one day seminar covers the latest developments in bulk compliance including ATEX and DSEAR directives. With major parts of the industry either in the process of implementing the new Industrial Emissions Directive, now is the time to come together to discuss how the engineers can help shape the emissions limits of the directives.

Find out more at http://events.imeche.org/ViewEvent?e=6417

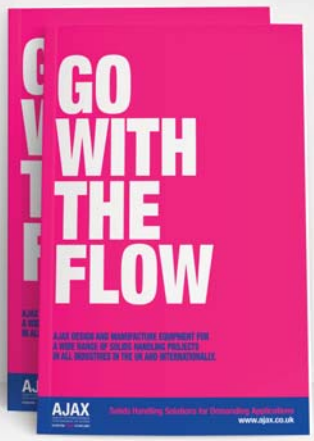
Reliable Flow of Particulate Solids V (RELPOWFLO V)

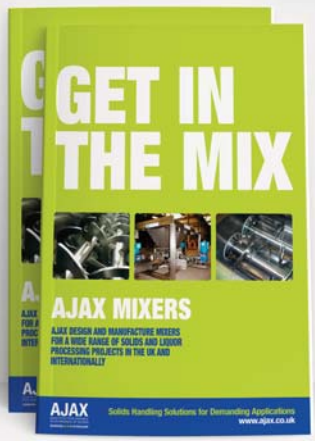
13-15 June 2017, Skien, Norway.

RELPOWFLO V is an international symposium aimed to bring together academics, scientists and industrialists to exchange ideas and experiences in established, new and emerging technologies of all topics of powder technology.

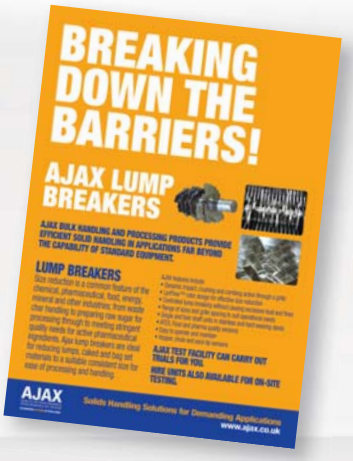
Find out more at http://www.relpowflo.no/

NEW BROCHURES





Ajax Equipment has updated their brochures to reflect the latest developments in solids handling. The new literature includes a comprehensive overview of Ajax's products in '*Go with the Flow*', while '*Get in the Mix*' looks at how continuous mixers can enhance production and processing. Size reduction is the topic of Lump Breaker leaflet '*Breaking down the Barriers!*' showing how lump breaking can be enhanced with Ajax.



To receive the latest brochures contact Ajax via the details below.

AJAX AT POWTECH

Ajax exhibited at POWTECH in Nuremberg, showing their twin screw mixer and lump breaker. With around 16,000 visitors from 31 countries, POWTECH is one of the world's largest solids handling and processing events.

Continuous mixing offers excellent operating efficiency for producing a steady output in consistent conditions. While Ajax's lump breakers are ideal for reducing lumps, caked and bag set materials to a suitable consistent size for ease of processing and handling and are available in for a wide variety of applications including ATEX and pharma quality versions.

As well as exhibiting, Ajax's Eddie McGee presented a technical project aiming to refine the method used to measure wall friction to the Working Party Mechanics of Particulate Solids while Lyn Bates poster 'Evaluation of Options to Change the Flow Profile in Silos' was shown at PARTEC.

GET THE LATEST SOLIDS HANDLING AND PROCESSING NEWS

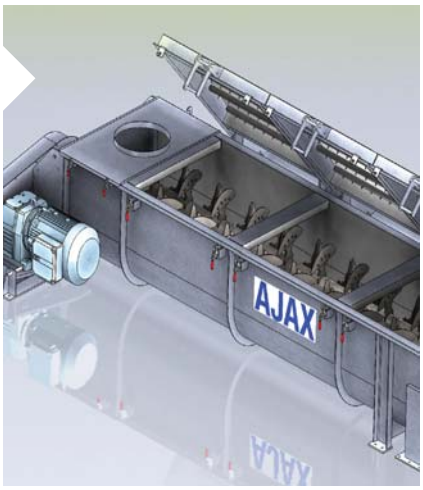
To get the latest solids handling and processing news from Ajax sign up for our monthly e-newsletter and Top Tips series.

Sign up and each month you will receive either our most recent news or Ajax's Top Tips on an area of solids handling or processing.

To sign up visit **Ajax.co.uk** or email: **sales@ajax.co.uk**

3D DESIGN DEVELOPMENTS

Ajax has enhanced its design capabilities with the 3D work package SOLIDWORKS®. This addition to the design process will assist with everything from presentation of drawings and sub-assemblies through to product development.



Commenting on the benefits of 3D Richard Newby, design manager, Ajax said, *"3D will help our customers better understand the bespoke equipment we produce as well as in developing new designs, where we are finding 3D capability useful to explore complex paddle shapes for intermeshing mixer screws to review system dynamics and avoid clashes before anything is manufactured."*

AJAX
QUALITY BY PERFORMANCE
PERFORMANCE BY DESIGN

CELEBRATING 45 YEARS OF EXCELLENCE

KEEP IN TOUCH AND FIND OUT MORE

Register for our enewsletter and Top Tips on solids handling

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@ajaxequipment
Ajax-Equipment
AJAXequipment

+44 (0)1204 386 723
sales@ajax.co.uk
www.ajax.co.uk

Ajax Equipment Limited, Milton Works, Mule Street, Bolton BL2 2AR, UK.