SCHOOL OF ENGINEERING

UNIVERSITY of GREENWICH

The Wolfson Centre for Bulk Solids Handling Technology

www.bulksolids.com

Providing cost-effective solutions to industrial problems

Our mission

...is simply to help industry to get its powders and bulk materials to behave in the way they need them to!

Our philosophy

Our key to achieving this is to measure a material's behaviour in a relevant setting, then use that information in a sound process model to design or select the right solution.

The same techniques can also be used to help in reformulating materials you make, so they behave better in your own, or your customers', plants.

Resources

We have the greatest collection of resources to tackle solids handling challenges under one roof, anywhere in Europe – possibly in the world!

The expertise of our people – our industrial consulting engineers have between them well over a hundred man-years of experience in solving problems in the flow and processing of powders, granules and lump materials, in all industries from pharmaceuticals and food to mining and chemicals. These people concentrate on nothing else but the needs of industry – and are at your disposal.

They are backed up by a large team of researchers engaged in pushing back the boundaries of bulk solids characterisation, handling equipment design and process models.

Pilot plant – our industrial-scale plant is available for your project, including pneumatic and mechanical conveying, hoppers and silos, screening, blending, feeding, dosing, pressing, transport, drying, environmental effects, control systems and all that you find in a real plant or logistics chain.

Material characterisation – we can measure every behavioural aspect of a powder or bulk material; our comprehensive facilities include not only standard techniques but also all the latest methods of putting numbers to the behaviour of powders and bulk materials.

We can use those measurements in our proven process models to predict what will happen to the material in your existing or proposed plant or logistics chain, or to select the right solution. Many of the tests and models have been developed here at the Wolfson Centre and are available nowhere else in the world.

Challenge us!

Don't struggle on by yourself. Phone us with your solids handling challenge. There is a 95 per cent chance our engineers have seen the same problem on other plants, or with the same or similar materials elsewhere. Even if we haven't, we have the experience to find the right path to the solution you need:

- **Telephone assistance** – a short chat (free of charge) to point you in the right direction
- **Day visits** – to offer advice, or to audit your operations for improvement
- **Troubleshooting** – recommending changes, redesigns, material reformulations, etc.
- **Material characterisation and assessment** – on a contract or one-off basis
- **System/equipment selection and design** – to arrive at the best designs or components
- **Technology transfer** – so you can meet the challenges yourselves (funding may be available)
- **Equipment development** – for your novel idea or unique solids processing requirement
- **Research** – If you need to understand your materials and processes in more depth
- **Short courses** – both here at the Wolfson Centre and at your own premises
- **Expert witness services** – reports, analyses, 'forensic engineering' and court appearances
- **Process modelling** – to predict what will happen to the material in your existing or proposed plant or logistics chain, and to select the right solution
- **Pilot plant trials** – test the materials or proposed system off-line to avoid problems on start-up.

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Consultancy services

The Wolfson Centre undertakes consultancy services in industry in the fields of:

- Hoppers and silos
- Pneumatic conveying
- Product feeders
- Product quality (segregation, attrition, caking)
- Environmental and transport effects
- Dosing and dispensing
- Instrumentation and control
- Abrasion and wear
- Overall system design and integration
- Sampling
- Dust prevention and control
- Packaging
- Processing of powders and bulk solids
- Expert witness services.

Hoppers and silos

Hoppers, silos, bins and bunkers are widely used in industry for storing bulk solids materials. Users of such facilities often experience operational difficulties, especially where facilities have been designed without knowledge of the relevant flow characteristics of the material to be stored. This leads to the occurrence of problems, such as erratic flow, flooding, blockages and rat holing, mechanical and cohesive arching, product segregation, product degradation, lack of storage capacity or even structural failure.

By measuring the flow properties of the material to be stored, the Wolfson Centre can determine the hopper angle, outlet size and internal finish needed to ensure the vessels discharge without trouble. Through the use of various characterisation tests, it is possible to design, and re-design, hoppers and silos for constant, reliable flow. Reliable discharge will ensure that process plant can be operated with the minimum of down time caused by materials handling problems.

Structural design is also a challenge for large silos. We have the knowledge and understanding to undertake prediction of loads on silo structures.

Pneumatic conveying

Pneumatic conveying is a commonly used means of transporting bulk solids. Applications range from unloaders for large-scale ship bulk cargo through to small in-plant systems. The centre has wide experience of all of these systems and of solving the problems that can arise as a result of mismatching materials, feeders, pipeline designs or air movers with each other.

Facilities in our laboratories include:

- Pipelines in a range of industrial sizes, with a large number of layouts available for system simulation, with both dense and lean phase flow conditions
- Fully instrumented pipe loops for measuring the performance of conveyed products
- Data gathering and processing systems for analysing the conveying behaviour of products tested and for prediction of performance of proposed systems
- Rotary valves, top and bottom discharge blow tanks, venturi feeders and suction nozzles for feeding negative and positive pressure conveying systems.

Product feeders

Many industrial processes require that a product is discharged from a storage bin or hopper at a controlled rate. Often the flow of material has to be 'throttled' to enable a steady flow rate from the attached feeder. The delivery of material to the feeder from the hopper must also take place in a controlled and steady manner, which in itself is achieved by correct discharge section design. Both of these aspects are interdependent and need to be addressed as a single requirement at the design stage if trouble-free operation is to be achieved.

Feeders should only be selected for a system once the hopper has been properly designed so as to prevent arching and rat holing, and to provide the maximum discharge rate required (see 'Hoppers and silos' on page 2).

Product quality: environmental and transport effects, segregation, degradation and caking

Throughout industry, the maintenance or improvement of product quality is directly linked to both market perception of a brand and, by implication, its profitability. Various factors can be present with a process that can have a direct bearing upon the qualities of a material.

The Wolfson Centre has world-leading expertise in a wide range of issues related to product quality, the most common of which include particle degradation, caking and segregation in handling, transport and storage. This includes test techniques and process models, which are also available for purchase.

Dosing and dispensing

Often in pharmaceutical and food industries, materials have to be dispensed in small, closely controlled quantities, sometimes at high speed. The Wolfson Centre has special expertise in developing and troubleshooting systems for this purpose.

Instrumentation and control

The efficient operation of modern process plants can be highly dependent upon the effective measurement of process parameters and control of process variables. Key to achieving this is the appraisal of installed systems for their appropriate design and operation.

We have much experience of selection and design of the right measuring instruments and techniques for both process variables (weight, level, flow rate, etc.) and material properties (flowability, density, moisture content, etc.) including on-line, by-line and laboratory methods. We also have the facilities to test and verify and, if required, certify the operation of such instrumentation.

Abrasion and wear

Many handling systems suffer from wear, causing expensive component replacement and much more expensive plant downtime. The centre has developed the latest and most cost-effective test machines for evaluating product erosiveness/ abrasiveness and models for predicting plant life, as well as maintaining leading expertise in materials selection for wear protection.

Overall system design and integration

To get a complete processing system to work properly in balance requires that the elements are all interfaced to each other in the proper way, and any unwanted interactions contained, as well as each being capable in their own right. The Wolfson Centre has long experience of troubleshooting system integration problems, and undertaking overall system design projects to ensure smooth start-up of new plants, minimising over-run of cost and time and maximising performance from an early stage.

Dust prevention and control

Ineffective dust and powder control in the workplace can cause problems. Airborne particles are a major cause for concern, particularly since the introduction of increasingly stringent environmental legislation.

Any company that has (or is in the process of gaining) BS 7750, or that regularly undertakes a COSHH assessment, will understand the need to monitor and control airborne particles.

Our consultants are available to advise on a number of topics, including control techniques, on-site dust surveys, product degradation, material characterisation, dust generation, product segregation, explosion protection, design of new systems or modifications to existing systems and cost analysis of options, assessment of vendors' bids, and troubleshooting on site (from one-day visits to larger investigative projects). They are also available to undertake research into new technology and testing of special equipment.

Packaging

Apart from its expertise in controlling the rate and accuracy of filling, the Wolfson Centre also has the expertise to evaluate the relationship between packaging, the environment to which it is exposed and the effects on the material contained. Many bulk particulate materials are processed and loaded into 'packages' of various types. Such packages can range in size from $1m^3$ (a big bag) to 10g medicinal sachets or 10mg doses in inhaled drug dispensers.

Processing of powders and bulk solids

Many processing steps include the movement of particulates and their interaction with each other and the processing conditions.

The expertise at the Wolfson Centre is often brought to bear on analysing, improving or redesigning processes as diverse as:

- Blending
- Drying
- Granulation
- Pressing
- Pyrolysis and gasification
- Separation
- Size reduction.

Expert witness services

For companies involved in litigation, arbitration or adjudication matters, the Wolfson Centre can provide reports, analyses, 'forensic engineering' or court appearances.

Links with industry

The Wolfson Centre has very strong links with industry through its consultancy activities, and this often leads to industry becoming involved in other areas such as research, Knowledge Transfer Partnerships and short courses. In addition, the Wolfson Centre is closely engaged with trade and professional bodies including the Solids Handling and Processing Association, Materials Handling Engineers Association and the Institution of Mechanical Engineers.

Facilities

In addition to the pilot plant (see overleaf) the Wolfson Centre laboratories contain comprehensive facilities for measurement of the behaviour and properties of powders and bulk solids.

Research and knowledge transfer

Industrial collaboration

The Wolfson Centre's research activities are aimed at addressing problems found in industry and increasing the understanding of powder and bulk solids handling operations. Many equipment suppliers and users participate in these activities.

The centre receives grants from various sources to undertake research projects into powder and bulk solids handling. Donors include research councils, such as the Engineering and Physical Sciences Research Council, Powder MatriX, the British Coal Utilisation Research Association, EU Framework 6 (Marie Curie RTN), and government-funded bodies through doctoral training grants, as well as industrial collaborators themselves. All the projects that are undertaken are of direct relevance to the problems that are encountered in industry. The knowledge gained from these projects is disseminated in the form of technical papers and presentations at conferences. The information derived is also applied during consultancy work for industry, and to the centre's short courses.

Much of our research that is directly funded by industrial clients is confidential in nature and restricted in terms of what can be published. Often this covers new manufacturing processes, new materials and improvements to processing techniques.

For further information, see our leaflet *Current Research at the Wolfson Centre for Bulk Solids Handling Technology*.

Some of our current and recent research projects include:

- Development of a powder flowability tester
- Modelling of dosator filling and discharge
- Improving the adhesion of particulate ingredients to food products
- Development of a toolkit to predict the intensity and scale of air-induced segregation in powder handling and flow for compaction processes
- Powder flowability testing
- Improved discharge equipment performance for coals with poor handling characteristics
- Improving instrumentation on pneumatic conveying in order to produce better modelling techniques.

Knowledge Transfer Partnerships (KTP)

The KTP scheme is part-funded by the government (up to 60 per cent) and part-funded by industry. It helps businesses to improve their competitiveness and productivity through the better use of knowledge, technology and skills that reside within the UK knowledge base.

The scheme enables the expertise of the Wolfson Centre to be embedded into the collaborating company, through a programme which includes the training of a new graduate to work on a project that will develop the business. This may include marketing, training, sales and other business functions, as well as technical expertise.

Education at the Wolfson Centre

Short courses

The Wolfson Centre offers a series of short courses that combine technological excellence with personalised teaching. Most courses are held over two days in our specially designed short course centre. The dates for these courses are fixed throughout the year.

These courses can also be delivered at your plant or offices, and the dates and content can be arranged to suit the needs of your business.

Our annual programme of courses run at the university includes:

- Overview of Particulate Handling Technology (the basics of bulk solids handling)
- Pneumatic Conveying of Bulk Solids
- Powder Containment
- Segregation, degradation and caking
- Storage and Discharge of Powders and Bulk Solids.

We also run a variety of intermittent courses such as:

- Biomass Handling, Feeding and Storage
- Electrostatics in Powder Handling and Evaluation
- Guide on how to manage compliance with REACH
- Dust Explosions – how to demonstrate DSEAR/ATEX compliance
- Powder Characterisation.

In addition, we hold optional practical sessions to complement the theory after some courses.

Courses with wider or additional content can also be prepared on request. Details of these courses can be found on our website at **www.gre.ac.uk/wolfson**.

MSc Engineering (by Research)

The Wolfson Centre aims to provide high-quality postgraduate education through excellence in teaching and research.

Students who select this programme can choose to specialise in bulk solids handling. This gives them access to a field of engineering that is of great importance to a wide range of manufacturing industries, but which is only offered through formal education at a very limited number of academic institutions around the world. Our programme is designed to give students the abilities needed to design, manage and undertake research programmes that will meet the real needs of industry. We take a caring interest in all our students and our aim is to assist them to realise their full potential.

Technical papers

The results of the Wolfson Centre's public research activities are presented in various refereed and technical journals. These can be found on our website **www.bulksolids.com**.

To obtain any of these papers, e-mail full postal details and requests to wolfson-enquiries@gre.ac.uk.

Pilot plant testing and new product development

Pilot plant

Using our industrial-scale facility, we can test a processing step, or mock up a whole handling process or logistics chain, at full scale or near full scale. This can be used to find and solve the problems off-line – then, when you transfer the same process or material to your own or your customers' plant, you can be confident it will work.

Our plant extends over 450m^2 and includes:

- Pneumatic conveyors
- Pharmaceutical dosing test rigs
- Belt and mechanical conveyors
- Screening machinery
- Blenders
- Feeders (vibratory, screw, belt and others)
- Presses
- Transport simulators
- Drying test facilities
- Granulation and pelleting facilities
- Size-reduction facilities
- Environmental test facilities
- Control systems rigs.

We also have the flexibility to obtain and install any item of equipment not currently in our plant.

Frequent pilot plant test project objectives include:

- Assessing a new or reformulated material to determine if it will go through the existing systems or if changes are needed to accommodate it
- Setting up a short production run on a proposed new powder-route product to test formulation and manufacturing proposals
- Testing a proposed new handling system or item of equipment.

Equipment development

You may have plans or ideas for a novel or innovative solids processing method or equipment item. We have the facilities and expertise to develop and test it, and bring our expertise into the development to help it come to market quickly. These projects are confidential, the work does not need to be published and we have a sensible approach to intellectual property ownership. We also have lots of contacts with manufacturers and sellers of equipment, which may be useful.

On the other hand, you may simply have a unique solids processing requirement which is not covered by equipment in the market. We have the ability to identify, test and measure critical process parameters and come up with the best solution, whether it be a totally innovative idea or a modification to existing equipment.

Product development

If you are developing a new or modified powder, granule or particulate material, we have the skills and expertise to help you optimise its performance, quality, profitability and customer appeal. Again, such work is completely confidential.

How to find us

Medway Campus

Parking on campus is available to valid permit holders only.

For detailed information on public transport links to the Medway Campus, please log on to **www.gre.ac.uk/travel**

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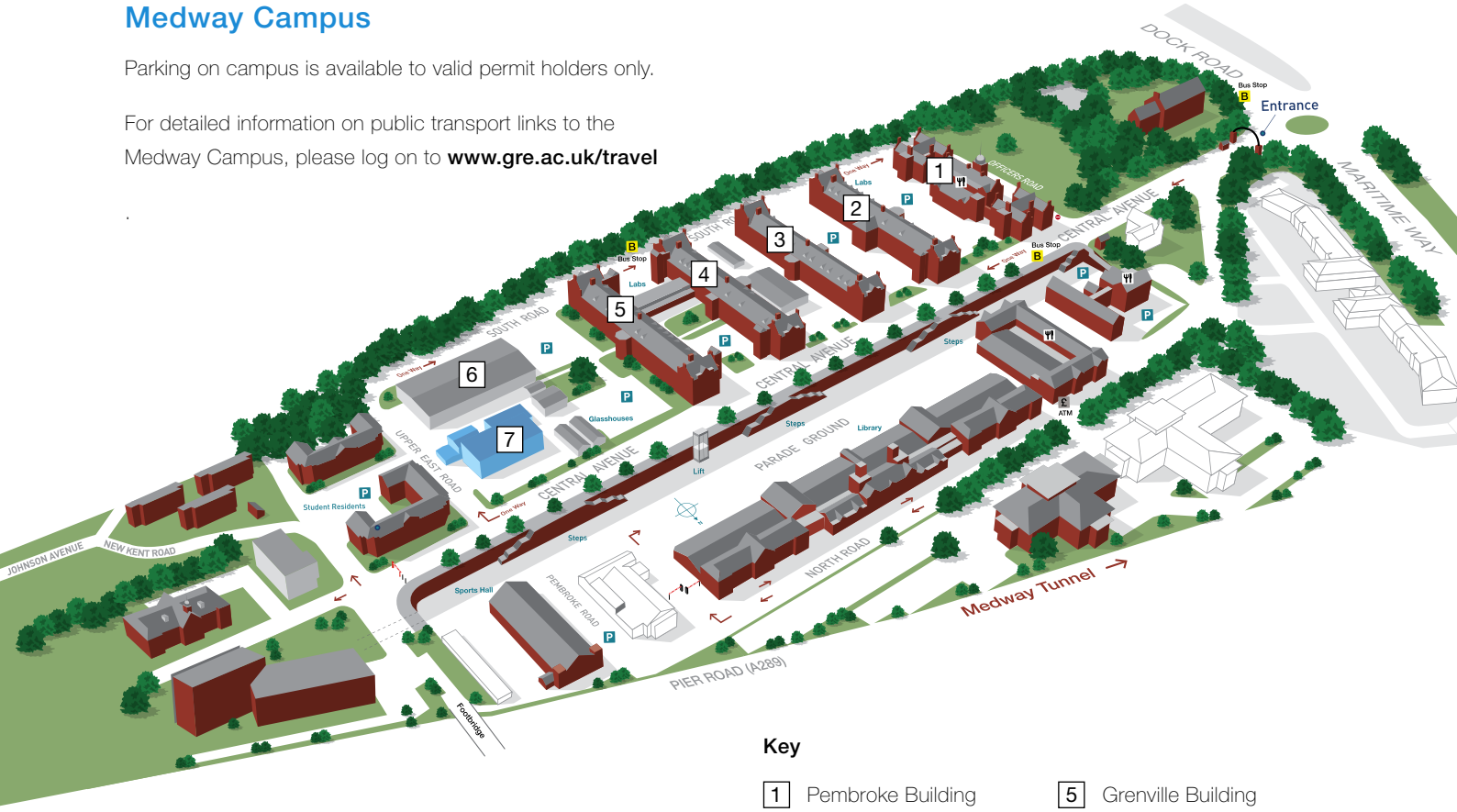

Key

1 Pembroke Building
2 Blake Building
3 Nelson Building
4 Anson Building
5 Grenville Building
6 Hawke Building
7 Wolfson Centre

Please note: while every effort is made to ensure the accuracy of information in this booklet, details of programmes and courses are subject to review and the university reserves the right to make such changes as appropriate.

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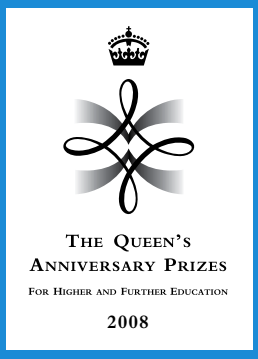

This document is available in other formats on request

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