THE SCIENCE OF SILENCE

Noise control is big business. Industry and Government spend billions of pounds every year attempting to protect workers and communities from the damaging impact of unwelcome sound. From the rumble of road traffic to the banging of industrial machinery, solid barriers are often employed to lessen the noise with varying degrees of success.

But now a new patented technology, developed by a team from the University's Department of Physics, looks set to revolutionise noise control and is already attracting a lot of interest.

When embarking on a joint undergraduate research project for their Physics degree, Drs Daniel Elford and Luke Chalmers had no idea that five years down the line it would see them on the brink of launching a brand new business venture with the University. At just 26 years old the friends seem to be taking it all in their stride.

"We are both really excited about where this is heading," Dr Elford says. "We have had a lot of support from the department and the University's Enterprise Office and have been quite shocked by the positive reaction we have had from industry."

Their undergraduate project focused on a relatively new area of physics called sonic crystals – a periodic array of sound wave scatterers that severely reduce sound in specific frequency ranges. Research in this area was already underway in the department, led by Professor Feo Kusmartsev and Dr Gerry Swallowe.

Following the interesting results of their undergraduate project Professor Kusmartsev and Dr Swallowe invited the duo to continue their research through a PhD.

"The PhD went really well," Dr Elford adds. "And in our final year we started to realise that what we had been working on could have some real commercial use."

Conventional sound barriers are solid structures built around machinery or installed along the sides of road or railway lines. However they are not always effective and can cause problems with ventilation and over-heating when used in an industrial setting.

The sound barriers developed by Drs Elford and Chalmers have built upon the extensive research already carried out by the department. They comprise of a series of cylinders, precisely arranged to absorb the frequency of sound waves in a specific environment. They enable the reduction of unwanted sound, whilst allowing wanted noise such as fire alarms to be heard. The barriers can be constructed from a wide variety of materials and use typically less than half of the matter needed for a solid barrier, making them more cost-effective than current solutions. Their design can also be tailored to cut very specific types of noise.

Dr Chalmers explains: "Basically our design is made from cylinders in a periodic row, similar to a fence but with spaces in between. In spacing the cylinders in a regular pattern you are able to block out a certain frequency of sound. This is achieved by matching the peaks in a sound wave to the spacing between the cylinders – the sound gets cancelled out.

"What makes our technology so unique is the design of the cylinders. A conventional sonic crystal is a solid cylinder and the sound control is only determined by the spacing between each one. To block out the lower frequency noises the spacing increases so your barrier gets bigger, making it unfeasible. The solution we developed involves using hollow cylinders with a slot cut in, which introduces a different mechanism to block out certain frequencies. Using this technique alongside the spacing of the cylinders we are able to block out even more sound frequencies at a useable scale."

To transform their research into a business venture they have secured commercialisation funding from the Engineering and Physical Sciences Research Council, the University's Enterprise Office, the European Regional Development Fund and the Royal Academy of Engineering. This has enabled them to carry out lab tests at the campus and develop prototypes. They are now at the stage where they are testing the technology in actual industry settings.

"We have our sound barriers in operation at two industrial sites," Dr Elford says. "To start the process we go out to visit the clients and perform a noise survey. We take noise measurements and then work out which frequencies we need to target. We then tune the barrier to block out those specific frequencies.

"We offer industry a unique solution to noise control that is cheaper, targeted at specific sounds and allows the free flow of air. The ability to allow air to pass through is particularly important to industry, where solid noise barriers enclosing machinery can lead to over-heating and the need for air conditioning."

The response to the new sound barriers has been incredible, with more that 30 companies spanning the rail and renewable energy sectors interested in the development of the technology and its potential uses.

"They all see the value of the new technology and know that the current options on offer do not work," Dr Chalmers adds. "In fact the interest has been that great that we have had to turn away some companies until we are at a stage to be able to help them."

"We offer industry a unique solution to noise control that is cheaper, targeted at specific sounds and allows the free flow of air."

Drs Elford and Chalmers, alongside Professor Kusmartsev and Dr Swallowe, are now working with the Enterprise Office to establish a University spin-out company. Loughborough is renowned for its successful transfer of academic research into commercial ventures and Drs Elford and Chalmers know they are in the best place possible to develop a business.

"The support we have received from the University has been fantastic," Dr Elford says. "Loughborough's reputation has opened a lot of doors for us in the business community and we want to retain our strong links with the University as things progress. Ideally we would like to base the new company at the campus on the Science and Enterprise Park, it is the perfect environment."