*" ...the purpose of **science** is to **correct rumour, black arts** and **superstition**..."*

The proof of the pudding

Ceramicx Centre for Infrared Innovation

The new Ceramicx Centre for Infrared Innovation, C^2I^2, has enjoyed a breathless start to life over the past three months. Operations Manager Dr Gerard McGranaghan picks out the highlights…

Unsurprisingly enough, our new Herschel instrument has been at the heart of everything at the new Centre since we began. We have been extremely busy since Day One with the bread and butter of the Centre remit; 3D IR heat mapping and testing. The Herschel is a world-first, built in Ireland by Ceramicx and Trinity College Dublin and launched at the K 2013 plastics exhibition in Düsseldorf.

The Herschel 3D IR Mapping Tool

We are all extremely proud of its capabilities. It now gives Ceramicx an exceptional opportunity to lead the industry in the proveable and scientific-based methods for IR heating and IR heat design.

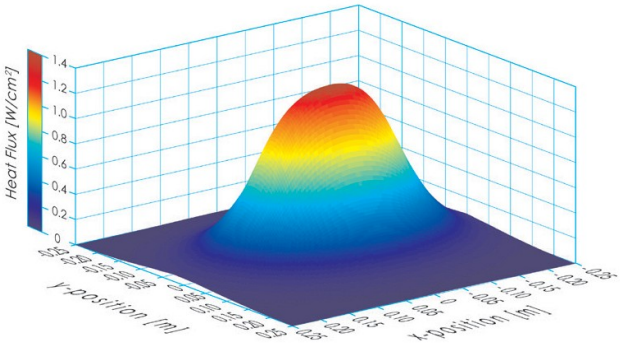
If the purpose of science is to correct rumour, black arts and superstition then the world of infrared heating is an ideal place for the Herschel to start. Guesswork, rule of thumb and 2nd hand know-how have for too long been the yardsticks of this industry. The time is right for change and the Herschel instrument offers a scientific basis for that change.

Product performance testing

Our first task at the new Centre was to measure and to set the facts straight regarding comparative performance of IR heating products. A number of manufacturer products were evaluated and a study programme was designed and selected. A Ceramicx component was compared and tested together with a number of competitor components from Europe and from the USA. The Centre also made use of the valuable research work conducted 2005-2010 by the University of Duisburg-Essen. We were aiming to produce an inclusive and comprehensive study, drawing upon all the known knowns of the industry over the past ten years or so. In a comparison of the warm up times, it was noted that variations in temperature can occur due to the various measurement methodologies used. However, despite these potential variations, the graphs indicate that steady state is achieved around the same time as the leading European competitor elements. Ceramicx warm- up times for elements are as fast if not faster than our competitors

Our programme also involved 3D Heat flux mapping tests. In this automated system an infra-red sensor is robotically guided around a pre-determined coordinate grid system in front of the heater element under test. IR in the band 0.4-10 micrometres is measured. The incident radiant heat flux is saved and then post processed to give

a 3D representation of the infra-red heat flux emission of that heating element. At present the measurement coordinate system is a 500mm cubic grid, however further coordinate systems are in development. This system not only allows visualisation of the complete infrared field, but also provides a mathematical measurement of the energy radiated from the heater surface.



Heat flux map for FQE 1000W (Units W/cm², 10cm from face of heater)

Tests were performed on Ceramicx heating elements with comparisons on competitor's elements. The range of elements tested were Square Flat Element Hollow (SFEH), Full Flat Element Hollow (FFEH), Full Quartz element (FQE) and Full Trough Element (FTE). Differing body material was also compared in the case of the FQE elements, which can be ordered with stainless steel or aluminised steel bodies. In addition, some independent test results performed by Trinity College Dublin are also included.

Our completed study offers what I believe to be a powerful affirmation in these matters; offering hard evidence data to our customers and distributors about the actual performance of Infrared heaters. Ceramicx products outperform some competitors by a consistent strong margin. Ceramicx are firmly in the league of leading producers and Ceramicx is also the only supplier to provide IR heat solutions across the three principal type of IR radiation; short, medium and long. Our company strategy and performance continues to develop along the right trajectory and I am happy to share the results of this work with enquirers on application.

Herschel at K 2013

After only a few weeks of beginning this testing programme at Ceramicx, the Herschel found its way back into its shipping crate en-route for the K-Show in Düsseldorf, Germany, the leading triennial plastics exhibition for the worldwide industry. At the K-show, the machine generated a lot of interest from new and existing customers especially in relation to the high tech nature of the measurements and the technical capability it offers Ceramicx and its customers.

The Herschel was extremely well received at the K show. Enquiries varied from the testing of arrays, continual product development, the heat testing of various polymers and other requests for project work, too many to mention. Three examples come to mind just now:

1. On the thermoforming front - An American thermoforming engineer for example wanted the Herschel, to give an optimal array spacing as against a given electrical wattage.

2. On the materials front - A materials provider was interested in how the Herschel could help them with the testing and thermal evaluation of their new materials.

3. Lastly, in a more unusual application - A designer of infant support systems (incubators) was interested in how the Herschel could assist him in complying with legislation regarding the maximum heat flux that the baby would be exposed to as per EU Safety regulations.

Ceramicx production benefits

A huge advantage for Ceramicx is that the Herschel can now evaluate and compare any proposed product change in relation to its earlier versions (see over the page for a worked example). The Centre has already tested ceramic elements in relation to precise positioning of the heater coil and also with regard to different surface finishes and treatments. These prototypes can now be swiftly evaluated for emitter performance issues before committing to production.

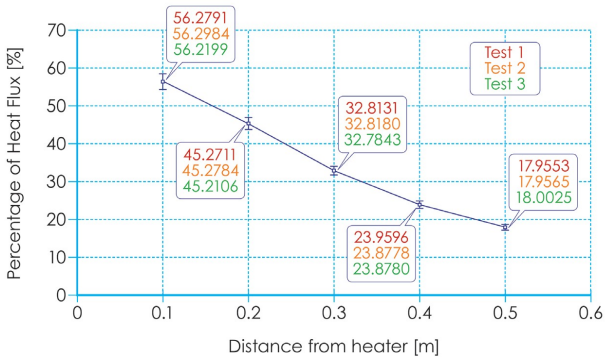
The Centre is helping Ceramicx with a testing programme that includes:

1. Test the most representative sample of Ceramicx product line
2. Test arrays to determine optimum spacing
3. Materials development
4. Repeatability of 3D Test Machine

Repeatability of the Herschel

A consideration arising from the recent testing of several elements was to verify the repeatability of the 3D mapping machine. This was ascertained by three repeated tests on a single element. The results are plotted in Figure 1. This figure shows that for the same test repeated three times on an 800W element, all three plots are virtually concurrent.

Figure 1: shows the percentage difference between each result, and it can be seen the maximum variation between results is 0.34% which is sufficiently small as to give a very high level of confidence in the repeatability of the 3D IR Mapping machine.

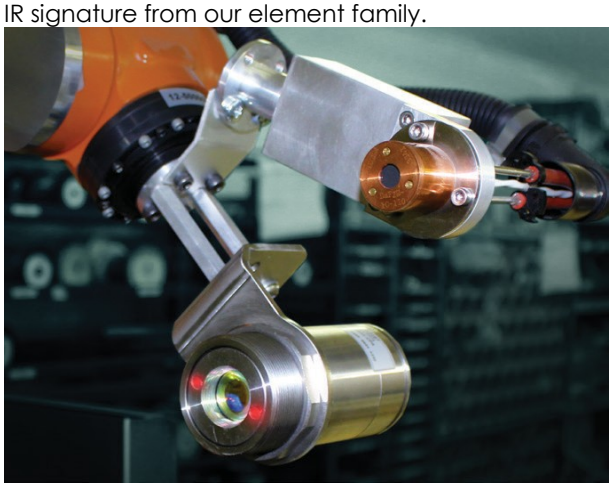


1: Repeatability of the Herschel testing machine

Integration of a new sensor into the Herschel robot arm.

A new sensor was also purchased to complement the abilities of the Herschel. This is a non-contact IR thermocouple with a spot size of 1.5mm diameter. This small spot size enables us to carry out a robotised scan of the ceramic element surface allowing determination of rib and trough temperatures.

Correlation of the temperature profile of the emitter face along with the heat flux from each emitter will provide another step in completing the IR signature from our element family.



New dual head since the K Show, heat flux and non-contact IR thermocouple.

Additionally, a high end thermoforming company has contacted us seeking to gain a more precise picture of the temperature field across small heater elements when used in arrays. We are currently carrying out these tests utilising the new non-contact thermocouple.

IR Training

Last but not least the Centre has been involved in devising a complete IR training syllabus; for distributors; suppliers, customers, associates and the world at large. This will become a major part of the online training programme launched with our partners in comfort heating "Green Energy" (featured elsewhere in this magazine). The online syllabus will be available by the end of February and will be hosted on our webserver from February. The classroom training can be performed here at Ceramicx or at the customer's location. It be divided into comfort and industrial heating and will feature:

- Fundamentals of infrared,
- Types of emitter, materials, and infrared emitter selection
- Industrial processes using infrared
- Using infrared for comfort heating
- Sample calculations
- Control of infrared
- How the Herschel can help solve clients problems with unique solutions

In short, the Centre has enjoyed a very active first quarter. We look forward to bringing you a raft of new developments in HeatWorks Spring 2014 – and please do not hesitate to get in touch with Ceramicx in order to discuss any matter of your IR heat work needs. Nothing breeds success like success. And having the new Ceramicx Centre for Infrared Innovation (C2I2) right beside the Ceramicx production doorstep has opened several new doors. The result is an influx of ideas from the Ceramicx production team, many of which will develop into new componentry and new products.

'The beauty of our new Herschel test instrument,' says Dr Gerard McGranaghan, C2I2 Operations Manager 'is that it gives us the instant ability to verify and back our hunches.

If, for example, we have a theory as to how Infrared energy might behave – in new product design; reflection or absorption – we can immediately test that theory with empirical testing on the Herschel machine. The Herschel's all seeing Infrared 'eye' tells us how the new idea or component will actually work in service. It's actually an indispensable aid for product innovation.'