



CALGAVIN

Driving Practical Energy Innovation

Lessons from Research, Engineering and Plant Adaptation

Martin Gough, Managing Director



CENTRE FOR
FLOW PROCESSING

Global Consulting Engineers for Heat Transfer Solutions

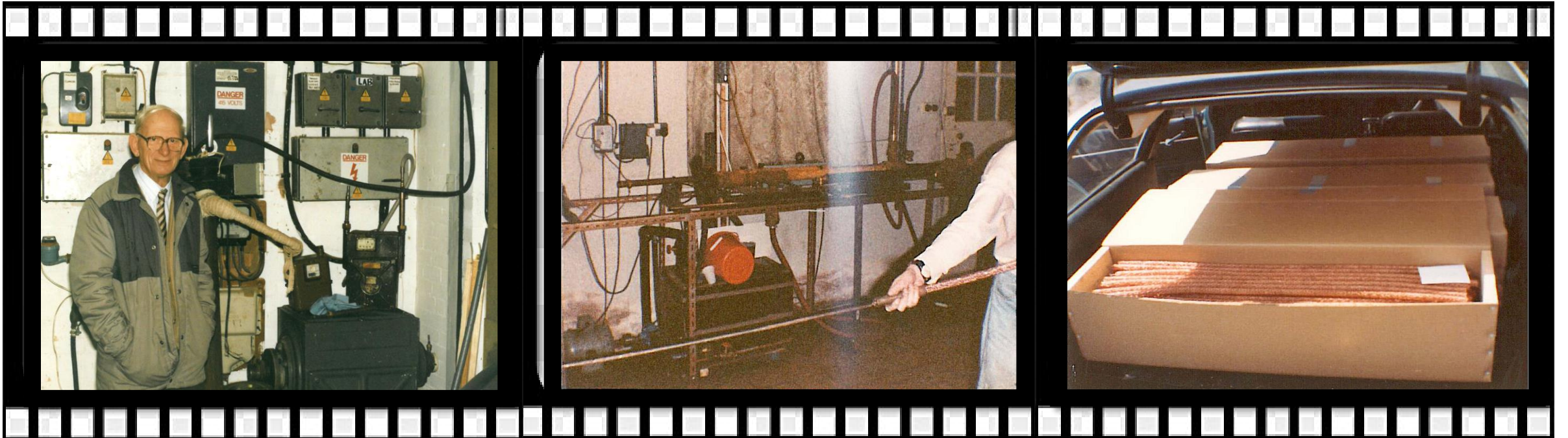
- CALGAVIN established 1980
- Head Office: Alcester, Birmingham, UK
- Manufacturing of technology carried out in UK

Extensive Research and Development in Hardware & Software

Work carried out at In-house Test Laboratory collaborating with 10+ Universities across Europe.



In The Beginning



Global Consulting Engineers for Heat Transfer Solutions

Completed Orders
20,000+

Successful Retrofits
5,800+

Countries Supplied
50+

Number of Industries
15+



DOOSAN

Engineering Services Provided

- **Analytical engineering**

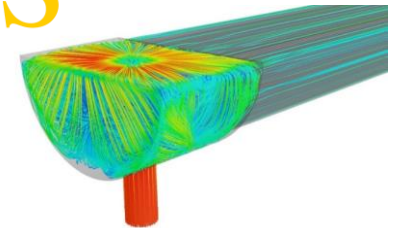
- Advise on design and performance improvement of new and existing heat exchangers

- **Design services**

- Evaluating specifications and modelling thermal & hydraulic ratings (HTRI®, AspenTech® EDR & CALGAVIN®.SP)

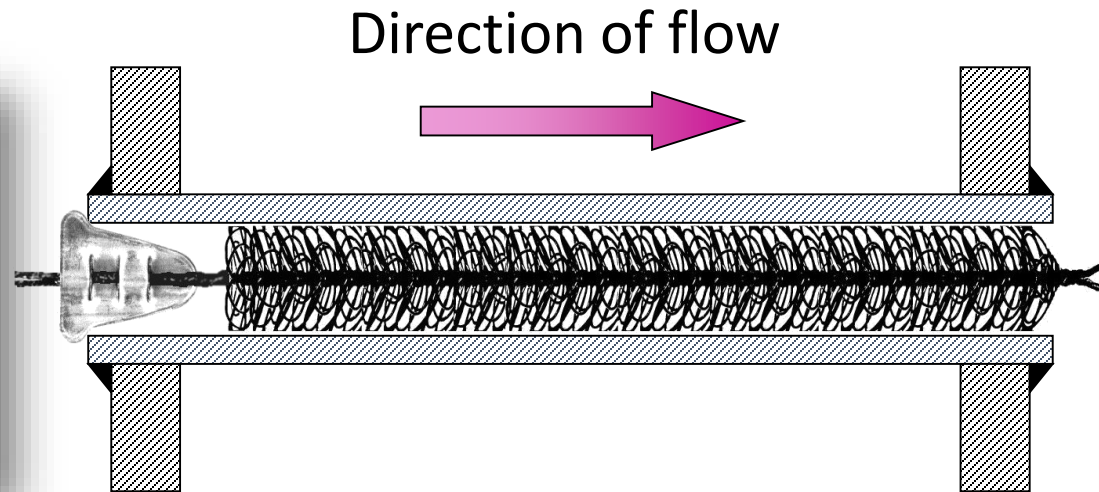
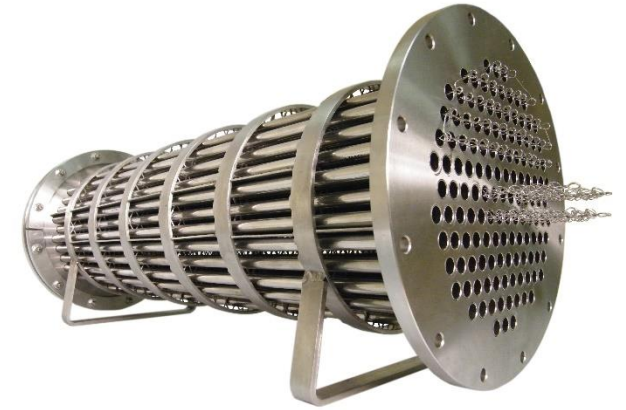
- **CFD analysis**

- Identify heat exchanger poor performance root caused by maldistribution, stratification or other causes via CFD

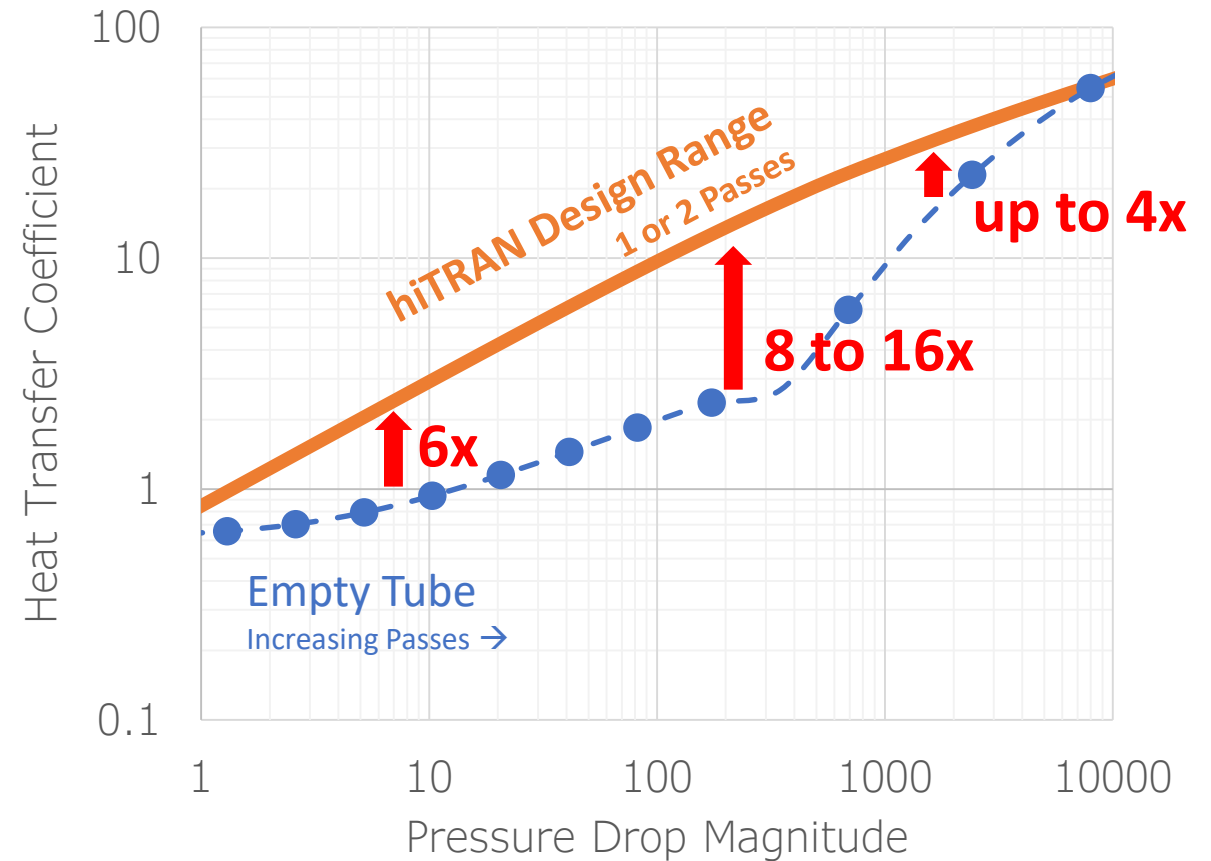
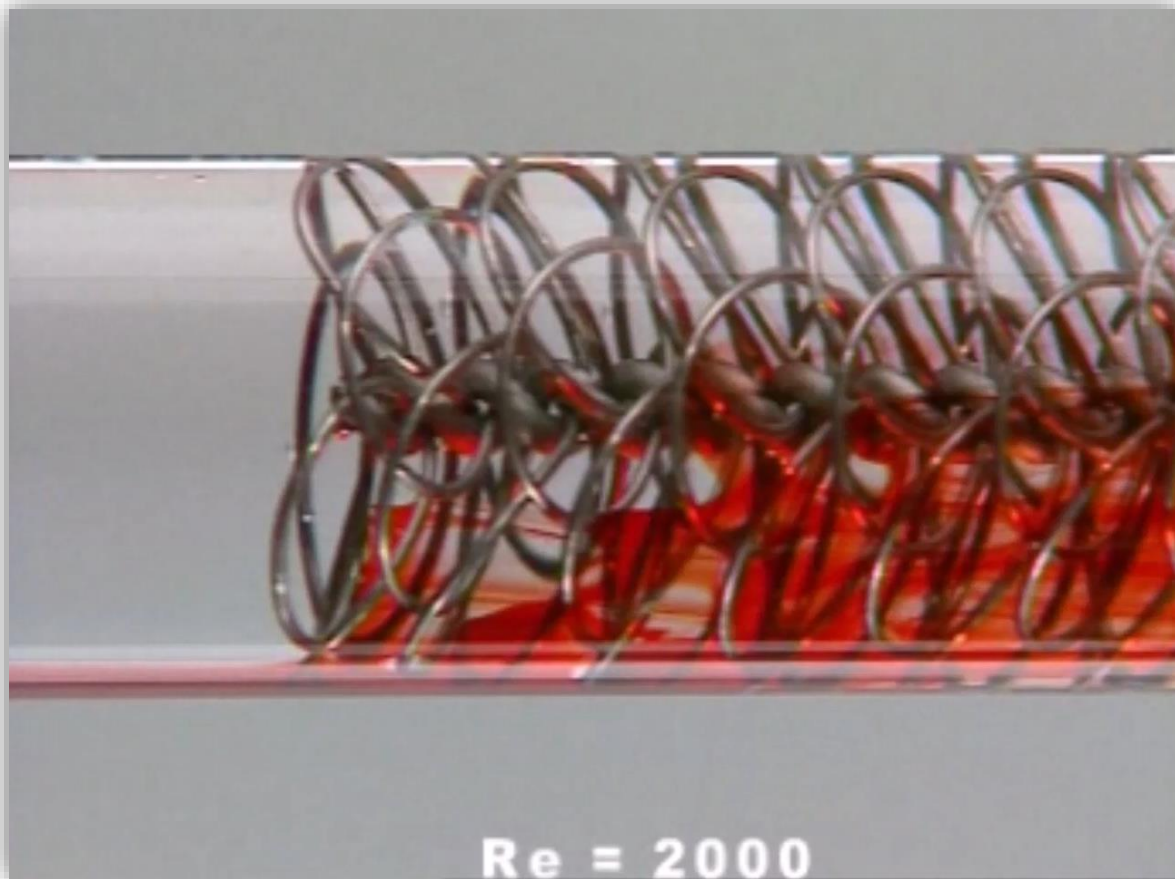


hiTRAN[®] Thermal Systems

The Science...



Flow Visualisation

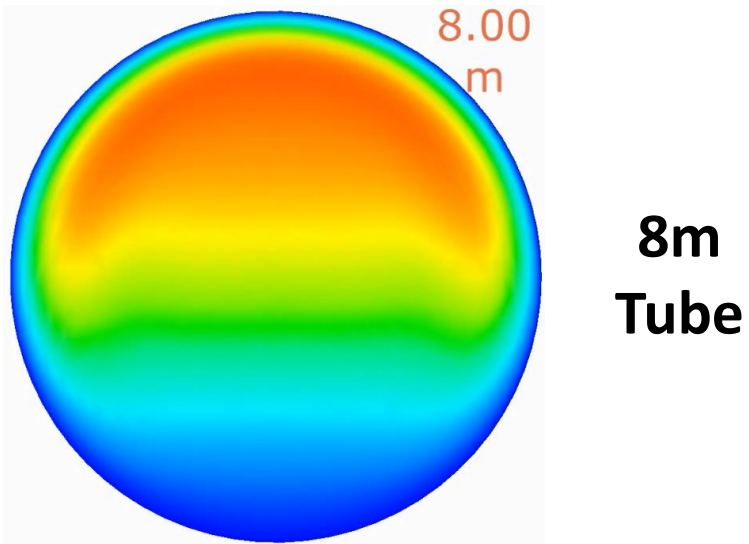


CFD Simulation of Plain Flow vs hiTRAN-Enhanced

Plain Empty Tube

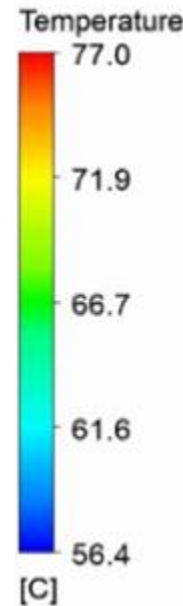
Stratified flow

Lower half of tube **not effective**



Natural convection:

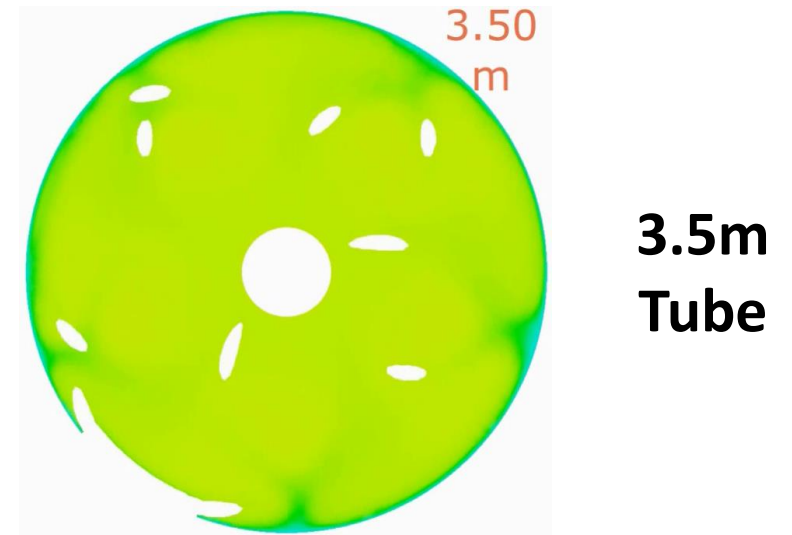
- Cold, heavy fluid sinks to the bottom of the tube



Enhancement with hiTRAN Tube

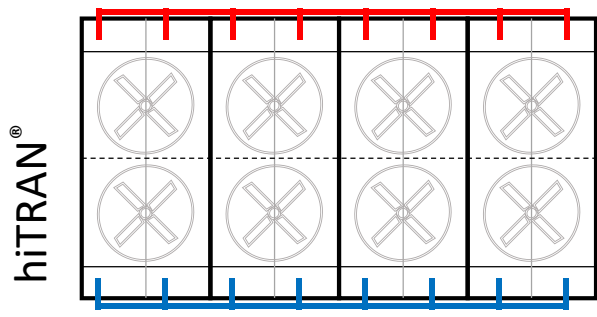
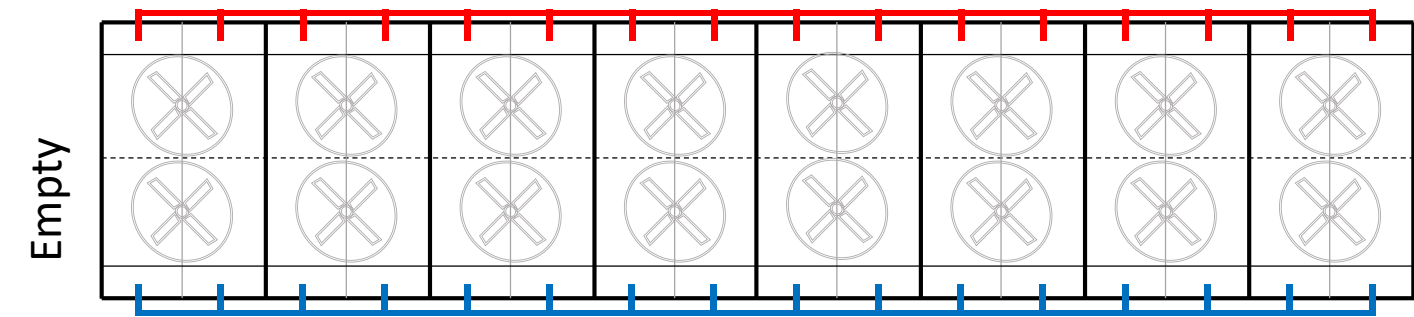
Fully mixed flow

Common temperature across tube



- hiTRAN enhanced flow delivers a **reduced flow length** by 56%

hiTRAN: Export Oil Trim Cooler



	Empty Tube Design	hiTRAN® Design
Heat Transfer Coefficient (W/m²K)	50	252
Bays in parallel	8	4
No of rows / passes	12 / 8	11 / 2
Tube per bundle / Total	600 / 9600	473 / 3784
Plot area (m²)	712.3	309.7
Fan Power (kW)	271	107
Predicted cost after 10 years	\$3,100,000	\$1,200,000 (incl. hiTRAN®)

hiTRAN ready to go...



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**CENTRE FOR
FLOW PROCESSING**



CENTRE FOR FLOW PROCESSING

- State-of-the-art flow and heat transfer laboratory
- Prototype development facilities
- Manufacturing for existing and new products

The new Centre for Flow Processing is the focal point for integration of commercial, research, and university educational activities to position the UK at the forefront of this science led technology for future generations.



H A R N E S S I N G
T H E S C I E N C E O F
F L U I D D Y N A M I C S



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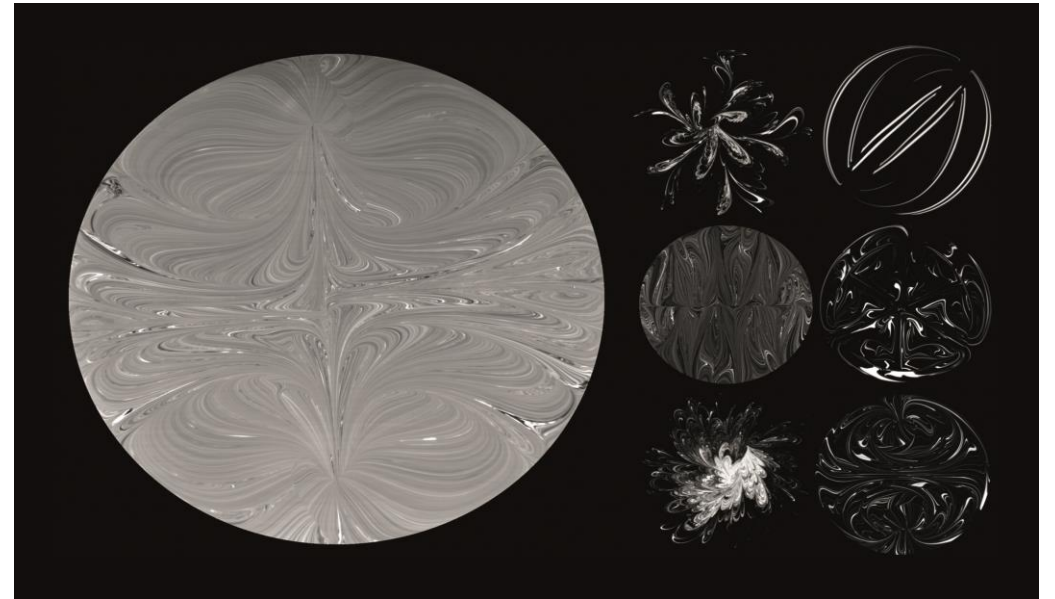


CENTRE FOR
FLOW PROCESSING

The Future for our Research

Cutting Edge Research & Development in:

- > Exchanger problem solving
 - > High Viscous single-phase flow
 - > Two-phase flow
 - > Bubble flow break-up
 - > Droplet de-entrainment
 - > Fouling reduction
 - > Film boiling and mist flow suppression
 - > Film flow behaviour with film removal and drainage
- > Fluid dispersion
 - > Combining and separating flows
 - > Mass transfer and mixing



In-House Thermal Testing Facilities

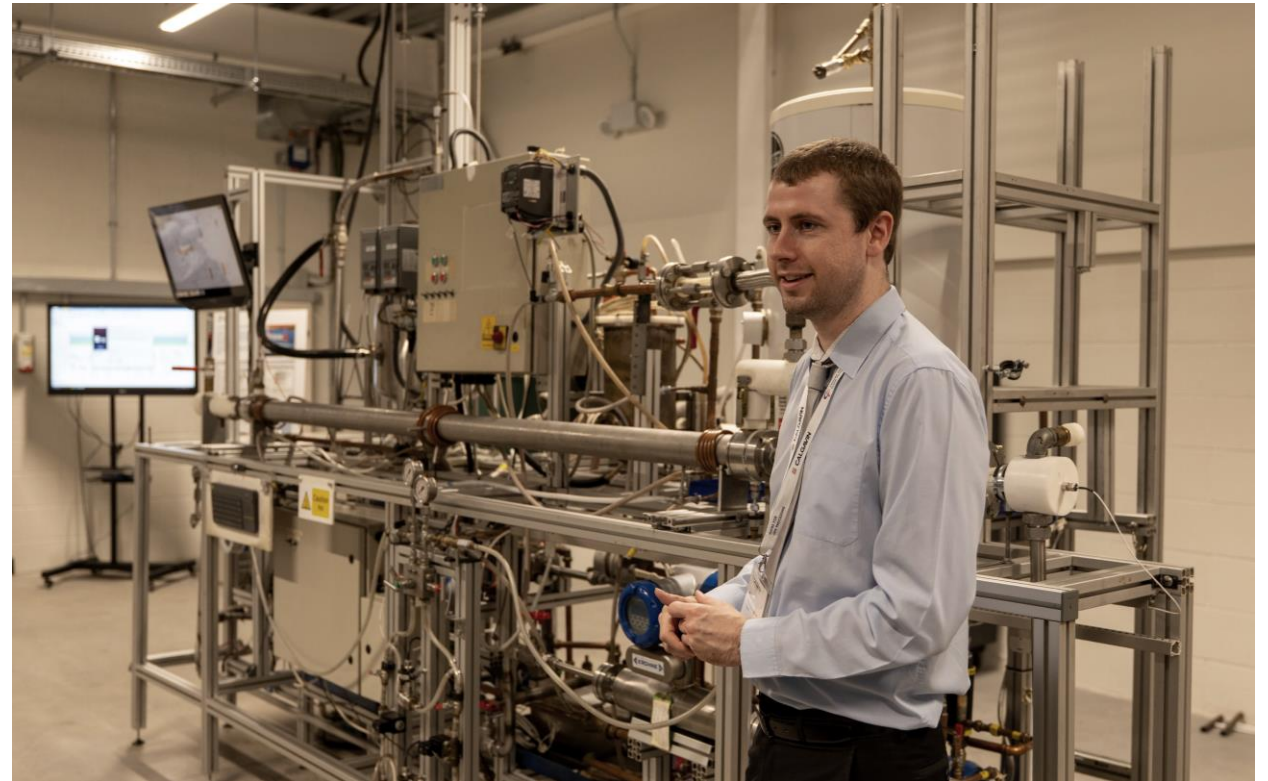
- 4 double pipe heat exchangers
- Tube diameters from 10mm to 32mm ID
- Heating & Cooling duty
- Laminar & turbulent flow
- 2-phase flow visualisation
- NEW: Critical Heat Flux



In-House Thermal Testing Facilities



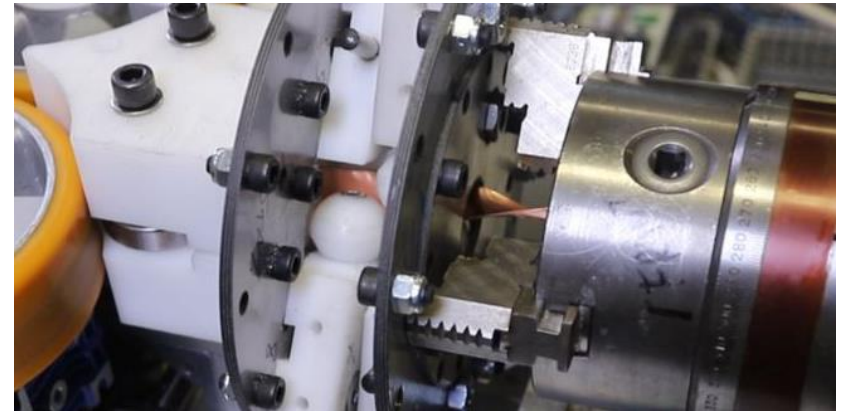
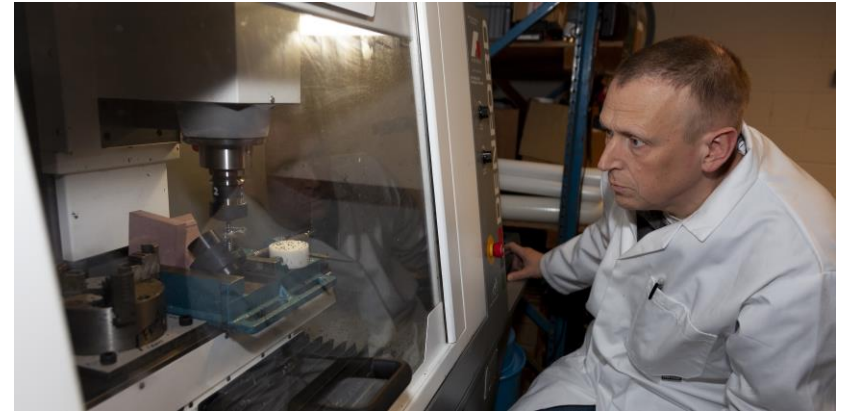
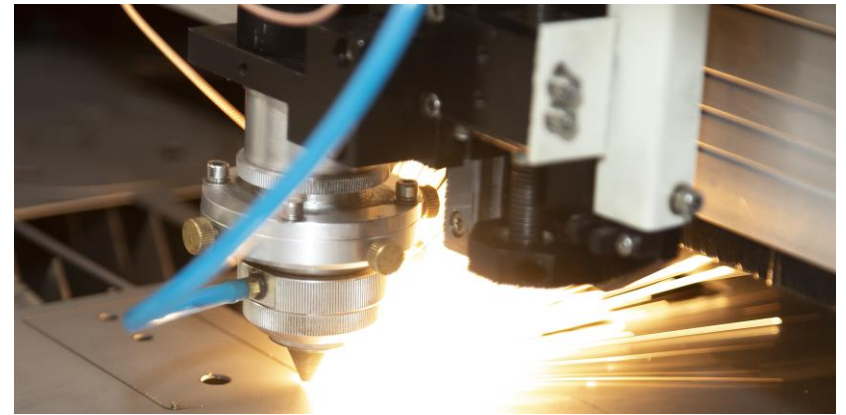
- **Test fluids**
 - Heat Transfer and Lube Oils
 - Glycerol
 - Water
 - Compressed air
 - Refrigerant
- **Viscosity range**
 - 0.3cP to 4000cP
- **Dimensionless numbers**
 - Reynolds range
 - $0.1 < Re < 200000$
 - Prandtl range
 - $0.5 < Pr < 12000$
- **Error in heat balance**
 - $< \pm 5\%$



Product Development

- Solution based bespoke technologies
- Ideation, design to creation concept
- Prototype manufacturing

Unique product development to meet specific process needs.



Companies & Institutions



Engineering and
Physical Sciences
Research Council



Innovate
UK



National Engineering
Laboratory



UK Atomic
Energy
Authority

Universities



Surprise Opportunity – Fusion Industry Challenge

- Application process
- Phase 1 – proof of concept / **6 months**
- Application for next phase
- Phase 2 – Design, assembly & testing of a new rig / **18 months**
- Funding received for contract research
- Initial Data presented to meet the deadline

Results for Fusion:

Critical heat flux; Film boiling & Mist flow conditions; Supercritical heat transfer

Future:

Research will benefit LNG Vaporisation
Concentrated Solar Power
Two-phase data for CALGAVIN.SP



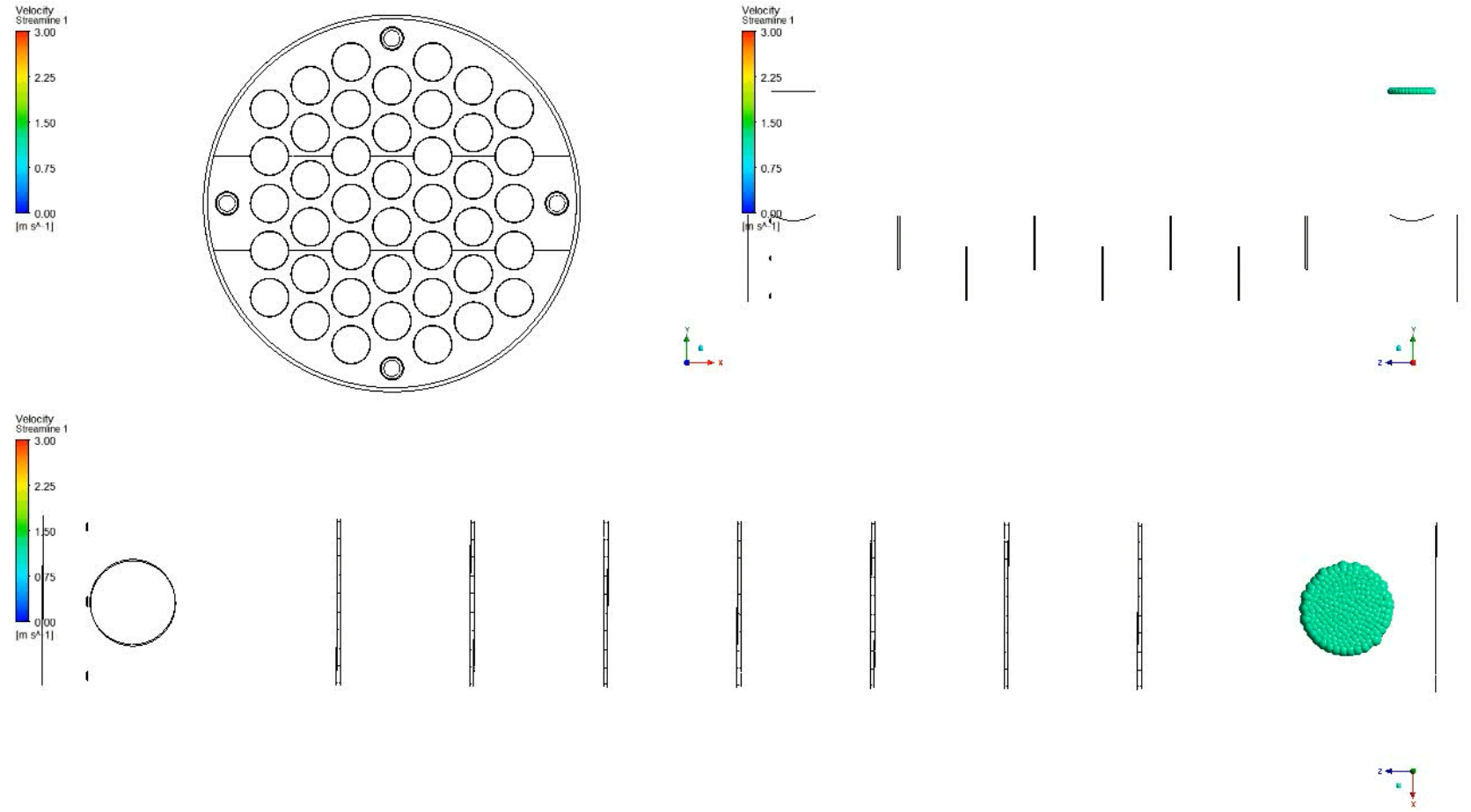
UK Atomic
Energy
Authority



Computational Fluid Dynamics (CFD)

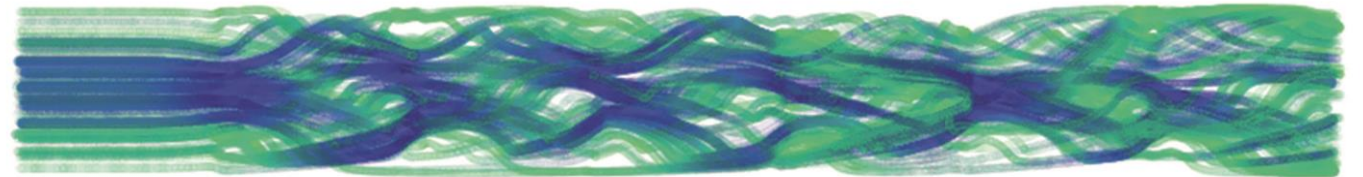
CFD is used to gain a comprehensive understanding of fluid behaviour in the Heat Exchanger, allowing us to identify problem areas in relation to heat transfer and fluid flow.

Dynamic simulation of flow through the shell side showing how losses are generated through maldistribution. Better geometries needed.



Investigating Viscous Flow with Positron Emission Particle Tracking (PEPT) – Gamma Ray

- Project with the University of Birmingham
- Used a special PEPT technique to see how shapes affect fluid flow
- Provided clear 3D images without disturbing the flow
- Created new ways to measure mixing and movement
- Used computer simulations to check results and test new designs



CALGAVINS Contribution to Carbon Emissions V's...



Martins travel to teach the world about how to increase heat exchanger efficiency:

Assuming: 3 long haul trips per year

Flight distance over 45 year

Carbon footprint:

total 50000km

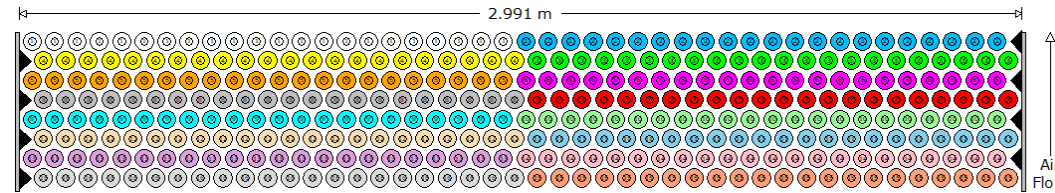
2.25Mil km

560 tonnes CO₂eq

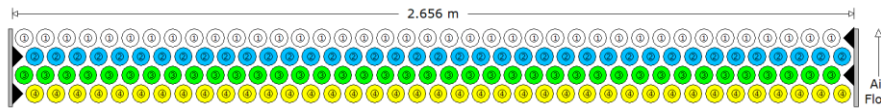
Savings In Carbon Emissions



Over last 4 decades CALGAVIN equipped around **5000** Lube Oil aircoolers with hiTRAN technology



Without
hiTRAN insert



With hiTRAN insert;
typically on 1/4 of size

CO2 savings

- Reduced fabrication consumption
- Much reduced fan power consumption

Including implementation in heat recovery services, shell & tube size reduction, other air coolers

Any Guess ??

~ 5 M tonnes CO₂eq

Estimation

~ 8M tonnes CO₂eq

Carbon credits, assumed £30, leads to £240M cooperate savings for Industry

Any questions?



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