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Collaborations with Universities: a win-win for SMEs

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1. ABSTRACT

Scientific collaboration between Universities and SMEs can lead to considerable acceleration in knowledge transfer from proof of concept to industrial product. Often Universities have access to novel highly accurate test equipment in the field of their main research activities. This is coupled with expert knowledge in using those technologies for experimenting, data evaluation and consequent modelling.

We show how CALGAVIN Ltd, a SME providing heat transfer solutions for different industry sectors, used the collaboration with various universities to change the perceived understanding of tube side heat transfer enhancement technology and the way it is used in industry.

2. Universities as pool for expert knowledge

Flow conditions are key for the understanding of heat transfer mechanisms in heat exchangers; this is true for simple geometries such as round tubes, but even more important when investigating the impact of tube side heat transfer enhancement technologies.

Taking the evolution of hiTRAN Thermal Systems from a brainstorm idea 40 years ago, to an industry accepted energy efficiency tool, we show how the cooperation with different universities proved crucial for industry acceptance. Flow visualisation experiments conducted at the University of Birmingham (UoB) were initially valuable in understanding the impact of insert geometry changes on near wall velocity profiles. The first screening experiments were dye stream Betamax videos, followed on by much more sophisticated Laser Doppler Velocimetry (LDV) and Particle Imaging Velocimetry (PIV) experiments; those experiments were conducted by a research student embedded in the company under the EPSRC Engineering Doctorate (EngD) scheme. The results indicated much higher near wall velocity gradients compared to an empty tube. This has considerable implications on heat transfer and fouling behaviour.

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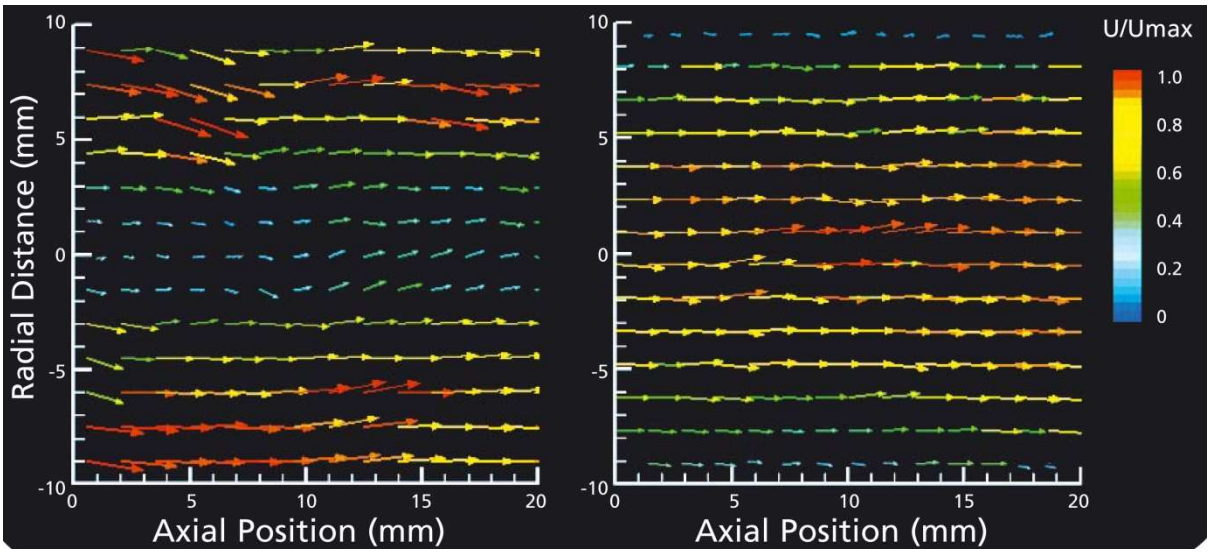

Figure 1: Typical PIV measurement in laminar flow, left hiTRAN® velocity vector field, right empty tube velocity field [1].

Subsequently and again as part of Birmingham's EngD scheme a cutting-edge heat transfer test facility was built at CALGAVIN premises. Using this facility heat transfer and pressure drop correlations were derived which are now used by more than 600 companies worldwide to design hiTRAN enhanced tubular heat exchangers. The sophisticated LDV results were also used to confirm measurements that had been made at the University of Bath, where hiTRAN was successfully used to supress crude oil fouling. Again, a University cooperation proved to be essential to deliver results accepted by Industry. In terms of modelling of the observed flow behaviour, Computational Fluid Dynamics (CFD) was essential, and here too the involvement of universities was crucial for CALGAVIN. A Masters project at the UoB was set up to investigate whether CFD could reliable model (predict) empty tube laminar flow behaviour and consequently also hiTRAN enhanced flow behaviour. The resulting detailed flow simulations were crucial to improve the insert geometry in terms of pressure drop penalty to heat transfer gain. CFD gave also useful insight into empty tube mixed convection laminar flow behaviour, resulting in explanations for the underperformance of industrial heat exchangers under certain process conditions.

At the same time research cooperations with universities in Germany provided detailed understanding of how hiTRAN inserts technology can significantly improve heat transfer conditions in multicomponent condensing and also falling film evaporators. The underpinning research was carried out in purpose-built 2-phase test facilities with highly accurate novel measuring techniques. The results aided enhanced 2-phase heat transfer and pressure drop modelling which has subsequently been applied in hundreds of industrial cases to improve the efficiency of 2-phase exchangers.

Moving on from here, the collaboration with the UoB was crucial to winning funding from Innovate UK to develop a new class of tube side heat transfer enhancement devices aimed at highly viscous fluids. This work is summarised in another paper at this conference [2] and resulted in a new product which is now ready to be employed in industry.

Over the last two decades, CALGAVIN employed 12 undergraduate industrial placement year students which contributed considerably to inhouse research activities. The benefits were mutual: CALGAVIN

benefitted from their enthusiasm and their recently acquired academic knowledge, while the students gained practical experience in designing, setting up and operating test facilities, together with valuable team-working skills.

3. Conclusion

Universities can play a pivotal role in supporting SMEs to bring new products to market. Their expert knowledge combined with cutting edge testing hardware can be harnessed to improve existing products but also for new product development.

REFERENCES

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