Howden/Royal Academy of Engineering sponsored project:

**PhD1:**

**Numerical study of conjugate heat transfer in leakage flows of rotating machinery**

Supervisors: Prof Ahmed Kovacevic, Dr Sham Rane

Leakage flows play critical role on the performance and reliability of rotary positive displacement machines. Such machines are used in refrigeration, air-conditioning, oil and gas, process industries, air compression, low grade heat recovery systems and many others. It is believed that more than 20% of electrical energy generated in industrialised countries is used for compression. Even small reduction in leakage flows will make significant savings and reduction in carbon footprint of these machines. Majority of such machines operate with fluid injection in the gas to be compressed in order to reduce risks of contact of rotating elements due to thermal growth and reduce leakage of gas due to pressure increase. However, this brings further impact on environment and causes many processes to be of lower efficiency and higher cost than these should be. The way forward to address reliability and efficiency issues of rotating positive displacement machines is to enable safe and efficient operation of oil-free machines which has not significantly developed since the very beginnings due to the lack of understanding of conjugate heat transfer in the clearance gaps of such machines.

In order to address this significant issue a major project has been started by the Centre for Compressors Technology at City, University of London, Royal Academy of Engineering and Howden. The project “Smart Efficient Compression: Reliability and Energy targets (SECRET)” aims to revolutionise the field of oil free rotating positive displacement machines by fully understanding principles of conjugate heat transfer in the clearances of these machines and developing technologies to enable reliable and efficient operation. It is expected that at the end of this project, leakage losses in such machines would be reduced by 20% and oil free machines will gain the share in the market from currently 13% to significant 30-40%. That will enable significant energy savings and significantly contribute to achieving challenging energy and carbon footprint targets.

This PhD study will investigate and develop high fidelity numerical methodology to enable understanding of conjugate heat transfer in clearance gaps of rotating machinery and enable full understanding of the complex physics of these leakage flows. It may include AI and ML tools. The validation of the methodology developed in this project will be performed on the basis of experimental results obtained by the state-of-the-art methods such as PLIF, PIV and Infrared thermography which are currently being conducted as a part of the project SECRET. The newly proposed methodology will be based on the principles previously developed at City for grid generation and CFD/CCM (Computational Fluid Mechanics / Computational Continuum Mechanics) modelling of screw machines. This methodology will be utilised to conceptualise clearance monitoring and leakage flow control by including surface features, secondary flows and smart coatings. Correlations/empirical relations obtained from CFD – Experimental validations on Roots blower machine will be hypothesised and extrapolated for Twin Screw Machines design tools such as SCORG.

The use of Artificial Intelligence and Machine Learning will also be explored during the project.

The project will fully fund 3 years of a PhD student including scholarship for international student in the amount of £18,000 p.a. and bursary in the amount of £ 17,208 p.a.

It is expected that the candidate has a good mathematical background, excellent knowledge of thermodynamics and fluid mechanics, has good skills in using programming languages like C#, Fortran or Python, C++ and has previous knowledge and experience in CFD. Experience with using OpenFOAM for CFD and other numerical analysis tools for thermal deformation calculations will be desirable. The candidate will be working closely with other participants in the project from City and Howden and is expected to have a positive attitude to team work, ability to work proactively and independently and has motivation to learn and contribute to this project.

**Guidelines how to apply:**

If you wish to apply for this prestigious position, please send the following documents to ivona.ivkovic-kihic@city.ac.uk:

1. Up to date CV
2. Personal statement of why do you think you are suitable candidate for this post
3. PhD project proposal to include: background, basic literature review and methodology

The deadline for receiving your application is 10th July 2022 at 17,00 GMT.

Please NOTE: Applications which do not contain all the documents or are received after the deadline will not be considered.