



HPC acceleration of valve design for hydrogen and carbon capture

STFC Hartree[®] Centre worked with Oliver Hydcovalves as a part of the EDRF-funded CW4.0 programme to develop a tool capable of calculating stresses within valves for carbon capture.

Challenge

As we look to the future of climate change, moving towards carbon-neutral goals is becoming an essential part of the discussion. Building on 40 years of technical experience, Oliver Hydcovalves is now turning its expertise to hydrogen and carbon capture challenges. The company manufacture and supply high-performance pipeline ball valves for hydrogen transport. This is performed at high pressures so the strength of the ball that controls flow inside valves needs to resist flexing while ensuring a metal-to-metal seal is maintained. Due to the properties of hydrogen at high pressure valve materials need to be resistant to hydrogen embrittlement to ensure a lossless environment and long-lasting operation to prevent hydrogen escaping. Designing and testing materials and geometry needed for a leak-free valve is a time-consuming and costly process.

Approach

Software Engineers at the Hartree Centre worked with Oliver Hydcovalves to develop a Finite Element Analysis (FEA) solver to calculate the displacements and stresses within the valve. Existing computer-aided design (CAD) geometry was taken directly from the company's engineering teams and used to generate accurate computer simulation meshes of the valves. These simulations were run on the Hartree Centre's supercomputer, Scafell Pike, enabling fast solve times and detailed visual models of stress and displacement in the valve assembly. This visualisation generated, likely points of failure for potential valve designs providing valuable insight into the state of valves under pressure.

Benefits

The power of fast, high-quality simulations coupled with the FEA solver helped Oliver Hydcovalves test a variety of highly detailed operating parameters, generating a much wider set of results than would be feasible to do with solely physical testing. This work will reduce the amount of prototyping and testing that will need to be performed, reducing costs and optimising the process to help the company reach Net Zero targets. The validation of these results gave Oliver Hydcovalves confidence in the digital-first approach, allowing them to adopt simulation and modelling more widely in their valve design processes.

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Product design and value engineering have taken a massive leap forwards as a result of the partnership developed between Oliver Hydcovalves and the Hartree Centre

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Nick Howard
Oliver Hydcovalves





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The Hartree Centre has allowed us to use specialist techniques to refine our designs to a level that otherwise would have been beyond our reach.

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Nick Howard
Oliver Hydcovalves

At a glance

- Created software to analyse stress and displacement in valves.
- Optimising design to reduce hydrogen embrittlement and maintain high-performance levels.
- Increasing the valve's efficiency and potential usage through improved design.
- Digital first modeling working towards reducing research and development timelines and costs.
- Helping reach net zero goals in the hydrogen and carbon capture market.
- Using HPC to create specialised solutions.

Who we are

- 70+ computational scientists and technologists
- World-leading supercomputing and AI infrastructure
- Bespoke small teams built around your project
- Tailored business development support
- Access to our network of industry, academic and technology partners

What we do

- Boost productivity and enhance innovation for industry
- Big data analytics and artificial intelligence (AI)
- High performance computing and quantum simulation
- Training and skills development
- Insights into future technologies



Credit: STFC Hartree Centre

Our impact on UK industry and society

The Hartree Centre was created by UK Government to help businesses and public sector organisations accelerate the adoption of high performance computing (HPC), big data analytics and artificial intelligence (AI) technologies. We play a key role in realising UK Government's Industrial Strategy by stimulating applied digital research and innovation, creating value for the organisations we work with and generating economic and societal impact for the UK.

The Science and Technology Facilities Council (STFC) Hartree Centre is part of UK Research and Innovation.