ADVANCES IN CFD SIMULATION OF POSITIVE DISPLACEMENT MACHINERY

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SUMMARY

The CFD simulation of Positive Displacement Machinery has traditionally been very difficult and in most cases too time consuming to be an effective tool for the product development process.

This presentation will show the recent advances in CFD technology that are contributing to why some companies are now seeing success when simulating the performance of positive displacement machines.

Centrally featured will be the development of a Bosch Rexroth MCR Radial Piston Motor. This work began within Leicester University's Department of Mechanical Engineering as a final year thesis validating the use of CFD against a range of known experimental data.

Bosch Rexroth's MCR Radial Piston Motor is a hydraulically driven device whose principle purpose is to deliver a controlled torque output as part of their hydraulic mobile drive and control range. The motor consist of 8 pistons being driven by a rotating CAM under an applied inlet pressure. During every piston compression the hydraulic oil is forced through narrow gaps and passages which present a real challenge for any CFD software attempting to model the full 3D system motion.

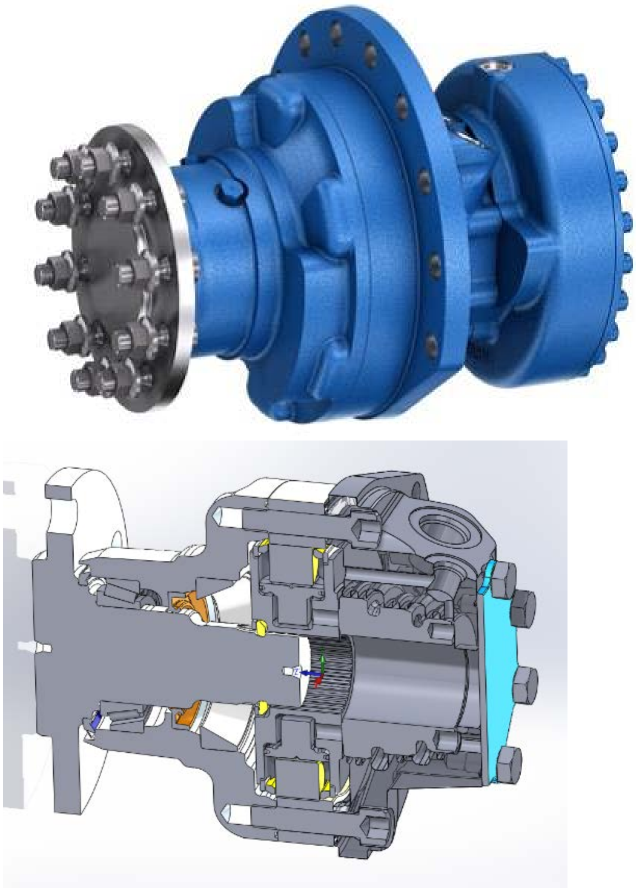

Figure 1 – MCR Radial Piston Motor

However, a major part of Bosch Rexroth's Engineering Development Strategy in Scotland, is to increase the understanding of the MCR radial-piston motor's function and operation through accurate modelling and simulation. Various computational fluid dynamics (CFD) software had been demonstrated to the company in recent years and one software package in particular; PumpLinx provided in the UK by 80/20 Engineering, appeared to offer significant advances in the field of CFD simulation of positive displacement machinery. This is principally due to specific meshing template functionality so that the complex dynamics of the fluid-power components can be modelling relatively easily as well as advances in the numerical solver robustness and speed of computation of this type.

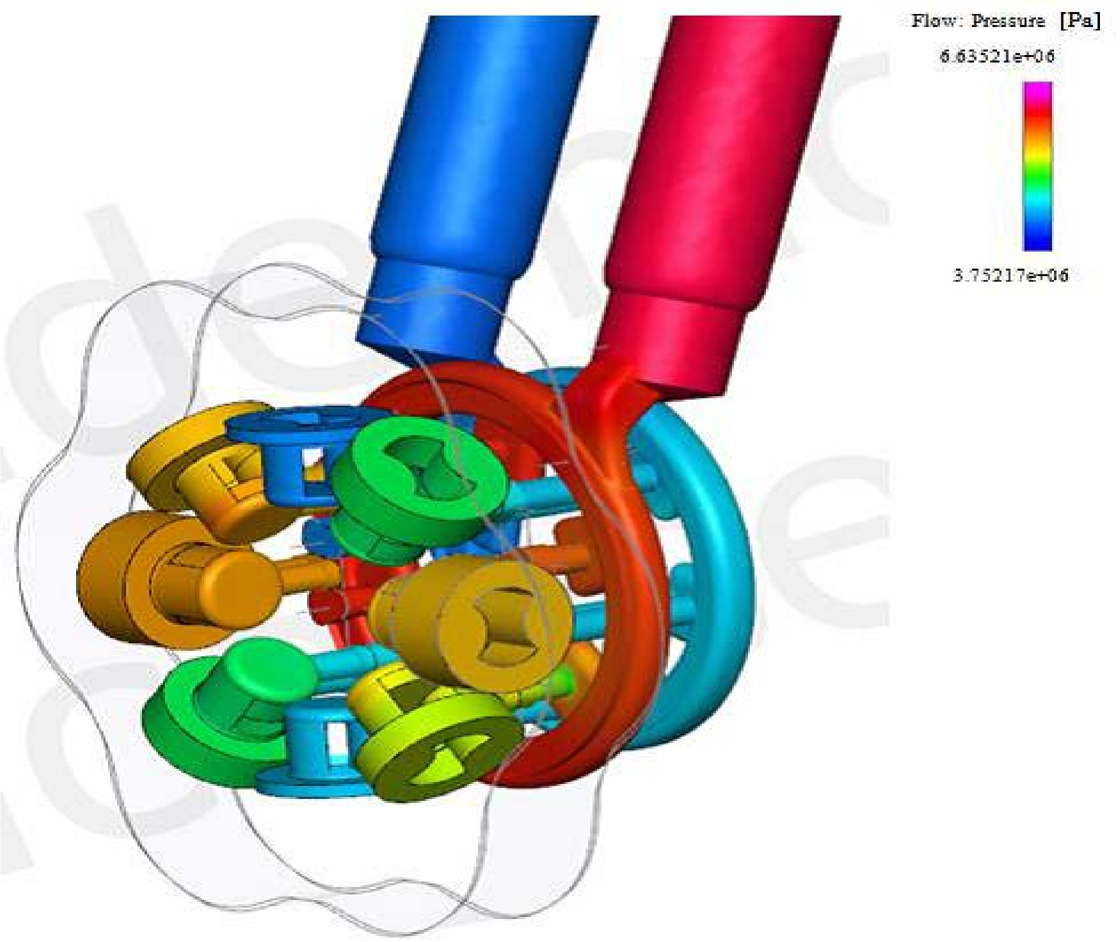

Figure 2 – MCR Radial Piston Motor – CFD Output (During the cycle)

The actual CFD results corresponded to experiment so well that Bosch Rexroth decided to implement the software themselves as part of their continuous development program. This will now allow the range of MCR motors to be further optimised in terms of flow losses and pressure fluctuations.

During the presentation the modelling procedure will be outlined along with many of the insights so far gained from the CFD simulations.

Other client examples will also be presented illustrating successful CFD simulation of other positive displacement machines such as a diesel fuel injection pump, a duplex gear pump and a screw compressor.

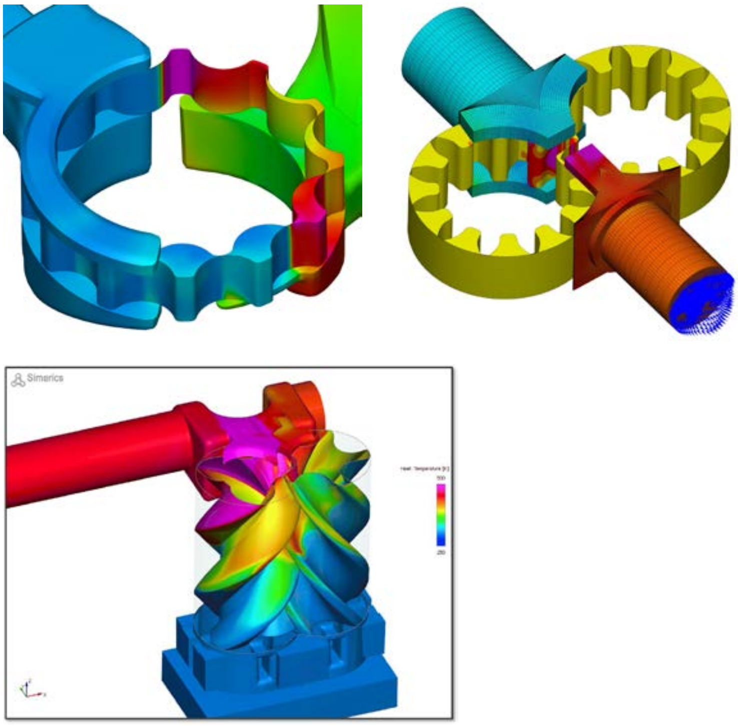

Figure 3 – Other examples of Positive Displacement Machines

8020 Engineering is a specialist Fluid Flow Simulation and Thermal Analysis Consultancy Company. We have a long track record of helping companies implement CFD software within ‘Fluid Machinery’ design environments and we believe CFD simulation will play an ever increasing role within this challenging product development application area.

REFERENCES

A Paper entitled ‘Computational Fluid Dynamics Modelling of a Hydraulic Radial Piston Motor’ was presented at the International Conference on Mechanics, Building Material and Civil Engineering (MBMCE 2015), Guilin, China with joint authors from Bosch Rexroth and Leicester University

SUGGESTED THEMES:

COMPUTATIONAL FLUID DYNAMICS

COUPLED AND MULTIPHYSICS

VERIFICATION AND VALIDATION