DESIGN INTEGRATION FOR SCREW COMPRESSORS

Lecture by:

Dr Ahmed KOVACEVIC

School of Engineering and Mathematical Sciences
City University London
Northampton Square, EC1V 0HB, London, UK

Part One

BASIC METHODS AND TOOLS FOR THE DESIGN OF SCREW COMPRESSORS

Screw compressor, is today more then ever used throughout the industry for air compression, refrigeration and process gas applications. According to statistical facts, about 17% of energy generated in developed countries is used for gas compression. A majority of newly installed industrial compressors is of the screw type. This clearly indicates increased market demands for quick design and production of such machines, which need to be competitive, both in efficiency and unit price. Depending upon the compressor duty and required capacity of the machine, as well as on manufacturing capabilities, each screw compressor design has to be optimised and its development must be conducted individually. This in turn requires flexible and reliable design tools, which accommodates all design phases. A design should, therefore start with generation of a suitable rotor profile, continue with the compressor component design by use of a CAD package, and lead to the precise determination of the compressor performance through one- and three-dimensional calculations of the compressor flow and thermodynamics. Improvements in computer speed and capacity allow today almost everybody to use computer software packages like 3D CAD or Computational Continuum Mechanics (CCM) programs, which have until recently been used only on fast corporate computers and supercomputers and therefore limited to a small number of designer groups.

Advances in mathematical modelling and computer simulation are extensively used for analysis and design optimisation of screw machines. This led to a steady evolution in screw rotor profiles and compressor.

The software packages exist which can be used in different phases of a screw compressor design process. The preliminary phase of a screw compressor design is mostly performed by use of SCORPATH – Screw Compressor Rotor Profiling and Thermodynamics, for the compressor analysis and optimisation, which enables calculations of the compressor performance and its optimisation for a specified duty. Preliminary mechanical design may than be conducted manually or automatically by use of a CAD system. This software makes development of a virtual compressor easier and optimisation of its structural elements simpler.

Later a detailed mechanical design can be conducted by use of a CAD system, which may be different than one used in the first design phase. As a result, the manufacturing drawings are produced and a numerical basis for manufacturing process is generated. Finally, the screw compressor performance is estimated precisely by use of a 3D CFD - Computational Fluid Dynamics code as described in. However, a special program for grid generation of the screw compressor rotor geometry had to be developed by the author. SCORG – Screw Compressor Rotor Geometry generates numerical grid automatically and allows the use of the same grid for estimation of distortions of the compressor elements and its influence to the flow parameters.