Development of a Reactive Silencer for Turbo Compressors

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Abstract

Turbo compressors can generate tonal noise in a frequency range of 1000 to 5000 Hz, which may cause nuisance in the environment. The cause of this tonal noise is the interaction between flow and rotating blades inside the compressor. The noise is transmitted from the compressor internals to the pipe system at suction and discharge and radiated from the pipe walls to the environment. This noise source cannot be suppressed by changing the design of the compressor without consequences for the performance. Therefore, a silencer is installed between the compressor and the pipe system that blocks the transmission of the noise.

The silencer type that is often applied for this is the so-called absorption type silencer, which is a vessel that is partly filled with material that dampens acoustic waves. In order to achieve sufficient damping, material like glass or rock wool is applied which consists of very thin fibres that are packed together and shielded with a perforated plate. Yet due to high flow velocities and vibrations the absorption material may deteriorate and be blown out of the silencer, where it can cause further damage. Therefore a more robust design concept has been developed based on acoustic resonators that block the acoustic waves that come out of the compressor. As the resonators are made of solid material, it is obvious that the integrity of this silencer concept is no issue.

COMSOL Multiphysics® has been used to predict the acoustic performance of this silencer concept. A practical case has been used to make a realistic silencer design. The performance has been compared with a conventional silencer.

In the paper the way in which the silencer has been modelled is presented. As the silencer contains a large number of resonators the model consists of a large number of elements requiring long computation times. Therefore the initial design has been made by means of a simplified one-dimensional model and only the final optimisation has been made with a three dimensional model. Finally a comparison is presented of a calculation of the transfer function of a scale model of a silencer and a measured transfer function.