Optimization of Acoustic Silencer for the Screw Compressor System

M. Swamy[1], L. J. van Lier[1], J. Smeulers[1]

[1]TNO, Delft, The Netherlands

Abstract

Screw compressors are becoming more common due to increased compression needs for gas applications. Normally these generate significant pulsations at the lobe passing frequencies and its multiples. The frequency of the source, in the range of 100-2000 Hz, affects a strong coupling of this acoustical power to the mechanical structure and it can cause vibrations that are difficult to control. These high pulsations can transmit into the upstream or downstream piping of the system and affects the integrity of the system. Often, one badly designed silencer can underscore the importance of reliable design and the need for a complete system acoustic/mechanical evaluation. Hence, there is a need to design a good silencer which could dissipate the pulsations and decouple them from the rest of the piping.

Generally, absorptive type or combination of absorptive/reactive silencers are used in the screw compressor systems. It contains absorption material, such as glass wool, rock wool or polymer foam and it will dissipate the acoustic power. This can be used an inner core material or/and additional layer along the inner wall of the silencer shell. The absorption inner core is made up of four layers, absorption material, thin fiber layer, wire-mesh around and finally packed into the perforated sheet. This combination gives mechanical integrity of the inner core. They perform very well at the higher frequencies. However, if this is not sufficient for the lower frequencies, an additional resonator can be installed in combination of the absorptive silencer.

For the analysis of low frequency pulsations we use the in-house 1-D PUSLIM tool for pulsation analyses. For screw compressor system (including dampers, piping etc.) we apply PULSIM for the low frequency range. For the higher frequencies that are generated by a screw compressor, 3-D acoustic modes become dominating in the silencers and 1-D PULSIM model becomes invalid. Hence, COMSOL Multiphyics® is used to predict the acoustic performance of the silencer and results obtained will be used to predict he acoustic performance in the rest of the piping.

In this paper, we present optimization steps used to improve the acoustic performance of the silencer. Transmission losses and attenuation coefficients were calculated for each case. The 3-D model of the silencer that has been used in the present investigation is discussed. The effect of the process parameters (molecular weight and speed of sound of the gas) and geometric parameters (size of silencer, thickness of the absorption core, length of the absorption core) on the damper performance have carried-out.

Reference

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