COMSOL CONFERENCE ROTTERDAM 2013

TNO innovation for life

Development of a Reactive Silencer for Turbo Compressors

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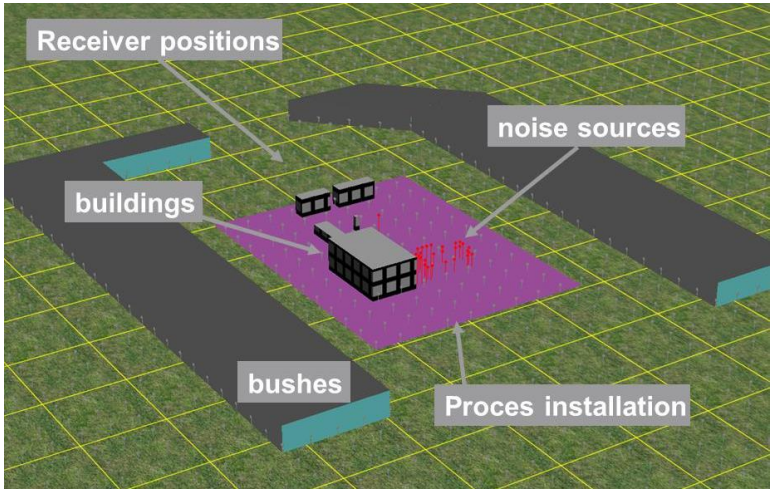
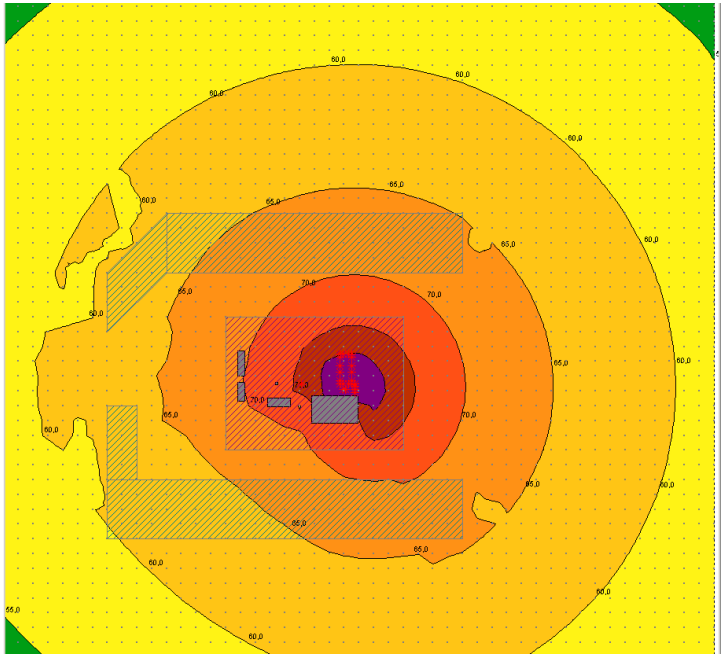
Backgrounds

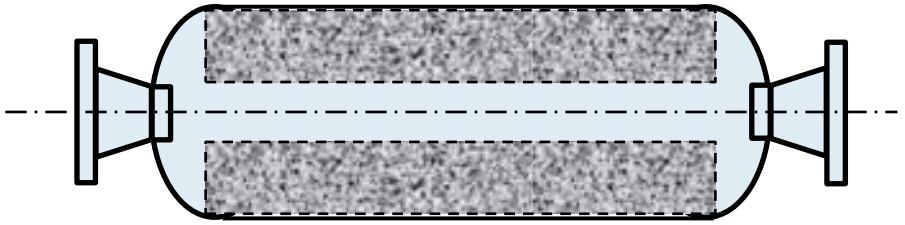
- Turbo compressors generate tonal noise at high frequencies (range 500 – 5000 Hz) that can cause nuisance in the neighbourhood
- The tonal noise is radiated from the piping and from static equipment such as vessels and heat exchangers
- Therefore tonal noise should be avoided from entering the pipe system

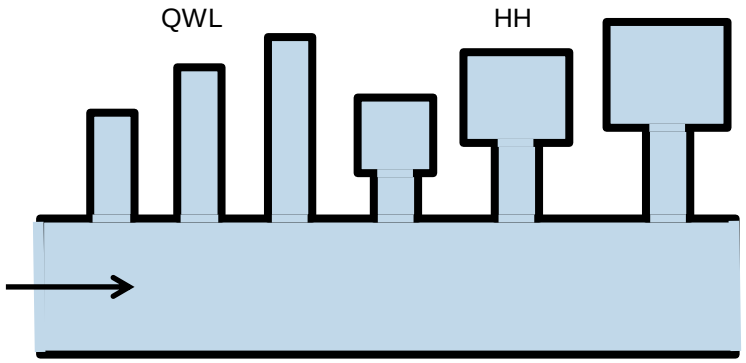




Backgrounds

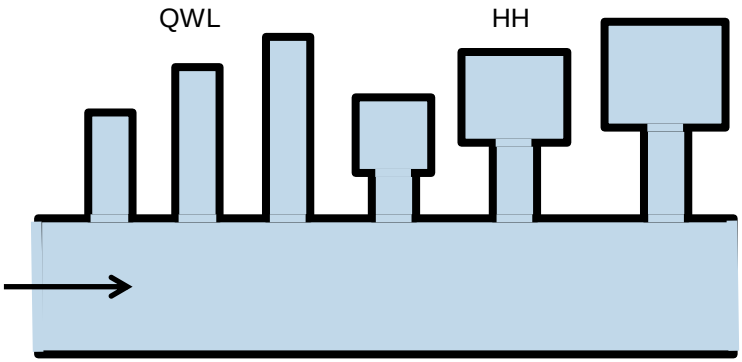
- For these high frequencies absorption silencers are used based on glass or rock wool or other porous material
- These silencers appear to fail and absorption material disappears in the pipe system or into the compressor
- Therefore a new silencer concept has been developed based on resonators

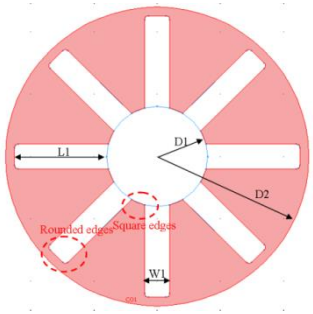


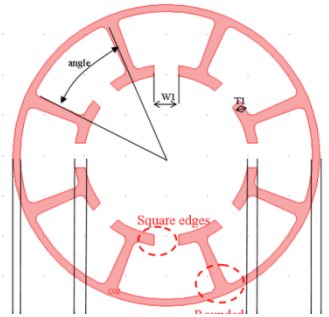


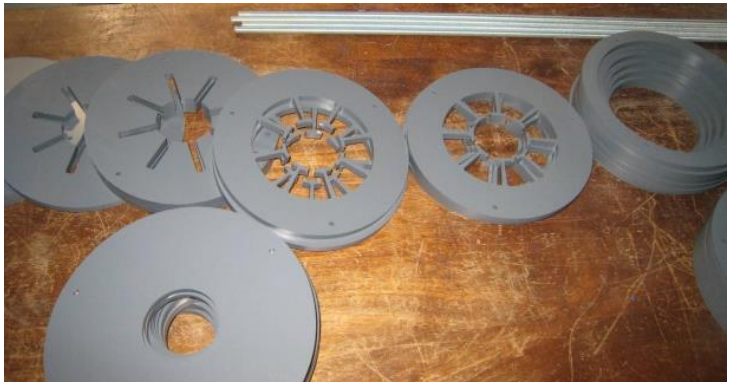
Another silencer concept

- A silencer based on acoustic resonators has been developed
- The absorption material has been replaced by rows of resonators
- Each row is tuned to a specific frequency band
- The frequencies of adjacent bands overlap → a continuous attenuation spectrum
- A row is made by milling a pattern in a plate
- A resonator is assembled by stacking a number of plates



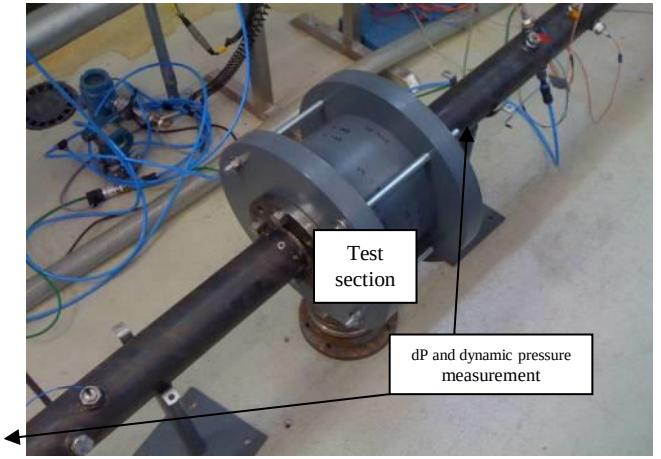


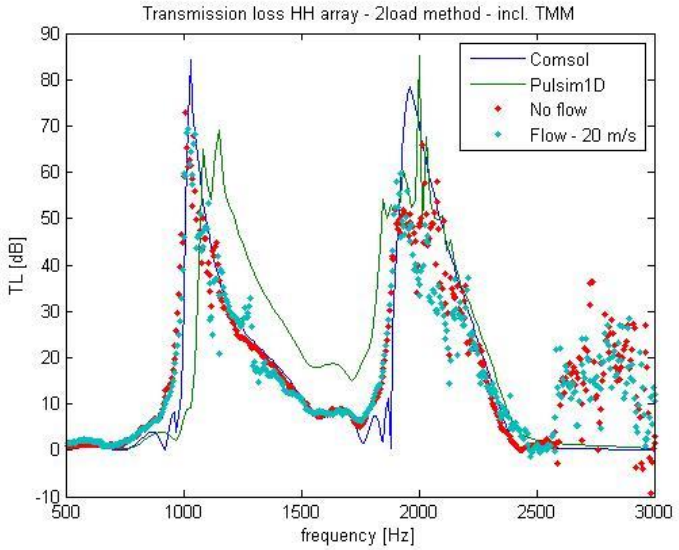




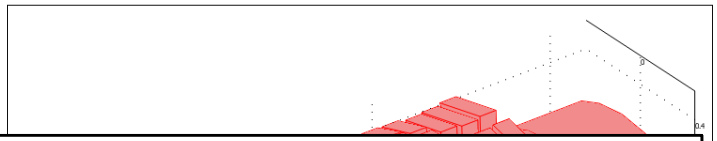
Modelling of a silencer using COMSOL

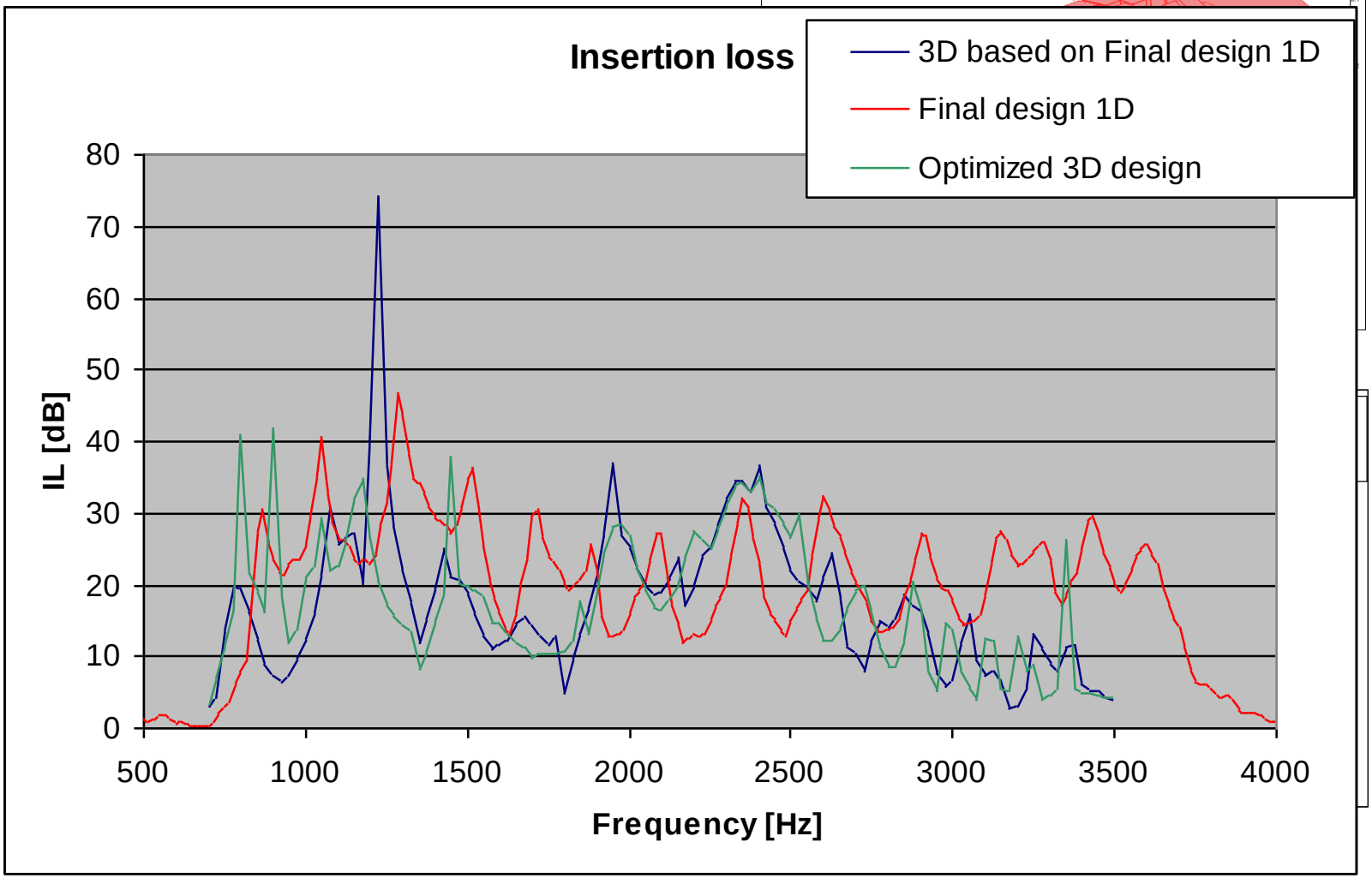
- For validation of the concept first a small scale silencer was designed and built
- One based on quarter wavelength tubes and one with Helmholtz resonators
- The first design was made with a 1D PULSIM model
- The fine tuning with COMSOL in 3D
- COMSOL predicts the resonance frequencies more accurately
- The 1D model predicts damping more accurately





Complete silencer design





Concluding remarks

- COMSOL has been a powerful tool in analysing silencer designs
- Parametric modelling has been essential. This has improved considerably in the new versions
- Damping is under estimated in COMSOL, but presently better damping modelling is available. Still not straightforward.
- Model size was at the edge by limitation of available memory. This will improve in the future.

Thank you for your attention!