Leak Detection for Gas Pipelines With Inline Tools

Leak detection is an important task for pipeline operators with a huge amount of different technologies available. There are internal systems and external ones, some are working during operation and some are used when the line is shut down. Unfortunately there is no "one for all" system that suits for all different lines and all operation modes.

There are also a lot more technologies available for pipelines transporting liquids than for gas pipelines. That is why Gottsberg Leak Detection decided to develop an inline tool for the detection and localization of leakages in gas lines.

Introduction

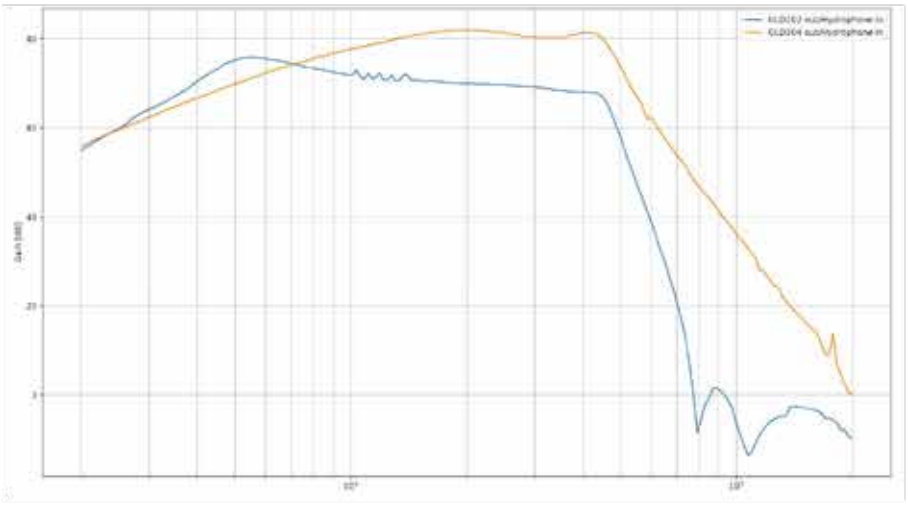
During development phase, most important was of course the detection of even the smallest pinholes with a location accuracy of only a few meters within just one run of the tool.

After long considerations and planning we started a cooperation with the university of applied science in Karlsruhe. The Institute for Materials and Production (IMP) has a lot of experience and facilities for computer based simulations and hardware testing which gave us the option to make detailed trials.

Gas leak detector development

Like all the other leak detection tools from GOTTSBERG Leak Detection, the new gas leak detector works on an acoustic basis to distinguish the unique signal of a leak from any background noise or interference. To get a first idea of the difference in frequencies and signal geometry of liquid and gas leaks several tests had been made with our "old" electronic in our test rig. After first evaluations it turned out that the main difference is the frequency range of the signal and also the background noises. To compile the right filter and amplifying algorithms several test setups had been made to compare our old electronics with the new development and to see how the detection abilities can be improved.

Figure 1 shows the different setups with their filtering characteristics.



The different leak detection trials we performed in our test rig have shown that compared to liquid leaks the typical signal frequencies shift to a higher range but in general have comparable geometry.

The straight frequency response can be seen and is results in an amplification that works up to the frequencies we recorded for gas leaks in our test rig. The blue line particularly shows good characteristics with a steep decline at the higher frequencies which we would like to attenuate to not interfere with the signals that shall be detected.

Another big challenge was the ATEX certification. It was not easy to develop a device that is only 12cm in length and 6cm in diameter, equipped with sensors for all the different data recordings that need to be

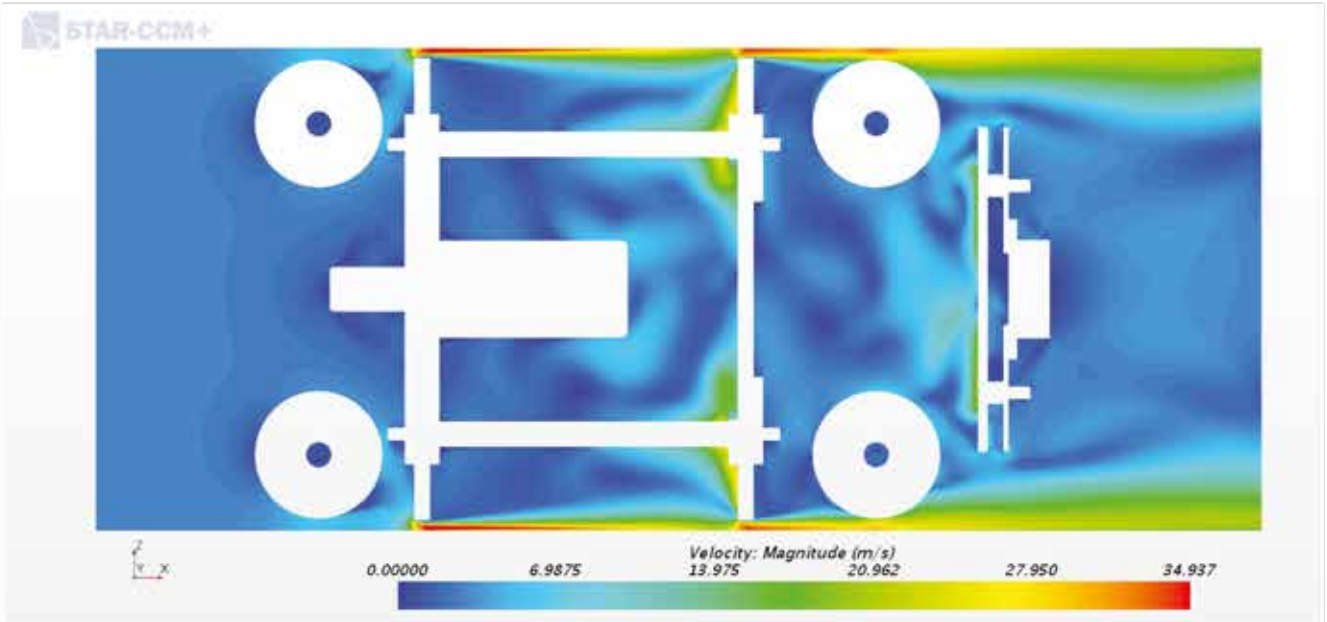
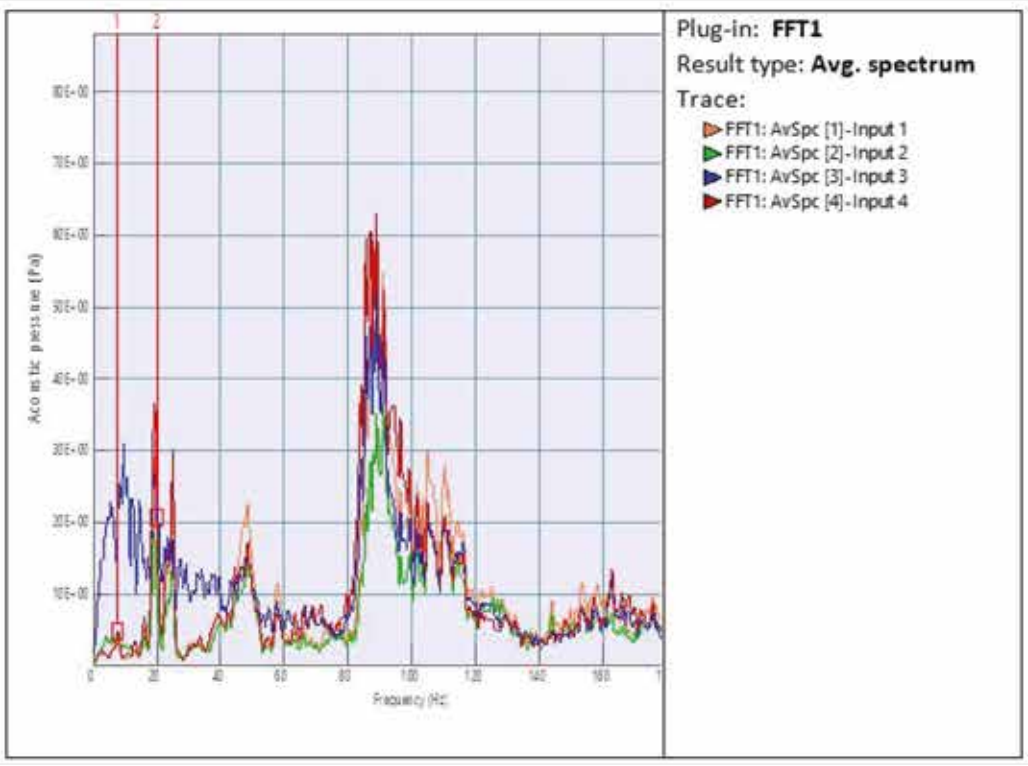


Figure 2: Circulation of medium.

done. Additionally there should be sufficient runtime and a pressure resistance up to 200 bar or 2800 psi. All that also needs to be ATEX certified for the strictest regulations of zone 0. Therefore different protective mechanisms like intrinsic safety, pressure safe housing and different kinds of advanced safety need to be in place to get the tools approved.

Figure 3 (right) shows the noises and the main frequencies for different materials. Concluding there had been bigger differences but almost all of the materials showed their main friction noises way below the frequencies that will be the typical for detecting gas leaks.



Chassis development for gas

The second big development was a suitable chassis that can be used in gas. Until now the devices for pipelines transporting liquid had been designed on wheels and with quite a bit of bypass to ensure a movement is as quiet as possible. Due to the compressibility of gas, it is not possible to have a big amount of bypass, as too much of the medium would flow around the tool and the driving force would get lost. Simulations regarding the circulation around the tool have been made to see where the limits are. It was now necessary to find a solution to construct a carrier that seals to the pipe wall but does not create too much noise, and for that reason, affect the data recording. Together with the IMP we developed a test setup in an acoustic laboratory to test different materials and how they produce noises scratching along steel pipes.

Figure 4: optional tool setup.

Some of the materials had been NBR which is currently used for the chassis, PU which is the common material for rubber cups at pigs or PU foam.

Additionally there had been several tests regarding the abrasion of the different materials. Due to higher flow rates in gas pipelines and the absence of lubrication liquids provide, the material must withstand higher abrasion. The PU particularly provided the best results here and probably also therefore is the common material used for pipeline pigs.

Conclusion

At the end of that long and challenging development process, a tool had been designed, small enough to run through pipelines down to 4", but still providing all the necessary data recordings. Naturally, a reliable and precise detection, and localization of even the smallest leaks in pipelines transporting gas is also guaranteed. Certification for ATEX zone 0 was also one of our main tasks and gives the operator a huge benefit when it comes to safety regulations.

On the other hand, our design and testing together with the IMP in Karlsruhe resulted in different versions of possible chassis which also give us the ability to react to different operational states in the line.

Finally, GOTTSBERG Leak Detection is now capable of providing a state of the art technology leak detection tool to their customers which increases the safety of their gas lines. It is also a great addition to the existing and already installed leak detection technologies that, in contrast to our system work continuously, but are not capable of detecting the very small leakages which will then stay undetected. The new tool with its ATEX certification, and the ability to locate any features within the first run to an accuracy of less than 5m, is the first of its kind for gas lines and will surely help pipeline operators to increase the safety, and therefore also the acceptance of pipelines in the communities. •

If you would like to know more about the solutions discussed in this article, or have any questions, please contact GOTTSBERG Leak Detection GmbH using the information below:

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