Simulation of Sound Wave Propagation Inside a Spherical Ball Submerged in a Pipeline

W. R. Chalgham[1], A. C. Seibi[1], and M. Mokhtari[1]
1. University of Louisiana at Lafayette, Petroleum Engineering Department, Lafayette, LA, USA

Scope:

- Develop a new inspection tool technique
- Mobile ball detecting leaks inside pipelines using acoustic signals
- Leak noise propagation inside the ball
- Calibrate the control system inside of the ball using the simulation results

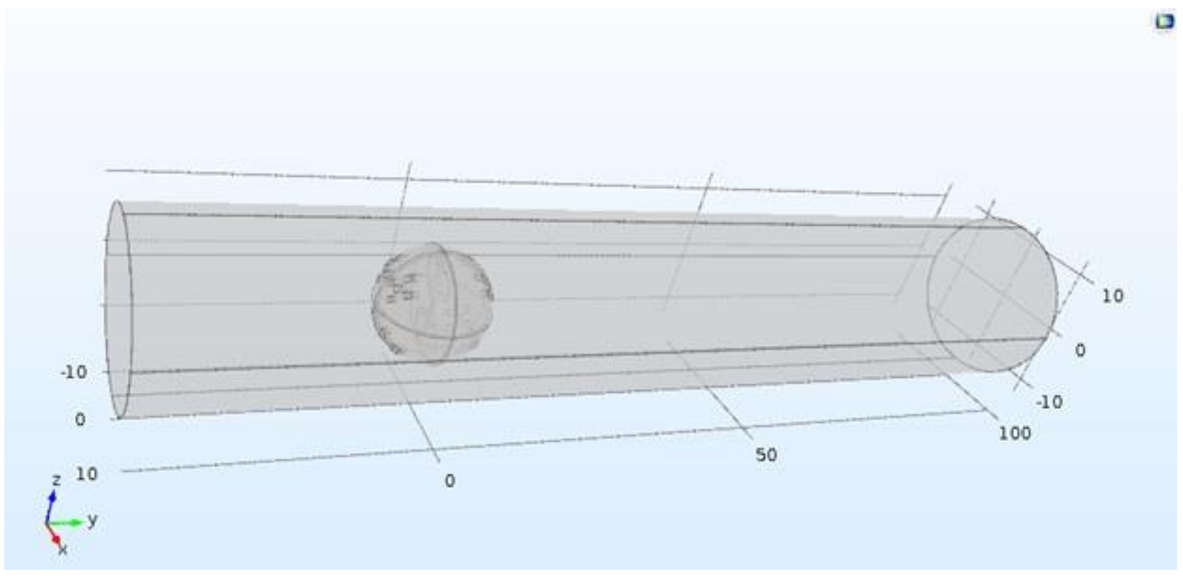

Figure 1. Mobile Ball Flowing inside the Pipeline

Simulation Results:

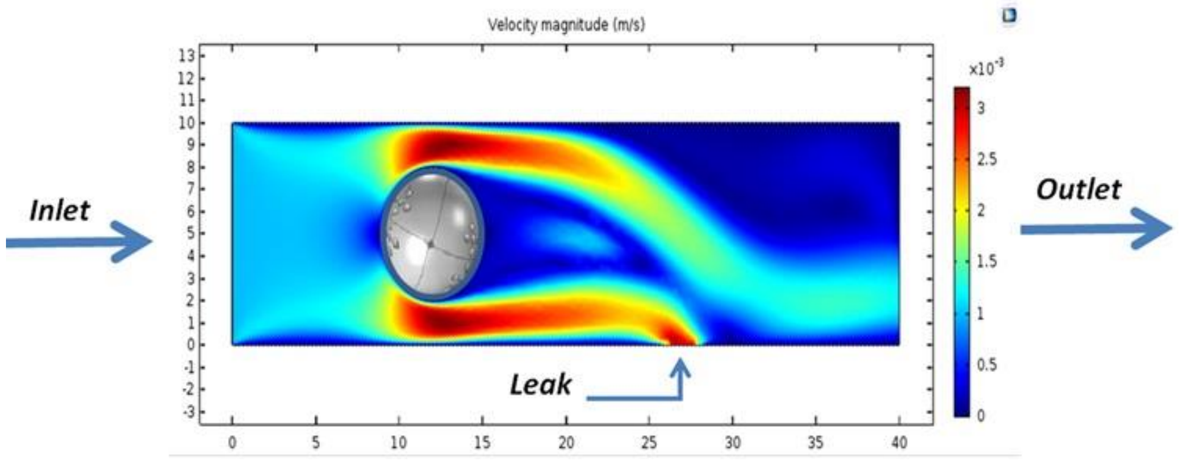

Figure 2. 2D Velocity Distribution of the Fluid around the Mobile Ball in Case of a Leak

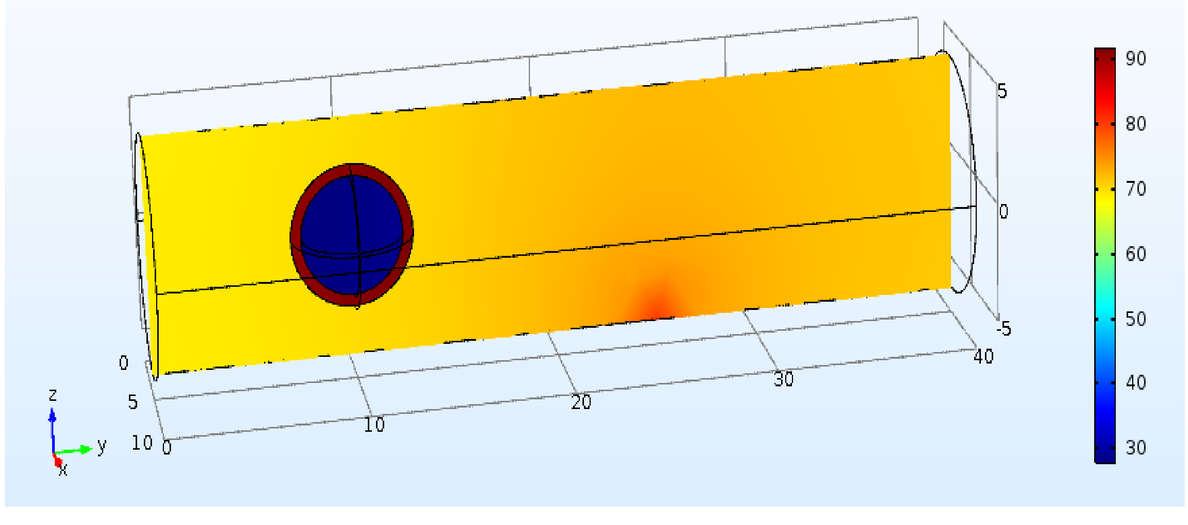

Figure 3. Sound Pressure Level in dB in the Presence of a Leak at a location of 25 in.

Sensitivity Analysis:

Effect of fluid type, ball material, leak noise power and leak location on the sound pressure level propagation

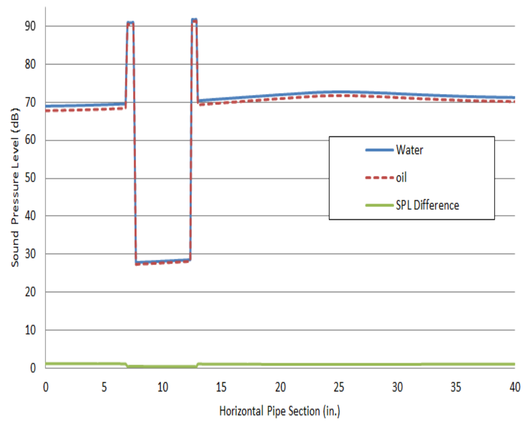

Figure 4. Fluid Type Effect

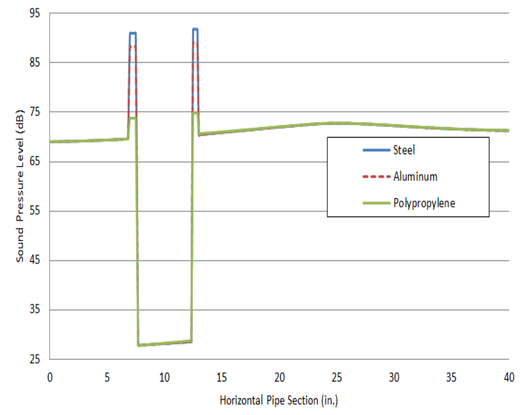

Figure 5. Ball Material Effect

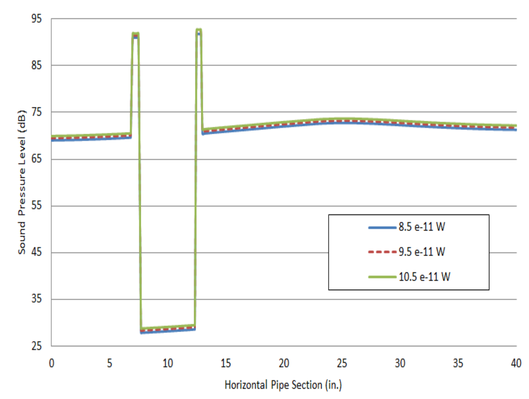

Figure 6. Leak Noise Effect

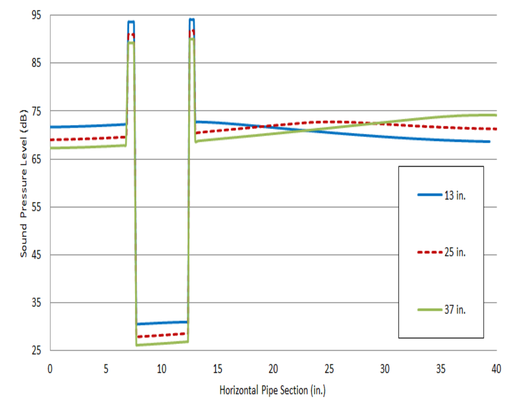

Figure 7. Leak Location Effect

Conclusions:

- The fluid type has an effect of ± 1.2 dB
- The ball material has an effect of ± 17.2 dB
- The leak noise has an effect of ± 0.48 dB per 1e-11 W change in power
- The leak location has an effect of ± 23.6 dB per 1 foot change in distance

References:

1. Wadie R. Chalgham, Abdennour C. Seibi and Fathi Boukadi, Simulation of Leak Noise Propagation and Detection Using COMSOL Multiphysics, *ASME Proceedings of the International Mechanical Engineering Congress & Exposition, Phoenix, Arizona, USA* (2016)
2. Wadie R. Chalgham, Abdennour C. Seibi and Matthew Lomas, Leak Detection and Self-Healing Pipelines Using Twin Balls Technology, *SPE Annual Technical Conference and Exhibition, Dubai, UAE* (2016)