

Simulation Studies on the Image Quality of Industrial Film Radiography

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Problem

In-Service Radiographic Non-Destructive Testing (RT) of liquid-filled pipelines and piping systems is limited. The scattering and absorption of radiation by the liquid affect the exposure of the film to cause a significant drop in the probability of detection.

Objective

This communication highlights investigations aimed to attain comprehension about the RT of water-filled pipes; with the objective of improving the radiographic quality.

Procedure

aRTist, the analytical simulation toolkit (Demo. version) was used to simulate film radiography of a water-filled pipe having an outside diameter of 219 mm (8 inches), using Ir-192.

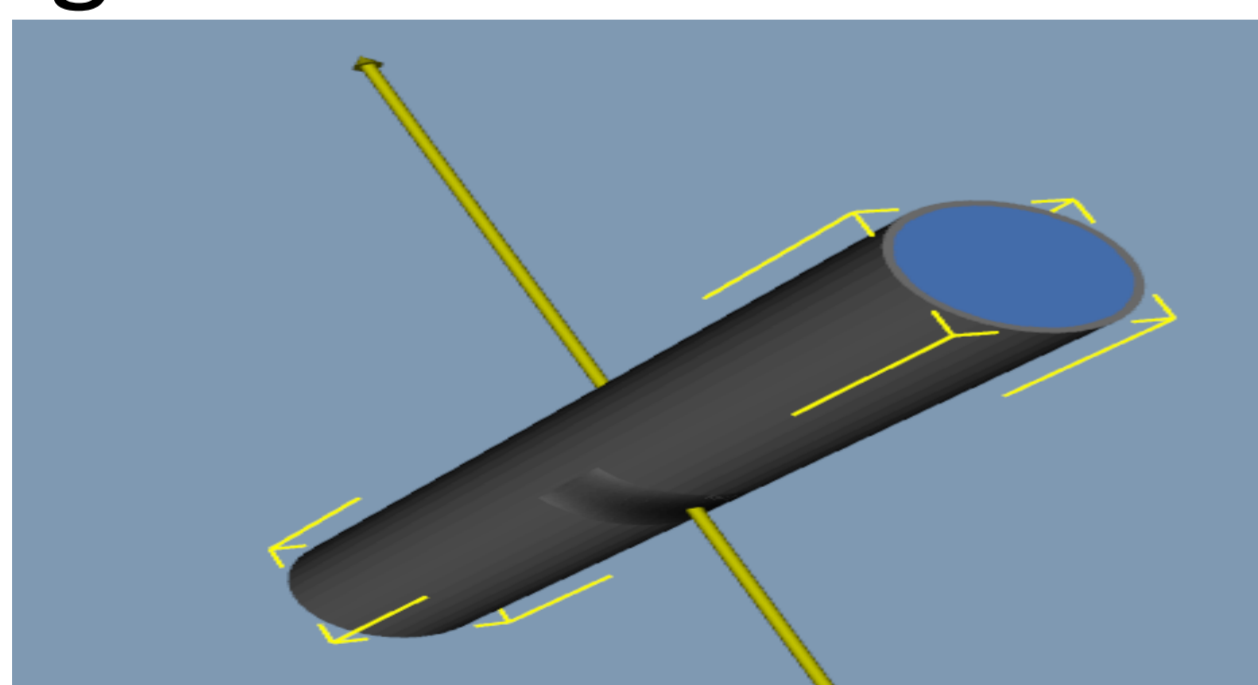


Fig. 1 Radiographic setup used in the simulations

Different combinations of radiographic screens were examined to obtain the optimum material and thickness that maintain the direct radiation besides reducing scattered photons. The Scattered Direct Ratio (SDR) was used as an indicator of the image quality.

The increase in the SDR indicates deterioration in the image quality.

Results

The study of radiation behavior



Fig.2 Direct radiation: Empty pipe



Fig.3 Direct radiation: Water-filled pipe

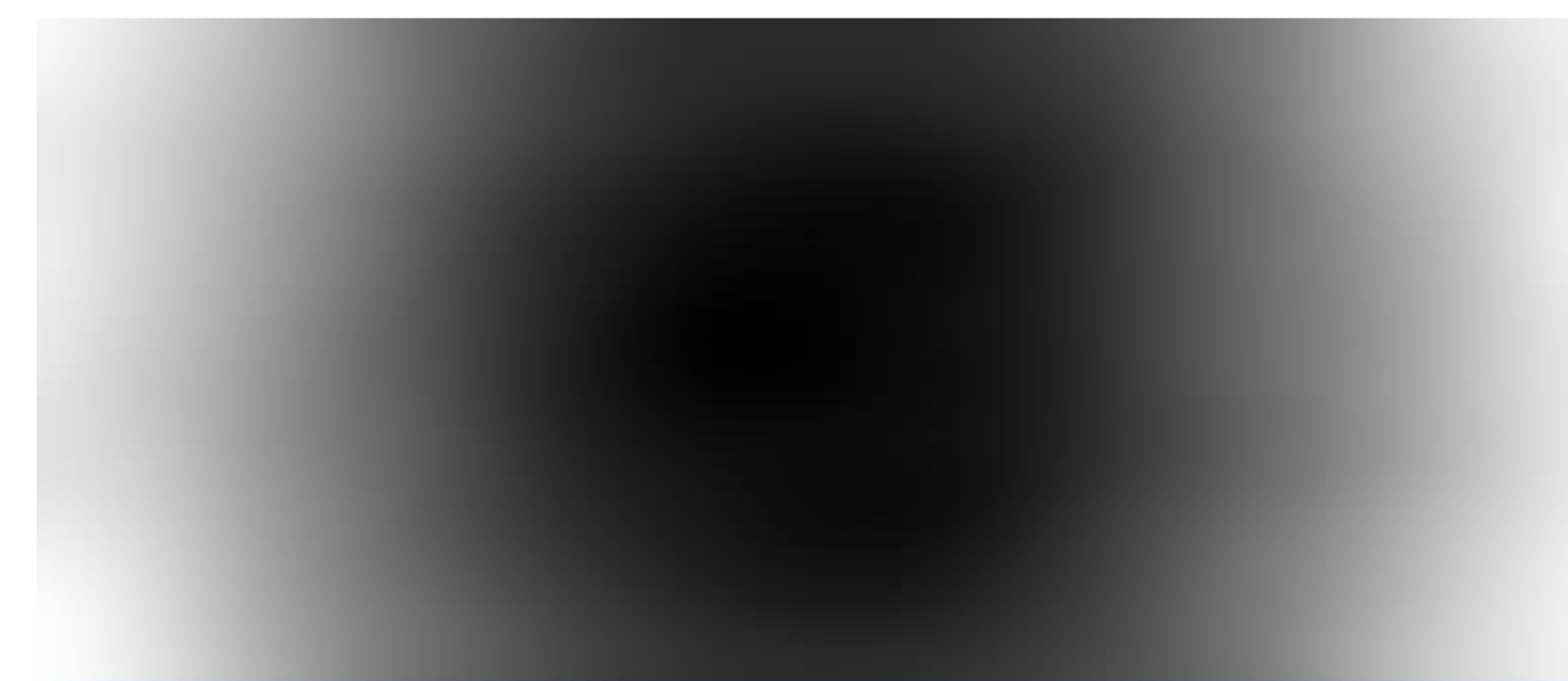


Fig.4 Scattered radiation: Empty pipe

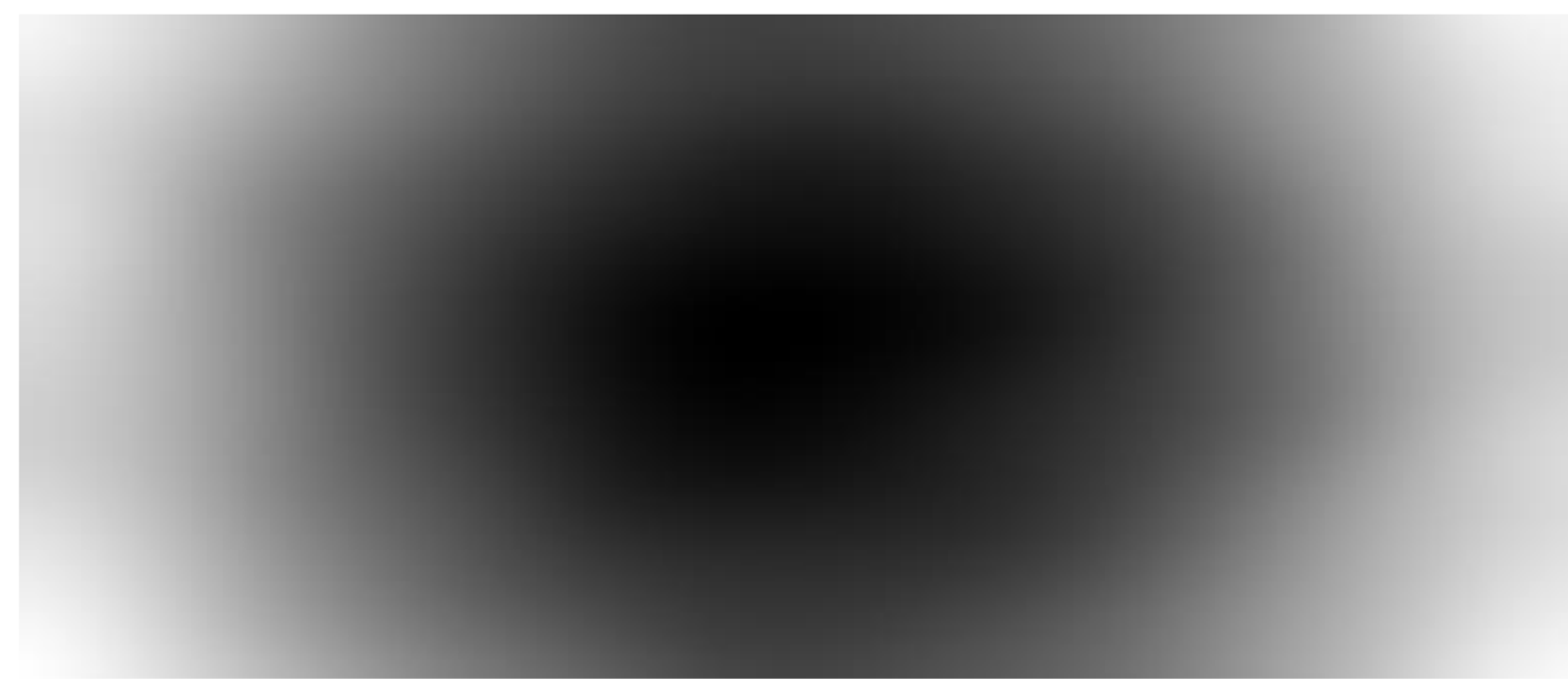


Fig.5 Scattered radiation: Water-filled pipe

Improving the SDR using radiographic screens

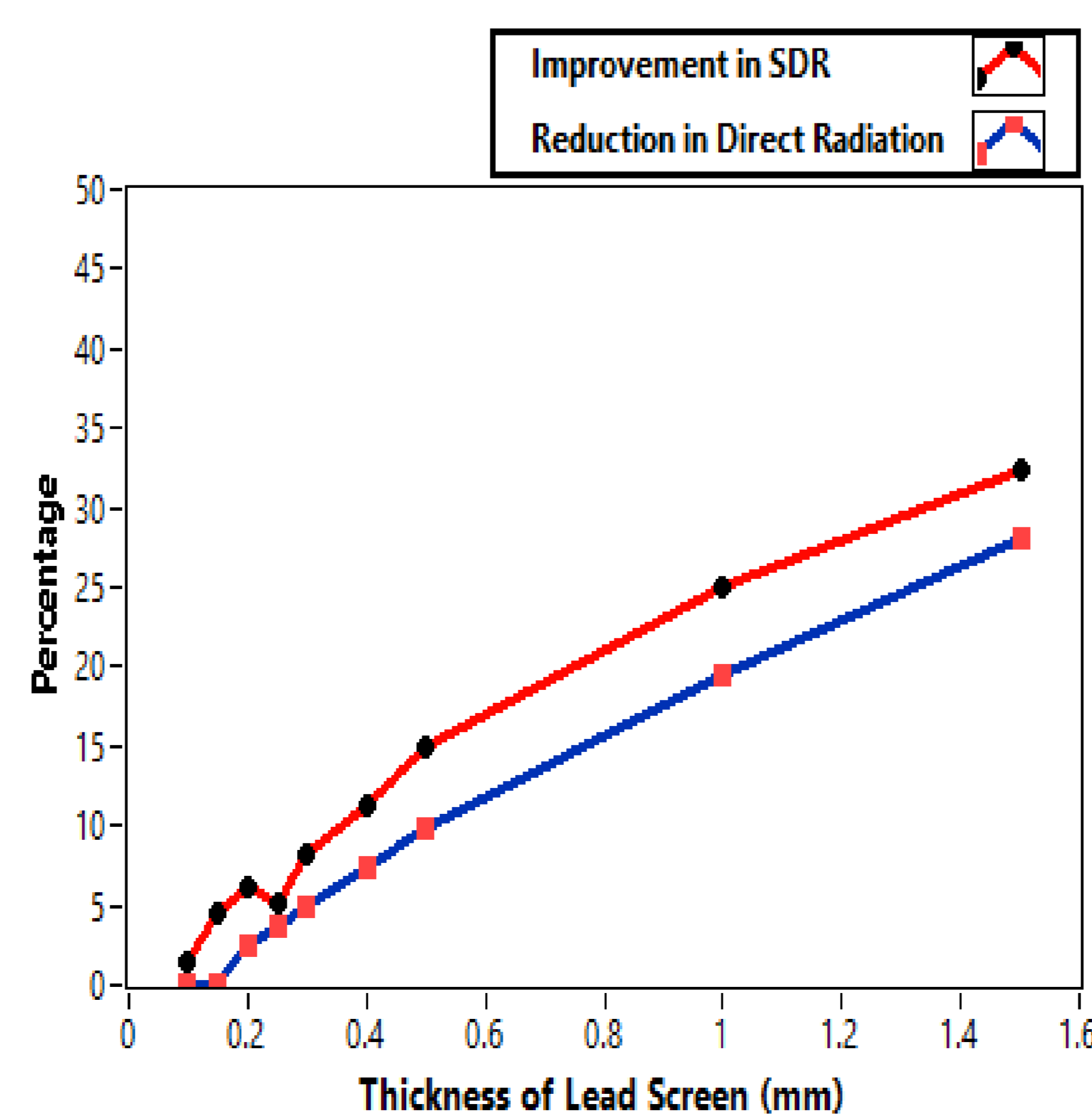


Fig.6 Effect of different lead screen thicknesses

Table 1. Effect of different aluminum screens thicknesses

Screen thickness (mm)	Direct photons	Scattered photons	SDR
0	0.0085	0.027	3.18
0.01	0.0085	0.027	3.18
0.05	0.0085	0.027	3.18
0.1	0.0085	0.027	3.18
0.127	0.0085	0.027	3.18
0.15	0.0085	0.027	3.18
0.2	0.0085	0.027	3.18
0.25	0.0084	0.026	3.10
0.3	0.0084	0.026	3.10
0.4	0.0084	0.026	3.10
0.5	0.0084	0.026	3.10
1.0	0.0083	0.026	3.13
1.5	0.0084	0.026	3.10

Conclusions

The radiographic quality in water-filled pipes is deteriorated by the increase in the SDR. Optimizing the thickness of the front lead screen decreases the SDR.

An Experimental evaluation is necessary to observe the improvement in image definition corresponding to the decrease in the SDR, and to assess the intensifying action of the screen.

Acknowledgment

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