DIGITAL RADIOGRAPHY CONDITION ASSESSMENT OF VALVES, FIRE PLUGS, AND PIPES.

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ABSTRACT

Within this investigation we evaluated the use of digital radiography for the assessment of valves and pipes within the field. Digital radiography is a technique that uses radiation to image critical assets, images of the critical assets are obtained instantly.

This investigated imaged various fire plugs, pipes, and valves. The fire plug images where very clear and gave us the ability to determine the presence of any internal blockages. The valve stems where also imaged to determine if they were broken, the other area of interest was the vale seats. Various sizes of assets where investigated from 50mm to 600mm, also the materials within this study varied from mild steel, cast iron, and fiberglass pipe. Digital radiography was observed to be very useful in imaging all the assets, though the presence of water did reduce the clarity of the images.

KEYWORDS

Condition assessment, digital radiography, asset management

1 INTRODUCTION

Radiography has been an evolving technological field with the release of new digital radiography panels. Previously radiography required long exposure times with strong sources to obtain an image with film. Digital radiography uses a digital panel to obtain the image in a fraction of the time previously required by the radiography film. The additional benefit of a digital radiography panel is there is no longer the need for the development of the radiography film, the image is obtained instantly on a laptop. We investigated the possible applications of this technology for the condition assessment of valves and pipes.

2 METHODS

A Vidisco sparX digital radiography panel was used to capture the images, Vidisco imaging software was used to obtain and control the digital radiography panel. The X-ray source used within this investigation was a XRS4 Golden Engineering 370 KeV source. The amount of X-ray pulses used within this study varied for each material. The maximum amount of pulses a Golden Engineering XRS4 device can produce is 200 pulses maximum for one image, the maximum exposure time was no longer then 2 mins. Samples where obtained from a local wholesale depot which stocks valves and pipeline off cuts. The valves obtained where brand new while the pipe samples ages are unknown. The asset sizes investigated within this study ranged from 50mm to 600mm. The materials within this study are mild steel, cast iron, and fiberglass pipe.

3 RESULTS AND CONCLUSION

This investigation observed the capability of applying digital radiography to water assets within the field to determine their condition. Various assets where assessed such as fire plugs, valves, and pipes. Digital radiography displayed a great ability to obtain sharp images of the inside of the valves. These images where obtained instantly on site and could be measured using the Vidisco software.

The first sample we investigated was a fire plug that would be commonly used within the eastern states of Australia. The images clearly display the inside mechanics of the fire plug. Within the imaged we placed a 50cent coin and a $2 coin in the fire plug, this is to represent the presence of a foreign object. Both the coins where clearly observed within figure 1. Old fire plugs commonly suffer from tuberculation, this can reduce the flow rate of a fire plug causing it to fail fire flow testing. A potential use of digital radiography is to image the fire plug to determine the presence of tuberculation.

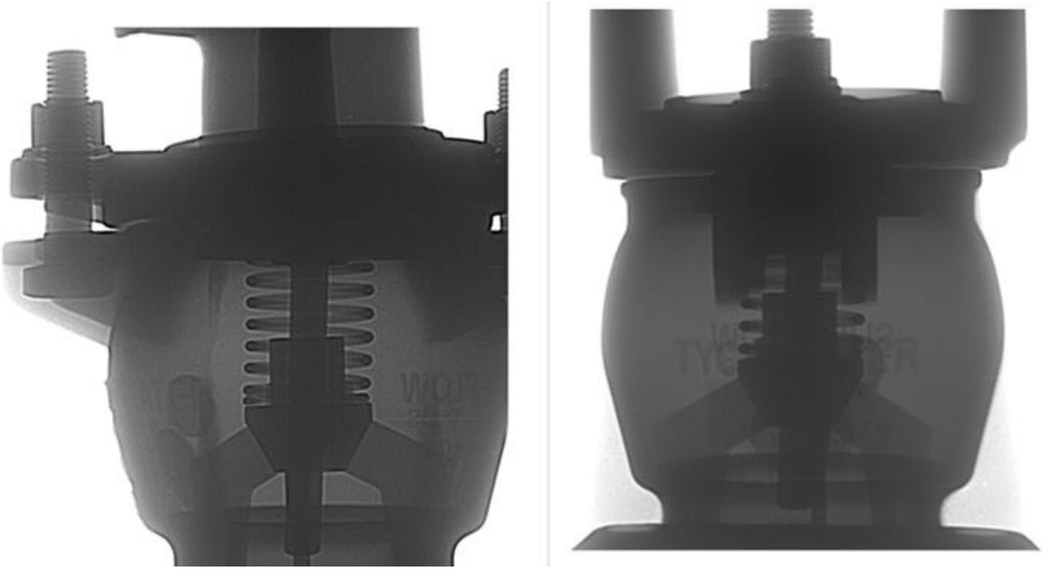

Figure 1, An X-ray image of a fire plug with two foreign objects.

A 100mm valve was inspected using digital radiography to determine its ability to assess the internal mechanics (Figure 2, Figure 3). Two areas of interest where imaged, firstly the valve spindle and secondly the sealing of the valve. The image of the valve spindle was very clear (Figure 2), the depth of the bolts on either side of the valve spindle can also be clearly observed. Commonly the valve spindle is one of the main problems with broken valves, the main issue is due to over torqueing and snapping the spindle. Once the spindle is snapped that valve can be turned and provide the impression the valve is operational, though the valve is non-functional.

Figure 2 X-ray image of a valve spindle.

The valve seat was also imaged using digital radiography (Figure 3). The X-ray images obtained where very clear allowing us to inspect the internal condition. Commonly the valve seat can have tuberculation present or something lodged in the seat preventing the valve from completely sealing. This image was obtained instantly allowing us to assess this valve and make a quick assessment of its condition.

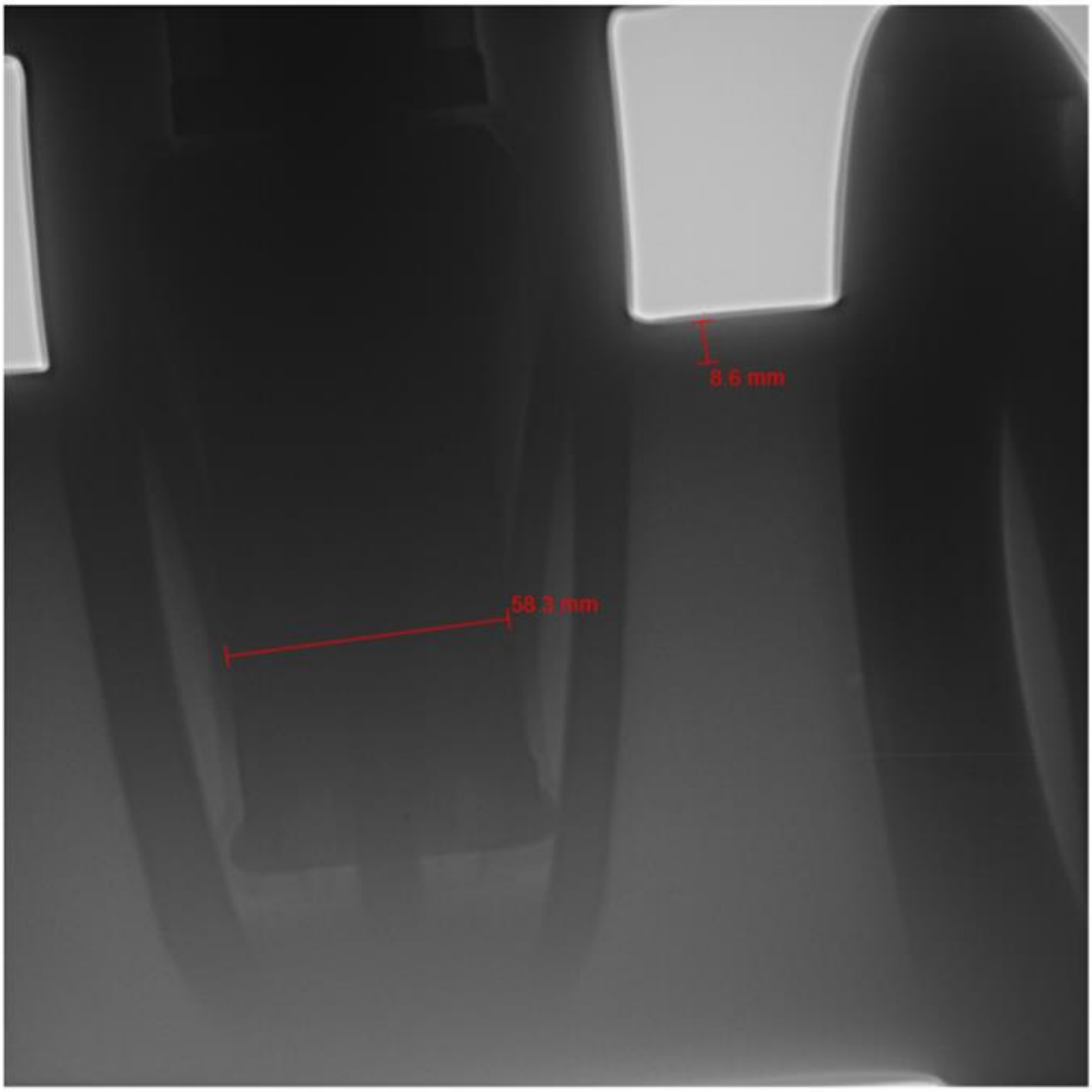

Figure 3 X-ray image of a valve.

A GRP pipeline 600mm in diameter was scanned to determine the presence of a possible split or crack (Figure 4, Figure 5). We introduced a small piece of carbon fibre panel which we split and placed behind the 600mm fiberglass pipe. It was clearly observed within figure 5 that the weaves from the fiberglass pipe could be clearly identified. Additionally, the carbon fibre sheet with the split was also clearly observed within the image.

Figure 4 A side picture of the GRP pipe imaged

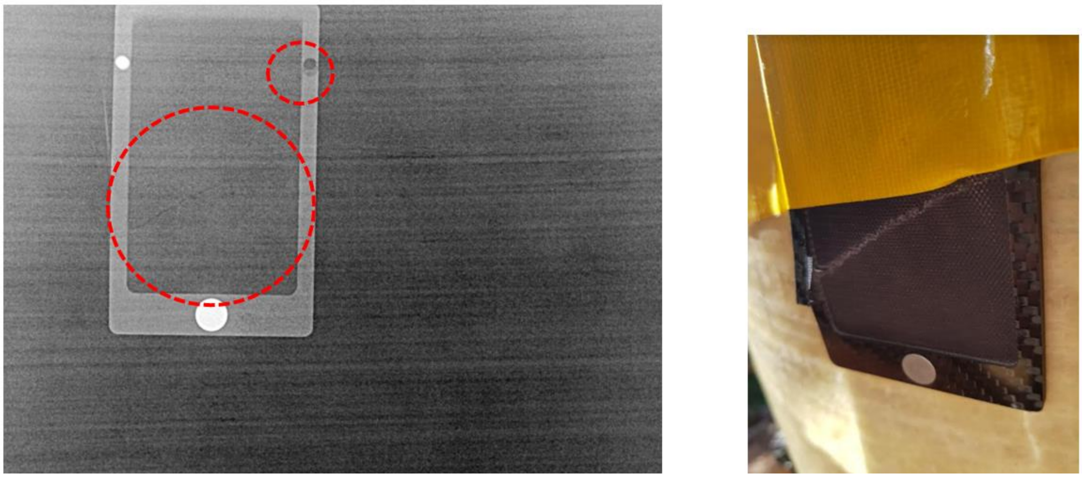

Figure 5 (left) X-ray image of the GRP pipe, (Right) The example defect using the carbon fibre flat panel.

A comparison between the presence of water in the asset and not in the asset was compared with a 50mm and 150mm mild steel pipe. The presence of water did affect the overall quality of the image that could be obtained for both the 50mm and 150mm mild steel pipes. The 50mm pipe was formed by 5mm thick pipe wall with a 50mm ball valve at the bottom, the pipe was filled with stones to represent a blockage. In figure 6 it is clearly observed that the presence of water for a 50mm pipe had little effect on the image and we were able to generate a clear image. A large 150mm with and without water was also compared (Figure 7 and Figure 8). The 150mm mild steel pipe without water was very clear, though when water was placed in front of the pipe the image quality was not as clear. Therefore, the presence of water for pipes 150mm and above would cause an issue with the image quality and dewatering the pipeline would be suggested.

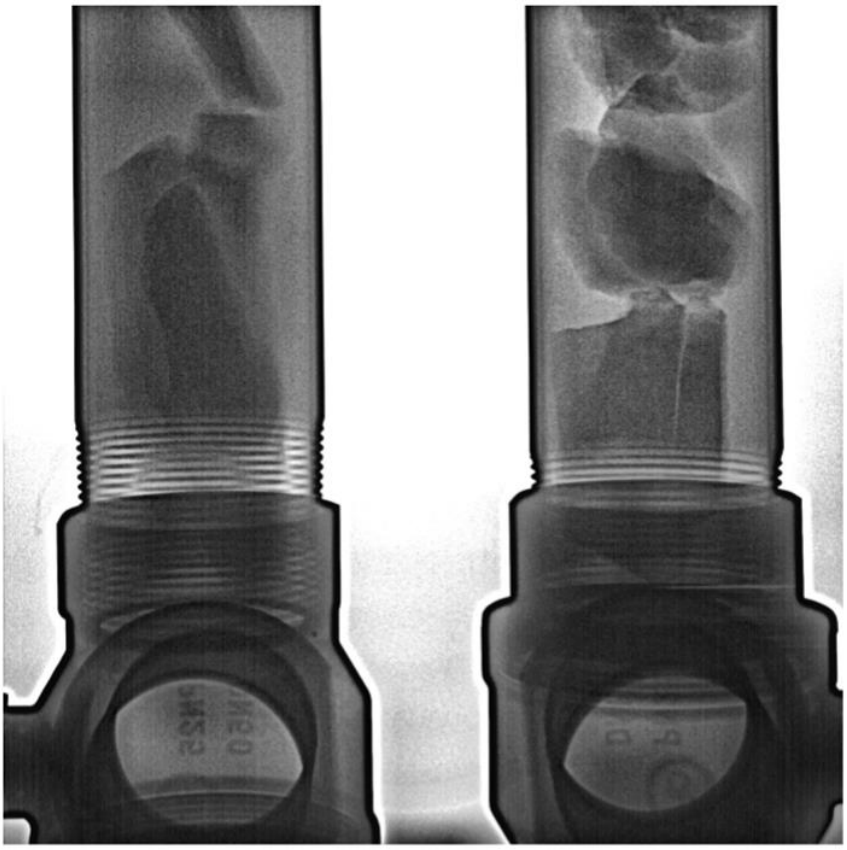

Figure 6 X-ray image of a 50mm pipe with rocks, the left pipe is with water and the right no water.

Figure 7 X-ray image of a 150mm pipe with water and sediment.

Figure 8 An X-ray image of a 150mm pipe without water and with sediment.

Overall, we believe that this tool is an ideal solution to many issues currently faced within the water industry and can help lower the costs of condition assessment in the future. The rapid ability to obtain and image instantly on site is greatly beneficial.