The effect of object to film distance (OFD) to industrial radiography image

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Abstract. The object to film distance (OFD) to image when using radiography testing were discussed and whether the image can be improved by IIP Console Software in Digital Radiography method were studied. The artificial defect of wooden block with different size was used as the test sample in this study. The object to film distance (OFD) to the image were capture by using XRS-4 model X-ray source and flat panel detector. The image was analyzing by using IIP Console Software. The obtained results show that irregular surface has better and sharper image compare to flat surface to 9 mm hole wooden block. Meanwhile for 15 mm hole, flat wooden block show better and sharper image compare to irregular surface.

1. Introduction
Radiography testing is one of the non-destructive testing (NDT) applications. The internal structure of the object is basically equivalent to the imparted energy of radiation source. Thus, it is essential to analyze the object’s details of non-destructive testing method in medical and industrial application using radiography imaging [1]. The internal structures of industrial object are guessed from a set of projection of the radiography method [1]. Radiography generates the test object's visual response on the film. The quality of the radiographic image is determined by the film form, the source to film distance, the time and angle of exposure. A radiographic image consists of varying shades of grey, ranging from white grey on one end to black grey on the other. A film showing quite bright but also very dark areas has a high contrast or a short grey scale, because there are few shades of grey from one side to the other [2].

The voltage has an effect on the radiographic image, as the energy used to make the X-rays is related to the X-rays' penetrating power. Source to film distance (SFD) is a measurement of the variation to the film to be viewed from the X-ray tube [3]. The effect of source to film distance would also cause the film density and exposure time to change accordingly. Digital imaging creates a permanent virtual copy of a sample that can be re-evaluated, sent to experts remotely but also protects the original sample against damage. It can be used to take long fracture measurements for estimating the stature particularly [4]. Image displays are required to integrate visual information and can be embedded with various technology forms. Other significant factors which can interfere with this phase have not been evaluated jointly [4]. The rapid development of digital imaging techniques needs guidance on how to produce an effective display of the electronic image. Radiographic caries detector
is a restricted activity local-area-contrast, it remains unknown if this high-contrast detection model is relevant to low-grey level differences [5][6].

The X-ray image from the radiographic test is computed by using image processing to measure the region of defect in terms of pixel count. An attempt to fill this void by applying image processing technique directly to the X-ray image for process parameter selection. Furthermore, the relation between the size of the defect and the tensile strength of the X-ray image is produced [7].

2. Methodology

2.1. Sample preparation

Two types of wooden block which were used in this study were flat surface and irregular surface. An artificial defect has been made by using drill press machine with 9 mm and 15 mm diameter of drill size through the center of the sample (Figure 1).

![Figure 1](Image)

**Figure 1.** (a) Flat surface 9 mm hole wooden block and (b) Irregular surface 9 mm hole wooden block.

2.2. Testing method

The X-Ray source Model XRS-4 and flat model detector Model SENTINELDR were used for this project (Figure 1). IIP Console Software was used for image processing and digitalization of X-Ray images (Figure 2). This method uses X-Ray sensitive plate to collect data during object processing, which is transferred to the device directly without any need of intermediate cassette. The object to film distance were tested at a distance of 0 mm, 5mm, 10 mm, 20 mm, 25 mm, 30 mm and 35 mm.

![Figure 2](Image)

**Figure 2.** (a) Radiography test for flat sample and (b) radiography test for irregular sample.
3. Results and discussion

3.1 Wooden block 9 mm hole

Table 1 shows the value of defect size for flat and irregular wooden block when object to film distance (OFD) increases. From the data obtained, both defect size for flat and irregular wooden block increase significantly with increasing of OFD. This may due to the surface that come into contact with the panel detector is different. For examples at the OFD 5mm, 10mm and 35mm both defect size show in high gap values where the defect size for flat is 9.27mm irregular is 9.02mm at OFD 5mm. Defect size of flat is higher than the defect size of irregular. The same goes to defect size at OFD 35mm which defect size in flat block is 12.58mm and the defect size in irregular block is 12.06mm.

Table 1. Data of defect size and OFD for 9 mm hole.

| OFD (mm) | Defect size flat (mm) | Defect size irregular (mm) |
|----------|-----------------------|---------------------------|
| 0        | 9.02                  | 9                         |
| 5        | 9.27                  | 9.02                      |
| 10       | 9.65                  | 9.28                      |
| 15       | 9.91                  | 9.91                      |
| 20       | 10.41                 | 10.29                     |
| 25       | 10.8                  | 11.05                     |
| 30       | 11.56                 | 11.56                     |
| 35       | 12.58                 | 12.06                     |
The defect size for flat wooden block is higher compared to irregular wooden block when the value of OFD increases and the value for both flat and irregular shape wooden block increase simultaneously with the increasing of OFD value as shown in Figure 4.

![Defect size vs OFD](image)

**Figure 4.** Graph of defect size versus OFD for flat and irregular wooden block for 9 mm hole.

The irregular surface has sharper and better image compare to flat surface wooden block as the value of gap is higher for flat surface.

### 3.2 Wooden block 15 mm hole

Table 2 shows the value of defect size for flat and irregular wooden block when object to film distance (OFD) increases. From the data obtained, both defect size for flat and irregular wooden block increase with increasing of OFD. The gap size of irregular surface is higher compared to flat surface as shown in Figure 5.

| Defect size | OFD (mm) |
|-------------|----------|
| flat (mm)   |          |
| 14.99       | 0        |
| 15.25       | 5        |
| 16.14       | 10       |
| 16.77       | 15       |
| 17.66       | 20       |
| 18.18       | 25       |
| 18.81       | 30       |
| 20.45       | 35       |

#### Table 2. Data of defect size and OFD for 15 mm hole.
The flat surface wooden block give sharper and better image compare to irregular wooden block surface as the gap size for irregular is higher compare to flat surface wooden block.

4. Conclusion
This study focuses on the image and gap size value when the object to film distance increases. The value of gap size increases simultaneously with the increasing of OFD for both flat and irregular wooden surface for 9 mm and 15 mm holes. The obtained results show that irregular surface has better and sharper image compare to flat surface to 9 mm hole wooden block. Meanwhile for 15 mm hole, flat wooden block show better and sharper image compare to irregular surface.

5. References
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