

STUDY ON THE EFFECT OF EXPOSURE TIME ON THE IMAGE OF X-RAY RADIOGRAPHY

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Abstract –This research work describes about the operation of X-ray radiography System, Non-Destructive Testing Technique with two exposure times for inspection of internal structure of test material (spark plug). The spark plugs were measured with X-ray machine ANDREX 257 SMART 5A3 DIRECTIONAL at Non-Destructive Testing Laboratory. The result images were compared and indicated the exposure time (30 sec) is better than the exposure time (10 sec).

Key Words: X-ray Radiography, Non-Destructive Testing, exposure time, spark plug, X-ray Machine.

1. INTRODUCTION

Non-destructive testing (NDT) is a descriptive term used for the examination of materials and components in such a way that allows materials to be examined without changing or destroying their usefulness. The purpose of NDT is to ensure product reliability, to prevent accidents and to save lives and then to make profits to the users. In industrial applications, X-ray and gamma ray are used to get the internal defect image of welds and metal castings. X-ray radiography is a Non-Destructive Technique based on a different passage of X-rays through a sample onto a specific film. There are many factors to be considered to get a radiograph. Among them, the factors which are essential for the process will be discussed:

- Fundamentals of a radiographic process
- Geometric principles
- Inverse square law
- Exposure factors
- Exposure chart
- Intensifying screen
- X-ray equivalency

2. MATERIAL AND METHOD

2.1. Sample Preparation

Firstly, choose the spark plug for X-ray radiography system. After clean the spark plug from dust. And then the spark plug is prepared to get the image of the spark plug by using X-ray radiography. To get the image, the film and lead foil are put together in the film cassette in the dark room. After that the sample spark plug was placed upon the film cassette.

2.2. Experimental Set Up and Procedure

In this research, the X-ray machine is (ANDREX 257 SMART 5A3 directional) with shielding room and the control box. For this X-ray machine, the warming time is about two minutes. Finishing the warming statement, the voltage and the ampere were typing in the control panel. According to the exposure chart, the exposure time was about 10sec, the voltage was 120kV and the ampere was 3amp and SFD was 700mm. After the exposure time, the film was taken from the sample table and it was processed in the film processing system.

And then the second experiment was done with 120 kV, 30amp, SFD (Source-to-Film Distance) 700mm and the exposure time was 30sec. And then the film processing was done with the procedure.

2.3. Film Processing Steps for Kodak Structuric

Stir the developer and fixer solutions. Measure the temperature and the thermometer is immersed in the developer for 2 minutes. Determine development time. Set timer to the time required for development. Lock the door. Switch on safelight and switch off all white lights. Unload film and attach film carefully to hanger. Avoid finger marks, scratches or bending. Immerse film completely in developer solution. Immediately raise and lower hanger continuously for the first 30 seconds. Then for every 1 minute, agitate the film for 5 seconds. When the alarm rings,

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take out the film and drain for 2-3 seconds. Place the film in stop bath. Agitate for 30 seconds. Immerse the film in fixer solution for 6 minutes. Agitate for the first 30 seconds. Then drain for 2-3 seconds. White light can now be switch on. Measure the water temperature to be used to wash the film. Wash the film in running water for a period of time. Immerse the film in photo-flo solution for 30 seconds and then drain for 5 seconds. Remove the film from hanger and then clip the film with clip hanger. Place the film in a drier for 30 minutes and the temperature is not more than 40°C. Keep the film well separated. When dry, remove the film from clip hangers and trim the corner with clip marks. Insert in identified envelopes. This procedure is in table 3.4 and the film processing room is in figure 3.16. During the period of film processing no film viewing is permitted.

2.4. Final Wash

The silver compounds which are formed during the fixing state must be removed from the emulsion, since they can affect the silver image at the later stage. For this reason the film must be washed thoroughly in running water. The duration of washing will depend upon the temperature of the water used. The relationship with temperature and washing time is in table 2.1.

Table-2.1 Washing Time for Film

Temperature (°C)	5-12	13-25	26-30	More than 30
Washing time (minutes)	30	20	15	10

3. RESULT AND DISCUSSION

In X-ray radiograph, the image of exposure time (10 sec) of the spark plugs is shown in fig. 3.1.

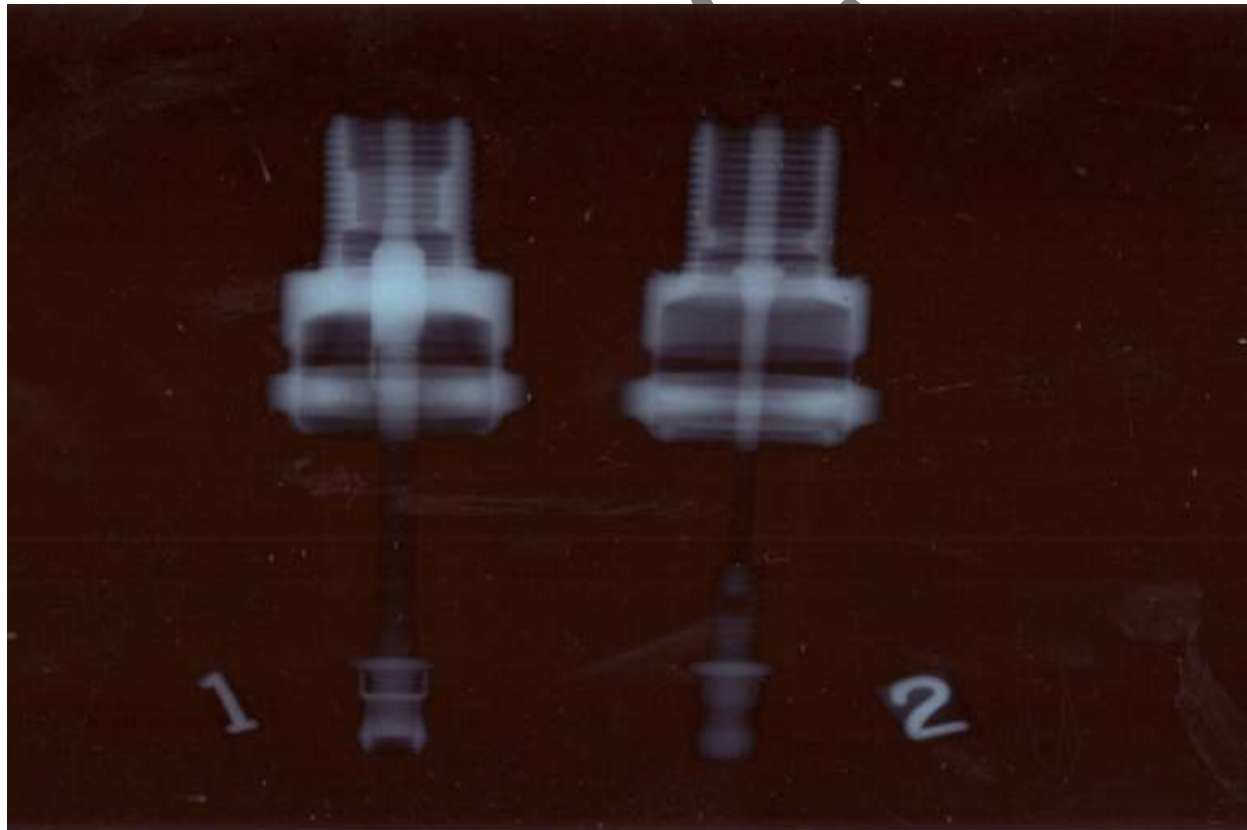


Fig. 3.1 The Image of X-Ray Radiograph of Spark Plugs (120kV, 3.0mA, 10sec)

This X-ray radiograph takes source to film distance (SFD) is 700mm and the voltage of the X-ray is 120kV, the ampere is 3.0mA and the exposure time is 10sec, the X-ray machine is ANDREX. In this X-ray radiograph, we cannot see the whole part of the electrode with film viewer. And also exposure time (10 sec) for X-ray radiograph does not have Image Quality Indicator (IQI) for multi materials. This exposure time cannot do the image of the multi materials of test material to be sharp and get good contrast.

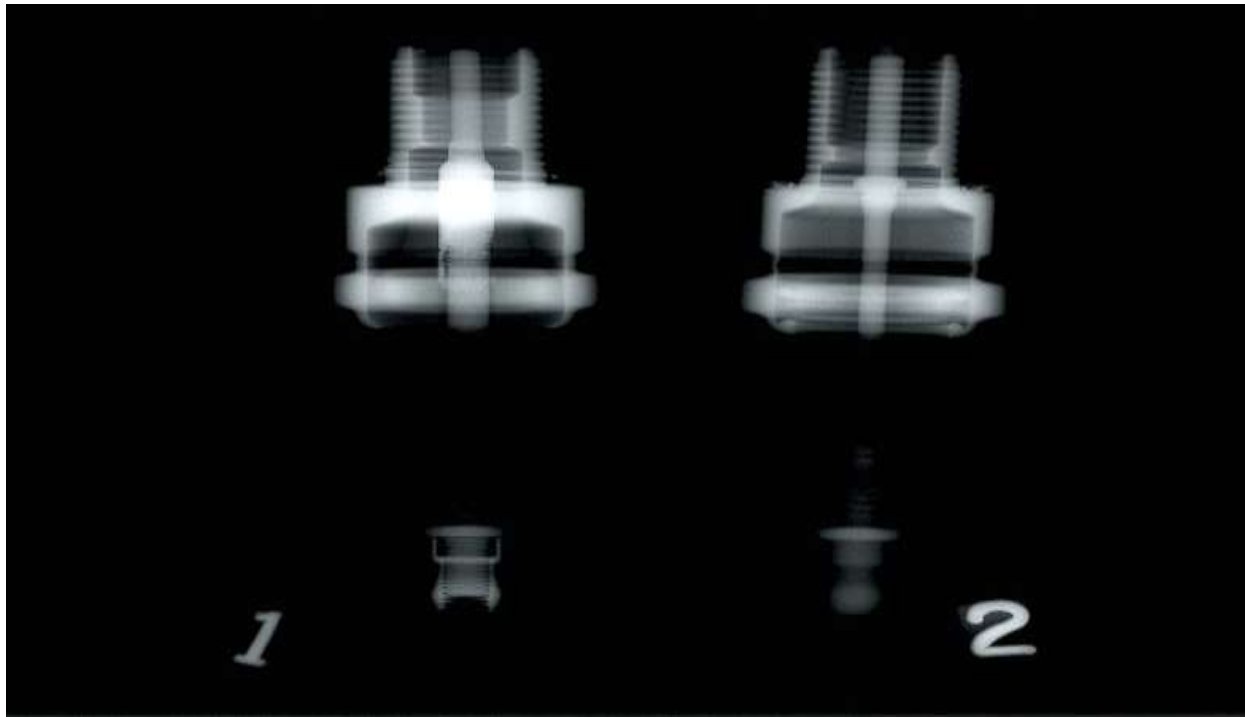


Fig. 3.2 The Image of X-Ray Radiograph of Spark Plugs (120kV, 3.0mA, 30sec)

Fig. 3.2 also shows the image of X-ray radiograph of spark plugs with different exposure time. This figure takes different exposure time of the spark plug with the same X-ray machine. For this image, the exposure time (source to film distance is 700mm, the X-ray voltage is 120kV, the ampere is 3.0mA, the exposure time is 30sec) is different and the image is more clear. The image of the whole part of the spark plug electrode and can imagine the defect of the electrode by using film viewer.

The image of spark plug can differentiate which spark plug upper portion is good or not. Really the exposure time (30 sec) can show the portion image of the spark plug and defect.

CONCLUSION

In this experiment, X-ray radiograph system had the X-ray machine, Control panel, film, biological shielding and film processing system. The sample of spark plug, from the internal combustion engine, has been investigated by using X-ray radiography system with two exposure times. The image quality of spark plug by using (30 sec) exposure time is better than (10 sec) exposure time. According to the results, not only X-ray machine, control panel, film, biological shielding but also exposure time is very important for good result of X-ray radiography system.

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