EVALUATING OF SPEED, BASE, FOG, AND GRADIENT OF X-RAY FILMS IN TERM OF EXPOSURE

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Abstract - Quality control is a process that is used to ensure a certain level of quality in a product or service. In this study, an experiment of Quality Control was done to evaluate the important parameters (film speed, base, fog, and gradient) that associated with Quality Control of film processing. The procedure was done by using three different methods. Two methods were modified using two types of sensitometers and the third one was done by using Aluminium stepwedge. The results that are achieved from these methods showed different values in every part for film speed, base and fog, and gradient. All the measured values were still in the acceptable of limit, except for gradient. The values of base and fog were within the acceptable range which is less than 0.22 OD (optical density). Whereas, steep of gradient was higher compared to the typical radiograph value.

Keywords - Quality control; X-Ray Film Processing; Sensitometer and Aluminium Stepedge; Optical Density

I. INTRODUCTION

Quality control involves thoroughly examining and testing the quality of products or the results of services [1-4]. The basic goal of this process is to ensure that the products or services that are provided meet specific requirements and characteristics, such as being dependable, satisfactory, safe and fiscally sound. It is an aspect of the quality assurance process that consists of activities employed in detection and measurement of the variability in the characteristics of output attributable to the production system and includes corrective responses[5-8].

Quality control of film processors is an important aspect of quality assurance program[9, 10]. Since processor operation can change in a short period of time, it should be checked daily. The most effective way to monitor film which has been given accurately known exposure. In this experiment, this procedure was done by using sensitometer and aluminium stepwedge. All procedures that were performed in this experiment are a part of quality control procedure which is an experiment on quality control of X-ray films processing.

II. EXPERIMENT ON QUALITY CONTROL OF PROCESSING OF FILMS

To evaluate the performance of film and film processor and determine half value layer (HVL) using aluminium stepwedge. The materials were used in this study are RMI aluminium stepwedge, RMI process control sensitometer model 201B (Figure 1), sensitometer model XRITE 396, RMI densitometer model 211C, film, automatic film processor, and illuminator. The method was started with using sensitometer model 201B, film was being slipped between the box and the spring clamp on the front of the sensitometer. Then, the film was exposed using the sensitometer. Then, the process was repeated at the other side of film on the other end. The film was being processed. All the procedures have been done in the dark room. After that, by using the densitometer, the optical density that has being produced was evaluated using specific indication. Graph was plotted and being evaluated. There were there important criteria need to evaluate in this experiment, which is film speed, film gradient (latitude) and base fog. Then, the procedure was repeated using sensitometer model XRITE 396. Quality assurance graph was plotted using all the data. Moreover, by using RMI aluminium stepwedge, the same type of film was being exposed under optimum exposure under 100cm SSD. Finally, the film was being processed, the optical density was evaluated and from the data, a characteristic curve of the x-ray film was plotted. HVL also be determined.

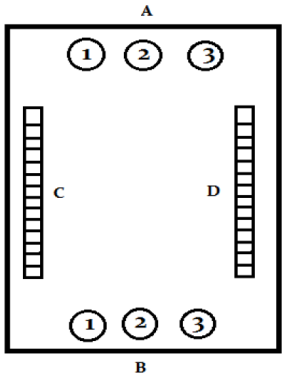


Figure1: RMI process sensitometer model 201 B

III. RESULTS AND DISCUSSION

Film is an important component used in radiology. Therefore, quality control for film and film processor is a must to ensure the good radiograph will be process. Optical density is defined as percentage of light transmitted through the film. It is an important parameter in order to determine the image contrast in

diagnostic imaging. In this experiment, the values of OD obtained were highly depending on chemical processing in the film processor. Two different optical densities were obtained from two sensitometers. Figures 2 and 3 show that the optical densities reading are increased as the step number is increased to reach maximum value and start to be constant. The performance was evaluated based on the measurement of optical density and also from the film speed, film latitude, toe and shoulder.

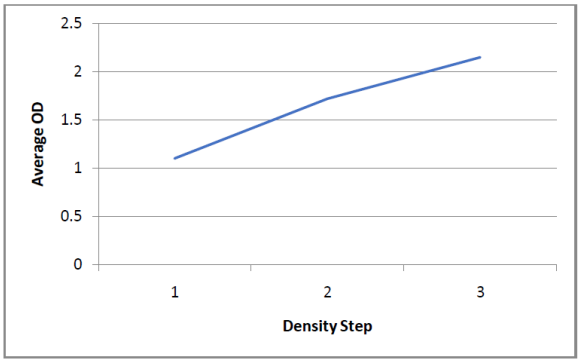


Figure 2: Three reading of optical density of the film by using RMI process sensitometer model 201 B

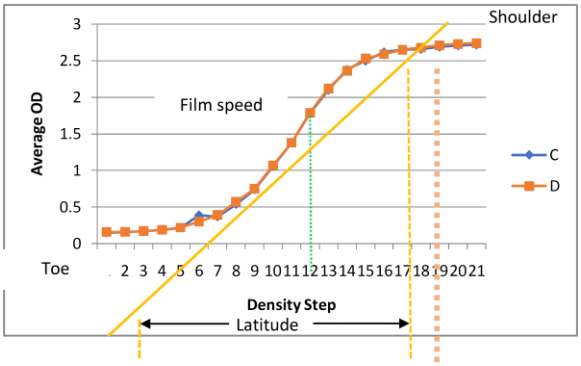


Figure 3: The optical densities of 21 step of Sensitometer model XRITE 396

Base and fog define as the optical density when there is no exposure. Base and fog usually occurred due to heat, light or chemical. Based on theory, the value of base and fog must not exceed 0.22 OD, (Radiologic Science Student, 2008). From the results, the value of base and fog is 0.15 OD which was within the range of acceptable value. Latitude is a range of exposure. It is the linear region that has highest level of contrast. It was calculated from the highest OD minus lowest OD obtained. The steeper the gradient that observed from the graph indicates that the contrast produced is higher. From this experiment, the contrast was not same for each method. For diagnostic purpose, the latitude usually lies from range of 0.5 OD until 1.25 OD above the base fog. However, from our experiment, the range of latitude had been exceeded the value. For instant, the gradient that was observed from the graph was not too steep.

Another important aspect that we observed from the graph was film speed. Film speed is defined as the amount of density produce by given exposure. It was measured at the midpoint or the intercept. Film speed depends on performance of crystal and size of grain of the film. By using 21 step sensitometers, it shows the film speed of films is 1.79 O.D and 1.72 OD by using the 3 step sensitometer. The differences of OD reading obtained from different sensitometers might be causing of lack of maintenance of the equipment.

Aluminium Stepwedge

Figures 5 and 6 show that each method produces different value from each other. The most effective way to monitor the film performance was by using sensitometer. However, using aluminium stepwedge also is necessary method. There were seven shades of gray obtained for aluminium stepwedge. Based on the value of OD obtained from aluminium stepwedge, it shows that lighter image will form as the thickness of aluminium were increase.

This is due to the attenuation that occurs in different thickness. As the thickness increased, there were more attenuation occurred. Therefore, light image formed on the film. Same goes to if the thickness were decreased; more x-ray will penetrate the aluminium. Thus, darker image was formed on the film.

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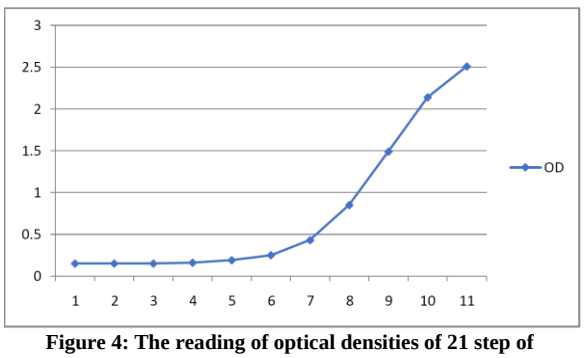


Figure 4: The reading of optical densities of 21 step of Sensitometer model XRITE 396 for 50 kVp, 20 mA, 1.8 msec

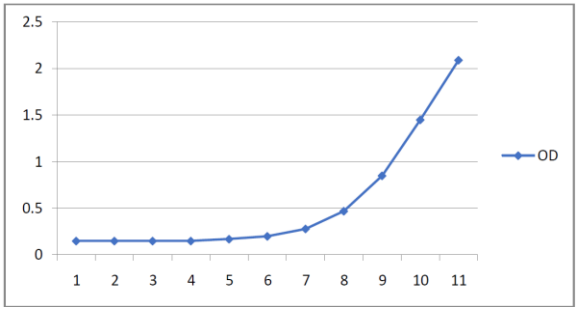


Figure 5: The reading of optical densities of 21 step of Sensitometer model XRITE 396 for 55 kVp, 20 mA, and 0.5 sec

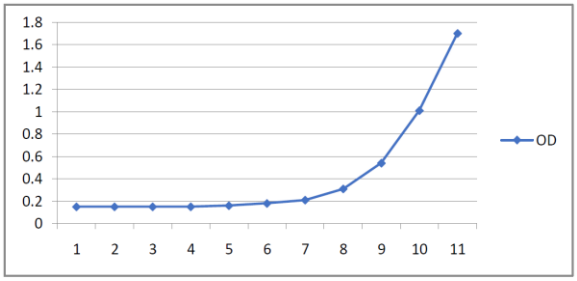


Figure 6: The reading of optical densities of 21 step of Sensitometer model XRITE 396 for 55 kVp, 20 mA, 0.28 msec

IV. CONCLUSION

By using these three different methods of evaluating, all the methods are given different values. From the results, all the base and fog values were within the acceptable range which is less than 0.22 OD. However, steep of gradient was higher compared to the typical radiograph value.

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