SNS COLLEGE OF ALLIED HEALTH SCIENCES- COIMBATORE 35

DEPARTMENT : RADIOGRAPHY AND IMAGNG TECHNOLOGY

SUBJECT : GENERAL PHYSICS, RADIATION PHYSICS AND PHYSICS OF DIAGNOSTIC RADIOLOGY

PAPER : PAPER II

TOPIC : 4.1 MANUAL IMAGE PROCESSING

MANUAL FILM PROCESSING PROCEDURE

MANUAL FILM PROCESSING EQUIPMENT

1. Developing, rinsing, fixing, and washing tanks.
2. Immersion heater.
3. Chemical stirring rods.
4. Thermometer.
5. Film hangers
6. Dryer.
7. Gloves and goggles protective waterproof apron.
8. Mopping cloths, hand towels for cleaning darkroom floor and hands

MANUAL FILM PROCESSING PROCEDURE

MANUAL-PROCESSING PROCEDURE STEPS

1. The levels of developer chemicals and fixer should be checked and replenished. The developer should be stirred well and make sure that chemicals should be at the proper temperature.
2. The workbench should be cleaned and dry, make sure that the safelight is functioning properly and the filter of the safelight is correct for the films.
3. Close the darkroom door, then switch on the safelight and switch off the white light.
4. The cassette is placed on the workbench and carefully opens the cassette. The exposed film should be removed with clean, dry hands and should be handled by comers and edges only.
5. The exposed film is clipped into a suitable-sized hanger. The corners of a film should be checked for proper placement, and then the hanger is immersed in the developing tank for the developing process. The developing agent converts the exposed silver halide into metallic silver. The hanger is agitated two or three times within the developing tank for fresh chemicals.

MANUAL FILM PROCESSING PROCEDURE

MANUAL-PROCESSING PROCEDURE STEPS

6. After developing the film is removed from the developer and Immerse in The stop bath or rinse bath for 30 seconds. The stop bath or rinse bath stops the development process and removes the excess developer from the film.
7. The film is removed from the rinse tank and immersed in the fixing tank. The fixer solution removes the undeveloped silver halide crystals from the film emulsion and also hardens the emulsion.
8. After proper fixing and hardening, the film is removed from the fixer and immersed in the washing tank for 20-30 minutes, where excess fixer is removed from the film before it is allowed to dry.
9. The film is then removed from the hanger for drying. The drying process can be accomplished either by an electric dryer or by room air. The dying process removes the moisture and hardens the radiographic image on film. The film should be dried in a dust-free environment to prevent artifacts.
10. After completion of the procedure, the lids of the developer and fixer are closed to prevent oxidization. The cassette is reloaded with a new film and placed in the pass box.

MANUAL FILM PROCESSING PROCEDURE

SAFETY PRECAUTIONS IN FILM PROCESSING :

1. The processing solutions should not come in contact with skin and eyes and the chemical fumes should not be inhaled. The film solutions are hazardous to health.
2. Before the film processing, the developer and fixer should be stirred well. Use separate stir rods for the developer and fixer. The developer and fixer should be kept full and changed when they become weak or within 30 days.
3. The rinse tank and washing should be kept full and changed every day.
4. The personals should wear protective clothing during the handling of chemicals.
5. Suppose the processing solution is spilled. It should be cleaned immediately.
6. The wet and dry bench of the darkroom should be cleaned and dry, and the floor of the darkroom must be mopped every day.
7. Ensure that there should be no white light and light leakage in a dark room.
8. The films must be handled at the corners with clean, dry hands in suitable hangers. The dust or chemical residual on hand can cause unwanted marks on the film as well as on intensifying cassette.

MANUAL FILM PROCESSING PROCEDURE

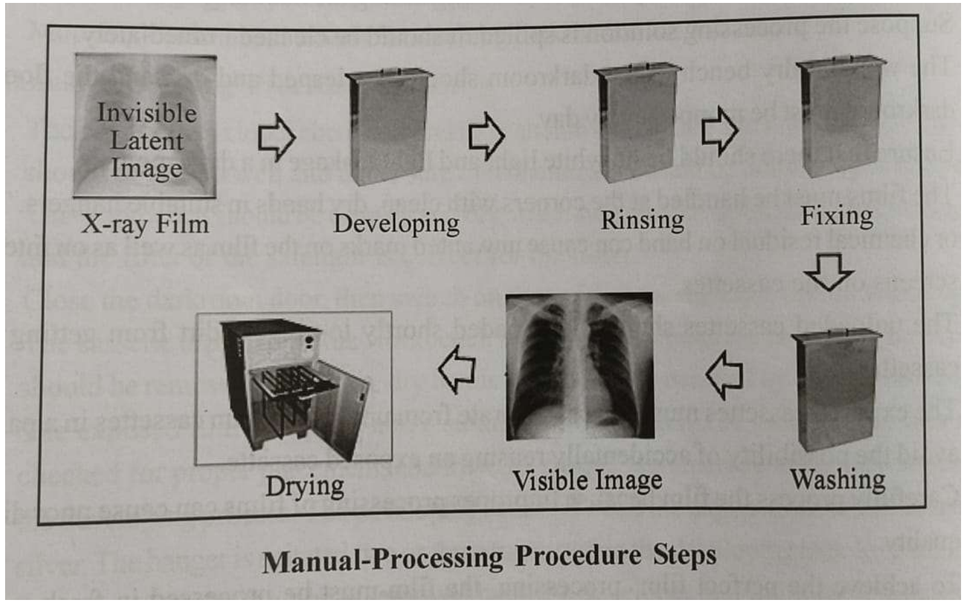
SAFETY PRECAUTIONS IN FILM PROCESSING :

9. The unloaded cassettes should be reloaded shortly to prevent dirt from getting into the cassette.
10. The exposed cassettes must be kept separate from unexposed film cassettes in a pass box to avoid the possibility of accidentally reusing an exposed cassette.
11. Carefully process the film because Improper processing of films can cause poor diagnostic quality.
12. To achieve the perfect film processing, the film must be processed in fresh processing solutions and in running water at the proper temperature.
13. To achieve a perfect film contrast and proper image density, the correct radiographic factors should be given.
14. The darkroom film fog decreases the radiographic contrast and density. The darkroom film fog possibly will be caused by unsafe safelights, white light leakage, excessive developer time, excessive temperature.
15. The darkroom should be well ventilated and ensure that the processing solutions do not mix with each other.

MANUAL FILM PROCESSING PROCEDURE

FACTOR AFFECTING THE FILM QUALITY :

- **a. Dichroic Fog :** When the developer mixed with fixer greenish-blue and pinkish stains a on X-ray film. Appears
- **b. Brown Stains :** When the developer is oxidized, the brownish stains appear on the X-ray film.
- **c. Streaks :** Prolong the development of film causes streaks on X-ray film.
- **d. Scratches :** Improper handling of hangers.
- **e. Electrostatic Charge :** Appears due to friction of films.
- **f. Fingers Marks :** Improper handling of the film causes Finger marks.
- **g. Film Fog :** Film fog occurs due to Improper safe lighting Light leakage, Over development, Exposed to radiation, film stored at high temperature and at high humidity.
- **h. Inadequate Contrast :** Inadequate Contrast occurs due to Under development, Under exposure and Excessive film fog.



Manual-Processing Procedure Steps

LATENT IMAGE FORMATION (EMULSION LAYER)

- The emulsion (3-5µm thick)is coated over the adhesive layer. Emulsion is consists of gelatin and silver halide crystal in a uniform manner.
- Gelatin is transparent to light and porous for chemicals. It gives support for silver halide, by holding them properly. among the halides, silver bromide (98%)and silver iodide (2%) is used as crystal in the film.
- These halides are flat and high atomic numbers, bromide (Z=35),silver (Z=47), and iodide (Z=53), compared to gelatin (Z=7).
- The halide crystals are available in tabular, cubic , octahedral, polyhedral or irregular grain shapes. Tabular grain shape thickness (0.1µm)is commonly used in radiography.

LATENT IMAGE FORMATION (EMULSION LAYER)

- The crystal formations are done in dark as follows; the metallic silver is dissolved in nitric acid, to form a silver bromide.
- **Ag** (metallic silver) + **2** $\boldsymbol{HNO_3}$ (nitric acid) → $\boldsymbol{AgNo_3}$ (salt) + $\boldsymbol{No_2}$ (gas) + $\boldsymbol{H_2}$ **O** (water)
- $\boldsymbol{AgNo_3}$(silver nitrate) + **KBr** (potassium bromide) → **AgBr** (silver bromide) + $\boldsymbol{KNo_3}$ (potassium nitrate)
- This is done in the presence of gelatin under given temperature and pressure conditions.
- The arrangements of an atoms in the crystal is cubic and lattice structure that has imperfections. These imperfections provide the sensitivity centers, for latent image formation.
- Direct exposure film has thicker crystals than screen type film. The film speed is controlled by size and concentration of the crystal.

LATENT IMAGE FORMATION (EMULSION LAYER)

- When the film is exposed to X-rays, photon interacts with bromine (photon + Br^- = Br + e^-)and releases secondary electrons .
- These interactions are either photoelectric or Compton type. These electrons migrate to the sensitivity center and get trapped.
- Mobile silver atoms (Ag^+) are attached to the sensitivity centers, where they combine with electrons and become metallic silver ($Ag^+ + e^-$ = Ag).
- The metallic silver atoms give latent image, which is invisible. Basically, the bromine and iodine are present at the surface, whereas silver is inside the crystal. mostly electrons provided by bromine and iodine atoms, resulting in collapse of crystal structure.
- As a result bromine and iodine are free to move to the gelatin area. No more ionic force is acting in the crystal.

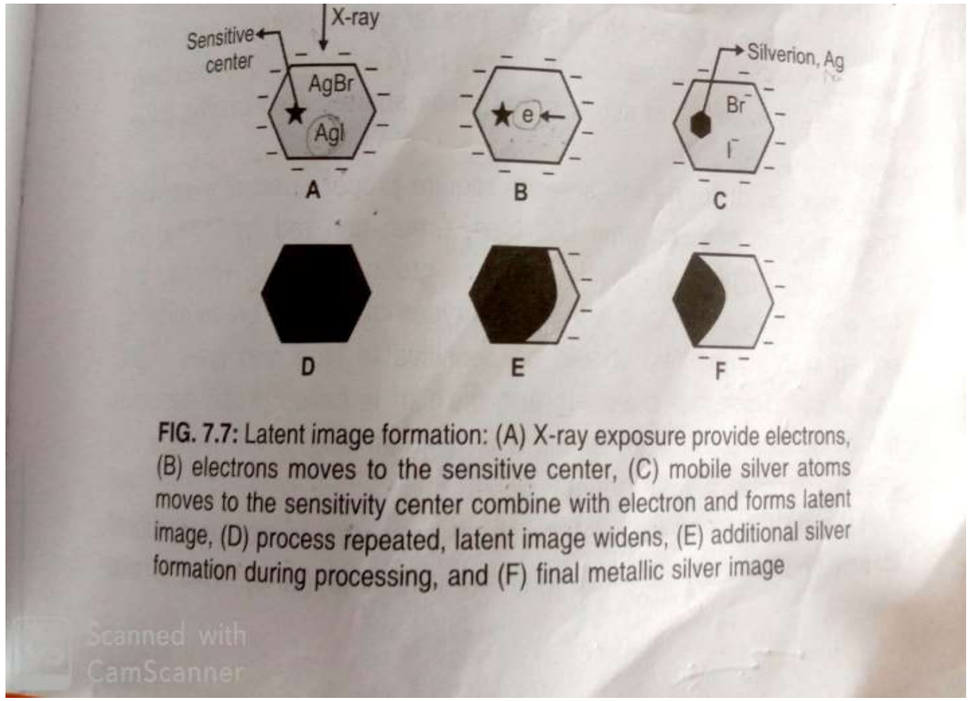


FIG. 7.7: Latent image formation: (A) X-ray exposure provide electrons, (B) electrons moves to the sensitive center, (C) mobile silver atoms moves to the sensitivity center combine with electron and forms latent image, (D) process repeated, latent image widens, (E) additional silver formation during processing, and (F) final metallic silver image

SILVER RECOVERY

- The X-ray film has a thin coating of silver compounds.
- During the film processing, the fixer washes away the unexposed silver which comes into the fixing solution.
- When the amount of dissolved silver reaches saturation level, no more fixing of films can be done.
- The concentration of silver can be checked by silver estimation paper.
- Three methods are used for recovering the silver from waste fixer,
- 1. Chemical method.
- 2. Electrolysis method.
- 3. Metallic replacement method.

SILVER RECOVERY

Chemical Method of Silver Recovery from Waste Fixer

- Silver recovery from waste fixer is made by the sodium hydroxide precipitation method. The NaOH has added to the waste fixerand stirs for 30 minutes to complete the precipitation. Allow the precipitate to be settled. The precipitate is collected and dried for three hours under low heat.
- The dried sample is transferred into a ceramic container with borax then the mixture is smelted. The crude silver is isolated in the smelting.

The Electrolysis Method

- In the electrolysis method, the waste fixer is placed in a tank. The tank consists of two electrodes. The Anode is made up of carbon or graphite and the cathode ismade up of stainless steel or alloy. The direct current is applied between two electrodes. Thesilver in the solution starts depositing on the cathode.

Metallic Replacement Method

- In the metallic replacement method, the ion exchange takes place. Iron, zinc and copper are more active metals than silver and these are called base metals. The base metal donates the ions and accepts the silver ions. So the silver is deposited on the base metal. The residual is known as silver sludge.

INTERROGATIONS

1. Steps for manual film processing
2. What is latent image formation ?
3. What is silver recovery ?

REFERENCES

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2.Diagnostic Radiography – A concise practical Manual – Glenda J. Bryan (4th edn),

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THANK YOU