General Radiology

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Q1:- Differentiate b/w Calcium Tungstate Screen & Rare Earth Screens.

	Calcium Tungstate Screens	Rare Earth Screens
(1)	Calcium tungstate emits blue light	Rare Earth- emits green light.
(2)	It is not as efficient - It is not used as often.	It is most efficient - most common in use today.
(3)	Calcium Tungstate Screens are slower than Rare Earth Screen.	Rare earth Screen are faster than calcium tungstate because they have higher absorption

Rare Earth Screen

→ efficiency at the mean x-ray energies normally used in radiology.

→ Rare earth screen also have a higher conversion efficiency and produce more light for a given amount of deposited x-ray energy.

→ Rare Earth screen have increased speed for two reason:-

(1) Detecting Quantum Efficiency (DQE) or the ability to absorb the photons (High Z number)

(2) Conversion Efficiency:- Amount of light emitted per x-ray.

→ Phosphors:- Modern screens use rare earth screen elements such as:- (1) Gadolinum
(2) Lauthanum
(3) Yttrium

Calcium Tungstate Screens

→ Calcium tungstate screen have high x-ray absorption ability and physically strong but it lacks in light conversion ability.

→ These blue emitting intensifying screens are less efficient than the now standard rare earth screen. They results in comparatively higher patient dose and more motion artifacts with resultant repeat examination.

→ Calcium Tungstate was used as phosphor. It absorbs the x-ray photon and converts it to visible light that is recorded by the film.

→ Calcium tungstate ($CaWO_4$): blue light

→ lanthanum oxybromide: blue light

→ Gadolinium oxysulfide:- Green light.

Q2:- Explain the latent Image formation?

Formation of Latent Image:-

→ The latent image is the invisible change that is induced in the silver halide crystal.

→ The Image-forming x-ray exiting the patient and incident on the radiographic intensifying screen-film deposit the visible light energy in the emulsion primarily by interaction with atoms of the silver halide crystal.

→ This energy is deposited in a pattern that is representative of the anatomical part that is being radiographed.

→ Immediately after exposure no image can be observed on the film.

→ An invisible image is present however it is called latent Image.

→ With proper chemical processing, the latent image becomes a visible image.

• Silver Halide crystal:-

→ The Silver, bromine and iodine atoms are fixed in the crystal lattice in ion form.

→ Silver is a positive ion, and bromide and iodide are negative ions.

→ When a Silver halide crystal is formed, each Silver atom releases an outer-shell electrons which becomes attached to a halide atom (either bromine or iodine)

→ The Silver atom is missing an electron and therefore is a positively charged ion identified as Ag^+.

→ The bromine and iodine atoms each have one extra electron and therefore are negatively charged ions identified as bromine and iodide (Br^- and I^-) respectively.

→ The Silver halide is not as rigid as some crystals such as diamonds.

→ The halide ions, bromide & iodide are generally found in concentration along the surface of the crystal.

→ Therefore the crystal takes a negative surface charge which is matched by the positive charge of the interstitial Silver ions & the Silver ions inside the crystals.

Photon Interaction with Silver Halide crystal:-

When the light photons from the radiographic intensifying screen interacts with film. It is the interaction with the silver and halide atoms (Ag, Br) that forms the latent image with the silver/halide atoms. This interaction releases electrons in the crystals.

Secondary Election Formation:-

$$Br^- + Photon \rightarrow Br + e^-$$

→ These electrons are release with sufficient energy to travel a large distance with in the crystal

⇒ While crossing the crystal the electron may have sufficient energy to dislodge

additional electrons from the crystal lattice.

→ The result is the same whether the interaction involves visible light from a radiographic intensifying screen or direct exposure by x-rays.

Metallic Silver formation:-

$$e + Ag \rightarrow Ag$$

→ Most of these electron come from bromide and iodide ions because these negative ions have one extra electron.

→ The bromine and iodine atom are now free to migrate because they no longer are bound by ionic forces.

→ They migrate out of the crystal into the gelatin portion of the emulsion.

- **Latent Image:-** The concentration of electrons at the sensitivity center produces a region of negative electrification

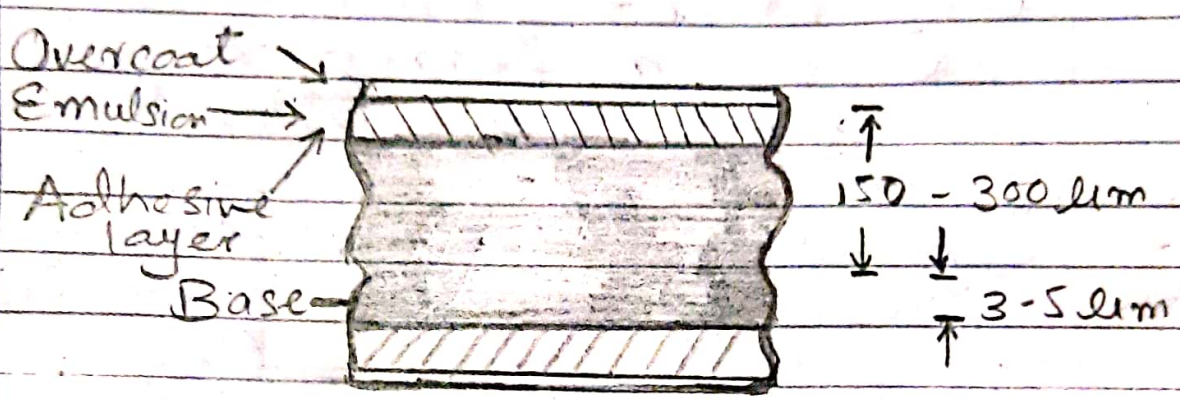
→ As halide atoms are removed from the crystal, the positive silver ions are electrostatically attracted to the sensitivity center.

→ Consequently, the silver deposition is not observable, even microscopically.

→ Crystals with silver deposited at the sensitivity center so the visible qualities form during processing to create the radiographic image.

→ The unobservable formation contained in radiation activated and inactivated silver halide crystal constitutes the latent image.

Q3:- Briefly describe the construction of Radiographic film with diagram-



Radiographic film manufacture is a precise procedure that requires tight quality control.
Manufacturing facilities are extremely clean because the slightest bit of contaminant in the film limits the film ability to reproduce information from the x-ray beam.

→ Radiographic film has two parts; the base and Emulsion-

In most x-ray film the emulsion is coated on both sides, therefore most film has two layers of emulsion so it is referred to as Double Emulsion film.

→ Between the emulsion and base is a thin coating of material called Adhesive layer which ensures uniform adhesion of the emulsion and base to maintain proper contact and integrity during use and processing.

→ The emulsion is enclosed by a protective layer covering of gelatin called the overcoat. It protects the emulsion from scratches, pressure etc. Processed film may be handled with very less regard for damage.

→ Base is the foundation of radiographic film which provide a rigid structure into the emulsion can be coated. Base maintain size and shape during the use of processing.

→ Emulsion is the heart of the radiographic film. It is the material with which x-rays or light photons form radiographic intensifying screen interact.

→ The emulsion consists of a very homogeneous mixture of gelatin and silver halide crystals about 3 to 5 μm thick.

→ Gelatin is clear so it transmits the light to the silver halide crystals.

→ It is porous so the processing chemicals can penetrate to the silver halide crystals.

→ Its primary function is to provide a support medium for the silver halide crystals by holding them in place.