UNIVERSITY OF SCIENCE, VNU HCM

FINAL EXAMINATION

Semester 1 - Academic Year 2023-2024

STORAGE CODE (to be filled by the QA-AE department)

Course name:	**Applications of Nuclear Engineering in Industry**	**Code:**	**NTE10108**
Exam Duration:	**60 minutes**	Date:	**13/01/2024**

Note: *Students* [□ *are allowed /* □ *not are allowed*] *to use materials during the exam.*

Question 1 (2 points): Describe the principles of radiography? What factors affect the quality of the film?

Solution:

Describe the principles of radiography:

- The reduction in the intensity of X-ray or gamma rays as they pass through a material is called attenuation.
- Attenuation depends on the energy of the X-rays, the type of material and the thickness of the material the rays pass through.
- Defects in the material are reflected in changes in the thickness (if the defect is a void) or changes in density (if the defect is a localized area of increased density).
- The presence of defects will result in variations in the attenuation coefficient of the material being recorded on a radiographic film.
- Increased thickness will result in changes in the darkness of the film.
- Therefore, changes in the darkness of the film will provide information about the type, size, and location of the defect.

Factors affect the quality of the film:

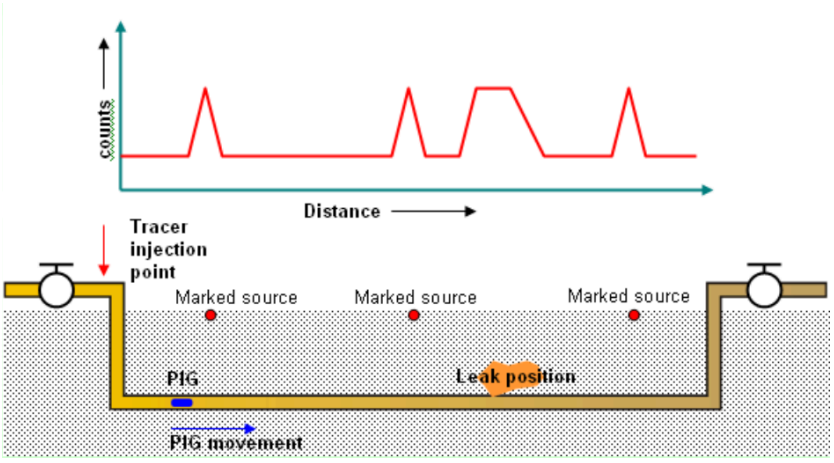
- The fixed exposure parameters of film-type
- SFD
- processing technique
- focal spot size and
- the quality/quantum of X-ray energy.

Question 2 (3 points): To handle the leakage of domestic water in water pipes 3m below the ground and not detected by the eyes. Please tell us which nuclear technique can be used. From there, please suggest a radiation measurement system to be able to survey this

situation. Present the steps (measurement principle, isotopes used and experimental layout and advantages of this method).

Solution:

- The technique can be used: Radioisotope radiography (RIR) is a method of surveying processes by introducing suitable radiopharmaceutical compounds along with materials into the system to investigate the movement and transformation processes of the system through a radiation measurement system without the need to halt production operations.
- The system: A small amount of gamma-emitting tracer material is pumped in pulses into a pipeline to create a radioactive "piston," followed by a detector "probe" to detect any radiation leakage into the environment. The probe is capable of recording radiation counts over time and storing the data in its memory. Based on the probe's movement speed and the timing of detecting excess radiation, the location of the leakage in the underground pipeline can be determined.



Question 3 (3 points):

a. State the general principle of the ultrasound method. (2 points)

b. An employee wants to check the thickness of a metal plate, which type of probe should he use in the ultrasonic method? Suppose this employee uses the IIWV1 standard plate (see Appendix), and uses a range of 150mm. How many reflected pulses are there on the device screen and how many millimeters are each pulse apart? (1 point)

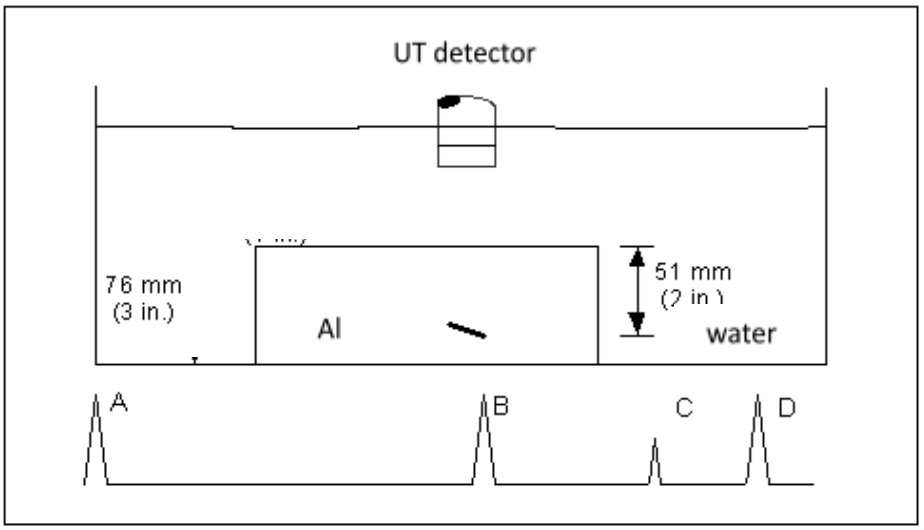
Solution:

a. The general principle of the ultrasound method: When high voltage is applied, a piezoelectric crystal "vibrates" at its resonant frequency and generates short high-frequency pulses. Ultrasonic waves, high-frequency sound waves, are transmitted into the test material, reflected from surfaces/discontinuities. The energy of the reflected sound is detected by the equipment, processed, and displayed corresponding to the propagation time and the size of the reflecting surface, indicating the presence, location, and size of defects.

b. The number of reflected pulses can be seen: 150/25 = 6 pulses

Distance between two pulses: 25 mm.

Question 4 (2 points): Given the following picture:



a. State the meaning of the indicator pulses A, B, C and D. (1 point)

b. Calculate the distance from indicator C to indicator D (give detailed calculation method). (1 point)

Solution:

a. The meaning of the indicator pulses

Pulse A: initial pulse

Pulse B: reflected pulse from the front surface of the Aluminium plate

Pulse C: reflected pulse from the defect inside the Aluminium plate

Pulse D: reflected pulse from the back surface of the Aluminium plate

b. Calculate the distance from indicator C to indicator D: 76 – 51 = 25 mm

---THE END---