Fényképalbum11

szerző: PGY

Other medical tracers

^{99m}Tc

- detects necrotic heart tissue.
- evaluation of kidney function.

^{201}Tl

- used to show blood flow in the heart.

Many additional isotopes are used associated with CT and MRI imaging.

- varies based on organ being evaluating.

Siltation measurement

The movement of mud and sand in river estuaries.

Tracer to use.

Since the study is relatively short term, use a short half-life tracer.

Use an insoluble form of the tracer

($^{140}BaSO_4$ - $t_{1/2}$ = 12.8 days)

Due to the volume, several curies may be required.

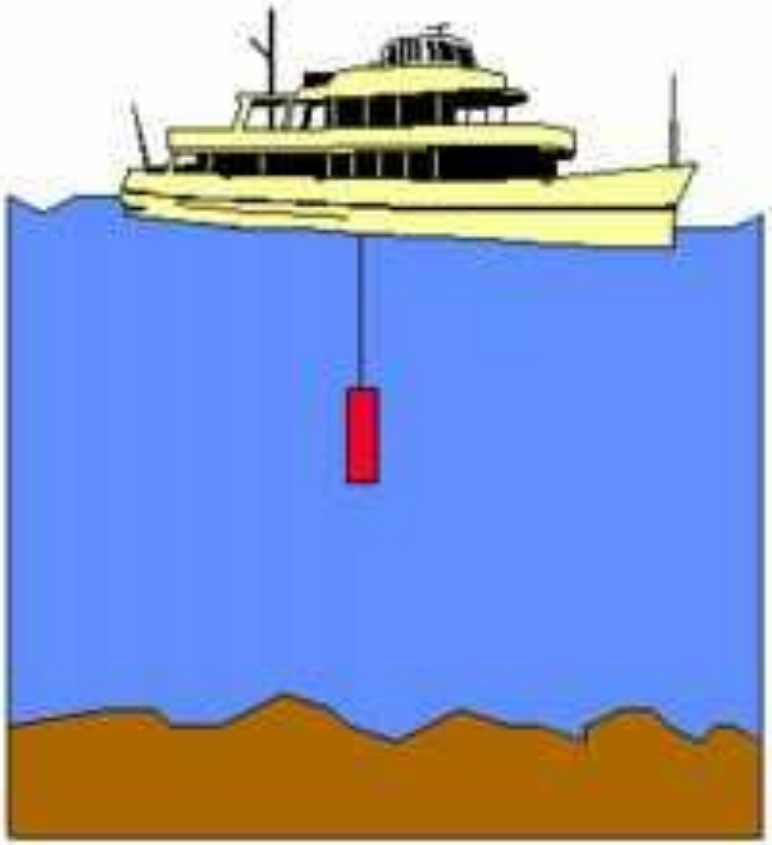
Siltation measurement

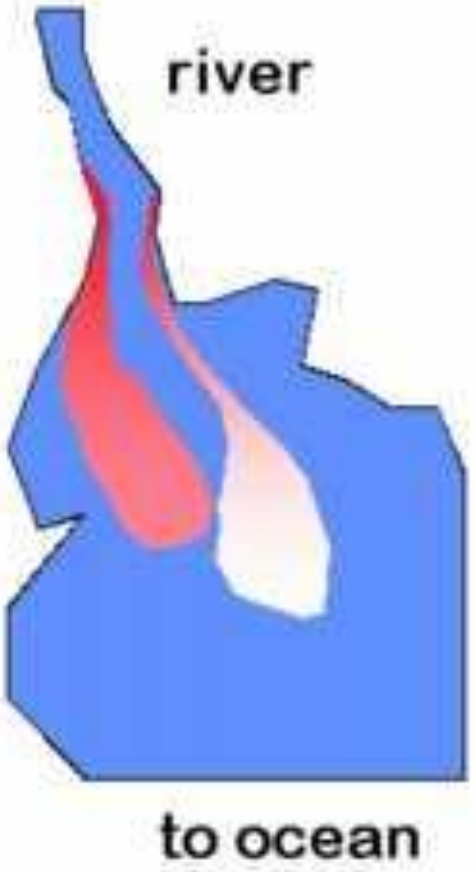
Grind precipitate to a size range that is representative of river silt.

Dump tracer in the river at a known point.

Send a boat into the estuary with a suspended detector to map the silt patterns.

Siltation measurement





This type of study can help predict how often commercial waterways will need to be dredged.

Movement of ground water

This approach can be used to determine the source of ground water or monitor landfill leakage.

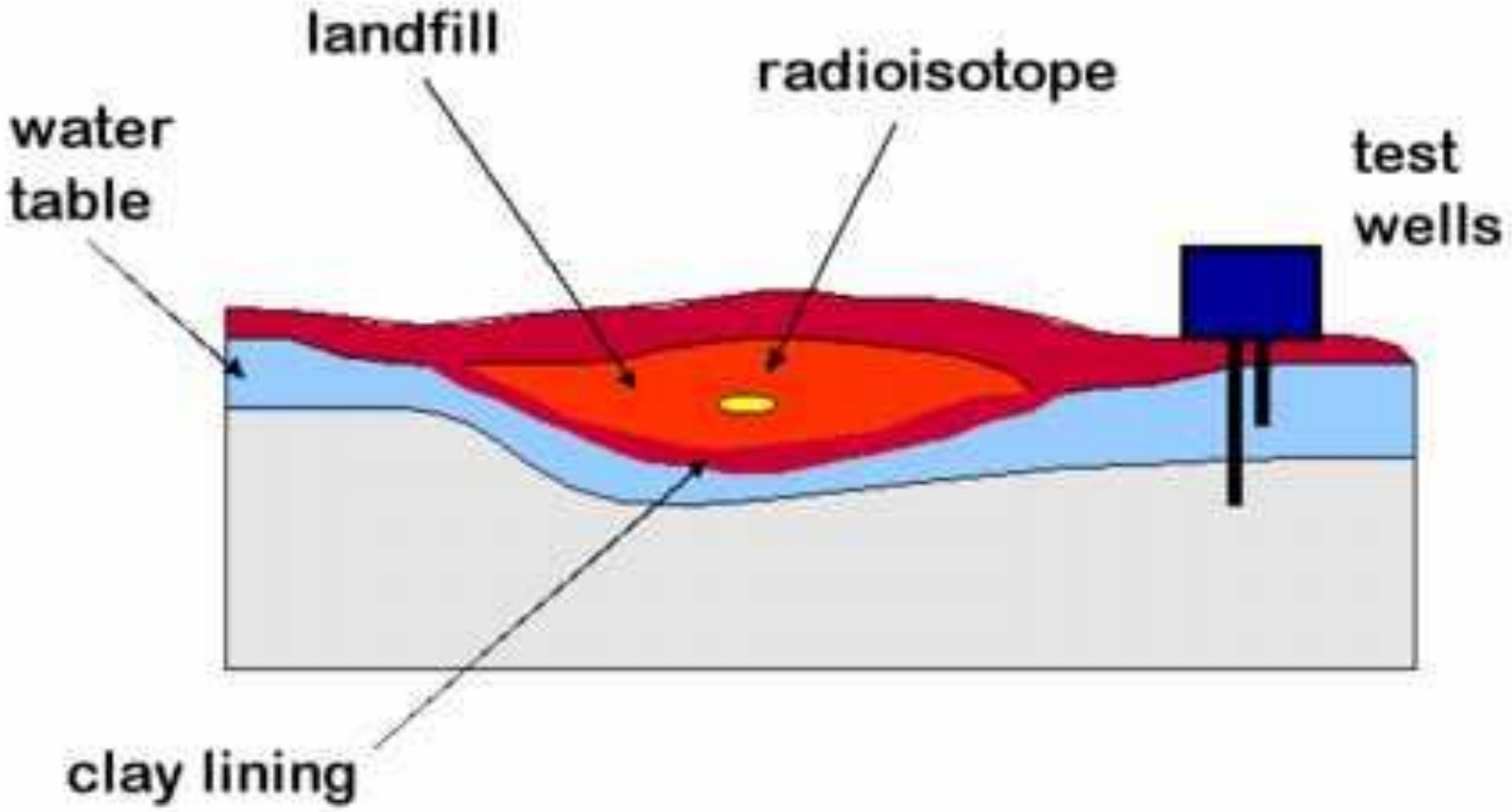
Landfill example

Bury a long half-life isotope in a slightly soluble form.

Monitor wells around landfill for activity.

You will be able to tell degree and direction of any leakage.

Movement of ground water



Leak detection

While massive water leaks may be easy to locate, smaller ones are more difficult.

Adding a small amount of a radioisotope (^{24}Na - $t_{1/2}$ 15 hours) can be used to determine leaks.

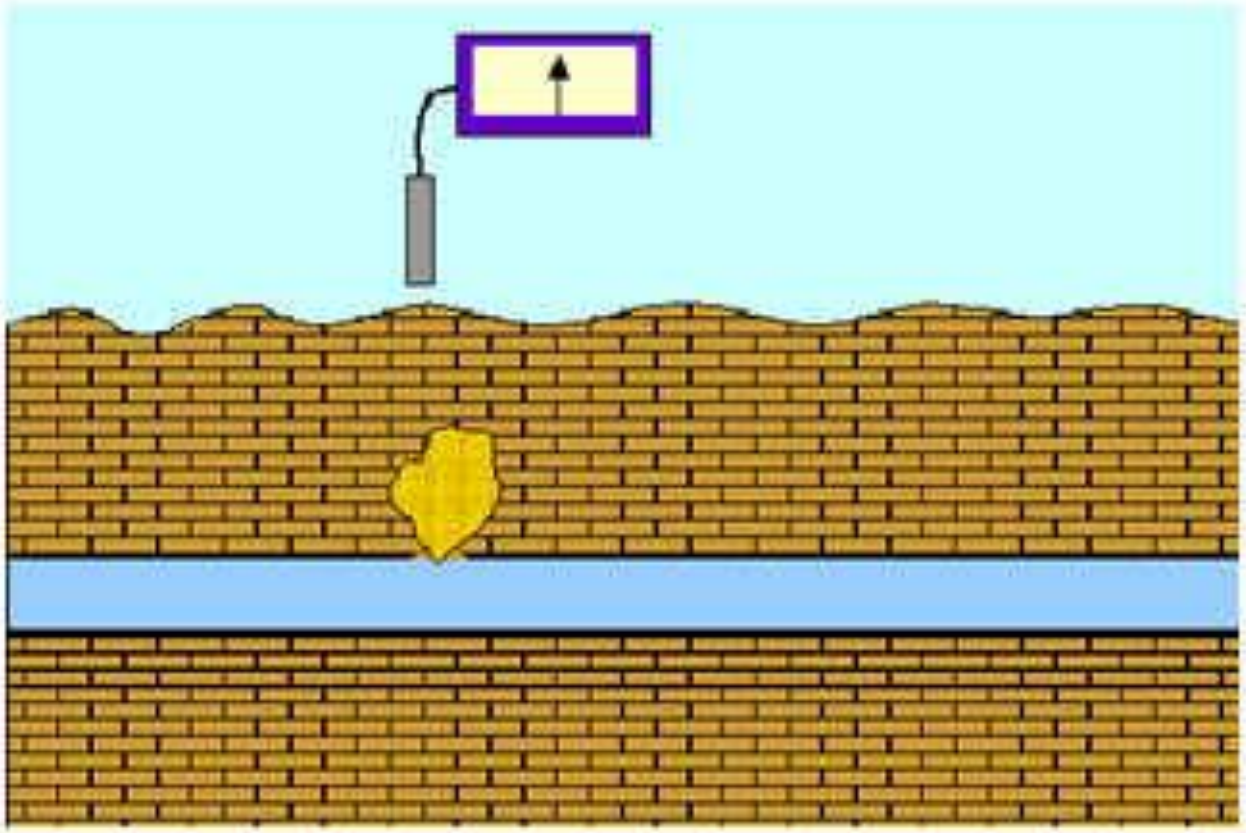
A plug of the isotope can be added to the water line and followed with a detector.

While the water should be flowing, people should not be using it.

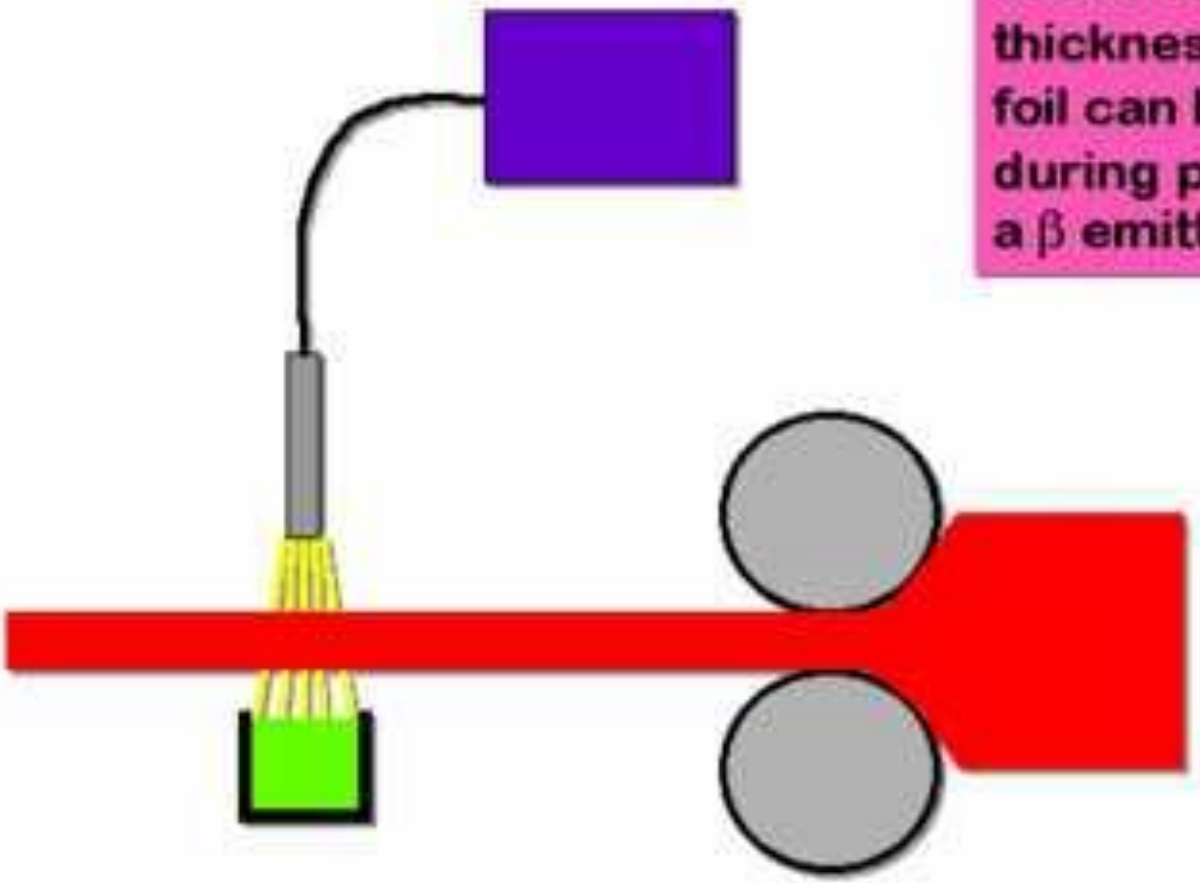
Leak detection

Some isotope will remain at the point of the leak.

Small amounts of isotope are retained on the pipe and help you find the line to begin with.

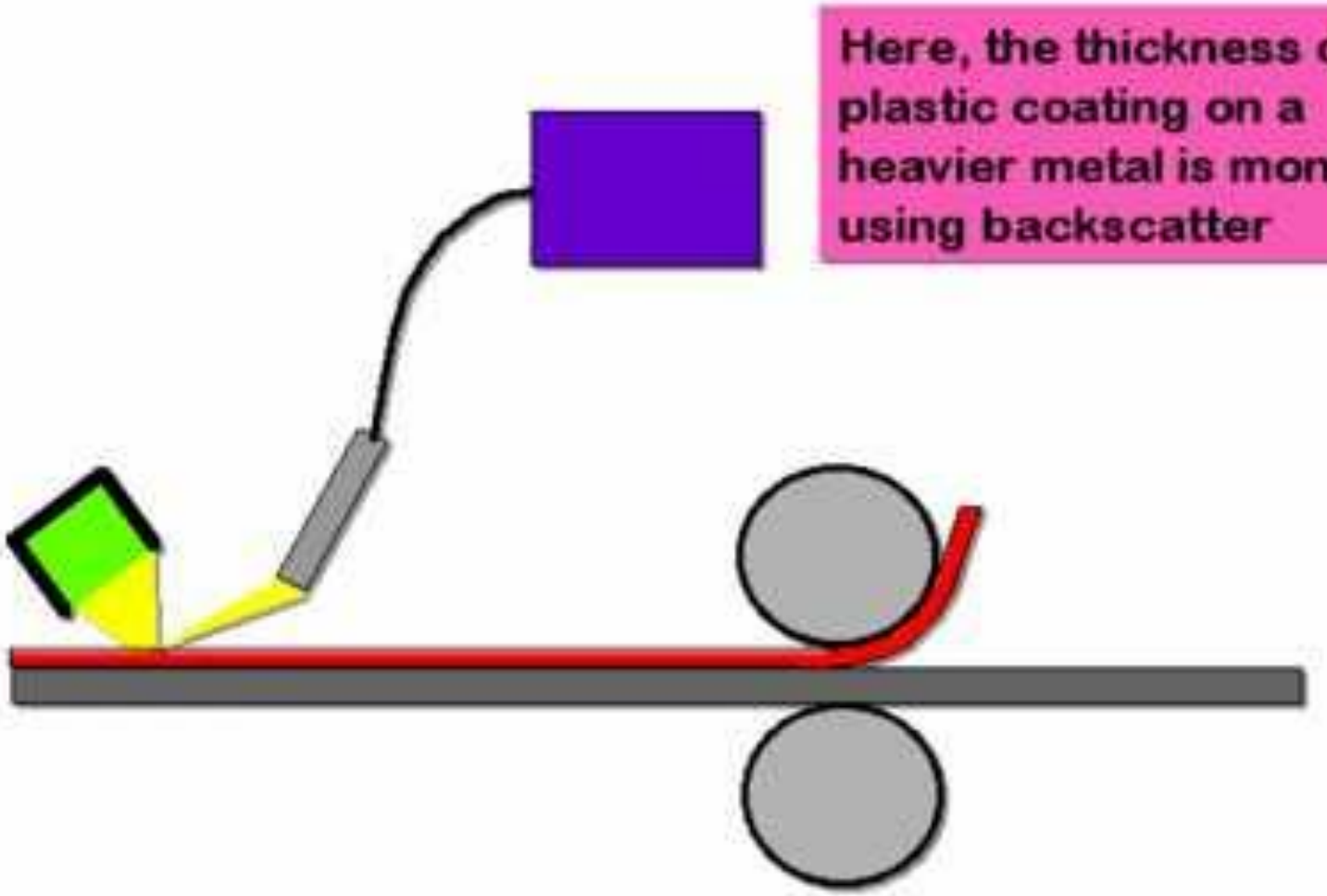


Thickness measurement



In this example, the thickness of aluminum foil can be monitored during production using a β emitter.

Thickness measurement

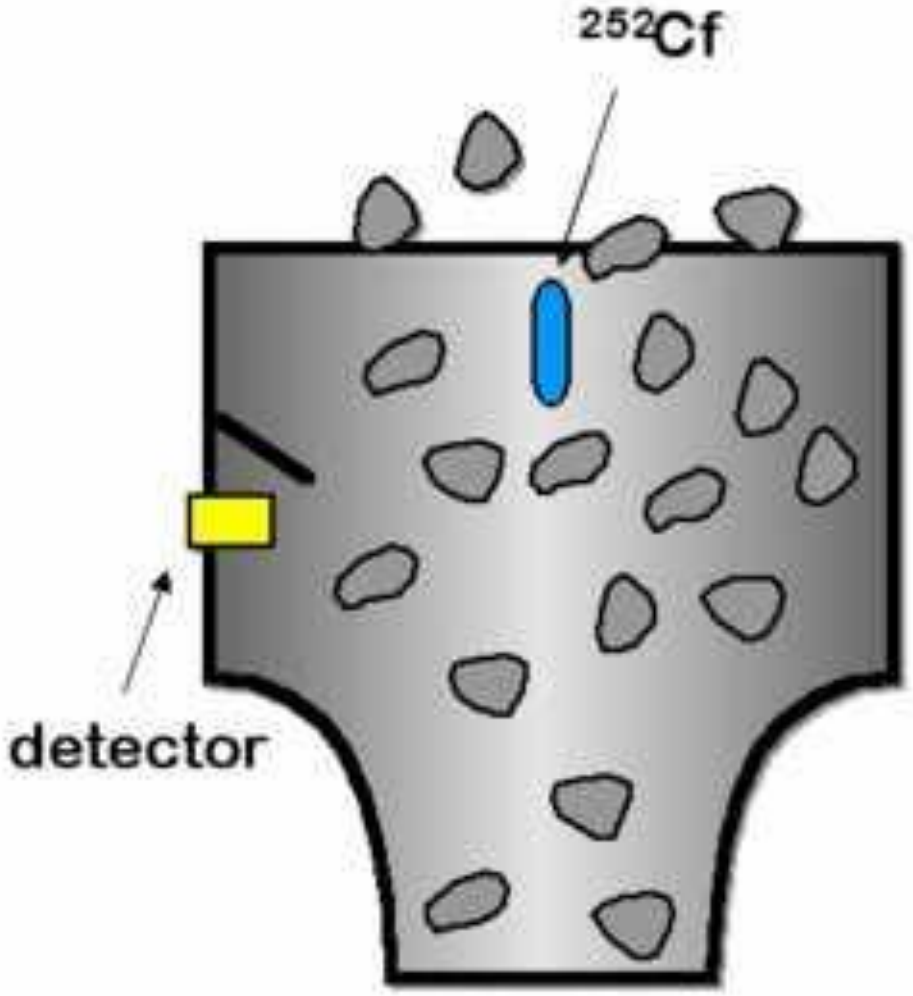


Sulfur in coal

Sulfur levels in coal can be monitored as received or used.

A neutron source will bombard the coal as it passes through a chute.

Prompt gammas can be monitored.



Other examples

Mixing efficiency in large tanks

Add a tracer and measure the time it takes for it to uniformly distributed.

- only needs to be done once.

Measurement of bearing wear

Add Co-60 or Ni-63 to bearings.

Monitor the lubricant to determine wear.

- no need to tear-down the engine.

Autoradiography

Based on fact that photographic emulsions will darken when exposed to ionizing radiation.

Factors that effect the method include:

- type of nuclide
- efficiency
- method of exposure
- emission type
- background
- resolution
- temperature
- film type

Autoradiography

Choice of nuclide/emission

The nuclide will determine how rapidly a film is exposed - each type radiation will have a different effect.

α emitters

- **Not a good choice**
- **Low efficiency - can't easily penetrate**
- **May give background problems**

Autoradiography

β emitters

As E_{MAX} increases, film darkening will occur at a greater distance

While this decreases resolution, distance can be used to identify different source.

Example

You can distinguish H-3 from C-14 based on distance.

Autoradiography

γ sources

All will give comparable exposure.

Lower efficiency than b.

Its possible to use various thickness of lead or other shielding materials to get some resolution.

There are far better ways of qualifying gamma energies.

Autoradiography

Exposure conditions.

Typically use X-ray film.

Larger grain size - more sensitive.

Simple contact is often best.

Example

For a ^{14}C labeled sample with 10μCi/cm^2, you can get a usable image in 24 hours.

5μCi/cm^2 of ^{3}H will give comparable results.

Autoradiography

So what's it good for?

Location of labeled materials

Visualization of PC and TLC

Location of tracer in plants or tissue

Quantitative work

Comparison of density to standards.

Medical applications

More radioactive sources used in medicine than in any other scientific field.

Includes

- Cancer treatment
- Tracers
- Imaging
- Testing methods

Medical applications

Cancer therapy

- Radiation both causes and can treat cancer
- Radiation causes molecules in the cell to break apart - ionization
- Most significant damage is when DNA is destroyed.
- Effect is greatest rapidly growing cells.

Medical applications

Cancer Characterized as rapid, out of control cell growth

Radiation does more damage to cancer cells than other tissues.

Examples

Hair loss Hair is a rapidly growing tissue. Radiation affects it.

Bone marrow Another site that may be damaged during treatment.

Examples of radiation treatment

External bombardment

^{60}Co - expose area to gamma rays.

Implants

^{182}Ta - used as wire, treatment of eye.

^{137}Cs - use in a balloon catheter for bladder.

Interstitial therapy

^{198}Au - inject directly into tumor.

Internal irradiation

^{131}I - Ingest solution, goes to thyroid.

Nuclear tracers in medicine

Can introduce a small amount of a radioactive material and see where it goes in the body.

- Tracers and Autoradiography

Can be used to measure small amounts of chemicals in the body like hormones.

- Radioimmunoassay

Example

Iodine-127 is used to trace thyroid function.

Medical application ofautoradiography.

Normal Thyroid

Benign tumor

Cancer