

Transfer standard for PET gases

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What are they?

- Short half-life positron emitters
- Positron and electron annihilate, producing two 0.51 MeV gammas emitted in opposite directions
- Used with an imaging system to identify areas of uptake.



- Several, all low Z and neutron deficient
- Examples
 - Carbon 11, 960 keV positron, 20 minute half-life
 - Fluorine 18, 634 keV positron, 110 minute half life, used for Flurodeoxyglucose (FDG).

Radiological significance

- Produced using accelerators
- Then converted into the right form in a radiochemistry suite
- Significant stack discharges
- Hospitals often in populated areas



- Various approaches
- Plastic scintillators to detect the 0.51 MeV gammas mounted on the outside of ducts
- Positron detectors based on beta detectors inside ducts

- A set of proportional counters of different lengths
- Pulse counting
- Gas to be standardised mixed with a counting gas and circulated
- Subtracting count rates from the different counters give counts per second per ml of gas

- A traceable source?
- Impractical – half life is far too short
- A secondary standard instrument – much more practical
- Tap into stack, compare stack monitor reading with reference instrument
- As it's a gas, there are much reduced problems with sampling compared to particulate in air

To be measured?

- Either the 0.51 MeV gammas or the positrons
- Pick up the gammas using a sodium iodide scint gated on the 0.51 MeV peak
- Fixed volume cavity with efficient shielding to minimise outside interactions
- Not very sensitive (about 20 cps/MBq/m³) but low positron energy dependence

The positrons?

- Fixed volume cavity
- One wall made from a large area beta scintillator?
- Or a cylindrical scintillator in the middle?
- Positron energy dependent
- Low gamma response therefore requires less shielding
- More sensitive

- Go for the beta scintillator approach
- Fixed volume cavity of about 1 litre
- High ratio of scintillator area to cavity wall area
- Low background
- About 100 cps/MBq/m³
- No need for a very thin window
- No need for a light tight window at all for a detector inside the cavity

Problems?

- Energy dependent, hence keep path length down so that very few of the positrons are stopped in the air

Prior applications?

- Similar systems used for krypton 85 etc