

Radiochemistry Developments

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Layout

- Introduction
- Production of ^{224}Ra (^{224}Ra)
- $^{224}\text{Ra}/^{212}\text{Pb}$ Generator Production
- Quality and Efficiency
- Conclusion



TAT Radionuclides

$^{227}\text{Th}/^{223}\text{Ra}$

$^{225}\text{Ac}/^{213}\text{Bi}$

^{211}At

$^{212}\text{Pb}/^{212}\text{Bi}$

$^{230}\text{U}/^{226}\text{Th}$

^{149}Tb



Introduction

- ^{224}Ra Radium is a pure alpha emitter
- Favorable half life 3.6 day
- Short lived daughter product

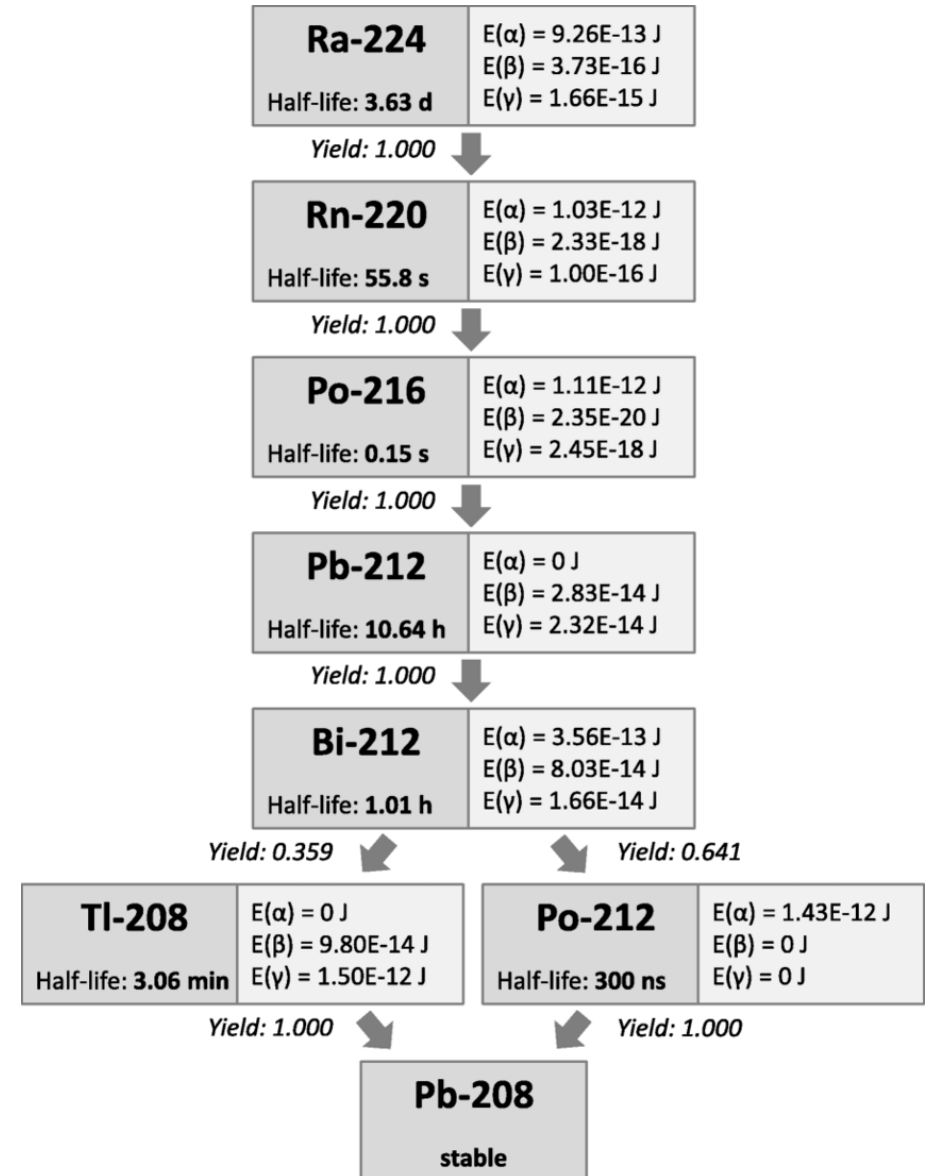
Production of $^{224}\text{Radium}$

- Several methods for the production
 - Radiochemical separation from the Th/U
 - Spallation reaction of thorium by proton irradiation
 - $^{228}\text{Th}/^{224}\text{Ra}$ Generator



$^{224}\text{Ra}/^{212}\text{Pb}$ Lead Generator Production

- There are two methods of $^{224}\text{Ra}/^{212}\text{Pb}$ generator production
 - Collection of emanated radon from radium source
 - Radiochemical separation of using cation exchange resin.



$^{224}\text{Ra}/^{212}\text{Pb}$ Generator by Radon Collection

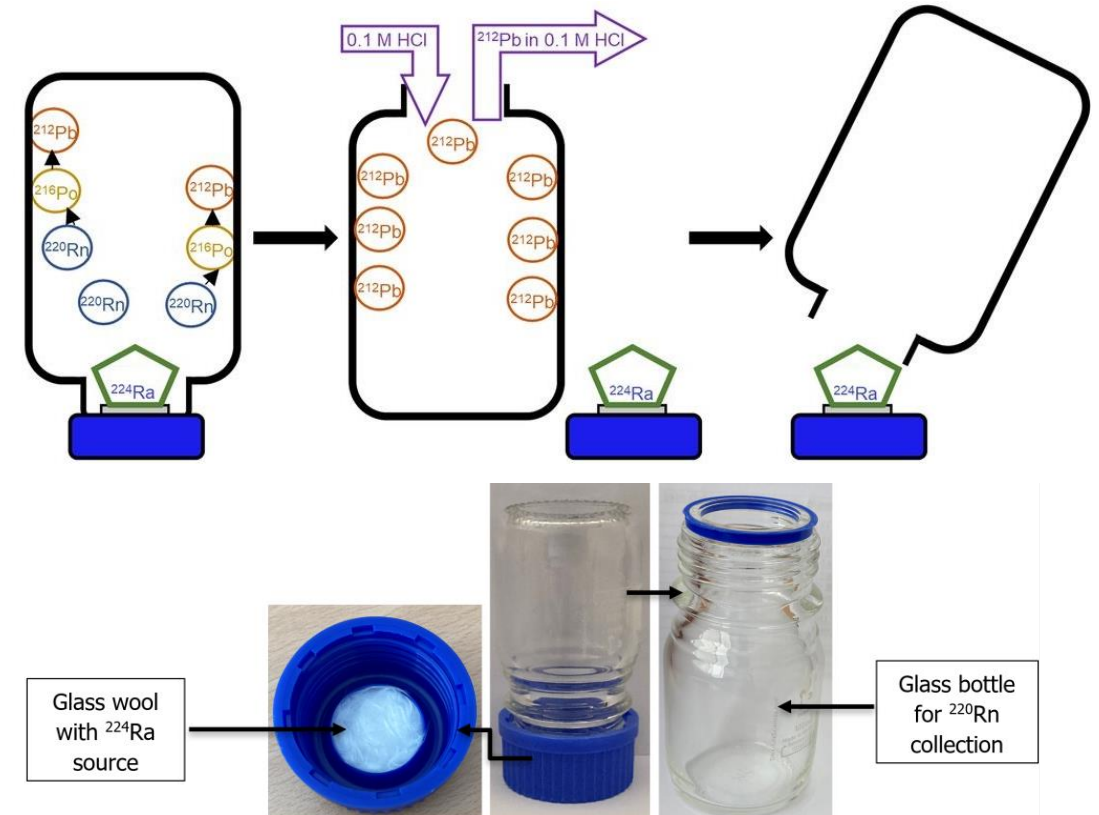
^{224}Ra Radium is used as source in the generator

Glass bottle with plastic lid as generator body

Source adsorbed on the glass wool

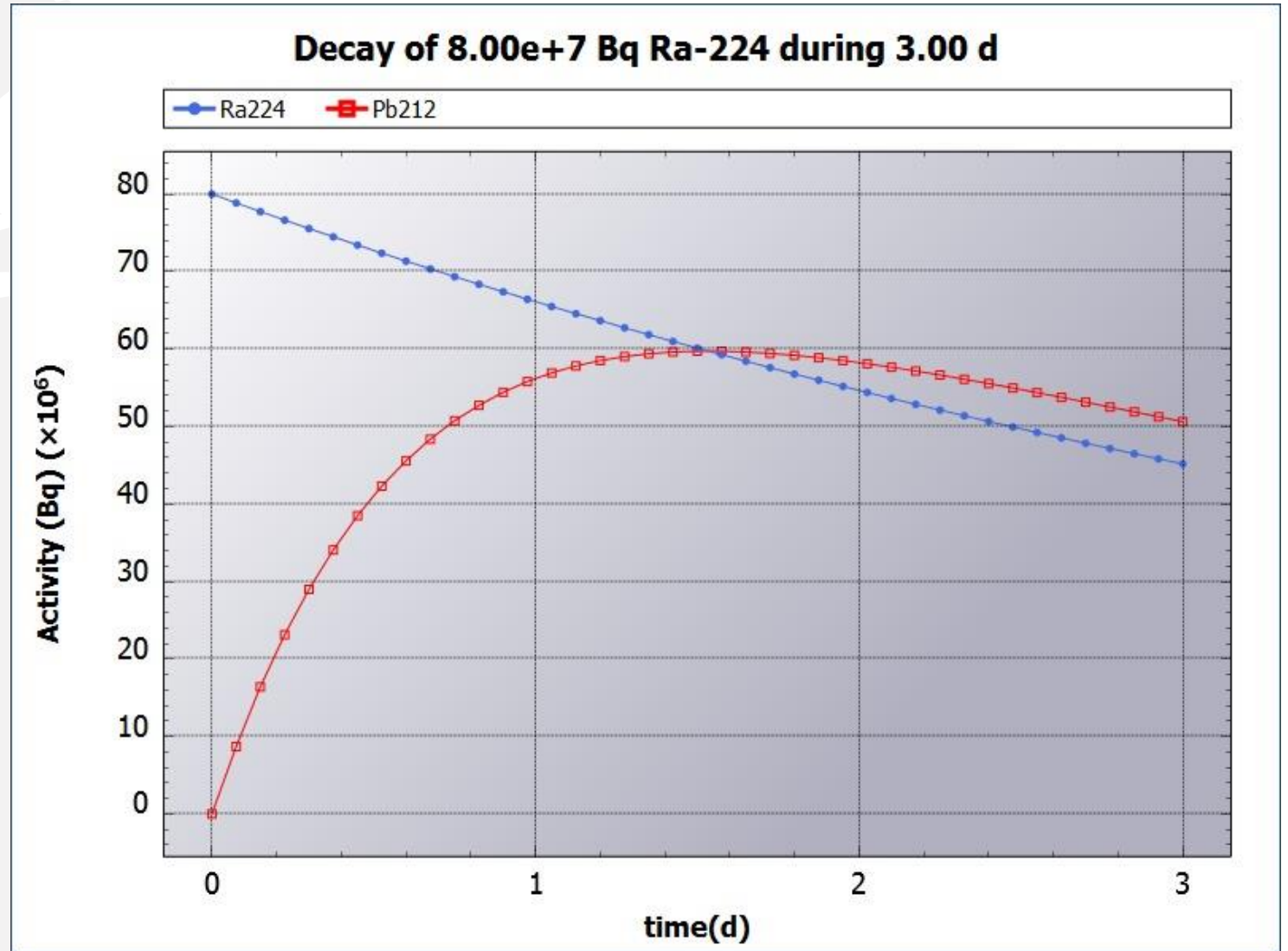
Collection chamber for radon

Decays into ^{212}Pb



Elution of Generator

- Elution of generator after the establishment of secular equilibrium
- Elution of ^{212}Pb with 0.1M HCl



Quality of ^{212}Pb from Generator

- Gamma spec. analysis of the generator
- High Purity Ra-224
- Generator of activity $\sim 700\text{MBq}$ (400MBq at reception) dispatch to one of partner institute for further labelling and preclinical studies



GAMMA SPECTROMETRY OFFICIAL REPORT

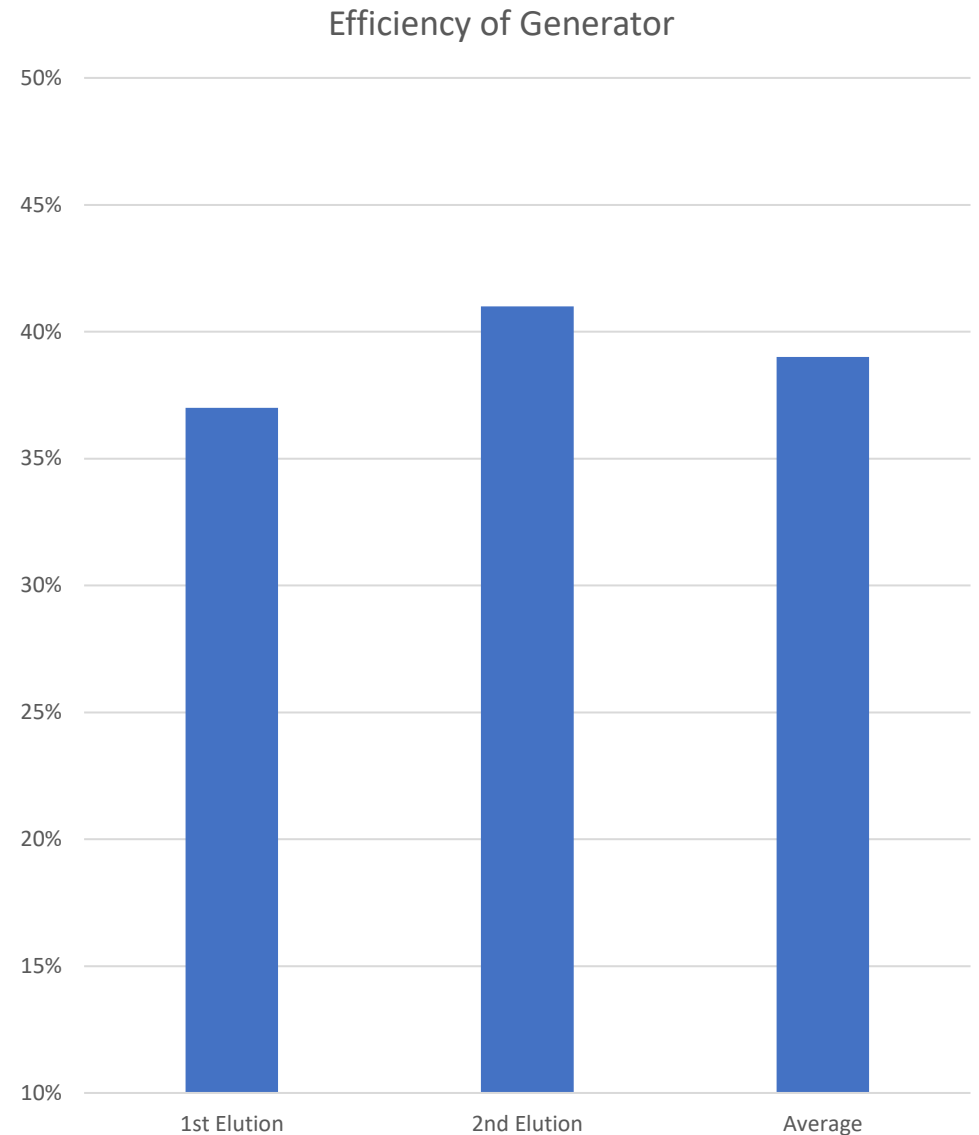
ANALYSIS: 33423675
ITEM(S): CR-160543/ MEDICIS - Ra-224 2024-#1/ coton dans fiole en verre/ cyl@336.7cm/ A. DORSIVAL
DETECTOR: MED01-B22158
ACTIVITY DATE: 5/6/2024 10:59:16AM

Nuclide Name	Weighted Mean Activity		Detection Limit (MDA)
	(Bq/units)	Unc. (%)	(Bq/units)
Tl-208	1.31E+08	4.11	3.58E+05
Bi-212	3.68E+08	4.29	2.42E+06
Pb-212	3.86E+08	7.01	7.30E+05
Rn-220	8.19E+08	41.98	2.80E+08
Ra-224	6.97E+08	11.46	7.24E+06
Ra-225	1.48E+07	69.85	2.43E+06

The uncertainties are calculated at 2 sigma (95% confidence level)
The detection limit values are calculated using ISO 11929 method with a 5% confidence factors

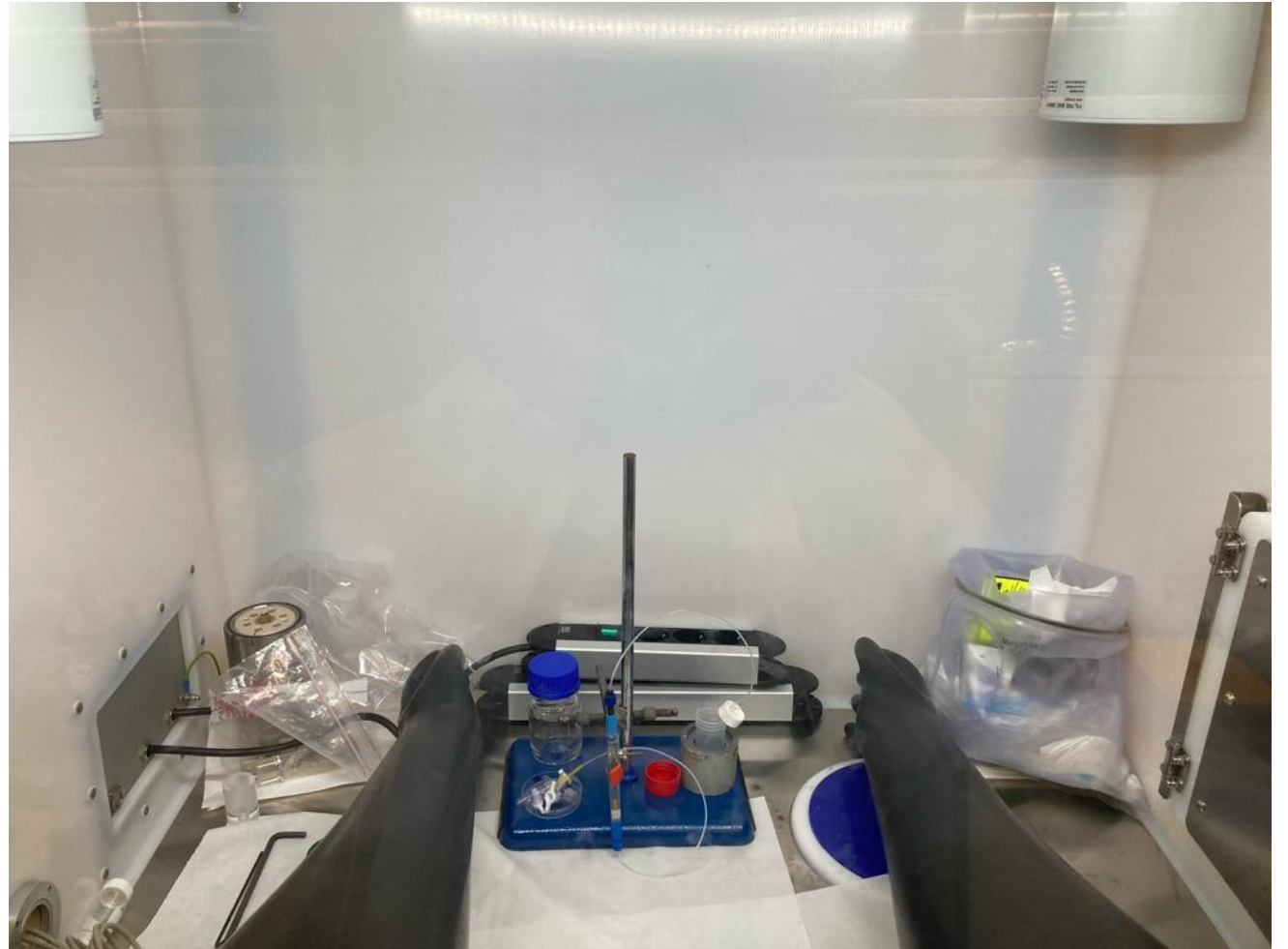
High Activity Generator

- 700MBq activity was loaded to the generator
- Elution are taken after two days
- Generators are eluted with average efficiency of 39%
- High activity did not damage the generator structure
- Some issue at user end reported trying to solve the issue



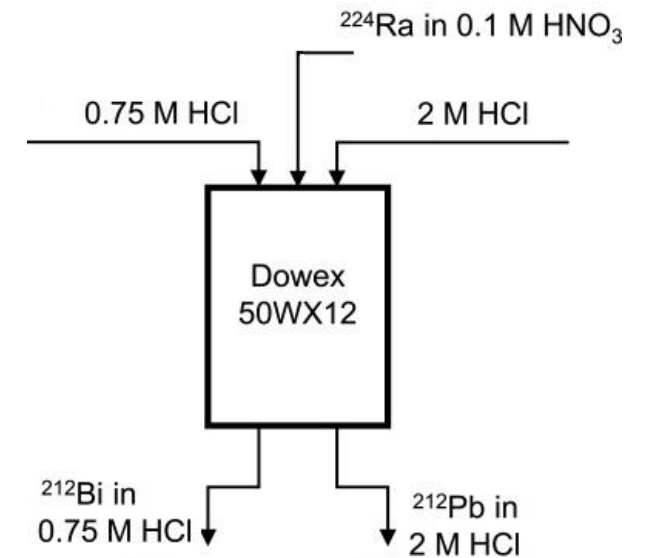
Radiation Safety

- All the following steps for generators carried out in Gloves box
 - ^{224}Ra foil retrieval for target holder
 - Dissolution of the ^{224}Ra
 - Generator production
 - Elution
- No release of radon or any contamination



$^{224}\text{Ra}/^{212}\text{Pb}$ Generator by Cation exchange resin

- Generator consist of a glass column
- Cation exchange resin for adsorption of radium source
- Preconditioning of column
- Loading of Barium (Radium analogue), lead and bismuth
- Elution of generator with few ml of HCl



Cold Experiments for Method Development



Tb/Gd separation for Tb-161 which is produced in research reactor by enriched Gd-160



Purification of HSA Sm-153 (removal of Eu formed by the decay of Sm) for clinical use

Conclusion



Production of $^{224}\text{Ra}/^{212}\text{Pb}$
high activity generator



With generator efficiency
up to 41%.



Method development,
High quality product with
safe operation



Good labelling and
stability results

*Thank
you*

