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.Ra-228 Ra-226 Ra-224 Ra-223

- 226- ()
.(3.66 11.4) Ra-224 Ra-223 - 1600

(40)
.(48)

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Determination of Radium-226 in fresh Water, Using Alpha Spectroscopy

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Abstract

Four Radium isotopes are present in nature, i.e. Ra-223, Ra-224, Ra-226, and Ra-228. The first three are alpha emitters while the last is a beta emitter. Because of the importance of the determination of Alpha isotope emitters in pure water (drinking water), this work focuses on the determination of radium-226 as it has the longest half-life (1600 years, in comparison to 11.4 day, 3.66 days for Ra-223 and Ra-224, respectively) using Alpha spectroscopy.

This method has the capability to be applied in sampling fields and low detection limit which in turn makes the analysis of low-level radioactive environmental water samples, with hardness does not exceed 40 French Degree, satisfying for Health and Environment Control Programmes. However, counting the samples using Alpha spectroscopy has to be immediate (or within 48 hours)

Keywords: Radium, Alpha spectroscopy, Hardness, Pure water, Radio analytical methods.

31
52
63
64
75
86
137
138
149

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.Ra-228 Ra-226 Ra-224 Ra-223

238-

226

Ra-226

.(1600)

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238-

(mBq/L 18.5-3.7)

133-

238-

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/

(230-

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210-

210-

.Rn-222 Bq/L 5.9 Ra-226 Bq/L 0.185 :

1973

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(International Commission on Radiological Protection) ICRP

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	MPC ^a for Workers/General Public		MPBB ^b
	In air (10-12Ci/liter)	In water (10-9 Ci/liter)	Occupational (10-4Ci)
Soluble- Ra223	2/0.06	20/0.7	-
Insoluble-Ra223	0.2/0.008	100/4	50
Soluble-Ra226	0.03/0.003	0.4/0.03	-
Insoluble-Ra226	0.05/0.002	900/30	100
Soluble-Ra228	0.07/0.002	0.8/0.03	-
Insoluble-Ra228	0.04/0.001	700/30	60

^aCode of Federal Regulations, 10 CFR 20, Appendix B. The MPC for workers assumes a 40-h work week. The critical organ for soluble Radium is bone, for insoluble radium in air or water, the critical organ is lung

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210- 210-
(Resolution)

: _____

15

210- 210-

0.5

(1) / 2

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222- •

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.(9) / 0.34

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0.2

222-

(LSC)

.(9) /

:

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222-

(LSC)

.() / 0.051 بکریل

.(218-)

: _____

(

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: .3

226-

(40
/ 10
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:Seeding)

(
(Self-absorption)
48 200-100

.4

() PH~2
(25 Gelman Metrical Polypropylene or Whatman Anodisc) 0.1 μm
(200-100)

15 0.5 (Bq/ml 13.16) 133-
1 / 1/ 25 1
(PH#5) 4 -3

15
30 Seeding 100μ 1

3 .0.1 μm 10
(1N +%0.1)
133- () .%80 1

()
) Oxford Oasis .(Geometry)
(

1 ()133-

$$R(\%) = \frac{A(^{133}\text{Ba}) \text{ in sample filter (cps)}}{A(^{133}\text{Ba}) \text{ in reference filter} \times 1^{-0.00018t} \text{ (cps)}} \quad (1)$$

: 4.78MeV 226-

$$A(^{226}\text{Ra}) = \frac{\text{Net counts in the } ^{226}\text{Ra spectral region} \times 1000}{\text{time (s)} \times ^{133}\text{Ba recovery} \times \text{sample mass (g)} \times \text{eff (\%)}} \text{ (Bq/kg)} \quad (2)$$

(4.68MeV 4.71MeV 224 223-)

.(1) 2

.5

3×SD

() () SD
 .(MDL#0.48Bq/L) / 1.3 226- 40

.(/ 1 226-) X 2.8 =) HZ-003

.(2) ()

226- ()

226- ()

(0.24035 Bq/ml) 226-

.() μL 200 ,150 ,100 ,50

/ 0.48

(2)

/ 0.02

0.34

0.38

(1)

40 20

0.32

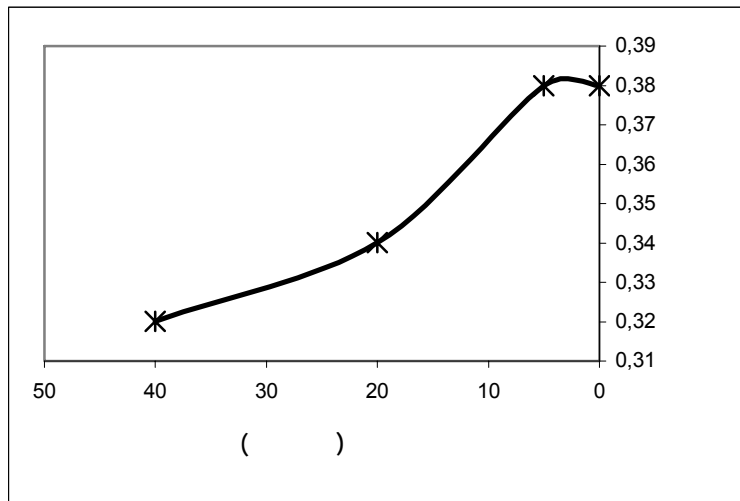
(2)

Method Name				(Analyst)		
Ra226		Parameter		Instrument Used		
Method detection limit			Repeatability			
Value Measured		Deviation Standard	Value Measured		/ 1 #	
1	0.988	0.16	1	0.786	0.93	
2	0.985		2	1.068		
3	1.011		3	0.590		
4	1.203	M.D.L	4	1.074	0.23	
5	1.372	MDL=3*STD	5	1.271		
6	1.004		6	0.904		
7	1.094	0.48 /	7	0.985	$x = \bar{x} \mu (std * t) \div \sqrt{n}$	
8			8	0.585		
9			9	1.065		
10	1.09		10			
Replicability			Recovery Coefficient			
	Measured Value	Standard Deviation		Spike Value	Recovered Value	% Recovery Coefficient
1	3.339	0.93	1	19.996	14.3	71.51
2	2.772		2	39.99	33.8	84.52
3	1.372		3	80	72	90.00
4	1.203	Replicability	4	120	113.3	94.42
5	1.011		5	160	155.46	97.16
6	1.004	/ 2 #				87.52
7	0.985		Relative Error			
8	0.988	$x = \bar{x} \mu (std * t) \div \sqrt{n}$ #DIV/ ± 0.83				RE (%)
9			1	1	0.786	0.214
10			2	1	1.068	-0.068
			3	1	0.590	0.410
			4	1	1.074	-0.074
			5	1	1.271	-0.271
			6	1	0.904	0.096
			7	1	0.985	0.015
			8	1	0.585	0.415
			9	1	1.065	-0.065
			10			

من نتائج قابلية الإعادة نجد بان تركيز الراديوم ينخفض من لحظة جمع العينة وحتى التوازن مع المؤثرات في الوسط المائي للعينة (الامتزاز على سطح الوعاء بسبب تشكل بلورات واجسام صلبة في الوسط , غازات منحلّة

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:(1)



0.93± 0.21

.(1)

.(2)

SD=0.93

48

60

48

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Bq/L 1.0

Bq/L 3.5

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(2)

.(8) (3)

.2

226-

10

226-

(3)

30

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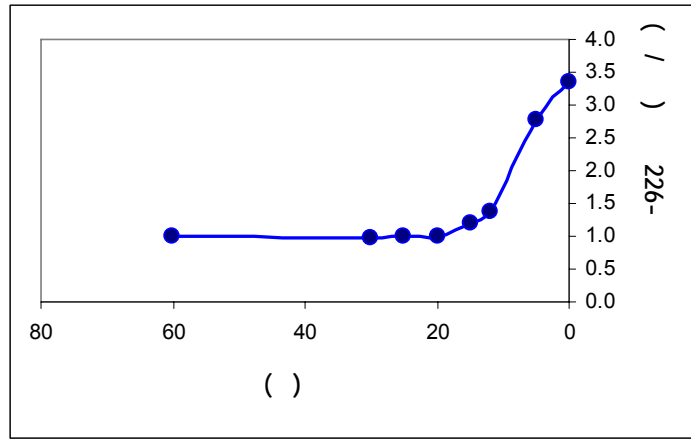
.3

(2)

.Na₂SO₄+0.0033 M H₂SO₄

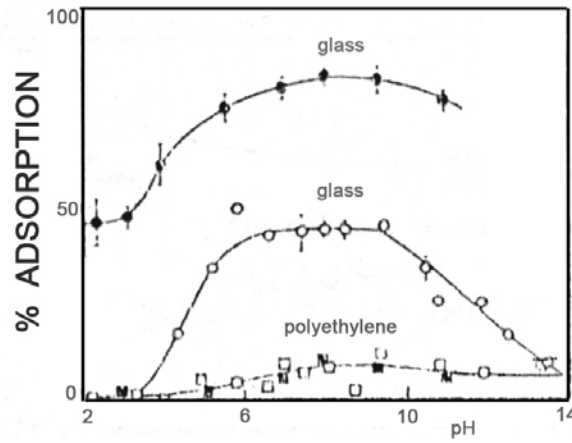
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:(2)



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Na₂SO₄+0.0033M H₂SO₄

NaCl+HCl0.01M

(1) %87.52

%100

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(Self Absorption)

0 1Bq /L 226-

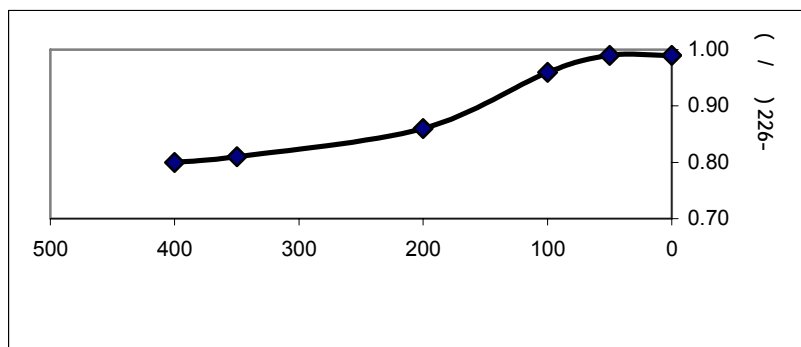
.(4)

226-

400

Bq/L 0.8

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4.73, 4.77

) 233- 234- (MeV 4.68) 230-

(4.78MeV) 226-

(Mev

234-

(7 3)

(5)

:(5)

R. C. BURK, D. R. WILES: COPRECIPITATION OF ²³⁴TH, II

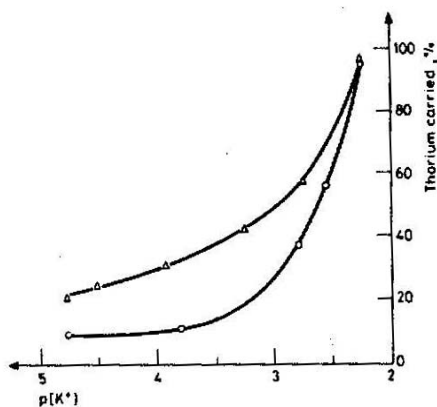
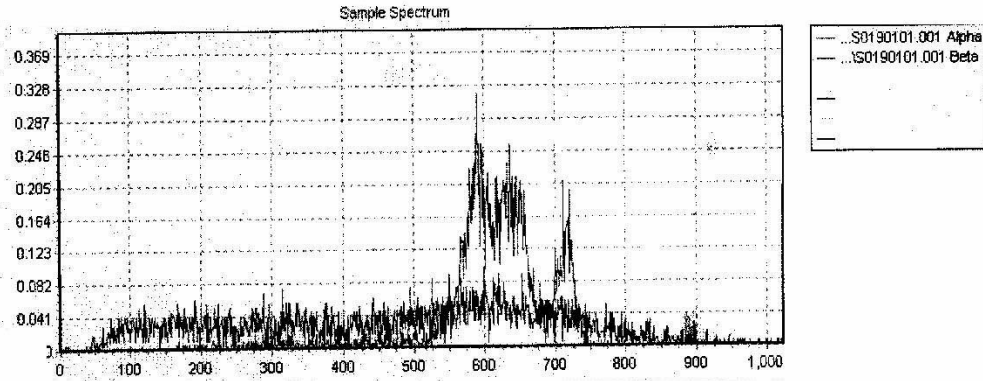


Fig. 1. Percent of ²³⁴Th carried on BaSO₄ as a function of potassium ion concentration. (I. G. DE JONG, BaSO₄ precipitated at ~90 °C)

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(2)



:(2)

نتيجة مخبر السائل الوماض	نتيجة مخبر غاما	Std Ra226 {Bq/l}	Ra-226 Bq/L	رقم العينة	
0.053±0.003		0.016	0.06	18295	(1)
		0.016	0.059	18295	(1)
0.052±0.003		—	0.18	18296	(3)
		0.055	0.19	18296	(3)
0.217±0.007	0.28	0.032	0.24	18302	
0.186		0.026	0.18	18302	
0.278	0.36	0.043	0.27	18300	(4)
0.328		0.027	0.15	18300	(4)
1.246±0.006	1.3	0.186	2.41	18303	()
1.290		0.156	2.00	18303	()
0.053±0.005		0.024	0.19	18305	
		0.018	0.12	18305	18305
0.180±0.005	0.3	0.022	0.13	18304	18304
0.144		0.020	0.11	18304	18304
0.33±0.01		0.028	0.14	19113	(1)
0.3±0.01		0.039	0.17	19110	(2)
0.57±0.01		0.021	0.12	19112	(3)
0.41±0.01		0.028	0.18	19114	(4)
0.28±0.01		0.032	0.16	19111	

.7

226-

(ii)

40

(i) :

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(iii)

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**Report on Laboratory Reconnaissance Experiment
Department of Protection and Safety**

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