PROFILE OF ^{210}Pb TO DETERMINE MASS FLUCTUATION AT SURABAYA COAST

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ABSTRACT

The research of profile of ^{210}Pb to determine mass fluctuation at Surabaya coast has been done. The objective of this research is to determine mass fluctuation of sediment samples taken from Surabaya coast based on the profile of ^{210}Pb gamma activity.

The sediments have taken by using PVC (Polyvinil Clorida) tube with diameter of 10 cm. The sediment is sliced in 2 cm thick. The outer parts of the sediment slices were separated from the inner parts. The inner parts will be analyzed. Sediment samples were dried by using a heating lamp and measured. The inner parts of sediment is granulated up to 100 mesh, 70 grams of samples measured in polyetilene cup and counted using spectrometry γ Ge(Li) for 7200 seconds. The mean of supported ^{210}Pb is observed to determine the excess ^{210}Pb. Therefore, the sediment mass fluctuation can be established.

The result of the research based on quantitative analysis shows that ^{210}Pb total activity does not always depends on the condition and the history of sediment's existence per 2 cm. The value of ^{210}Pb total activity at location A ranges about 10.69568 Bq/ Kg up to 28.21181 Bq/ Kg, while at location B the value of ^{210}Pb total activity ranges about 15.70871 Bq/Kg up to 35.34226 Bq/ Kg. The sediment mass fluctuation from the upper layer up to the bottom layer is in fact various and does not depends on the years is was formed. The sediment mass fluctuation at location A ranges about 1.198 ($Kg.m^{-2}.y^{-1}$) up to 11.227 ($Kg.m^{-2}.th^{-1}$), while at location B the sediment mass fluctuation ranges about 1.701 ($Kg.m^{-2}.y^{-1}$) up to 24.603 ($Kg.m^{-2}.th^{-1}$).

Key words: Sediment, Radionuclide ^{210}Pb, Spectrometry γ and Ge (Li) Detector

c. Macam-macam peluruhan radioaktif

Macam-macam peluruhan radioaktif diantaranya adalah:

1. Peluruhan α
2. Peluruhan β^-
3. Peluruhan β^+ dan tangkapan elektron ($\bar{e}$)
4. Peluruhan γ

Peluruhan α

Tipe peluruhan radioaktif dimana inti tidak stabil memencarkan partikel α sehingga inti tersebut nomor atomnya berkurang 2 dan nomor massanya berkurang 4.

Peluruhan β

Tipe peluruhan radioaktif dimana inti tidak stabil memencarkan sebuah elektron dan sebuah antinetrino (β^-), atau memencarkan sebuah positron dan sebuah netrino (β^+).

Peluruhan γ

Setelah inti memancarkan zarah β^- ,β^+, α atau setelah peristiwa tangkapan elektron, inti atom tersebut akan berada dalam keadaan teruja (excited state). Inti yang teruja ini segera akan menuju ke keadaan dasar dengan jalan memancarkan radiasi elektromagnetik yang disebut sebagai *sinar* γ. Sinar γ, sama seperti radiasi elektromagnetik lainnya bisa dipandang sebagai paket-paket catu tenaga yang disebut *foton* γ.Massa dan muatan suatu inti yang memancarkan sinar γ tidak berubah / tetap.

Lampiran 1. Perhitungan Effisiensi Pencacahan Material SRM IAEA-315

1. Perhitungan aktivitas awal material SRM IAEA-315

   Diketahui:

   Aktivitas (A_0) 1 kg ^{210}Pb dari sertifikat SRM IAEA-315 = 30,1 Bq/ Kg

   Berat material SRM IAEA-315 = 70 gram

   Aktivitas (A_0) 70 gram material SRM IAEA-315 ?

   $$A_0 = \frac{70\ gram}{1000\ gram} kg \times 30{,}1\ Bq/\ Kg$$

   $$= 2{,}107\ Bq$$

2. Perhitungan aktivitas material SRM IAEA-315

   Diketahui:

   $(A_0) = 2{,}107$ Bq

   Waktu (t) peluruhan Januari 1993 - Februari 2005

   = 145 bulan

   = 12,083 tahun

   Waktu paro (T) ^{210}Pb = 22,3 tahun

   Aktivitas akhir material SRM IAEA-315 ?

   $A_t = A_0 . e^{-0{,}693\ (t/T)}$

   $= 2{,}107 . e^{-0{,}693\ 12{,}083/\ 22{,}3}$

   = 1,447 Bq

3. Perhitungan efisiensi material SRM IAEA-315

   Diketahui:

   Waktu cacah = 7200 detik

   Net area material SRM IAEA-315 = 67

$A_{excess} = A\text{-}A_{supported}$

A_{excess} = 28,21181 Bq/ Kg – 11,62574 Bq/ Kg = 16,58606 Bq/ Kg

Begitu pula untuk perhitungan aktivitas *excess* ^{210}Pb (Bq/ Kg) untuk kode yang lain. (seperti yang disajikan dalam tabel 4).

3. Perhitungan aktivitas *excess* ^{210}Pb (Bq/ m^2) pada kode $A_{0\text{-}2}$ adalah sebagai berikut:

$L = \pi r^2$

$L = 3,14 \times (0,05)^2 = 7,854 \times 10^{-3}$ m^2

$$A_{exc} = \frac{A.m}{L}$$

$$A_{exc} = \frac{16,58606 \times \left(\frac{133,229\,(g)}{1000\,(g/\,kg)}\right)}{7,854 \times 10^{-3}\,m^2} = 281.3527\ Bq/\ m^2$$

Begitu pula untuk perhitungan aktivitas excess ^{210}Pb (Bq/ m^2) untuk kode yang lain. (seperti yang disajikan dalam tabel 4).

4. Perhitungan Flukstuasi Massa Sedimen di lokasi A adalah sebagai berikut:

$$A_0 = \sum_{0}^{x} A\ excess$$

A_0 = 281,3527 + 156,9001 + 140,0222 + ... + 15,50414 Bq/ m^2

A_0 = 1279,126 Bq/ m$^{2=}$

$A_x = A_0 - A_{cum}$ (Bq/ m^2)

A_x = 1279,126 Bq/ m^2 – 1125,4411 Bq/ m^2 = 997,773 Bq/ m^2

Untuk menentukan estimasi umur setiap lapisan sedimen adalah:

$Ax = A_0.e^{-\lambda t}$

Lampiran 3. Data hasil pencacahan di Lokasi A (Morokrembangan)

Kode	h (cm)	Berat kering (g)	Net Cacah			Cps	Dps	Aktivitas total ^{210}Pb (Bq/Kg)	Aktivitas *excess* ^{210}Pb (Bq/Kg)	Aktivitas *excess* ^{210}Pb (Bq/m^2)
			X_1	X_2	$\overline{X}$					
A 0 - 2	2	133,229	90	92	91	0,012639	1,974826	28,21181	16,58606	281.3527
A 2 - 4	4	100,63	78	76	77	0,010694	1,671007	23,87153	12,24579	156.9001
A 4 - 6	6	116,305	69	67	68	0,009444	1,475694	21,08135	9,455609	140.0222
A 6 - 8	8	94,108	68	59	63,5	0,008819	1,378038	19,68626	8,06052	96.58256
A 8 - 10	10	110,302	58	57	57,5	0,007986	1,24783	17,82614	6,200401	87.07876
A 10 - 12	12	111,203	56	58	57	0,007917	1,236979	17,67113	6,045391	85.59532
A 12 - 14	14	93,56	58	61	59,5	0,008264	1,291233	18,44618	6,820441	81.24783
A 14 - 16	16	105.086	46	54	50	0,006944	1,085069	15,50099	3,875252	51.85062
A 16 - 18	18	110,326	39	65	52	0,007222	1,128472	16,12103	4,495292	63.14586
A 18 - 20	20	97,135	42	60	51	0,007083	1,106771	15,81101	4,185272	51.7617
A 20 - 22	22	93,753	48	46	47	0,006528	1,019965	14,57093	2,945193	35.15669
A 22 - 24	24	109,915	58	49	53,5	0,007431	1,161024	16,58606	4,960322	69.41861
A 24 - 26	26	108,404	40	46	43	0,005972	0,93316	13,33085	1,705113	23.53464
A 26 - 28	28	96,447	46	50	48	0,006667	1,041667	14,88095	3,255212	39.97396
A 28 - 30	30	130,926	48	33	40,5	0,005625	0,878906	12,5558	0,930064	15.50414
A 30 - 32	32	100,177	40	37	38,5	0,005347	0,835583	11,93576	*	*
A 32 - 34	34	126,099	36	40	38	0,005278	0,824653	11,78075	*	*
A 34 - 36	36	118,939	45	33	39	0,005417	0,846354	12,09077	*	*
A 36 - 38	38	133,35	44	25	34,5	0,004792	0,748698	10,69568	*	*
A 38 - 40	40	117,522	45	30	37,5	0,005208	0,813802	11,62574	*	*

Keterangan : * Tidak dapat dihitung (karena yang dihitung hanya aktivitas ^{210}Pb *excess*)

* Tidak dapat dihitung

Lampiran 8. Deret Thorium

Nama Nuklida	Lambang	Radiasi	Waktu Paro (t 1/2)
Thorium (Th)	$_{92}TH^{232}$	a	$1,39.10^{10}$ tahun
Mesothorium 1 (MsTh1)	$_{88}Ra^{228}$	b	6,7 tahun
Mesothorium 2 (MsTh2)	$_{89}Ac^{228}$	b	6,13 tahun
Radiothorium (RdTh)	$_{88}TH^{224}$	a	1,91 tahun
Thorium X (ThX)	$_{88}Ra^{224}$	a	3,64 hari
Th Emanation (Tn)	$_{86}Em^{220}$	a	51,5 detik
Thorium A (ThA)	$_{84}Pb^{216}$	a,b	0,16 detik
Thorium B (ThB)	$_{82}Pb^{212}$	b	10,6 jam
Astatine 216	$_{85}At^{216}$	a	3.10^{-4} detik
Thorium C (ThC)	$_{83}Bi^{212}$	a,b	60,5 menit
Thorium C' (ThC')	$_{84}Po^{212}$	a	3.10^{-7} detik
Thorium C'' (ThC'')	$_{81}Ti^{208}$	b	3.10 menit
Thorium D (ThD)	$_{82}Pb^{208}$	Stabil	-

GAMMA RAYS IN THE ENVIRONMENT WITH ENERGY GREATER THAN 13

ENERGY	NUCLIDE								
14.4	CO-57								
26.4	AM-241								
30.0	BA-140								
35.0	I-129								
39.9	BI-212								
40.6	MO-99								
46.5	PB-210								
49.7	TE-132								
53.2	BA-133								
55.9	AM-241								
60.0	EU-155								
61.5	NP-235								
63.3	TH-234								
66.9	CS-136								
74.8X	PB-214								
74.8X	PB-212								
75.0X	TL-209								
77.1X	PB-214								
77.1X	PB-212								
79.6	BA-133								
80.1	CE-144								
80.1	I-131								
81.0	BA-133								
81.0	XE-133								
84.4X	TH-226								
86.3	CS-136								
86.5	EU-155								
87.3X	PB-214								
87.3X	PB-212								
88.0	CD-109								
90.0X	AC-228								
91.1	ND-147								
92.6D	TH-234								
93.4X	AC-228								
99.6	AC-228								
105.0X	AC-228	1.6	LONG	99.5	1.3	129.1	2.5	TH-232	
105.3	EU-155	20.5	4.96Y	55.5	30.5	60.0		PA-233	
106.1	NP-235	22.7	2.36D	61.5	1.0	117.0X	11.2	PA-233	
109.3	U-235	1.4	7.1E7Y	61.0X	1.1	143.8	10.5	PA-233	
111.8	TE-132	1.9	78.2H	49.5	1.5	116.3		PA-233	
116.3	TE-132	1.9	78.2H	1.6	1.9	228.2	85.0	PA-233	
121.8	EU-152	26.6	13.5Y	3.0	1.9	241.7		PA-233	
122.1	CO-57	85.6	271D	2.0	1.9	1.0		PA-233	
123.1	EU-154	40.5	8.6Y	2.0	1.9	1.0		PA-233	
127.2	RH-101	88.0	3H	1.5	1.9	591.7	4.6	PA-233	
129.1	AC-228	2.5	LONG	95.6	1.9	328.0	12.0	PA-233	
133.5	CE-144	11.1	284D	1.0	1.9	209.3	3.2	TH-232	
136.5	CO-57	10.6	271D	1.0	1.9	80.1			
138.1	CS-138	1.5	32.2M	1.0	1.9	1.0			
140.5	MO-99	5.7	66.0H	1.0	1.9	402.0	30.0		
140.5	TC-99M	88.5	6.02H	18.3X	6.2	181.1	6.2		
143.8	U-235	10.5	7.1E7Y	10.7	1.2	20.0X	1.2	MO-99	
145.4	CE-141	48.0	32.5D	3.7	1.8	145.4	4.8		
151.2	KR-85M	75.5	4.48H	3.7X	13.2				
153.2	CS-136	7.5	13.0D	304.9	14.0				
153.8	XE-138	6.0	14.2M	85.3	6.3	163.9	6.8		
162.6	BA-140	5.6	12.80	242.6	3.5	258.3	31.5		
				304.8	3.4	30.0	1.2		

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The values listed above were [illegible] submitted by laboratories which had participated in an international intercomparison exercise organized in 1993. The details concerning the criteria for qualification as a recommended value can be found in the report (IAEA/AL/065; IAEA/MEL/61) "Report on the Intercomparison for IAEA-315: Radionuclides in Marine Sediment" [1]. This report is available free of charge upon request.

Intended Use

This sample is intended to be used as a reference material for the measurement of radionuclides in marine sediments. It can also be used as a quality control material for the assessment of a laboratory's analytical work, for the validation of analytical methods and for quality assurance within a laboratory.

Origin and preparation of the material

The sediment material was obtained from the Health Physics Division of the Bhabha Research Centre, Bombay, India in 1991 near the Tarapur Atomic Power Station. This material is influenced by discharges from the Tarapur Atomic Power Station. The sediment is composed of clay minerals, mainly illite-montmorillonite with minor amounts of quartz, calcite, dolomite and feldspar. The material was freeze-dried then ground in pestle and mortar to pass a 250 µm sieve and the fraction below this size was homogenised in a rotating drum [illegible] periods. The material was dispensed in 100 g units.

Homogeneity

The homogeneity of the bottled material was [illegible] (^{137}Cs, ^{210}Pb, $^{239+240}$Pu and ^{241}Am) in 25 bottles taken at random.

Note: Evidence has been presented to suggest that this material may be contaminated with "hot particles" resulting from discharges from the Tarapur Atomic Power Station. The frequency of the occurrence of these "hot particles" is unknown and consequently, it is possible that significantly elevated activities may be observed for anthropogenic radionuclides in some sub-samples. For this reason activities of the anthropogenic radionuclides have been excluded from the certification of IAEA-315. However, data received for these radionuclides are presented in the report IAEA/AL/065.

Dry weight determination

All recommended values are expressed on a dry weight basis. Therefore, the dry weight must be determined at the time of analysis, on separate sub-samples [illegible] constant weight in a drying oven set to 105 °C. Moisture [illegible] 5 mg.

Instructions for use

The recommended minimum intake mass for [illegible] gamma and alpha,beta-emitters respectively.

Analysts are reminded to take appropriate precautions in order to avoid contamination of the material during handling. No special precautions are required for the storage of this material.

Legal disclaimer

The IAEA makes no warranties, [illegible] this reference sheet and shall not be [illegible] data.