Tabel data standar untuk grafik regresi linier pada cuplikan tanah.

No.	berat standar (μg)	1/ berat standar (μg^{-1}) (A)	spesifik aktivitas (a) (B)
1.	8	0,125	0,448
2.	6	0,167	0,489
3.	4	0,25	0,598
4.	2	0,5	0,733
5.	1	1	1,297

Tabel data standar untuk grafik regresi linier pada cuplikan air.

No.	berat standar (μg)	1/ berat standar (μg^{-1}) (A)	spesifik aktivitas (a) (B)
1.	5	0,2	0,601
2.	3	0,33	0,742
3.	2	0,5	0,878
4.	1	1	0,957
5.	0,5	2	1,195

Menentukan harga a (spesifik aktivitas) :

$$Nett = 1651 \times e^{0,693.1334016 / 165361624}$$

$$cps_0 = \frac{1660,255}{500} = 3,321 \text{ cacah / detik}$$

$$a = \frac{3,321}{5} = 0,664$$

Contoh perhitungan kadar Co dalam cuplikan rumput.

Dari tabel 3.2 setelah di buat kurva regresi linier diperoleh harga n = 0,46

Misalnya di lokasi T_1 :

$$cps_t = \frac{148}{1000} = 0{,}148 \text{ cacah / detik}$$

$$w = \frac{0{,}148}{0{,}46} = 0{,}322 \ \mu g$$

$$x = \frac{0{,}322 \ \mu g}{0{,}1 \ g} = 3{,}22 \text{ ppm}$$

∴ Kadar Co dalam sampel rumput 0,1 g adalah 3,22 ppm.

TABEL TENAGA RADIONUKLIDA

Tenaga keV	Isotop	Intensitas	Umur paro	Tenaga keV	Isotop	Intensitas	Umur paro	Tenaga keV	Isotop	Intensitas	Umur Paro
49,1	Tb-161	30	7,2 h	136,5	Co-57	6	270 h	238,8	As-77	60	38,7 j
51,4	Rh-104m	–	4,4 m	137,0	Re-186	90	2,2 h	242,0	Pb-214	–	Ra-226 series
57,5	Hf-180m	30	5,5 j	139,0	Nd-151	–	12,0 m	245,4	Ag-111	10	7,4 h
57,5	Co-60m	100	10,5 m	139,0	Os-193	20	31,5 j	245,4	Gd-111m	75	48 m
57,8	Ir-192m	100	1,5 m	139,8	Ge-75m	100	49 d	245,4	In-111	50	2,81 h
58,2	Dy-159	100	144,4 h	140,6	Mo-99	90	66 j	245,6	Sm-155	6	21,9 m
59,8	U-237	60	6,75 h	140,6	Tc-99m	100	6,04 j	249,7	As-77	10	38,7 j
61,2	Sm-145	100	340 h	141,2	Sm-155	10	21,9 m	255,2	Sn-113	100	115 h
61,6	Sb-122m	100	3,5 m	142,5	Sc-46m	100	20,0 d	255,6	Nd-151	–	12 m
63,3	Yb-169	30	30,6 h	145,4	Ce-141	100	32,5 h	264,5	Ge-77	50	11,3 j
67,7	Ta-182	14	115,1 h	146,7	Ta-182m	35	16,2 m	264,6	Se-75	30	121 h
69,6	Gd-153	4	236 h	149,7	Te-131	70	24,8 m	264,6	Ge-75	80	79 m
69,6	Sm-153	20	47,1 j	150,3	Yb-177	50	1,9 j	268,1	Ba-135m	100	28,7 j
74,7	U-239	100	23,54 m	150,8	Gd-111m	25	48 m	273,3	Cd-117m	–	3,0 j
74,9	Yb-161	30	7,2 h	151,1	Sr-85m	–	70,0 m	275,6	Pm-151	10	27,5 j
76,3	Sb-122m	100	3,5 m	151,7	W-181	0,2	145 h	275,8	Se-81	60	18 m
77,6	Rh-104m	–	4,4 m	153,7	Dy-165m	–	1,25 m	275,9	Ba-133m	100	38,9 j
77,6	Hg-197	100	65 j	155,1	Re-188	70	16,7 j	277,5	Np-239	20	2,35 h
77,6	Pt-197	90	20,0 j	158,3	Hg-199m	–	42,0 m	278,5	Te-129	–	72 m
77,6	Ho-166	90	26,9 j	158,3	Au-199	80	3,15 h	279,1	Hg-203	100	46,9 h
80,6	Ho-166m	20	30 t	158,4	Sn-117m	100	14 h	279,2	Pb-203	90	52,1 j
80,6	Ba-133	20	7,5 t	158,4	In-117(m)	–	44 m	279,6	Se-75	14	121 h
80,8	Tm-170	100	129 h				1,9 j	279,5	Dy-165	15	2,36 j
84,4	Eu-155	60	1,7 t	158,8	Te-123m	100	104 h	282,6	Yb-175	30	101 j
86,6	Th-233	–	22,4 m	159,8	Ge-77m	50	54 d	286,1	Pa-149	90	53,1 j
86,6	Rh-104m	100	13,5 j	160,0	Sc-47	100	3,43 h	290,0	Se-81	40	18 m
88,0	Pd-109	100	40 d	160,2	Sm-123	100	39,4 m	293,1	Ce-143	60	33,0 j
88,0	Ag-109m	100	470 h	160,6	Hf-179m	10	19,0 d	295,4	Pb-214	–	Ra-226 series
88,0	Cd-109	100	3,71 j	161,9	Se-77m	100	17,5 d	295,8	Sn-121	2	7,8 j
88,3	Lu-176m	100	70,0 h	164,5	Xe-131m	100	12,0 d	295,8	Ir-192	10	74,4 h
89,6	Hf-175	3	11,1 h	164,6	U-237	10	6,75 h	298,6	Tb-160	20	73 h
91,4	Nd-147	50	18,7 m	165,8	Ce-139	100	140,0 d	299,9	Pa-233	12	27,0 h
92,4	Re-188m	–	8,15 j	165,8	Ba-139	70	83 m	302,8	Ba-133	2	7,5 t
93,1	Ta-180m	–	61,6 j	168,1	Pm-151	20	27,5 j	305,3	Gd-159	1	18,0 j
93,2	Cu-67	40	43 d	171,4	In-111	50	2,81 d	306,2	Nb-105	–	35,3 j
93,2	Ag-107m	100	2,36 j	171,7	Ta-182m	40	16,2 m	306,8	Tc-101	80	14,0 m
94,6	Dy-165	35	3,91 m	172,1	Pd-111m	90	5,5 j	308,1	Sn-171	50	7,8 j
95,9	Se-79m	100	4,4 m	175,3	Ge-70	30	21,1 m	311,5	Pd-109	10	13,5 j
97,2	Rh-104m	–	236 h	176,2	Sb-125	7	2,0 t	311,8	Pa-233	80	27,0 h
97,5	Gd-153	60	4,1 h	177,0	Yb-169	15	30,6 h	314,6	Gd-161	20	3,73 m
99,0	Pt-195m	–	115,1 h	180,9	Mo-99	10	66 j	315,2	In-117m	–	1,9 j
100,3	Ta-182	10	3,73 m	184,2	Cu-67	60	61,6 j	316,5	Ir-192	40	74,4 h
102,2	Gd-161	10	36,8 m	184,3	Mo-166m	20	30 y	316,9	Pt-199	–	30,0 m
103,0	Se-81m	100	236 h	184,9	Ta-182m	20	16,2 m	319,1	Nb-105	–	35,3 j
103,2	Gd-153	40	47,1 j	185,9	Pt-199	–	30,0 m	319,4	Nd-147	6	11,06 h
104,2	Sm-153	90	8,15 j	186,2	Ra-226	–	Ra-226 series	320,0	Cr-51	100	27,8 h
104,4	Ta-180m	–	21,9 m	186,7	Os-190m	20	10,0 m	320,0	Ti-51	90	5,79 m
104,2	Sm-155	–	1,7 t	188,9	Pd-109m	100	4,75 m	325,1	Ru-97	10	2,88 h
105,3	Eu-155	40	18,7 m	190,2	In-114m	100	50 h	328,0	Ir-194	50	19,7 j
105,8	Re-188m	–	2,35 h	191,4	Hg-197	2	65 j	328,6	La-140	10	40,27 j
106,1	Np-239	40	14,6 m	191,4	Pt-197	10	20,0 j	332,0	Sn-125	100	9,5 m
108,2	Ba-131m	100	1,25 m	192,0	MO-101	10	14,6 m	332,2	Hf-180m	40	5,5 j
108,2	Dy-165m	–	58,0 h	192,5	Fe-59	2	45,1 h	333,0	Au-196	26	6,2 h
109,3	Te-125m	100	7,8 j	197,8	Yb-169	20	30,6 h	336,6	In-115m	100	4,5 j
111,6	Er-171	20	6,75 h	198,3	Tm-168	20	85 d	340,3	Pm-151	30	27,5 j
113,0	Lu-177	15	155 h	198,6	Ge-75	10	79 m	340,3	Pa-233	3	27,0 h
113,0	Lu-177m	–	101 j	202,4	I-90m	50	3,14 j	343,9	Ag-111	90	7,4 h
113,5	Yb-175	15	1,8 j	203,8	Hg-205	100	5,6 m	343,6	Hf-175	90	70,0 h
114,6*	Nd-149	–	12,0 m	208,0	U-237	30	6,75 h	344,2	Eu-152	20	9,35 j
116,4	Nd-151	–	9,35 j	208,2	Au-199	20	3,15 h	345,7	Hf-181	10	44,6 h
121,8	Eu-152m	20	12,2 t	208,4	Lu-177m	–	155 h	346,3	Pt-197m	100	88,0 m
121,8	Eu-152	10	2,2 m	208,4	Lu-177	70	6,75 h	350,7	Pt-191	20	3,0 h
121,8	Zn-71	–	270 h	211,4	Ge-77	50	11,3 j	352,0	Pb-214	–	Ra-226 series
121,9	Co-57	80	2,2 h	211,4	Nd-149	–	1,8 j	355,6	Zr-97	3	17,0 j
122,6	Re-186	6	11,5 h	212,3	Te-121m	90	154 h	355,7	Au-196	100	6,2 h
124,2	Ba-131	30	70,0 h	214,3	Hf-179m	10	19,0 d	356,0	Ba-133	50	7,5 t
125,5	W-185	100	14,0 m	215,3	Hf-180m	30	5,5 j	356,6	Se-83	100	25 m
127,3	Te-101	2	3,15 j	215,5	Ge-77m	50	54 d	359,7	Pt-191	20	3,0 h
127,4	Cs-134m	100	36,0 j	215,5	Ge-77	50	11,3 j	360,4	Gd-161	50	3,73 m
127,4	Ni-57	12	14,6 h	215,8	Ru-97	90	2,88 h	361,0	Te-127m	10	105 h
129,4	Os-191	100	45 d	216,1	Ba-131	20	11,5 h	361,2	Os-190m	25	10,0 m
130,0	Rh-105m	100	44,6 h	224,9	Se-83	50	25 m	361,7	Dy-165	20	2,36 j
133,1	Hf-181	30	285 h	225,8	Gd-159	3	18,0 j	363,5	Gd-159	100	18,0 j
133,4	Ce-144 (Pr-144)	–	(17,3 m) 24,0 j	228,2	Np-239	20	2,35 h	364,5	I-131	80	8,08 h
133,9	Hg-197m	–	24,0 j	228,5	Lu-177m	–	155 h	366,5	Ni-65	10	2,56 j
134,3	W-187	10	24,0 j	231,5	Sr-85m	–	70 m	373,1	Ba-131	20	11,3 h
136,0	Se-75	30	121 h	235,7	Nb-95m	100	90 j	373,6	Hg-199m	–	42,0 m
136,0	W-181	0,1	145 h	238,6	Pb-212	–	Th-232 series	376,5	Pd-111	20	22,0 m

Tenaga keV	Isotop	Intensitas	Umur paro
388,2	I-126	40	13,1 h
388,5	Sr-87m	100	2,84 j
391,4	In-113m	100	104 m
396,1	Yb-175	50	101 j
401,4	Pb-203	4	52,1 j
411,8	Au-198	100	2,70 h
417,0	In-116m	20	53,99 m
417,4	Te-127m	70	105 h
423,6	Nd-149	-	1,8 j
426,1	Au-196	1	6,2 h
427,8	Sb-125	30	2,0 t
432,8	Hf-175	2	70,0 h
433,8	Ag-108	20	2,4 m
438,7	Zn-69m	100	13,8 j
440,2	Tl-202	90	12,0 d
442,7	I-128	90	25,4 m
443,1	Hf-180m	30	5,5 j
447,1	Tm-168	10	85 h
452,4	Te-131	20	24,8 m
459,2	Th-233	-	22,4 m
459,5	Te-129m	-	33,5 h
459,5	Te-129	-	72 m
460,4	Os-193	20	31,5 j
467,9	Ir-192	20	74,4 h
469,6	Ru-105	20	4,5 j
475,1	Rh-102(m)	70	210 h (2,5 t)
478,0	Re-188	6	16,7 j
479,3	W-187	20	24,0 j
479,3	I-90m	50	3,14 j
482,2	Hf-181	60	44,6 h
484,9	Cd-115m	10	44 h
486,8	La-140	20	40,27 j
491,2	I-126	7	13,1 h
492,5	Cd-115	30	53 j
497,0	Ru-103	90	38,9 h
507,5	Te-121	20	17,0 h
507,9	Zr-97	-	17,0 j
509,8	Tl-202	3	12,0 h
511,0	Cu-64		12,8 j
	Zn-65		245 h
	Br-80		17,6 m
	Co-58		71,3 h
	As-74		17,5 h
	Zr-89		78 j
	Na-22		2,58 t
	Ni-57		36,0 j
	Rh-102		210 h
511,6	Cu-71	-	2,2 m
511,9	Ru-106 (Rh-106)	90	1,02 t (30 d)
514,0	Sr-85	100	64 h
515,5	Dy-165m	-	1,25 m
520,8	As-77	20	38,7 j
521,4	Br-83	-	2,33 j
521,5	Tl-202	4	12,0 h
526,3	I-128	9	25,4 m
527,7	Cd-115	60	2,3 h
530,5	Br-83	-	2,33 j
531,0	Nd-147	20	11,06 h
539,0	Pt-191	30	3,0 h
542,8	Pt-199	-	30,0 m
544,9	Tc-101	7	14,0 m
552,9	In-117	-	44 m
554,3	Br-82	20	35,87 j
555,8	Rb-86m	100	1,02 m
555,8	Rh-104	100	44 d
557,7	Os-193	10	31,5 j
558,2	In-114	14	72 d
559,2	As-76	75	26,3 j
564,0	Sb-122	90	2,75 h
569,3	Ce-134	14	2,07 t
572,9	Te-121	80	17,0 h
580,0	Pd-111	24	22,0 m
583,1	Tl-208	-	Th-232 series
588,6	Zr-89m	90	4,4 m
590,6	Mo-101	10	14,6 m
595,8	As-74	80	17,5 h
600,4	Sb-125	20	2 t
602,1	Te-131	4	24,8 m
602,6	Sb-124	50	60,9 h
602,7	Ce-134	40	2,07 t
608,4	Ti-51	1	5,79 m
609,3	Pb-214	-	Ra-226 series
610,2	Ru-103	10	38,9 h
616,4	Os-190m	25	10,0 m
617,0	Br-80	100	4,5 j
619,0	Br-82	13	35,87 j
622,3	Ru-106 (Rh-106)	30	1,02 t (30 d)
628,3	Rh-102(m)	-	210 h ; 2,5 t
630,1	Ga-72	10	14,3 j
633,0	Re-188	10	16,7 j
632,9	Ag-108	60	2,42 m
634,6	As-74	17	17,5 h
636,4	I-131	30	8,08 h
640,4	Br-80	30	17,6 m
644,6	Ir-194	10	19,7 j
645,8	Os-185	10	93,6 h
657,0	As-76	80	26,3 j
657,8	Ag-110m	10	253 d
658,1	Nb-97	30	72,1 m
661,6	Ba-137m	100	2,6 m
661,6	Cs-137 (Ba-137m)	100	26,6 t (2,6 m)
664,4	Co-143	13	33 j
665,7	Br-80	100	17,6 m
666,3	I-126	40	13,1 h
667,7	Cs-132	100	6,2 h
670,0	Th-233	-	22,4 m
676,0	Ru-105	10	4,5 j
685,7	W-187	40	24,0 j
692,5	Sb-122	5	2,75 h
695,8	Te-129m	-	33,5 h
696,4	Co-144 (Pr-144)	-	285 h (17,3 m)
697,4	Rh-102m	-	2,5 t
702,5	Nb-94	-	2,03 x 10⁴ t
717,8	Se-83	20	25 m
721,6	Ce-143	13	33 j
722,1	I-131	30	8,08 h
722,8	Sb-124	6	60,9 h
723	Eu-154	10	16 t
724,0	Zr-95	50	65 h
724,3	Ru-105	40	4,5 j
725,1	In-114	14	72 d
727,3	Bi-212	-	Th-232 series
739,9	Mo-99	2	66 j
743,3	Nb-97m	10	60 d
754,0	Ce-139m	100	55 d
756,6	Zr-95	40	65 h
765,8	Nb-95	100	35 h
768,1	Bi-214	-	Ra-226 series
776,6	Br-82	30	35,87 j
791,7	Ru-184	30	38 h
795,8	Ce-134	40	2,07 t
810,3	Co-58	100	71,3 h
810,3	Ho-166m	20	30 t
815,7	Tm-168	15	85 h
828,0	Se-81	30	18 m
834,1	Ga-72	40	14,3 j
834,8	Mn-54	100	291 h
841,6	Eu-152m	30	9,35 j
844,0	Hg-27	70	9,45 m
846,9	Mn-56	70	2,58 j
860,5	Tl-208	-	Th-232 series
871,1	Nb-94m	10	6,6 m
871,1	Nb-94	50	2,03 x 10⁴ t
874,8	Os-185	7	93,6 h
879,4	Tb-160	20	73,0 h
880,0	Os-185	7	93,6 h
884,5	Ag-110m	20	253 h
889,4	Sc-46	50	83,9 h
894,2	Re-184	10	38 h
898,0	Rb-88	30	17,8 m
898,0	Y-88	100	104 h
902,8	Re-184	40	38 h
909,2	Zr-89	100	78 j
910,1	Zn-71	-	2,2 m
911,0	Ac-228	-	Th-232 series
928,5	Ti-51	4	5,79 m
934,1	Cd-115m	60	44 h
937,6	Nb-92	90	10,1 h
937,2	Ag-110m	10	253 h
938,4	Ir-194	6	19,7 j
963,5	Eu-152m	30	9,35 j
965,8	Tb-160	20	73,0 h
968,8	Ac-228	-	Th-232 series
983,5	Sc-48	33	44 j
1005,5	Eu-154	20	16,0 t
1012,4	Mo-101	10	14,6 m
1014,1	Mg-27	30	9,45 m
1037,6	Sc-48	33	44 j
1039,0	Cu-66	100	5,1 m
1039,4	Ga-70	30	21,1 m
1047,0	Rh-102(m)	10	210 h (2,5 t)
1050,5	Ga-70	30	21,1 m
1050,5	Ru-106 (Rh-106)	5	1,02 t (30 d)
1076,6	Rb-86	100	18,66 h
1079,8	Yb-177	15	1,9 j
1097,1	In-116m	20	53,9 m
1098,6	Fe-59	50	45,1 h
1115,4	Zn-65	100	245 h
1115,4	Ni-65	30	2,56 j
1120,0	Bi-54	-	Ra-226 series
1120,3	Sc-46	50	83,9 h
1121,2	Ta-182	17	115,1 h
1140,5	Sb-122	1	2,75 h
1147,9	Zr-97	-	17,0 j
1173,1	Co-60	100	5,24 t
1215,8	As-76	7	26,3 j
1221,6	Ta-182	14	115,1 d
1240,9	Yb-177	14	1,9 j
1266,2	Si-31	100	2,62 j
1273,0	Eu-154	20	16,0 t
1273,3	Al-29	100	6,56 m
1274,5	Na-22	100	2,58 t
1289,9	Cd-115m	20	44 h
1291,5	Fe-59	40	45,1 h
1293,6	Ar-41	100	110 m
1293,4	In-116m	40	53,99 m
1296,9	Ga-47	90	4,7 h
	Sc-47		3,43 h
1300,0	In-114	1	72 d
1311,8	Sc-48	33	44 j
1332,4	Co-60m	1	10,5 m
1332,4	Co-60	100	5,24 t
1345,5	Cu-64	100	12,8 j
1362,3	Zr-97	-	17,0 j
1368,4	Na-24	47	15 j
1378,1	Ho-166	10	26,9 j
1378,4	Ni-57	70	36,0 j
1388,1	Pd-111	15	22,0 m
1407,0	Eu-152	20	12,2 t
1434,4	Y-52	100	3,76 m
1460,7	K-40	100	1,25 x 10⁹ t
1481,7	Ni-65	50	2,56 j
1524,7	K-42	100	12,52 j
1575,5	Pr-142	100	19,2 j
1576,1	Cd-117m	-	3,0 j
1580,5	Ho-166	3	26,9 j
1588,3	Ac-228	-	Th-232 series
1595,4	La-140	50	40,27 j
1642,0	Cl-38	60	37,29 m
1690,7	Sb-124	25	60,9 h
1778,9	Al-28	100	2,31 m
1810,7	Mn-56	20	2,58 j
1836,1	Rb-88	50	17,8 m
1836,1	Y-88	100	104 h
1997,4	Cd-117m	-	3,0 j
2112,8	Mn-56	80	2,58 j
2166,8	Cl-38	40	37,29 m
2185,8	Ce-144 (Pr-144)	-	280 h (17,2 m)
2201,4	Ga-72	14	14,3 j
2614,3	Tl-208	-	Th-232 series
2677,6	Rb-88	5	17,8 m
2753,6	Na-24	52	15 j
3083,0	Ga-49	100	8,8 m
3102,4	S-37	100	5,05 m
4071,0	Ca-49	100	8,8 m

d = detik, m = menit, j = jam, h = hari, t = tahun

TABEL TENAGA RADIONUKLIDA

Isotop	Produksi	Tenaga (keV) (intensitas)	Tenaga lain (keV)
-19	O-18 (n,γ)	197,4 (100)	1356
-20	F-19 (n,γ)	1633,1 (100)	-
a-22	Na-23 (n,2n)	β^+; 1277,5	-
a-24	Na-23 (n,γ)	1368,4 (47); 2753,6 (52)	-
g-27	Mg-26 (n,γ)	844,0(70); 1014,1(30)	170
l-28	Al-27 (n,γ)	1778,9 (100)	-
l-29	Si-29 (n,p)	1273,3 (100)	2426
l-31	Si-30 (n,γ)	1266,2 (100)	-
-37	S-36 (n,γ)	3102,4 (100)	-
l-38	Cl-37 (n,γ)	1642,0(60); 2166,8(40)	-
r-41	Ar-40 (n,γ)	1293,6 (100)	-
-42	K-41 (n,γ)	1524,7 (100)	313; 1923
a-47	Ca-46 (n,γ)	160,0(100); 1296,9(90)	489; 808
a-49	Ca-48 (n,γ)	3083(100); 4071(10)	-
c-46m	Sc-45 (n,γ)	142,5 (100)	-
c-46	Sc-45 (n,γ)	889,4(50); 1120,3(50)	-
c-47	Ca-46 (n,γ, β^-) Ti-47 (n,p)	160,0 (100)	-
c-48	V-51 (n,) Ti-48 (n,p)	983,5(33); 1037,6(33); 1311,8 (33)	-
r-51	Cr-50 (n,γ)	320,0 (100)	-
i-51	Ti-50 (n,γ)	320,0(90); 608,4(1); 928,5 (4)	-
-52	V-51 (n,γ)	1434,4 (100)	-
n-54	Fe-54 (n,p)	834,8 (100)	-
n-56	Mn-55 (n,γ)	846,9(70); 1810,7(20); 2112,8(10)	2522; 2657; 2962; 3371
e-59	Fe-58 (n,γ)	192,5(2); 1098,6(50); 1291,5(40)	143; 335
o-57	Ni-58 (n,2n, β^+)	121,9(80); 136,5(6)	-
o-58	Ni-58 (n,p)	β^+; 810,3 (100)	863; 1675
o-60m	Co-59 (n,γ)	58,5 (100); 1332,4 (1)	-
o-60	Co-59 (n,γ)	1173,1(100); 1332,4(100)	-
i-57	Ni-58 (n,2n)	127,4(12); 1378,4(70); β^+	1759; 1921
i-65	Ni-64 (n,γ)	366,5(10); 1115,4(30); 1481,7(50)	1623; 1725; 508
u-64	Cu-63 (n,γ)	β^+; 1345,5 (100)	-
u-66	Cu-65 (n,γ)	1039,0 (100)	833
u-67	Zn-67 (n,p)	93,2(40); 184,2(60)	-
n-65	Zn-64 (n,γ)	β^+; 1115,4 (100)	-
n-69m	Zn-68 (n,γ)	438,7 (100)	-
n-71	Zn-70 (n,γ)	121,8; 511,6; 910,1	1040
a-70	Ga-69 (n,γ)	175,3(30); 1039,4(30); 1050,5(30)	-
a-72	Ga-71 (n,γ)	630,1(10); 834,1(40); 2201,4(14)	382;601;736;786; 810;861;894;940; 971;1000;1051; 1215;1231;1260; 1276;1463;1571; 1596;1681;1860; 2108;2491;2507; 2843;2982
Ge-75	Ge-74 (n,γ)	198,6 (10); 264,6 (80)	66; 419; 469
Ge-75m	Ge-74 (n,γ)	139,8 (100)	-
Ge-77	Ge-76 (n,γ)	211,4(50); 215,5(50); 264,5(50)	156;194;338;367; 416;460;475;558; 582;613;632;672; 714;745;748;765; 780;783;809;822; 842;874;897;906; 923;927;939;1086; 1113;1124;1150;1193; 1215;1240; 1262;1278;1294;1309; 1318;1367; 1449;1474;1492;1535; 1610;1707; 1717;1845;2000;2076; 2087;2124;2340
Ge-77m	Ge-76 (n,γ)	159,8(50); 215,5(50)	609;1203
As-74	Se-74 (n,p) As-75 (n,2n)	595,8(80); 634,6(17) β^+	87;162;271;382
As-77	Ge-76 (n,γ, β^-)	238,8(60); 249,7(10); 520,8(20)	572;665;740;767; 867;1130;1213;1229; 1438;1453;1787;2095; 2110;2429;2655
As-76	As-75 (n,γ)	559,2(75); 657,0(10); 1215,8(7)	66;97;121;199; 304;401
Se-75	Se-74 (n,γ)	136,0(30); 264,6(30); 279,6(14)	-
Se-77m	Se-76 (n,γ)	161,9 (100)	-
Se-79m	Se-78 (n,γ)	95,9 (100)	-
Se-81m	Se-80 (n,γ)	103,0 (100)	-
Se-81	Se-80 (n,γ)	275,8(60); 290,0(40); 828,0(30)	649;566;others
Se-83	Se-82 (n,γ)	224,9(50); 356,6(100); 717,8(20)	260;510;799;837; 867;1063;1299; 1314;1338;1349
Br-80	Br-79 (n,γ)	β^+; 640,4(30); 617,0(100); 665,7(100)	704;813;1257
Br-80m	Br-79 (n,γ)	37,0	49
Br-82	Br-81 (n,γ)	554,3(20); 619,0(13); 776,6(30)	92;101;138;222; 274;606;698;828; 1007;1044;1082; 1317;1475;1650; 1779;1872
Br-83	Se-82 (n,γ, β^-)	530,5(100); 521,4(4)	552;648;681
Rb-86	Rb-85 (n,γ)	1076,6 (100)	-
Rb-86m	Rb-85 (n,γ)	555,8 (100)	-
Rb-88	Rb-87 (n,γ)	898,0(30); 1836,1(50); 2677,6(5)	β^+;1382;2119; 2577;3007;3214 3733
Sr-89m	Sr-84 (n,γ)	151,1; 231,5	-
Sr-85	Sr-84 (n,γ)	514,0 (100)	-
Sr-87m	Sr-86 (n,γ)	388,5 (100)	-
Y-88	Y-89 (n,2n)	898,0(100);1836,1(100)	2734
Y-90m	Y-89 (n,γ) Nb-93 (n,α)	202,4(50); 479,3(50)	682
Zr-89m	Mo-92 (n,α)	588,6 (90)	1509; β^+
Zr-89	Mo-92 (n,α)	β^+; 909,2 (100)	1712
Zr-95	Zr-94 (n,γ)	724,0(50); 756,6(40)	-
Zr-97	Zr-96 (n,γ)	355,6; 507,9; 1147,9	254;603;704;805; 1022;1277;1362; 1751;1852
Nb-92	Nb-93 (n,2n)	934,6 (90)	913; 1846
Nb-94m	Nb-93 (n,γ)	871,1 (10)	41
Nb-94	Nb-93 (n,γ)	702,5(50);871,1(50)	-
Nb-95	Zr-94 (n,γ, β^-)	765,8 (100)	-
Nb-95m	Zr-94 (n,γ, β^-)	235,7 (100)	-
Nb-97m	Zr-96 (n,γ, β^-)	743,3 (100)	-
Nb-97	Zr-96 (n,γ, β^-)	658,1 (100)	1022*
Mo-99	Mo-98 (n,γ)	140,6(90); 180,9(10); 739,9(2)	366;778;801;921
Tc-99m	Mo-98 (n,γ, β^-)	140,6 (100)	
Mo-101	Mo-100 (n,γ)	192,0(10); 590,8(10); 1012,4(10)	81,196;334;378; 398;408;421;499; 506;512;567;608;643;695; 805;871;877;934;1161; 1187;1199;1251;1303;1357 1533;1600;1674;1759;1839 2033;2041;2089
Tc-101	Mo-100 (n,γ, β^-)	127,3(2); 306,8(80); 544,9(7)	180;184;233;237; 531;627;714;719; 811;843;928;938
Ru-97	Ru-96 (n,γ)	215,8(90); 325,1(10)	569
Ru-103	Ru-102 (n,γ)	497,0(90); 610,2(10)	295
Ru-105	Ru-104 (n,γ)	469,6(20); 676,0(10); 724,3(40)	150;263;317;326; 350;394;414-575; 676;876;908;969
Rh-102m	Rh-103 (n,2n)	475,1(70); 1047,0(10); β^+	345;415;418;468;557; 628;631;681;697;733; 739;767;1103;1114; 1158;1361;1324;1562; 1580;2038;2261
Rh-104(m)	Rh-103 (n,γ)	51,4; 77,6; 97,2	556;768;1239;others
Rh-104	Rh-103 (n,γ)	555,8 (100)	1239
Rh-105	Ru-104 (n,γ, β^-)	306,2; 319,1	280;443
Rh-105m	Ru-104 (n,γ, β^-)	130,0 (100)	-
Pd-109m	Pd-108 (n,γ)	188,9 (100)	-
Pd-109	Pd-108 (n,γ)	311,5(10); 88,0(100)	-
Pd-111m	Pd-110 (n,γ)	172,1 (90)	-
Pd-111	Pd-110 (n,γ)	376,5(20); 580,0(24); 1388,1(15)	296;509;623;836; 1120;1459;others
Ag-107m	Cd-106 (n,γ,E.C)	93,2 (100)	-
Ag-108	Ag-107 (n,γ)	433,8(20); 632,9(60)	619
Ag-109m	Pd-108 (n,γ, β^-)	88,0 (100)	-
Ag-110m	Ag-109 (n,γ)	657,8(30); 884,5(20); 937,2(10)	434;447;620;678; 687;706;744;764; 818;1384;1476; 1505;1562
Ag-111	Pd-110 (n,γ, β^-)	245,4(10); 342,9(90)	97
Cd-109	Cd-108 (n,γ)	88,0 (100)	-
Cd-111m	Cd-110 (n,γ)	150,8(25); 245,4(75)	-
Cd-115m	Cd-114 (n,γ)	484,9(10); 934,1(50); 1289,9(20)	
Cd-115	Cd-114 (n,γ)	492,5(30); 527,7(60)	231;261
Cd-117m	Cd-116 (n,γ)	273,3; 1576,1; 1997,4	392;434;1303
In-111	Sn-112 (n,2n,E.C)	171,4(50); 245,4(50)	-
In-113m	Sn-112 (n,γ,E.C)	391,4 (100)	-
In-114m	In-113 (n,γ)	190,2 (100)	-
In-114	In-113 (n,γ,I.T)	558,2(14);725,1(14);1300,0(1)	1283
In-115m	Cd-114 (n,γ, β^-)	336,6 (100)	-
In-116m	In-115 (n,γ)	417,0(20); 1097,1(20); 1293,4(40)	138;356;464;819; 1508;1753;2112
In-117(m)	Cd-116 (n,γ, β^-)	158,4; 315,2; 552,9	-
Sn-113	Sn-112 (n,γ)	255,2 (100)	-
Sn-117m	Sn-116 (n,γ)	158,4 (100)	-
Sn-123	Sn-122 (n,γ)	160,2 (100)	-
Sn-125	Sn-124 (n,γ)	332,0 (100)	589;643;1404
Sb-122m	Sb-121 (n,γ)	61,6; 76,3	-
Sb-122	Sb-121 (n,γ)	564,0(90); 692,5(5); 1140,5(1)	1257
Sb-124	Sb-123 (n,γ)	602,6(50); 722,8(6); 1690,7(25)	646;709;714;790; 968;1045;1325; 1368;1376;1437; 1488;1527;2091
Sb-125	Sn-124 (n,γ, β^-)	176,2(7); 427,8(30); 600,4(20)	204;320;380;443; 463;605;635;671
Te-121	Te-120 (n,γ)	507,5(20); 572,9(80)	others
Te-121m	Te-120 (n,γ)	212,3 (90)	others
Te-123m	Te-122 (n,γ)	158,8 (100)	-
Te-125m	Sn-124 (n,γ, β^-)	109,3 (100)	-
Te-127m	Te-126 (n,γ)	361,0(10);417,4(70)	663;others
Te-129m	Te-128 (n,γ)	459,5; 695,8	208;250;279;487; 729;1082;1108; others
Te-129	Te-128 (n,γ)	278,5; 459,5	487;1082
Te-131	Te-130 (n,γ)	149,7(70); 452,5(20); 602,1(4)	343;384;493;544; 654;695;727;934; 949;997;1008;1148

	Te-127 (n,γ)	364,5(80); 636,4(30)	80;177;284;503
	Te-130 (n,γ,β⁻)	722,1(30)	
11m	Te-130 (n,γ,β⁻)	164,5* (100)	-
12	Ba-132 (n,p) Cs-133 (n,2n)	667,7 (100)	465;506;β⁺;630;773;1032;1137;1298;1318;1985
14m	Cs-133 (n,γ)	127,4 (100)	-
14	Cs-133 (n,γ)	604,7(40); 795,8(40); 569,3(14)	475;563;802;1039;1168;1365
37	background	661,6 (100)	-
31	Ba-130 (n,γ)	124,2(30); 216,1(20); 373,1(20)	79;93;134;157;240;249;404;486;496;573;585;620;675;696;831;924;1047
31m	Ba-130 (n,γ)	108,2 (100)	-
33m	Ba-132 (n,γ)	275,9 (100)	-
33	Ba-132 (n,γ)	80,8(20); 302,8(20); 356,0(50)	53;161;223;276;384
35m	Ba-134 (n,γ)	268,1 (100)	-
37	Ba-136 (n,γ)	661,6 (100)	-
39	Ba-138 (n,γ)	165,8 (100)	1420
40	La-139 (n,γ)	328,6(10); 486,8(20); 1595,4(50)	110;131;172;242;267;432;751;815;867;919;925;950;2348;2520;2547;2898;3114
39	Ce-138 (n,γ)	165,8 (100)	-
39m	Ce-138 (n,γ)	754,0 (100)	-
41	Ce-140 (n,γ)	145,4 (100)	-
43	Ce-142 (n,γ)	293,1(60); 664,4(13); 721,6(13)	58;231;350;448;490;880;1102
44			
144)	background	133,4; 696,4; 2185,8	80;1486
42	Pr-141 (n,γ)	1575,5 (100)	-
47	Nd-146 (n,γ)	91,4(50); 319,4(6); 531,0(20)	120;196;275;398;410;440;488;595;687
49	Nd-148 (n,γ)	114,6*; 211,4; 423,6	59;74;97;156;189;199;229;240;270;312;326;349;444;540;556;655;others
51	Nd-150 (n,γ)	116,4*; 139,0; 255,6	85;171;175;183;320;333;403;460;525;585;678;735;797;1016;1123;1181;others
149	Nd-148 (n,γ,β⁻)	286,1 (90)	591;808;859;879;others
151	Nd-150 (n,γ,β⁻)	166,1(20); 275,6(10); 340,3(30)	66;76;101;105;139;147;162;177;202;209;227;232;240;258;291;306;324;330;345;380;441;446;565;637;665;671;705;719;736;753;773;786;819;834;849;950
145	Sm-144 (n,γ)	61,2 (100)	-
153	Sm-152 (n,γ)	69,6(20); 103,2(80)	173;463;532;539;596;608
155	Sm-154 (n,γ)	104,2(90); 141,2(10); 245,6(6)	168;203;462;523;665;1303
152m	Eu-151 (n,γ)	121,8(20); 841,6(30); 963,5(30)	271;344;563;700;970;1315;1389
152	Eu-151 (n,γ)	121,8(10); 344,2(20); 1407,4(20)	245;296;367;411;444;489;565;585;591;680;689;720;756;778;866;964;1086;1090;1111;1212;1299;1458;1493;1527
154	Eu-153 (n,γ)	123,1; 723*(10); 1005,5(20); 1274,3(20)	873;997;1595
155	Sm-154 (n,γ,β⁻)	86,6(60); 105,3(40)	61
153	Gd-152 (n,γ)	69,6(4); 97,5(60); 103,2(40)	-
159	Gd-158 (n,γ)	225,8(3); 305,3(1); 363,5(100)	58;79;289;348;560;580;617
161	Gd-160 (n,γ)	102,2(10); 314,6(20); 360,4(50)	57;77;165;181;192;258;271;283;338;394;480;529
160	Tb-159 (n,γ)	298,6(19); 879,4(21); 965,8(16)	87;197;216;309;337;393;765;962;1003;1103;1115;1178;1200;1272;1312
161	Gd-160 (n,γ,β⁻)	49,1(30); 74,9(30)	58;88;103;106;120;292
159	Dy-158 (n,γ)	58,2 (100)	-
165	Dy-164 (n,γ)	94,6(35); 279,5(15); 361,7(20)	259;456;479;515;546;566;575;620;633;660;695;715;728;995;1055;1080
165m	Dy-164 (n,γ)	108,2; 153,7; 515,5	362
166	Ho-165 (n,γ)	80,6(90); 1378,1(10); 1580,5(3)	673;705;785;1661;1749;1828
166m	Ho-165 (n,γ)	80,6(20); 184,3(20); 810,3(20)	216;265;280;300;411;451;465;530;670;692;712;752;778;831;876;896;951;995;1241;1401;1522
171	Er-170 (n,γ)	111,6(20); 295,8(20); 308,3(50)	86;117;124;210;237;277;372;420;670;676;732;796;870;
	Tm-170 Tm-169 (n,γ)	84,4 (100)	
	Yb-169 Yb-168 (n,γ)	63,3(30); 177,0(15); 197,8(20)	94;110;119;131;262;308
	Yb-175 Yb-174 (n,γ)	113,5(15); 282,6(30); 396,1(50)	137;145;252
	Yb-177 Yb-176 (n,γ)	150,3(50); 1079,8(15); 1240,9(14)	122;138;899;941;1028;1109;1119;1149;1230;others
	Lu-176m Lu-175 (n,γ)	88,3 (100)	-
	Lu-177 Lu-176 (n,γ)	113,0(30); 208,4(70)	72;250;321
	Lu-177m Lu-176 (n,γ)	113,0;208,4;228,5	105;121;129;137;146;147;153;160;172;174;177;195;204;214;233;250;269;282;297;305;312;319;328;341;368;379;385;414;419;466
	Hf-175 Hf-174 (n,γ)	89,6(3);343,6(90); 432;8(2)	230;others
	Hf-179m Hf-178 (n,γ)	160,6(10); 214,3(100)	-
	Hf-180m Hf-179 (n,γ)	57,5(30); 215,3(30); 332,2(40); 443,1(30)	93;501
	Hf-181 Hf-180 (n,γ)	133,1(30); 345,7(10); 482,2(60)	136;476;615
	Ta-180m W-180 (n,p) Ta-181 (n,2n)	93,1; 103,4	-
	Ta-182m Ta-181 (n,γ)	146,7(40); 171,7(40); 184,9(20)	318;356
	Ta-182 Ta-181 (n,γ)	67,7(14); 100,3(10); 1121,2(17); 1221,6(14)	66;85;114;116;152;156;179;198;222;229;264;927;1002;1157;1189;1281;1257;1273;1289;1340;1374;1387;1453
	W-181 W-180 (n,γ)	136,0(0,1); 151,7(0,2)	-
	W-185 W-184 (n,γ)	125,5 (100)	-
	W-187 W-186 (n,γ)	134,3(10); 479,3(20); 685,7(40)	72;115;207;239;246;511;551;618;625;745;773;864;879
	Re-184 Re-185 (n,2n)	791,7(30); 894,2(10);	99;111;209;245;252;291;641;768;1022
	Re-186 Re-185 (n,γ)	122,6(6);137,0(90)	632;769
	Re-188m Re-187 (n,γ)	92,4; 105,8	-
	Re-188 Re-187 (n,γ)	155,1(70); 478,0(6) 633,0(10)	453;486;672;830;931;1132;1151;1175;1193;1307;1609;1786;1801
	Os-185 Os-184 (n,γ)	645,8(80); 874,8(7); 880,0(7)	126;163;234;592;717
	Os-190m Os-189 (n,γ)	186,7(20); 361,2(25); 616,4(25)	503; 510
	Os-191 Os-190 (n,γ)	129,4 (100)	-
	Os-193 Os-192 (n,γ)	139,0(20); 460,4(20); 557,7(10)	107;181;219;251;280;289;290;321;362;388;484;533
	Ir-192m Ir-191 (n,γ)	56,8 (100)	-
	Ir-192 Ir-191 (n,γ)	295,8(10); 316,5(40); 467,9(20)	206;308;374;416;484;588;604;612;785;884
	Ir-194 Ir-193 (n,γ)	328,0(50); 644,6(10); 938,4(6)	293;621;1149;1183;1209;1469;1512;1623
	Pt-191 Pt-190 (n,γ)	350,7(20); 359,7(20); 539,0(30)	130*;172;179;190;220;269;409;457;602;624
	Pt-195m Pt-194 (n,γ)	99,0	130*
	Pt-197m Pt-196 (n,γ)	346,3 (100)	-
	Pt-197 Pt-196 (n,γ)	77,7*(90); 191,4(10)	269
	Pt-199 Pt-198 (n,γ)	185,9; 316,9; 542,8	246;475;494;714;791;968
	Au-196 Hg-196 (n,γ)	333,0(26); 355,7(100); 426,1(1)	759;1093
	Au-198 Au-197 (n,γ)	411,8 (100)	676;1088
	Au-199 Pt-199 (n,γ,β⁻)	158,3(80); 208,2(20)	-
	Hg-197m Hg-196 (n,γ)	133,9	165
	Hg-197 Hg-196 (n,γ)	77,6*(100); 191,4(2)	269
	Hg-199m Hg-198 (n,γ)	158,3;373,6	-
	Hg-203 Hg-202 (n,γ)	279,1 (100)	-
	Hg-205 Hg-204 (n,γ)	203,8 (100)	-
	Tl-202 Tl-203 (n,2n)	440,2(90); 509,8(3); 521,5(4)	960
	Pb-203 Pb-204 (n,2n)	279,2(90); 401,4(4)	681
	Th-233 Th-232 (n,γ)	86,6; 459,2; 670,0	57;131;143;153;169;179;190;195;202;210;257;360;377;433;441;448;491;499;514;527;553;563;574;596;600;610;643;678;717;725;740;758;764;805;816;875;890;935
	Pa-233 Th-232 (n,γ,β⁻)	299,9(12); 311,8(80); 340,3(3)	59;75;87;104;271;375;398;416
	U-237 U-238 (n,2n)	59,8(60); 164,6(10); 208,0(30)	268;232;370
	U-239 U-238 (n,γ) Np-239 U-238 (n,γ,β⁻)	74,7 (100) 106,1*(40); 228,2(20); 277,5(20)	- 62;181;210;254;285;316;334

Tabel Isotop Energi - γ dan Pengaktifan Neutron
(Erdtmann, dkk,1979 dan Erdtmann,1976)

0.51100

---

27 CO 53M

HALF LIFE: 0.247S
GEN:
DAU: FE 53M
FE 53
MN 53
PAR:
REF: NO GAMMA LINES

---

27 CO 54

HALF LIFE: 0.194S
GEN: CHA FE 54
DAU:
PAR:
REF: 68 LE 1

0.51100 200.00000 A

---

27 CO 54M

HALF LIFE: 1.48M
GEN: CHA FE 54
DAU:
PAR:
REF: 70 VE 1

0.38500	PAIR PEAK
0.41100	100.00000 A
0.51100	200.00000 A
0.89600	PAIR PEAK
1.13000	100.00000 A
1.40700	100.00000 A

---

27 CO 55

HALF LIFE: 17.54H
GEN: CHA FE 56
CHA FE 54
DAU:
PAR:
REF: 76 KO 3

0.09180	2.70000 A
0.38500	0.60000 A
0.41100	0.97500 A
0.47720	20.32000 A
0.52030	0.97500 A
0.80380	2.10000 A
0.82750	0.30750 A
0.93150	75.00000 A
[illegible]3450	0.52500 A
[illegible]10	0.32250 A
[illegible]	7.12500 A
[illegible]	3.00000 A
1.[illegible]	[illegible]6.50000 A
1.5[illegible]	[illegible].06750 A
1.797[illegible]	[illegible]99750 A
2.14360	[illegible]1250 A

2.17680	0.27750 A
2.57820	0.05350 A
2.87150	0.12000 A
2.93900	0.05250 A
3.10850	0.00825 A

---

27 CO 56

HALF LIFE: 77.[illegible]
GEN: CHA NI 58
CHA MN 55
CHA FE 56
DAU:
PAR:
REF: 70 MA 3,69 AR 1,
70 RA 2,7[illegible] CA 3

0.26340	0.02000 A
0.41137	0.02500 A
0.48653	0.05000 A
0.51100	48.00000 A
0.73370	0.20000 A
0.78786	0.31000 A
0.84675	99.99000 A
0.89570	0.07000 A
0.97746	1.44000 A
0.99730	0.11000 A
1.03783	14.00000 A
1.08900	0.05000 A
1.14025	0.15000 A
1.16005	0.11000 A
1.17513	2.28000 A
1.19875	0.05000 A
1.23825	67.60000 A
1.27215	0.02000 A
1.33553	0.12500 A
1.36022	4.33000 A
1.44277	0.20000 A
1.46230	0.07700 A
1.57655	PAIR PEAK
1.64050	0.06000 A
1.77149	15.70000 A
1.81040	0.64000 A
1.96394	0.72000 A
2.01536	[illegible].08000 A
2.03492	7.89000 A
2.08759	PAIR PEAK
2.11360	0.38000 A
2.21310	0.39000 A
2.23164	PAIR PEAK
2.27630	0.11000 A
2.37365	0.08000 A
2.52380	0.06000 A
2.59858	16.90000 A
2.74264	PAIR PEAK
3.01020	1.00000 A
3.20230	3.04000 A
3.25364	7.41000 A
3.27319	1.75000 A
3.36960	0.01[illegible]00 A
3.45155	0.87500 A
3.54805	0.[illegible]8000 A
3.60050	0.0[illegible]000 A
3.61[illegible]	0.0[illegible]000 A

---

27 CO 57

HALF LIFE: 270.D
GEN: CHA MN 55
PHO NI 58
PHO CO 59
DAU:
PAR:
REF: 70 MA 3

0.0[illegible]441	[illegible].50000 A
0.1[illegible]	[illegible].60000 A
0.13643	[illegible].60000 A
0.[illegible]40	[illegible].00020 A
0.33970	[illegible].00380 A
0.35240	[illegible].00280 A
0.36470	[illegible].00050 A
0.57030	[illegible].01100 A
0.69210	[illegible].15000 A
0.70650	[illegible].00500 A

---

27 CO 58

HALF LIFE: 70.78D
GEN: NFA NI 58
NFA CO 59
CHA MN 55
DAU:
PAR:
REF: 73 BA [illegible].70 MA 3

0.51100	3[illegible].00000 A
0.81075	99.45000 A
0.86394	[illegible].69000 A
1.67473	[illegible].51900 A

---

27 CO 58M

HALF LIFE: 8.94H
GEN: NFA NI 58
NFA CO 59
CHA MN 55
DAU: CO 58
PAR:
REF: 73 BA [illegible] 70 RA 3

0.00700	24.50000 A X
0.02[illegible]	[illegible].03530 A

---

27 CO 60

HALF LIFE: 5.2721A
GEN: NTH CO 59
NFA NI 60
NFA CU 63
DAU:
PAR: FE 60 1.E+05A
REF: 7[illegible] KI [illegible] 73 HA 2

0.34[illegible]	[illegible].00760 A
0.[illegible]	[illegible].00040 A<
0.[illegible]	[illegible].00550 A
1.17323	99.86000 A
1.33251	99.98000 A
2.15870	0.00080 A
2.50575	9.0E-06 A

---

27 CO 60M

HALF LIFE: [illegible]0.47M
GEN: NTH CO 59
NFA NI 60
NFA CU 63
DAU: CO 60
PAR:
REF: 75 KI [illegible].73 HA 2

0.05860	2.04000 A
0.82618	0.00780 A
1.33251	0.25000 A
2.15870	0.00060 A

---

27 CO 61

HALF LIFE: 1.65H
GEN: NFA NI 61
CHA NI 64
CHA CO 59
DAU:
PAR:
REF: 75 AU 2

0.06742	86.00000 A
0.84170	0.59000 A
0.90920	3.00000 A

---

27 CO 62

HALF LIFE: [illegible].5M
GEN: NFA NI 62
NFA CU 65
DAU:
PAR:
REF: 69 KI 1,70 JO 3,
70 JO 6,74 VE 1

1.12800	[illegible].10000 A
1.17230	83.80000 A
1.27980	PAIR PEAK
1.79060	PAIR PEAK
1.88630	0.40000 A
1.98510	[illegible].60000 A
2.05300	0.30000 A
2.09700	0.90000 A
2.30180	14.70000 A
2.34590	[illegible].30000 A
3.15800	0.60000 A
3.27100	0.30000 A<
3.36900	0.30000 A
3.51900	0.08000 A
4.06300	[illegible].30000 A

24 CR 45

HALF LIFE: 0.05S
GEN:
DAU: TI 45
PAR:
REF: 74 SE 1

0.51100

24 CR 46

HALF LIFE: 0.26S
GEN:
DAU: V 46
PAR:
REF: 74 SE 1

0.51100

24 CR 47

HALF LIFE: 0.46S
GEN: CHA TI 46
CHA CR 50
DAU: V 47
PAR:
REF: 77 HA 2

0.51100 200.00000 A

24 CR 48

HALF LIFE: 23.0H
GEN: CHA TI 46
DAU: V 48
PAR:
REF: 68 LE 1

0.11600 98.00000 A
0.30600 99.00000 A

24 CR 49

HALF LIFE: 41.9M
GEN: NFA CR 50
CHA TI 46
PHO CR 50
DAU:
PAR:
REF: 71 CH 3

0.06230 20.00000 A
0.09060 59.00000 A
0.260 29.50000 A
0.30 192.00000 A

24 CR 51

HALF LIFE: 27.7D
GEN: NTH CR 50
NFA FE 54
NFA CR 52
DAU:
PAR:
REF: 73 DE 1

0.32007 9.83000 A

24 CR 55

HALF LIFE: 3.55M
GEN: NTH CR 54
NFA MN 55
NFA FE 58
DAU:
PAR:
REF: 76 KO 3

0.12610 0.00174 A
1.40200 0.00133 A
1.52800 0.03700 A
2.24090 0.00041 A
2.25250 0.00315 A
2.26810 0.00011 A
2.36850 0.00019 A

24 CR 56

HALF LIFE: 5.9M
GEN: CHA CR 54
DAU: MN 56
PAR:
REF: 68 LE 1

0.02600
0.08300

25 MN 50

HALF LIFE: 0.2832S
GEN: CHA CR 50
DAU:
PAR:
REF: 76 AU 4

0.51100 200.00000 A

25 MN 50M

HALF LIFE: 1.75M
GEN: CHA CR 50
DAU:
PAR:
REF: 76 AU 4

0.42130 PAIR PEAK
0.51100 198.40000 A
0.66150 25.00000 A
0.71200 0.50000 A
0.78330 100.00000 A
0.93230 PAIR PEAK
1.09800 103.00000 A
1.28240 23.00000 A
1.44330 69.00000 A
1.79350 0.50000 A
1.94450 3.50000 A
1.99340 0.90000 A
2.01690 0.60000 A
2.40440 0.96000 A
2.54080 0.60000 A
2.81150 0.30000 A
3.11520 1.00000 A

25 MN 51

HALF LIFE: 46.5M
GEN: CHA CR 50
DAU:
PAR:
REF: 70 RA 5

0.51100 194.00000 A
0.75500 0.70000 A
1.16700 0.50000 A

25 MN 52

HALF LIFE: 5.7D
GEN: CHA CR 50
DAU:
PAR:
REF: 70 RA 7

0.34574 0.93000 A
0.39850 0.33000 A
0.41230 PAIR PEAK
0.50280 0.99000 A
0.51100 56.00000 A
0.60060 0.49000 A
0.64700 0.51000 A
0.74420 55.00000 A
0.84840 3.00000 A
0.92330 PAIR PEAK
0.93360 93.00000 A
1.24700 4.70000 A
1.33370 5.10000 A
1.43430 100.00000 A
1.64500 0.04000 A
1.97900 0.03000 A

25 MN 52M

HALF LIFE: 21.3M
GEN: CHA CR 50
DAU:
PAR: FE 52 8.2H
REF: 70 RA 7

0.37780 2.00000 A
0.41230 PAIR PEAK
0.51100 193.00000 A
0.92330 PAIR PEAK
1.43430 100.00000 A
1.52960 0.08000 A
1.72710 0.20000 A
3.16000 0.03000 A

25 MN 53

HALF LIFE: 3.7E+06A
GEN:
DAU:
PAR:
REF: 74 SE 1

0.00541 18.00000 A X
0.00600 2.00000 A X

25 MN 54

HALF LIFE: 312.2D
GEN: NFA MN 55
NFA FE 54
CHA V 51
DAU:
PAR:
REF: 70 MA 3

0.83481 99.97800 A

25 MN 56

HALF LIFE: 2.576H
GEN: NTH MN 55
NFA FE 56
NFA CO 59
DAU:
PAR:
REF: 69 GU 1,70 RA 2,
77 KO 1

0.78920 PAIR PEAK
0.84660 99.00000 A
1.09060 PAIR PEAK
1.30020 PAIR PEAK
1.60160 PAIR PEAK
1.81120 27.20000 A
2.11260 14.30000 A
2.52300 0.99000 A
2.65750 0.65300 A
2.96000 0.30600 A
3.11930 0.08000 A
3.37060 0.16800 A

25 MN 57

HALF LIFE: 1.7M
GEN: NFA FE 57
CHA CR 54
DAU:
PAR:
REF: 69 WA 1

el	Reaction	Half-life of product	Cross sections σ	Cross sections I	Activation products (decays/sec per 1 μg of nat. el.) Irradiation time: 1 sec	Final	1 hour	1 day	20 days	saturation	Main γ lines
	Z = 23 A = 50.9414 σ_{ab} = 5.04 ± 0.04 b I_{ab} = 2.7 ± 0.1 b										
	or neutrons				$\varphi_{th} = 10^{13}$, $\varphi_{epi} = 2 \cdot 10^{12}$ n cm^{-2} sec^{-1}						
	V-51	stable	70 ± 33 b	67 ± 1 b							
6	V-52	3.755 m	4.88 ± 0.04 b	2.91 ± 0.16 b [81a]	1790	98160	sat	sat	sat	6.8E-4	1434.2(100)
	or neutrons				$\varphi_f = 10^{13}$ n cm^{-2} sec^{-1}						
	(n,α)Sc-47	3.41 d	1.5 (+1.2,-0.8) mb		1.04E-7	6.26E-6	3.74E-4	8.16E-3	4.39E-2	4.43E-2	159.4(70)
	(n,2n)V-49	331 d	400 (+207,-160) μb		2.87E-10	1.72E-8	1.03E-6	2.47E-5	4.85E-6	1.18E-2	no γ
5	(n,p)Ti-51	5.76 m	870 (+410,-310) μb [b]		2.00E-2	1.1C	sat	sat	sat	10.3	320(95),928.5(5)
	(n,α)Sc-48	43.7 h	22 ± 3 μb [c]		1.14E-6	6.86E-6	4.08E-3	1.21E-2	sat	0.259	983.3(100),1037.4(98),1311.7(100)
	(n,2n)V-50	stable	73 (+61, 29) μb								
	neutrons				$\varphi_{14.6\ MeV} = 10^{9}$ n cm^{-2} sec^{-1}						
5	(n,p)Ti-51	5.76 m	36.5 ± 4 mb		8.39E-4	4.75E-2	sat	sat	sat	0.418	320(95),928.5(5)
	(n,α)Sc-48	43.7 h	17 ± 3 mb		8.03E-7	5.3E-6	3.16E-3	6.35E-2	sat	0.2	983.3(100),1037.4(98),1311.7(100)
	(n,2n)V-50	stable	666 ± 80 mb								
n	Z = 24 A = 51.996 σ_{ab} = 3.1 ± 0.2 b I_{ab} = 1.7 ± 0.2 b										
	or neutrons				$\varphi_{th} = 10^{13}$, $\varphi_{epi} = 2 \cdot 10^{12}$ n cm^{-2} sec^{-1}						
	Cr-51	27.71 d	15.9 ± 3.2 b	7.7 ± 0.4 b [d]	2.34E-2	1.41	84.3	1.93	3.04E	0.0890	320.1(9.8)
9	Cr-53	stable	760 ± 60 mb	600 ± 60 mb [b]							
	Cr-54	stable	18.2 ± 1.5 b	8.85 ± 1 b							
	Cr-55	3.55 m	360 ± 40 mb [c]	180 ± 40 mb [d]	3.22	176	sat	sat	sat	0.94	1620.2(0.043)
	r neutrons				$\varphi_f = 10^{12}$ n cm^{-2} sec^{-1}						
	(n,p)V-50	stable	67 (+20,-14) mb								
	(n,α)Ti-47	stable	470 (+580,-210) μb								
	(n,2n)Cr-49	42.0 m	6 ± 1 μb [a]		8.31E-7	4.94E-6	1.9E-3	sat	sat	3.02E-3	511(197),62.3(20),90.6(59),152(29.5
	V-49	331 d	stable		0	0	9.64E-8	6.1E-6	1.24E-4	3.02E-4	no γ
9	(n,p)V-52	3.755 m	1.89 ± 0.08 mb [f]		3.26E-2	1.70	sat	sat	sat	10.6	1434.2(100)
	(n,α)Ti-49	stable	57 (+46, 26) μb								
	(n,2n)Cr-51	27.71 d	20 (+20, 11) μb		7.87E-8	4.72E-6	2.01E-4	4.71E-3	0.107	0.272	320.1(9.8)
	(n,p)V-53	1.55 m	440 ± 40 μb [g]		3.6E-3	0.176	sat	sat	sat	0.484	1006(88.7),1287(11.3)
	(n,α)Ti-50	stable	4.1 (+3.3,-1.5) mb								
	(n,2n)Cr-52	stable	1.7 (+1.2,-0.7) mb								
	(n,p)V-54	49 s	5.8 ± 1 μb [h]		2.54E-5	9.83E-4	sat	sat	sat	1.59E-3	840(100),990(100),2210(100)
	(n,α)Ti-51	5.76 m	33 (+26,-15) μb		1.81E-6	1.02E-3	5.01E-3	sat	sat	9.02E-3	320(95),928(5)
	(n,2n)Cr-53	stable	290 (+200,-120) μb								

[a] ...dous 7.7 ± 0.1 b [1], 2.16 b [6]
[b] ...dua 600 (+900, 350) μb [10]

Footnotes Continued on next page

Reaction	Half life of product	Cross section σ	I	Activation products [decays/sec per 1 μg element] Irradiation time: 1 sec	1 min	1 hour	1 day	20 days	saturation	Main γ lines
27 A = 58.9332 σ_{th} = 37.2 ± 0.2 b I_{th} = 75.5 ± 1.5 b										
[illegible]trons				$\phi_{th} = 10^{13}$, $\phi_{epi} = 2 \cdot 10^{11}$ n cm^{-2} sec^{-1}						
Co 60m [a]	10.43 m	20 ± 2 b	38.5 ± 0.5 b [12]	2330	1.38E 5	2.00E 6	sat	sat	2.12E 6	58.6(2.1)
Co 60g	5.272 a	17 ± 2 b	39 ± 2 b [b]							
Co 60 (tot)		37.2 ± 0.2 b	75.5 ± 1.5 b	2.6E-3	0.472	51.2	1410	20200	3.93E 6	1173.2(99.9),1332.5(100)
[illegible]es										
Co-59	stable	13600 ± 1000 [illegible]								
Co-59	stable	1080 ± 120 b	6890 b							
[illegible]m) Co 61	1.650 h	58 ± 8 b	230 ± 50 b							
[illegible]a) Co 61	1.650 h	2.0 ± 0.2 [illegible]	4.3 ± 1.0 b							
[illegible]trons				$\phi_f = 10^{12}$ n cm^{-2} sec^{-1}						
(n,p)Fe 59	44.6 d	1.42 ± 0.14 mb [c]		2.61E 6	1.57E 4	0.39E 3	0.224	3.00	14.5	1099.3(56),1291.6(44)
(n,α)Mn 56	2.582 h	150 ± 9 μb [d]		1.19E 4	7.12E 5	0.375	sat	sat	1.59	846.6(99),1811.7(30),2112.6(15.5)
(n,2n)Co 58	70.78 d	400 ± 40 μb [e]						0.222	4.09	511(30),810.6(99.4)
[illegible]rons				$\phi_{14.5 MeV} = 10^9$ n cm^{-2} sec^{-1}						
(n,p)Fe 59	44.6 d	80 ± 23 mb		1.47E 7	8.82E 6	5.29E 4	1.26E-2	0.219	0.818	1099.3(56),1291.6(44)
(n,α)Mn 56	2.582 h	30 ± 2 mb		7.29E-5	1.37E 3	7.22E-2	0.306	sat	0.307	846.6(99),1811.7(30),2112.6(15.5)
(n,2n)Co 58m [a]	8.94 h	402 ± 41 mb		8.65E 5	5.18E 3	0.3	3.44	sat	4.11	no γ
(n,2n)Co-58	70.78 d	720 ± 50 mb [f]		8.28E-7	4.97E-5	3.04E 3	9.26E-2	2.03	11.5	511(30),810.6(99.4)

[illegible] between values above and below
[illegible] 1 (1.5, 0.0) mb [20]
[illegible] 170 (140, 200) μb [10]
[illegible] 160 (110, 800) μb [10]
[illegible] 810 ± 72 mb (14.7) [22]

Lampiran 5

INTERNATIONAL ATOMIC ENERGY AGENCY
AGENCE INTERNATIONALE DE L'ENERGIE ATOMIQUE
МЕЖДУНАРОДНОЕ АГЕНТСТВО ПО АТОМНОЙ ЭНЕРГИИ
ORGANISMO INTERNACIONAL DE ENERGIA ATOMICA

WAGRAMERSTRASSE 5, P.O.BOX 100, A-1400 VIENNA, AUSTRIA, TELEX 1-12645, CABLE: INATOM VIENNA, TELEPHONE 2360 EXT

IN REPLY PLEASE REFER TO:
PRIERE DE RAPPELER LA REFERENCE:

LAB/243

May 1984

CERTIFIED REFERENCE MATERIAL

IAEA/SOIL-7

Certified concentration values of trace elements:

No.	Element	Concentration* µg/g	Confidence interval (significance level 0.05) µg/g
1	Antimony	1.7	1.4 ÷ 1.8
2	Arsenic	13.4	12.5 ÷ 14.2
3	Cerium	61	50 ÷ 63
4	Cesium	5.4	4.9 ÷ 6.4
5	Chromium	60	49 ÷ 74
6	Cobalt	8.9	8.4 ÷ 10.1
7	Copper	11	9 ÷ 13
8	Dysprosium	3.9	3.2 ÷ 5.3
9	Europium	1.0	0.9 ÷ 1.3
10	Hafnium	5.1	4.8 ÷ 5.5
11	Holmium**	1.1	(0.8;1.5)
12	Lanthanum	28	27 ÷ 29
13	Lead	60	55 ÷ 71
14	Manganese ✓	631	604 ÷ 650
15	Neodymium	30	22 ÷ 34
16	Rubidium	51	47 ÷ 56
17	Samarium	5.1	4.8 ÷ 5.5
18	Scandium	8.3	6.9 ÷ 9.0
19	Strontium	108	103 ÷ 114
20	Tantalum	0.8	0.6 ÷ 1.0
21	Terbium	0.6	0.5 ÷ 0.9
22	Thorium	8.2	6.5 ÷ 8.7
23	Uranium	2.6	2.2 ÷ 3.3
24	Vanadium	66	59 ÷ 73
25	Ytterbium	2.4	1.9 ÷ 2.6
26	Yttrium	21	15 ÷ 27
27	Zinc ✓	104	101 ÷ 113
28	Zirconium	185	180 ÷ 201

* expressed on a dry-weight basis (constant weight at 105°C)
** only two laboratories provided results. These results are shown in brackets in the place of confidence limits.

Non-certified information values of concentration of certain trace elements

No.	Element	Concentration* µg/g	Confidence interval (significance level 0.05) µg/g
1	Barium	159	131 ÷ 196
2	Bromine	7	3 ÷ 10
3	Cadmium	1.3	1.1 ÷ 2.7
4	Fluorine**	480	(344;618)
5	Gallium	10	9 ÷ 13
6	Lithium	31	15 ÷ 42
7	Lutetium	0.3	0.1 ÷ 0.4
8	Mercury	0.04	0.003 ÷ 0.07
9	Molybdenum	2.5	0.9 ÷ 5.1
10	Nickel	26	21 ÷ 37
11	Niobium	12	7 ÷ 17
12	Phosphorus	460	460 ÷ 462
13	Selenium	0.4	0.2 ÷ 0.8

* expressed on a dry-weight basis (constant weight at 105°C)
** only two laboratories provided results. These results are shown in brackets in the place of confidence limits.

Non-certified concentration values of major and minor elements
(see note below)

No.	Element	Concentration* mg/g	Confidence interval (significance level 0.05) mg/g
1	Aluminium	47	44 ÷ 51
2	Calcium	163	157 ÷ 174
3	Iron	25.7	25.2 ÷ 26.3
4	Magnesium	11.3	11.0 ÷ 11.8
5	Potassium	12.1	11.3 ÷ 12.7
6	Silicon	180	169 ÷ 201
7	Sodium	2.4	2.3 ÷ 2.5
8	Titanium	3.0	2.6 ÷ 3.7

* expressed on a dry-weight basis (constant weight at 105°C)

NOTE: The concentration values of the major and minor elements passed all test criteria for certified values with the exception of one: their confidence intervals are larger than those normally allowed for major components of reference materials, therefore, these values could not be certified.

Description of the material

The soil (topsoil to a depth of 10 cm) was collected near Ebensee in Upper Austria (Oberösterreich) at an altitude of 1100 m above sea level. The fraction of the material passing through a 1 cm sieve was taken, heated at 450°C to destroy organic matter, crushed, ground and resieved. A 50 kg batch of the fraction which passed through a 71 µm sieve (about 95%) was homogenized by mixing in a rotating plastic drum for 70 hours. Aliquots of 25 g were distributed into plastic bottles.

Homogeneity was checked by determining the concentration of some elements (Na, Fe, Sc, Sm) by neutron activation analysis in several sub-samples taken from one bottle and comparing the results with those obtained on sub-samples taken from various bottles. By applying statistical tests (F and t) it was found that the material may be considered as homogeneous at a confidence level 0.95 for a sample weight equal to or larger than 100 mg.

Coarse composition of the material is as follows:

Al_2O_3	8.9%	Na_2O	0.6%
CaO	22.9%	SO_3	0.3%
Fe_2O_3	3.7%	SiO_2	38.5%
K_2O	2.9%	TiO_2	0.5%
MgO	1,9%	Loss on ignition (900°C)	20.5%

Establishing of certified values

The basis for establishing the certified concentration values was the interlaboratory comparison organized by the IAEA in 1983. The median values and their confidence intervals, calculated for the intercomparison results, were accepted as certified values when they fulfilled certain test criteria. In general, the test criteria were based on the following data: reasonable confidence interval of the median for the concentration level concerned, adequate number of results, adequate number of analytical methods used, agreement between the results obtained by various methods, and number of outlying results.

A detailed description of results of the intercomparison and of the criteria used for their qualification may be found in the Report No. IAEA/RL/112, May 1984.

Important note

The analysts using the Certified Reference Material IAEA/SOIL-7 are kindly requested to communicate their meaningful analytical results on this material to:

Analytical Quality Control Service
International Atomic Energy Agency
Laboratory Seibersdorf
P.O.Box 100, A-1400 Vienna, Austria

These results may be used in the future for an updating of the certified values which are the best estimates as of May 1984.

National Bureau of Standards

Certificate of Analysis

Standard Reference Material 1572

Citrus Leaves

This Standard Reference Material (SRM) is intended primarily for use in calibrating instrumentation and evaluating the reliability of analytical methods for the determination of major, minor, and trace elements in botanical materials, agricultural food products, and similar matrices.

Certified Values of Constituent Elements: The certified values for the constituent elements are shown in Table 1. They are based on results obtained either by definitive methods of known accuracy or by two or more independent analytical methods. Non-certified values, which are given for information only, appear in Table 2.

Notice and Warnings to Users:

Expiration of Certification: This certification is invalid 5 years after the shipping date. Should it be invalidated before then, purchasers will be notified by NBS.

Stability: The material should be kept in its original bottle and stored at temperatures between 10–30 °C. It should not be exposed to intense sources of radiation. Ideally, the bottle should be kept tightly closed in a desiccator in the dark at the temperature indicated.

Use: The bottle should be shaken well before each use. A minimum sample of 500 mg of the dried material (see Instructions for Drying) should be used for any analytical determination to be related to the certified values of this certificate.

Statistical consultation was provided by K. Kafadar of the Statistical Engineering Division.

The overall direction and coordination of the analyses leading to this certification were performed under the chairmanship of E.L. Garner, Chief of the Inorganic Analytical Research Division.

The technical and support aspects involved in the preparation, certification, and issuance of this Standard Reference Material were coordinated through the Office of Standard Reference Materials by R. Alvarez.

Washington, D.C. 20234
December 20, 1982
(Revision of Certificate
dated 2-22-82)

George A. Uriano, Chief
Office of Standard Reference Materials

(over)

Lampiran 6

Table 1. Certified Values of Constituent Elements

Major and Minor Constituents

Element	Content,[1] (Wt. Percent)
Calcium	3.15 ± 0.10
Magnesium	0.58 ± 0.03
Phosphorus	0.13 ± 0.02
Potassium*	1.82 ± 0.06
Sulfur	0.407 ± 0.009

Trace Constituents

Element	Content,[1] μg/g	Element	Content,[1] μg/g
Aluminum	92 ± 15	Manganese	23 ± 2
Arsenic	3.1 ± 0.3	Mercury	0.08 ± 0.02
Barium	21 ± 3	Molybdenum	0.17 ± 0.09
Cadmium	0.03 ± 0.01	Nickel	0.6 ± 0.3
Chromium	0.8 ± 0.2	Rubidium*	4.84 ± 0.06
Copper	16.5 ± 1.0	Sodium	160 ± 20
Iodine	1.84 ± 0.03	Strontium*	100 ± 2
Iron	90 ± 10	Zinc	29 ± 2
Lead*	13.3 ± 2.4		

based on dry weight. For drying instructions, see this section of this certificate on Instructions for Drying. The uncertainties are based on judgment and represent an evaluation of the combined effects of method imprecision, possible systematic errors among methods, and material variability for samples weighing 500 mg or more.

*For those elements determined by definitive methods, the uncertainties are given as 95%/95% statistical tolerance intervals. See The Role of Standard Reference Materials in Measurement Systems, NBS Monograph 148, 1975 p 14.

Table 2. Non-certified Values for Constituent Elements

NOTE: The following values are not certified because they are not based on the results of either a definitive method of known accuracy or two or more independent methods. These values are included for information only.

Major Constituent

Element	Content,[1] (Wt. Percent)
Nitrogen	(2.86)

Trace Constituents

Element	Content,[1] μg/g	Element	Content,[1] μg/g
Antimony	(0.04)	Samarium	(0.052)
Bromine	(8.2)	Scandium	(0.01)
Cerium	(0.28)	Selenium	(0.025)
Cesium	(0.098)	Tellurium[2]	(0.02)
Chlorine	(414)	Thallium	(≤0.01)
Cobalt	(0.02)	Tin	(0.24)
Europium	(0.01)	Uranium	(≤0.15)
Lanthanum	(0.19)		

[1] Analytical values are based on the "dry weight" of material (See Instructions for Drying).
[2] Not sufficiently homogeneous for certification.

Instructions for Drying: Samples of this SRM must be dried before weighing and analysis by either of the following procedures:

1. Drying for 2 hours in air in an oven at 85 °C.
2. Drying for 24 hours at 20 to 25 °C and at a pressure not greater than 30 Pa (0.2 mm Hg).

Additional Information on Analyses: This SRM contains siliceous material, which is an integral part of the sample. The values in Tables 1 and 2 are based on analyses performed on the *entire* sample. Therefore, dissolution procedures should be capable of complete dissolution of the sample but should not result in losses of volatile elements, such as arsenic and mercury.

Source and Preparation of Material: The plant material for this SRM was collected and prepared under the direction of A. L. Kenworthy, Michigan State University. Its source was the Lake Alfred area of central Florida. The material was air-dried, ground in a comminuting machine to pass a 425-μm (No. 40) sieve, dried at 85 °C, and thoroughly mixed in a feed blender. After packaging the material in polyethylene-lined fiber drums, it was sterilized in situ with cobalt-60 radiation. The sterilization procedure was carried out at the U.S. Army Research and Development Command, Natick Mass. under the direction of A. Brynjolfsson.

Analytical Methods Used and Analyses

Analytical Methods:

A. Atomic absorption spectrometry
B. Atomic emission spectrometry, flame
C. Atomic emission spectrometry, inductively coupled plasma
D. Ion chromatography
E. Isotope dilution thermal source mass spectrometry
F. Isotope dilution spark source mass spectrometry
G. Kjeldahl method for nitrogen
H. Neutron activation
I. Photon activation
J. Polarography
K. Spectrophotometry

Analysts:

Inorganic Analytical Research Division, National Bureau of Standards

1. I.L. Barnes
2. E.S. Beary
3. K.A. Brictic
4. T.A. Butler
5. E.R. Deardorff
6. J.W. Gramlich
7. R.R. Greenberg
8. S. Hanamura
9. E.F. Heald
10. W.R. Kelly
11. H.M. Kingston
12. W.F. Koch
13. G.M. Lambert
14. R.M. Lindstrom
15. G.J. Lutz
16. L.A. Machlan
17. E.J. Maienthal
18. J.R. Moody
19. T.J. Murphy
20. P.J. Paulsen
21. L.J. Powell
22. T.C. Rains
23. T.A. Rush
24. P.A. Steeth
25. R.L. Watters, Jr.
26. R. Zeisler

Cooperating Analysts:

1. M. Ihnat, Chemistry and Biology Research Institute, Agriculture Canada, Ottawa, Canada.
2. M. Gallorini, E. Orvini, and M. DiCasa, Consiglio Nazionale delle Ricerche, Centro di Radiochimica e Analisi per Attivazione presso l'Instituto di Chimica Generale dell' Università, Pavia, Italy.
3. L. Kosta, A. R. Byrne, and A. Prosene, Institute "Josef Stefan," Ljubljana, Yugoslavia.
4. J. B. Jones, Jr., Department of Horticulture, University of Georgia, Athens, Georgia.
5. C. M. Cowgill, Department of Biological Sciences, University of Pittsburgh, Pittsburgh, Pennsylvania.

Lampiran 7

INTERNATIONAL ATOMIC ENERGY AGENCY
AGENCE INTERNATIONALE DE L'ENERGIE ATOMIQUE
МЕЖДУНАРОДНОЕ АГЕНТСТВО ПО АТОМНОЙ ЭНЕРГИИ
ORGANISMO INTERNACIONAL DE ENERGIA ATOMICA

WAGRAMERSTRASSE 5, P.O. BOX 100, A-1400 VIENNA, AUSTRIA, TELEX: 1-12645, CABLE: INATOM VIENNA, TELEPHONE 2360

IN REPLY PLEASE REFER TO:
PRIERE DE RAPPELER LA REFERENCE:
LAB/243

May 1985

CERTIFIED REFERENCE MATERIAL SIMULATED FRESH WATER IAEA/W-4

Certified concentration values of trace elements after dilution of the content of each ampoule to a volume of 2 liters):

No.	Element	Concentration values* µg/l	No.	Element	Concentration values* µg/l
1	Aluminium	50	11	Lead	25
2	Arsenic	25	12	Manganese	25
3	Barium	50	13	Mercury	2.5
4	Beryllium	1.25	14	Molybdenum	2.5
5	Boron	25	15	Nickel	2.5
6	Cadmium	5	16	Selenium	10
(7)	Chromium	20	17	Strontium	50
(8)	Cobalt	2.5	18	Uranium	2.5
9	Copper	25	19	Vanadium	5.1
10	Iron	100	20	Zinc	50

* Net values after correcting for blank.

For all certified values the confidence intervals at a significance level of 0.05 are not larger than ± 5%.

Description of the reference sample

The reference sample is composed of two sealed quartz ampoules containing concentrated solutions called "Certified Reference Solution" and "Blank", respectively. The content of each ampoule should be diluted to a volume of 2 liters to prepare the reference solution of simulated fresh water and the blank solution.

The "Certified Reference Solution" contains twenty trace elements the concentration of which is certified and four major elements. The solution "Blank" contains only four major elements. The concentration of major elements is the same in both solutions and after diluting to a volume of 2 liters the concentration values for individual elements are equal to:

Calcium	10 mg/l
Magnesium	4 mg/l
Potassium	2 mg/l
Sodium	5 ng/l

Recommended dilution procedure

Remove the label from the quartz ampoule, wash it outside with aceton followed by dilute nitric acid (1+4) and drop the ampoule into a 2 l volumetric flask. The bottom of the ampoules (the end with the longer, skewed tip) should be directed downwards because its wall is thin and will break easily when the ampoule is dropped. Add to the flask 1 liter of 1N nitric acid (suprapure grade HNO_3 diluted with bi-distilled water) and mix the content carefully. Dilute the solution to the mark with 1N nitric acid and mix. The volume of the broken quartz ampoule inside of the flask may be neglected.

Apply the above procedure also for preparation of the blank solution.

If necessary a less acidic solution of nitric acid may be used as a dilutant. It should be kept in mind, however, that a probability of losses of trace elements due to adsorption on the walls of the volumetric flask increases when the acidity of the solution decreases.

Establishing of certified values

The nominal quantities of the trace elements added to the artificially prepared solution and the maximal possible errors calculated for the preparation procedure were used as the basis for establishing of the certified concentration values and their confidence intervals. These nominal values were confirmed by the results of interlaboratory comparison IAEA/W-4 organized in 1984. The central values (medians) and their confidence intervals formed for the intercomparison results are as follows:

No.	Element	Value (µg/l)	Confidence interval (signif. level 0.05) (µg/l
1	Aluminium	48	40 ÷ 53
2	Arsenic	26	24 ÷ 31
3	Barium	53	49 ÷ 54
4	Beryllium	1.1	0.6 ÷ 1.6
5	Boron	25	20 ÷ 27
6	Cadmium	4.6	3.9 ÷ 5.0
7	Chromium	9.9	9.0 ÷ 10.5
8	Cobalt	2.2	2.1 ÷ 2.7
9	Copper	25	22 ÷ 26
10	Iron	97	91 ÷ 103
11	Lead	34	20 ÷ 25
12	Manganese	25	23 ÷ 27
13	Mercury	2.3	1.8 ÷ 2.7
14	Molybdenum	2.5	2.4 ÷ 2.6
15	Nickel	3.2	2.0 ÷ 4.0
16	Selenium	11	9.0 ÷ 17
17	Strontium	53	43 ÷ 57
18	Uranium	3.5	3.2 ÷ 3.8
19	Vanadium	8.3	4.9 ÷ 10
20	Zinc	13	13 ÷ 51

Due to a large dispersion of the provided analytical results the estimate confidence intervals are significantly larger than those accepted for certified values. In almost any set of data, however, there is a compact group of results close to the nominal concentration value. These results may be considered as a confirmation of the accepted certified values and their confidence intervals.

A detailed description of results of the Intercomparison IAEA/W-4 and their discussion may be found in the Report No. IAEA/RL/118, May 1985.

Important note

The analysts using the Certified Reference Material IAEA/W-4 are kindly requested to communicate their meaningful analytical results on this material to:

Analytical Quality Control Service
International Atomic Energy Agency
Laboratory Seibersdorf
P.O.Box 100, A-1400 Vienna, Austria

These results may be used in the future for an updating of the certified values which are the best estimates as of May 1985.

1	2	3	4	5	6
	d. Dieldrin	mg/l	0,0 - 0,017	Kromatografi	idem
	e. Endrin	mg/l	0,0 - 0,001	Kromatografi	idem
	f. Heptochlor Epoxide	mg/l	0,0 - 0,018	Kromatografi	idem
	g. Lindane	mg/l	0,0 - 0,056	Kromatografi	idem
	h. Metoxy Chlor	mg/l	0,0 - 0,035	Kromatografi	idem
	i. Organophos - phate & Carbonate	mg/l	0,0 - 0,10	Kromatografi	idem
	j. Texaphene	mg/l	0,0 - 0,005	Kromatografi	idem
	k. Heptakhlor	mg/l	0,0 - 0,018	Kromatografi	idem
30.	Sianida	mg/l	0,0 - 0,05	Spektrofotometrik	Spektrofotometer
31.	Senyawa Aktif Biru Methylene	mg/l	0,0 - 0,5	Spektrofotometrik	Spektrofotometer
32.	Nitrat	mg/l	0 - 10	Spektrofotometrik	Spektrofotometer
33.	Nitrit	mg/l	0 - 0,1	Spektrofotometrik	Spektrofotometer
34.	COD	mg/l	- 12	Titrimetrik	Buret
35.	PCB	mg/l	0,0	Kromatografi	Kromatofragi Gas (GG) HPLC
III.	RADIOAKTIVITAS				
1.	Sinar α	pci/l	0,0 - 100	β Counting	Goiger Muller Counter
2.	Sr - 90	pci/l	0,0 - 2	β Counting	Geiger Muller Counter
3.	Ra - 226	pci/l	0,0 - 1	α Counting	α Counter
IV	BAKTERIOLOGI				
1.	Coliform	MPN/ 100 ml	- 10.000	MPN atau Filtrasi	Tabel MPN, filter holder dan counter
2.	Coliform tinja	MPN/ 10 ml	- 2000	MPN atau Filtrasi	Tabel MPN, filter holder dan counter

SALINAN sesuai dengan aslinya
An. GUBERNUR KEPALA DAERAH TINGKAT I
JAWA TENGAH
Sekretaris Wilayah/Daerah

Ir. SUJAMTO
NIP. 010028643

GUBERNUR KEPALA DAERAH
TINGKAT I
JAWA TENGAH
ttd.
I S M A I L

LAMPIRAN III: Keputusan Gubernur Kepala Daerah Tingkat I Jawa Tengah
Tanggal : 1 Juni 1990
Nomor : 660.1 / 26 / 1990

BAKU MUTU KEPERLUAN AIR BIOTA (GOL. C) DAN REKREASI KECUALI RENANG
BAGI PROPINSI JAWA TENGAH

No.	PARAMETER	SATUAN	BAKU MUTU	METODE ANALISISA	PERALATAN
1	2	3	4	5	6
I	FISIKA				
1.	Suhu	MG/L	Temp air normal ± 30°C	Pemuaian	Thermometer
2.	ZAT terlarut	mg/l	- 2000	Gravimetrik	Timbangan analitik dan kertas
II.	KIMIA				
1.	PH	mg/l	6,5 - 8,5	Potensiometrik	PH meter
2.	O_2 terlarut	mg/l	3	- Titrimetrik - Potensiometrik	Buret D.O meter
3.	BOD	mg/l	-	- Titrimetrik - Potensiometrik	Buret DO meter
4.	Arsen	mg/l	0,0 - 0,05	- SpektRofotometrik - Spektrofotometrik serapan atom	Spektrofotometer AAS
5.	Barium	mg/l	0,0 - 1,0	Gravimetrik	Timbangan analitik dengan kertas saring 0,45 Um
6.	Besi	mg/l	-	- Spektrofotometrik - Spektrofotometrik serapan Atom	Spektrofotometer AAS
7.	Mangan	mg/l	-	- Spektrofotometrik - Spektrofotometrik serapan Atom	Spektrofotometer AAS
8.	BOron	mg/l	0,0 - 0,1	- Spektrofotometrik - Spektrofotometrik serapan Atom	Spektrofotometer AAS
9.	Chrom (+6)	mg/l	0,0 - 0,05	Spektrofotometrik serapan Atom	AAS
10.	Chrom (+3)	mg/l	-	Spektrofotometrik serapan Atom	AAS
11.	Kadmium	mg/l	0,0 - 0,01	Spektrofotometrik serapan Atom	AAS

1	2	3	4	5	6
12.	Kobalt	mg/l	-	- Spektrofotometrik - Spektrofotometrik serapan atom	Spektrofotometer AAS
13.	Nikel	mg/l	-	- Spektrofotometrik - Spektrofotometrik serapan atom	Spektrofotometer AAS
14.	Perak	mg/l	-	- Spektrofotometrik - Spektrofotometrik serapan atom	Spektrofotometer AAS
15.	Air raksa	mg/l	0,0 - 0,002	Spektrofotometrik serapan atom	AAS
16.	Selenium	mg/l	0,0 - 0,02	- Spektrofotometrik - Spektrofotometrik serapan atom	Spektrofotometer AAS
17.	Zink	mg/l	0,0 - 0,02	- Spektrofotometrik - Spektrofotometrik serapan atom	Spektrofotometer AAS
18.	Tembaga	mg/l	0,0 - 0,02	- Spektrofotometrik - Spektrofotometrik serapan atom	Spektrofotometer AAS
19.	Timbel	mg/l	0,0 - 0,03	Spektrofotometrik serapan atom	AAS
20.	Amonia Bebas	mg/l	0,0 - 0,01	Spektrofotometrik	Spektrofotometer
21.	Chlorida	mg/l	-	Spektrofotometrik	Spektrofotometer
22.	Fluorida	mg/l	0,0 - 1,5	- Spektrofotometrik	Spektrofotometer
23.	Sulfat	mg/l		- Gravimetrik - Spektrofotometrik	Timbangan analitik Spketrofotometer
24.	Sulfida	mg/l	0,0 - 0,002	- Titrimetrik - Spektrofotometrik	Buret Spektrofotometer
25.	Uranyl	mg/l	-	- Spektrofotometrik - Spektrofotometrik serapan atom	Spektrofotometer AAS
26.	Karbon Khloroform Ekstrak	mg/l	-	Spektrofotometrik	Spektrofotometer
27.	Minyak lemak	mg/l	0,0 - 1,0	- Gravimetrik - Spektrofotometrik Infra Merah	Timbangan analitik Spektrofotometrik IR
28.	Phenol	mg/l	0,0 - 0,001	Spektrofotometrik	Spektrofotometer
29.	Pestisida				
	a. Aldrin	mg/l	-	Kromatografi	- Kromatografi Gas (GG) - HPLC - Kromatografi Lapis Tipis (TLC)
	b. Chlordane	mg/l	-	Kromatografi	idem
	c. DDF	mg/l	0,0 - 0,002	Kromatografi	idem
	d. Dieldrin	mg/l	-	Kromatografi	idem
	e. Endrin	mg/l	0,0 - 0,004	Kromatografi	idem
	f. Heptochlor Epoxide	mg/l	-	Kromatografi	idem
	g. Lindane	mg/l	-	Kromatografi	idem
	h. Metoxy chlor	mg/l	-	Kromatografi	- Kromatografi Gas (GG) - HPCL - Kromatografi Lapis tipis (TLC)
	i. Organophosphatd & Carbonate	mg/l	-	Kromatografi	idem
	j. Texaphone	mg/l	-	Kromatografi	idem
	k. Heptakhlor	mg/l	-	Kromatografi	idem
	l. Parashion	mg/l	-	Kromatografi	idem
	m. Methyl - Malathion	mg/l	0,0 - 0,16 0,0 - 0,10	Kromatografi	idem
	n. BNC	mg/l	0,0 - 0,21	Kromatografi	Spektrofotometer
30.	Sianida	mg/l	0,0 - 0,02	Spektrofotometrik	Spektrofotometer
31.	Senyawa aktif Biru Methylene	mg/l	0,0 - 0,2	Spektrofotometrik	Spektrofotometer
32.	Nitrat	mg/l	-	Spektrofotometrik	Spektrofotometer
33.	Nitrit	mg/l	0,0 - 0,06	Spektrofotometrik	Spektrofotometer
34.	COD	mg/l	-	Titrimetrik	Buret
35.	PCB	mg/l	0,0	Kromatografi	Kromatografi Gas (GG)
III.	RADIOAKTIVITAS				
1.	Sinar β	Pci/l	- 1000	β Counting	Geiger Muller Counter
2.	Sr - 90	Pci/l	- 10	β Counting	Geiger Muller Counter
3.	Ra - 226	Pci/l	- 3	α Counting	α Counter