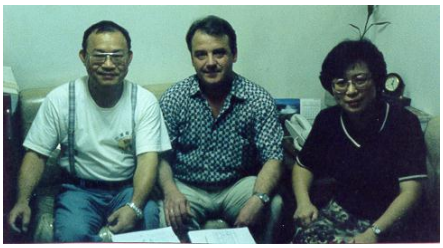

TEST RESULTS OF KALMATRON®KF-αβγ TAIWAN, ROC

Research provided by "TONDALEE TRADING" CO., LTD
8F, 219, SEC, 1, TUNG HWA S. ROAD, TAIPEI, TAIWAN
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Tondalee@ms14.hinet.net

TEST RESULTS of KFαβγ

"Tondalee Trading Co" (Taiwan) provided the present test procedure for evaluation of KALMATRON ® KFαβγ radioactive shielding material by coating on the radioactively contaminated rebar of concrete constructions. The samples of product and test instructions provided by Structural Protection Enterprise, Inc. USA.

Test Instrument:
"DM 3100" (USA)

Initial data's.
Emitter:

Co-60 (γ-ray emitter, Z = 27, $T_{1/2}$ = 5.3 years, E_γ =1.17MeV ÷ 1.33 MeV).

Specimens:
a. Concrete panels 60x60x3 cm with density 2.4 gr/cm^3;
b. KF-αβγ is the mix of Powder with conical filler "F":

CONCLUSIONS:

1. KALMATRON® KF-αβγ is completely compatible with cement containing building materials.
2. Application provided by the standard stucco technology by trowel without shrinkage and cracking. Any type of paint is applicable also on the surface of protective coating.
3. Effectiveness of KALMATRON® KF-αβγ layers, coated on the 30 mm concrete slab in compare with 30 mm lead slab is follows:
   - 10 mm ⇒ 38%
   - 15 mm ⇒ 44%
   - 20 mm ⇒ 47%
   - 25 mm ⇒ 56%
4. Average of Δ_i = 6.00%, i.e. every 5 mm layer increase radioactive protection on 6% or on 0.200 μ Sv/hour.
5. According to emitter's data Co 60, the energy of radioactivity will be reduced up to 50% after next five years. Therefore, after 3-5 years the present radiation will be suppressed till 0.2 μ Sv/hour.
6. KALMATRON® KF-αβγ has met the requirements of Sanitary Control of Radioactive Contamination.

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COMPARATIVE TEST RESULTS OF KALMATRON® KF-αβγ
Test Instrument "DM 3100" (USA); Dose on air 0.16 μ Sv/hr.

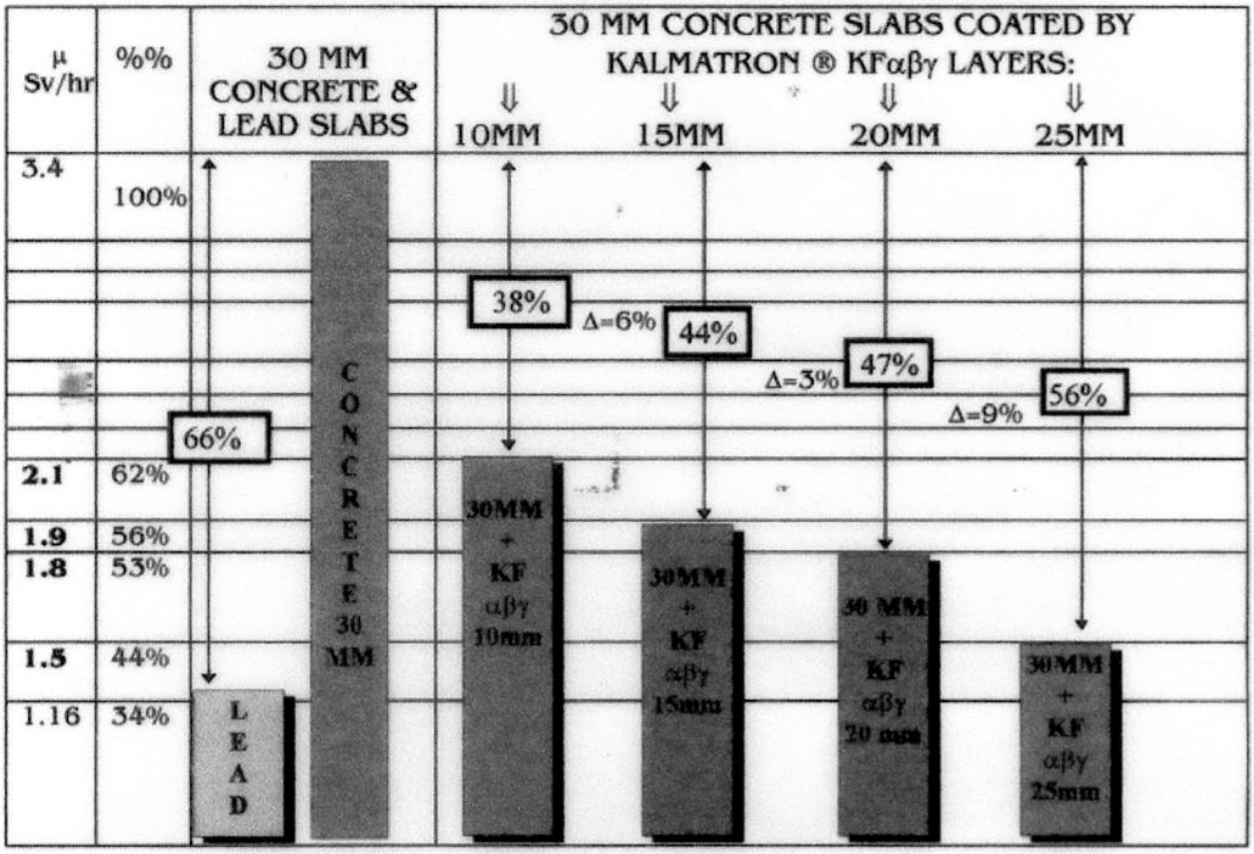

Table 0. The equivalent of absorbed dose of αβγ radiation by lead and by concre slabs with and without shielding by KF-αβγ (μ Sv/hour). The powder is used withc heavy fillers.

Emitter:
Co-60 (γ-ray emitter, Z = 27, $T_{1/2}$ = 5.3 years, E_γ =1.17MeV ÷ 1.33 MeV).

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COMPARISION OF KALMATRON® KF-αβγ and LEAD with CONCRETE
Test Instrument "DM 3100" (USA); Dose on air 0.16 μ Sv/hr.

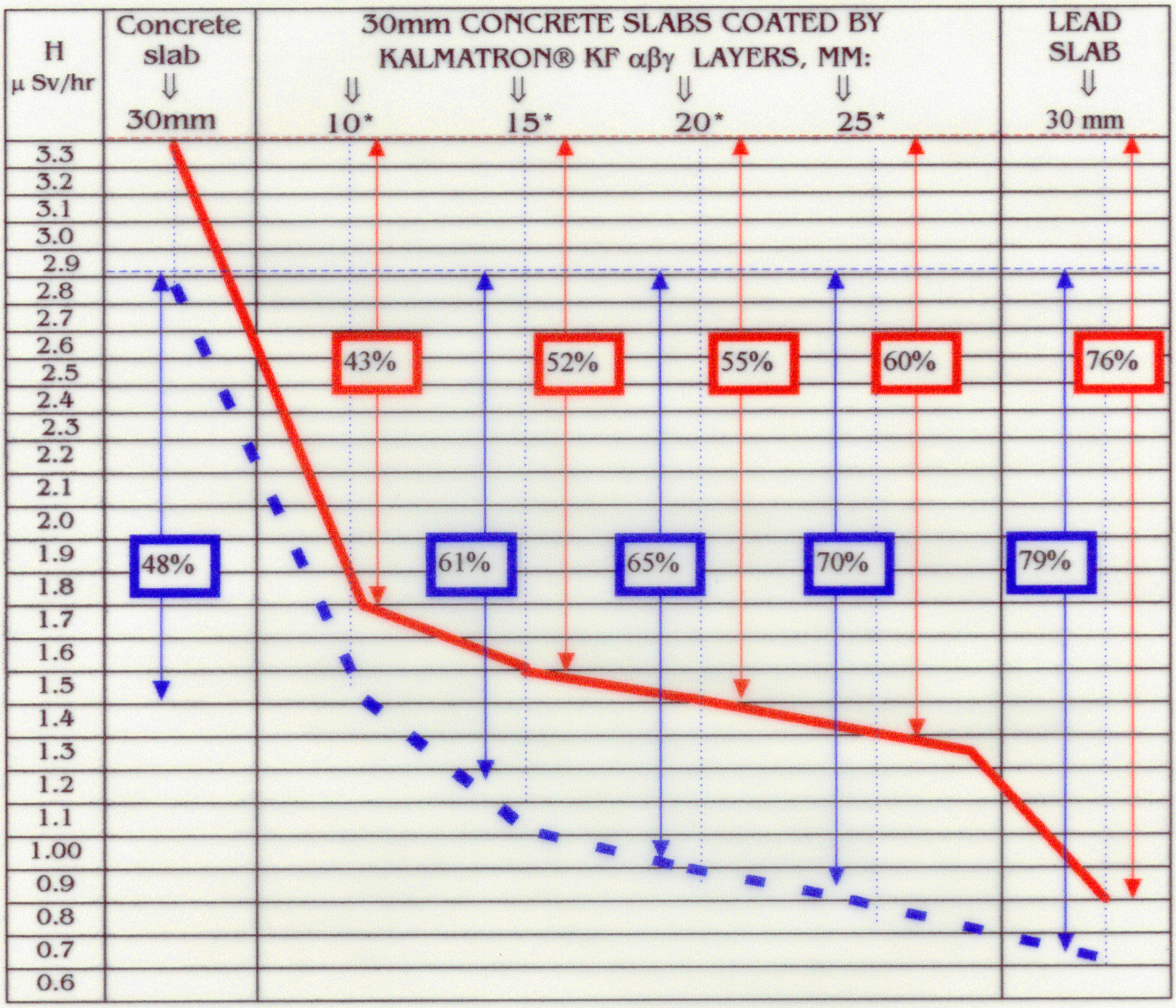


Table 1. The equivalents of absorbed dose of αβγ radiation by lead and concrete slabs with and without shielding by KF-αβγ (μ Sv/hour).
Emitter: Co-60 (γ-ray emitter, Z = 27, $T_{1/2}$ = 5.3 years, E_γ =1.17MeV ÷ 1.33 MeV).
Legend:
-High level of absorbed dose of radiation
- Low level of absorbed dose of radiation
60% 60% - Comparative percentage.

* - Layers were tested at the age of 7 days.

July, 98

COMPARISION OF CONCRETE SLABLS WITH AND WITHOUT KALMATRON® KF-αβγ

Test Instrument "DM 3100" (USA); Dose on air 0.16 μ Sv/hr.

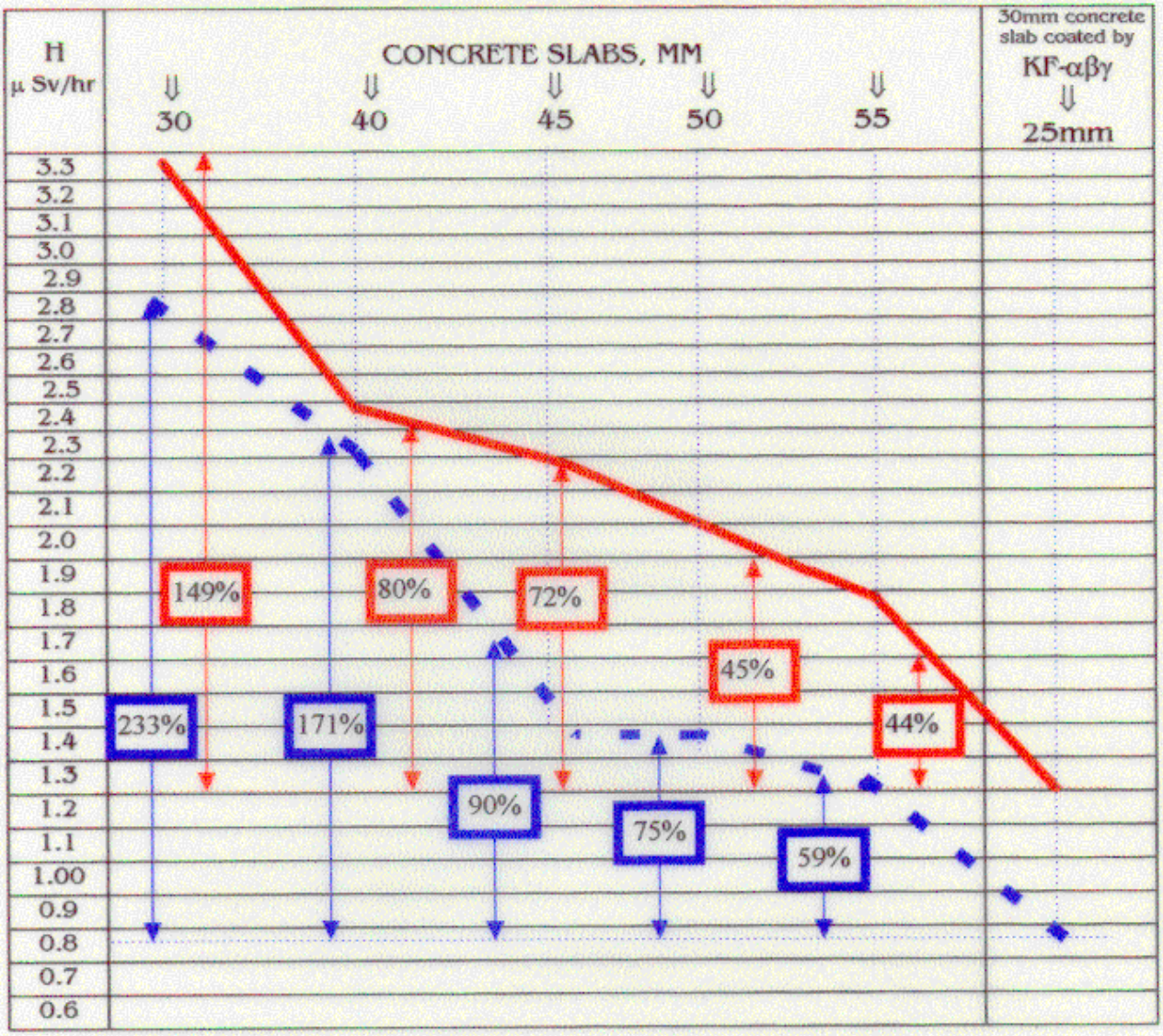


Table 2. The equivalents of absorbed dose of αβγ radiation by concrete slabs with and without shielding by KF-αβγ (μ Sv/hour).

Emitter: Co-60 (γ-ray emitter, Z = 27, $T_{1/2}$ = 5.3 years, E_γ =1.17MeV ÷ 1.33 MeV).

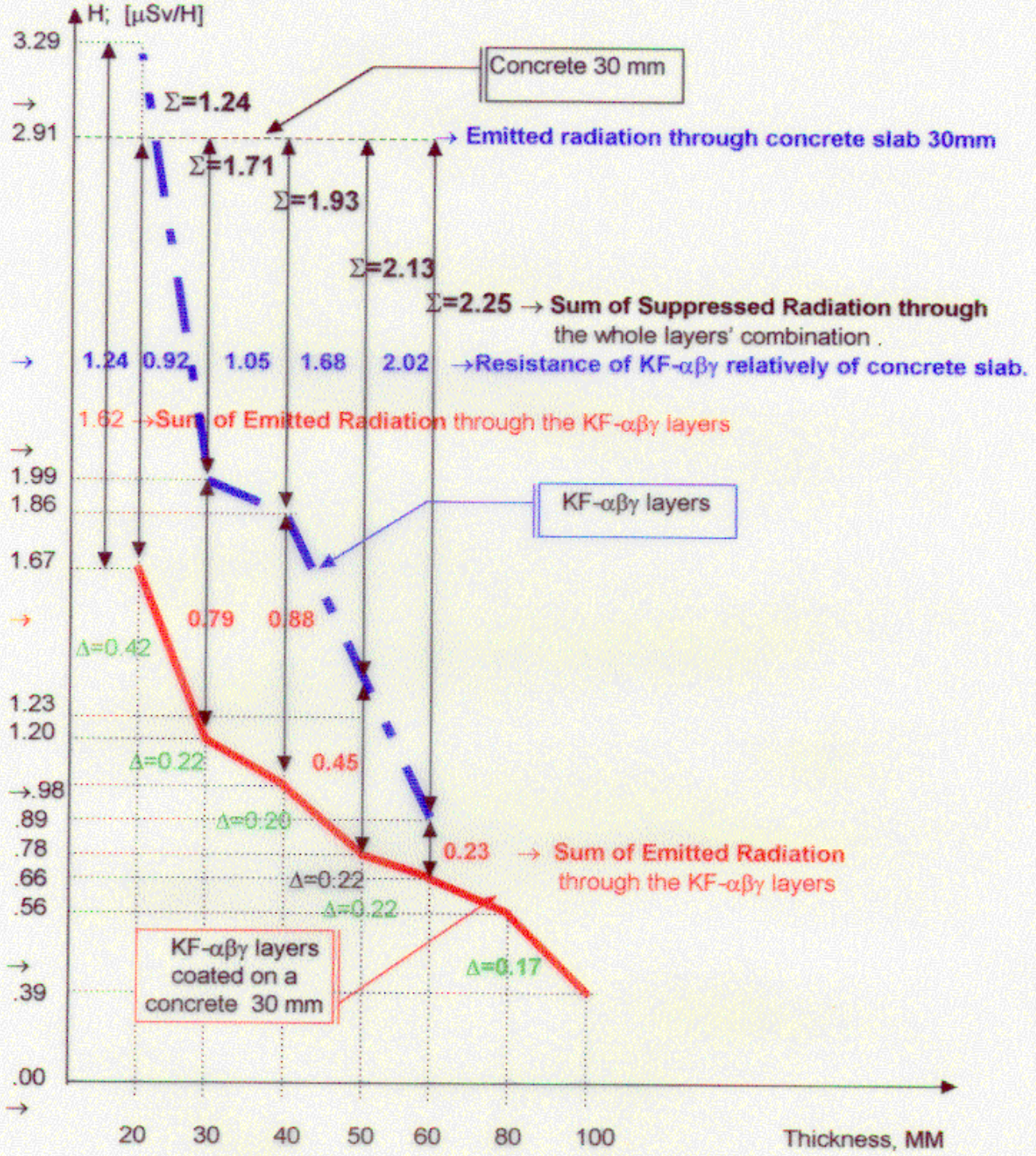
Legend:

-High level of absorbed dose of radiation

-Low level of absorbed dose of radiation

60% 60% - Comparative percentage.

RESISTANCE OF KF-αβγ TO X-RAY OF Co 60 1.33 MeV
BASED ON THE DATA OF TEST PROVIDED BY "TONDALEE TRADING CO." TAIWAN



Notice:
Δ - resistance of particular shielding layer
0.7 [μSv/H] - emitted radiation through 30 mm lead slab

Test Report of KF-α β γ as Radiation Shielding Material

Shielding Material / Test Instrument	Background Value	Co 60 radiation energy	Concrete 30mm	Concrete 30mm+ Powder 15mm	Concrete 40mm	Concrete 30mm+ KFα β γ 10mm	Concrete 45mm	Concrete 30mm+ KFα β γ 15mm	Concrete 50mm	Concrete 30mm+ KFα β γ 20mm	Concrete 55mm	Concrete 30mm+ KFα β γ 25mm
USA 3100 (Check α β γ)	0.15 ∫ 0.16	High 113	High 3.30	High 2.55	High 2.41	High 1.90	High 2.30	High 1.60	High 1.94	High 1.52	High 1.80	High 1.34
		Low 105~106	Low 2.54	Low 1.78	Low 2.33	Low 1.49	Low 1.63	Low 1.11	Low 1.50	Low 0.99	Low 1.37	Low 0.86
		Average 109	Average 2.92	Average 2.17 26%	Average 2.37	Average 1.8 24%	Average 1.97	Average 1.36 31%	Average 1.72	Average 1.26	Average 1.6~1.7	Average 1.1~1.2 31%

檢測單位: 中華民國輻射安全促進會　　檢測人員: 王玉麟　　檢測日期: 7/27/1998

Test Report of KF-α β γ as Radiation Shielding Material

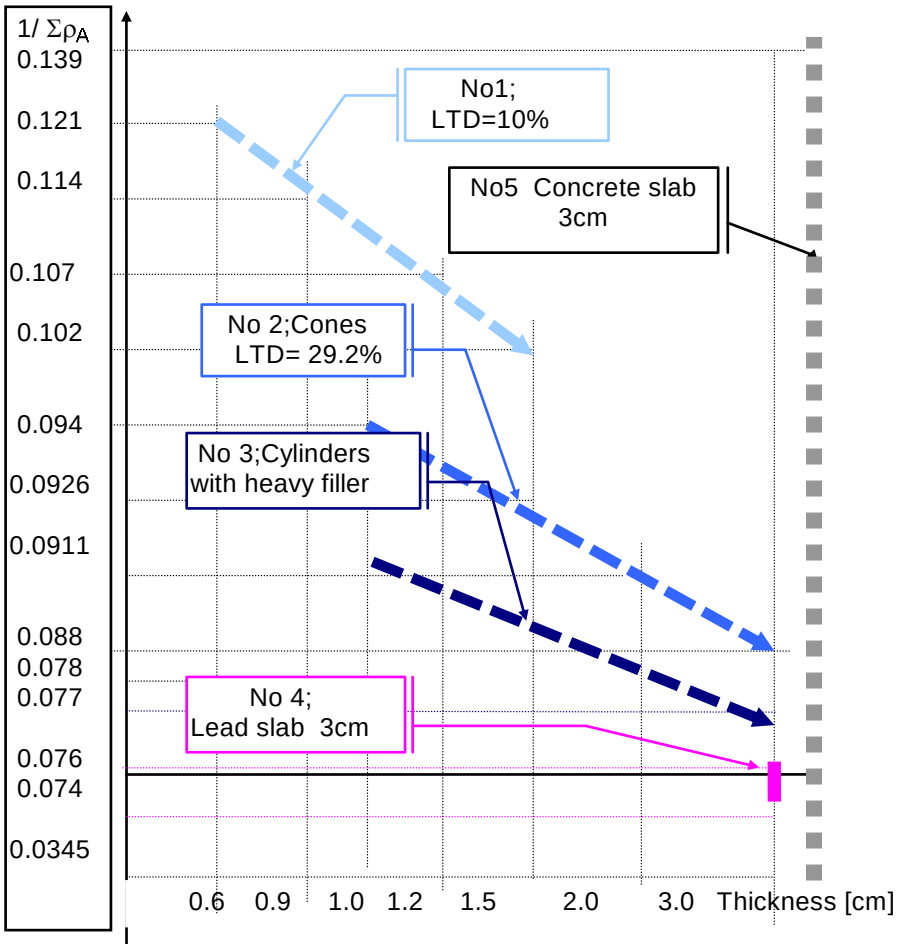
10/29/1998

Shielding Material / Test Instrument	Background Value	Co 60 radiation energy	30mm Concrete	Concrete 30mm	30mm α β γ	2×20mm α β γ	1×20mm +1×30mm α β γ	2×30mm α β γ	Lead 30mm			
USA 3100 (Check α β γ)	0.15 ∫ 0.16	High 113	High 3.20	High 3.30	High 2.24	High 2.14	High 1.52	High 1.06	High 1.27	High	High	High
		Low 105~106	Low 2.61	Low 2.54	Low 1.75	Low 1.57	Low 0.94	Low 0.71	Low 0.85	Low	Low	Low
		Average 109	Average 2.91	Average 2.92	Average 1.99 32%	Average 1.86 37%	Average 1.23 58%	Average 0.89 70%	Average 1.16	Average	Average	Average

Shielding Material / Test Instrument	Background Value	Co 60 radiation energy	1×30mm Concrete +1×20mm α β γ	1×30mm Concrete +1×30mm α β γ	1×30mm Concrete +2×20mm α β γ	1×30mm Concrete +1×20mm &1×30mm α β γ	1×30mm Concrete +2×30mm α β γ	1×30mm Concrete +2×30mm &1×20mm α β γ	1×30mm Concrete + 2×30mm & 2×20mm α β γ		
USA 3100 (Check α β γ)	0.15 ∫ 0.16	High 113	High 1.52	High 1.48	High 1.20	High 0.94	High 0.75	High 0.64	High 0.48	High	High
		Low 105~106	Low 0.99	Low 0.92	Low 0.76	Low 0.61	Low 0.57	Low 0.47	Low 0.30	Low	Low
		Average 109	Average 1.26	Average 1.2	Average 0.98	Average 0.78	Average 0.66	Average 0.56	Average 0.31~0.32	Average	Average

COMPARATIVE TEST RESULTS KF-αβγ

Sm = E / $\Sigma\rho_A$;
Superficial density



Dozes of Suppressing and Ionizing radiation	
Sm[MeVcm^2/gr]	H (μSv/hour)
0.185	2.95
0.161	2.35
0.152	2.18
0.142	2.14
0.136	1.75
0.125	1.40
0.123	1.25
0.121	1.1
0.117	0.95
0.104	0.75
0.102	0.60
0.101	0.55
0.0984	0.45
0.046	0.35

Fig. 1 The dependence of suppressing radiation from the different types of KF-αβγ and thickness' of the shielding layers. Calibrated emitter of γ-ray radiation is parent nuclide Co-56 (E_γ = 1.360175 MeV).

Legend:
No1- coating of 3cm by KF-αβγ layer with powder.
No2 – coating of 3cm by KF-αβγ layer with cones heavy filler.
No3 – coating of 3cm by KF-αβγ layer with cylinders' heavy filler;
No4 - lead slab 3cm;
No5 - concrete slab 3cm.

By sanitary requirements of radioactive protection, the required doze level is 0.293 (μSv/h). Therefore:

1. Theoretically, we have to have a material with 1cm thickness and superficial density ρ_A = 67 gr/cm^2 (lead has ρ_A=29.01gr/cm^2), which could provide suppressing radiation Sm =0.008 (MeVcm^2/gr) and ionizing radiation H=0.2(μSv/hour).

2. Practically, this is 5 cm of lead slabs. Therefore, we can to reduce radiation at least 2.5 times by 2 cm of KFαβγ shielding layer.

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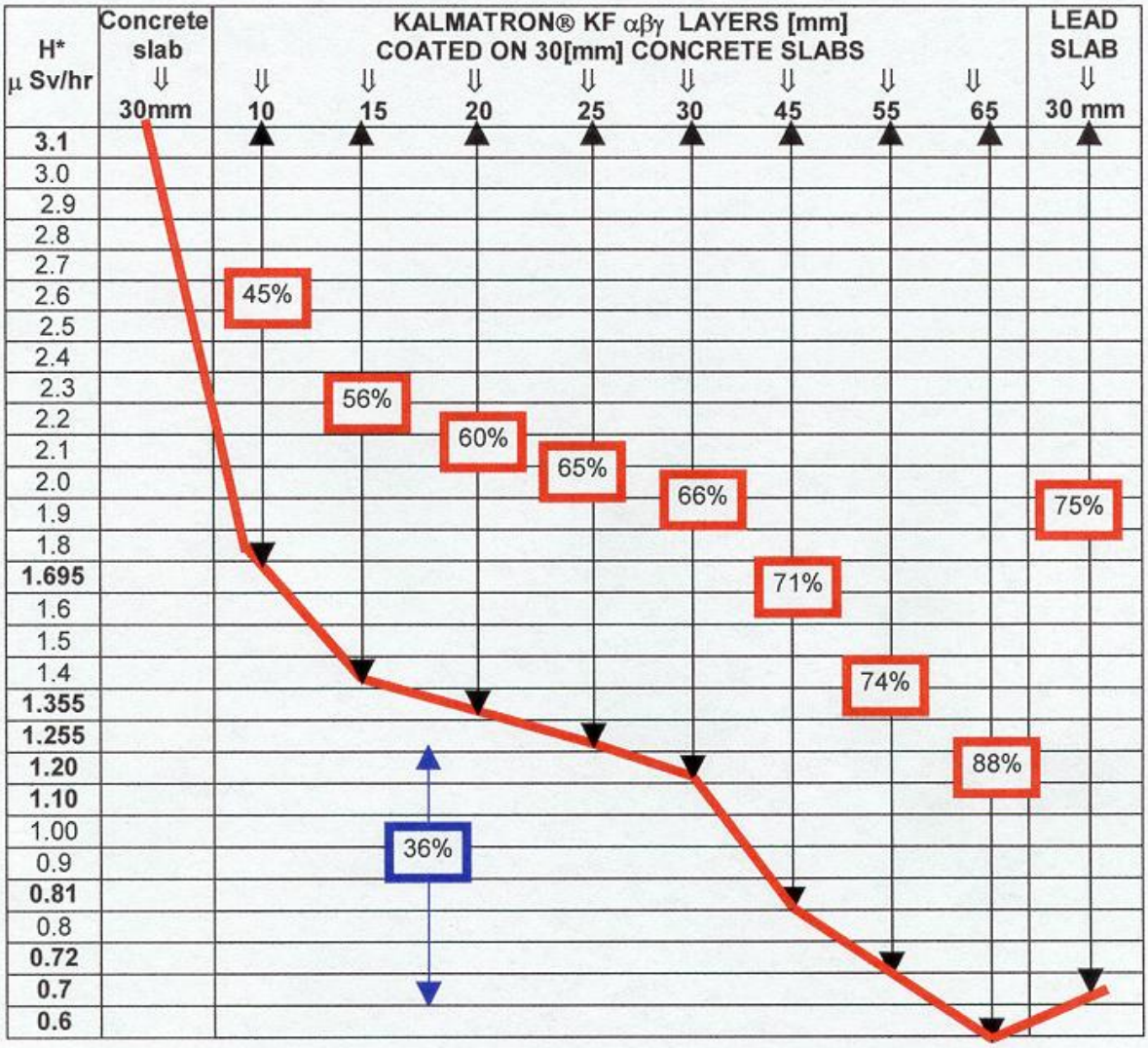
ATTENUATION OF RADIATON BY KALMATRON® KF-αβγ COATED ON A CONCRETE
COMPARISION WITH CONCRETE AND LEAD



The equivalents of absorbed dose of Y- radiation by lead and concrete slabs comprised with shielding of 30mm concrete by KF-αβγ with gradual thickness.
H* - readings from the surface of specified layer.

Test Instrument "DM 3100" (USA); Dose on air 0.16 μ Sv/hr.
Emitter: Co-60 (γ-ray emitter, Z = 27, $T_{1/2}$ = 5.3 years, E_γ =1.17MeV ÷ 1.33 MeV).
Legend: Average of the levels of absorbed dose of radiation

33% Comparative percentage with previous layer' attenuation.