SURFACE CONTAMINATION MEASUREMENTS AT KEK

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Surface contamination measurements around a high-energy accelerator cannot be done using a survey meter due to radionuclides induced in accelerator structures. Smear method may be only one method that is applicable in these circumstances. In ordinay case, gross β-ray measurements are used in smear method supposing one β-ray is emitted per decay. But around a high-energy accelerator, this estimation causes underestimate because a main nuclide do not emitt β-ray at disintegration. At KEK, an effective detection efficiency of a 2"ϕG-M tube has been determined from the comparison with γ-ray measurements and is used in a routine measurements. At first, a smeared sample is measured with a Ge(Li) detector and a contamination of each nuclide is determined. Next, the same sample is measured with 2"ϕ diameter GM tube, and the effective detection efficiency is determined from the comparison with the both results. The contamination of each nuclide and the obtained efficiency for the several case are shown in Table 1. Thus obtained effecincy of course varies with the variation of nuclide composition. As an example, in Fig. 1, the variation of the detection efficiency at the floor of a slow extraction beam line (EP-2) is shown as a function of the time after beam-off. In this case, main nuclide included are ^{7}Be and ^{24}Na, and the efficiency raidly decreases as the decay of ^{24}Na. In spite of the wide variation of nuclide composition at the different place and the different time after beam-off, always ^{7}Be is main nuclide. The effective detection efficiency become minimum when ^{7}Be only is included in the sample. Therefore, the detection efficiency of ^{7}Be, 3 %, is suitable for routine measurements.

Another important point is that there is a possibility a linear relation between the surface contamination and the exposure dose rate at the surface. Obtained results for Main Ring duct surface are shown in Fig. 2. The dispersion is larger wide, but the linear relation can be seen as a whole. The value of 2.9×10^{-4} and 8.0×10^{-5} μCi/cm^2 per R/h at surface can be obtained as the least upper limit for the Main Ring duct (SUS) surface and the EP-2 duct (AL) surface or the floor, respectively. These values are useful as a standard of the surface contamination control.

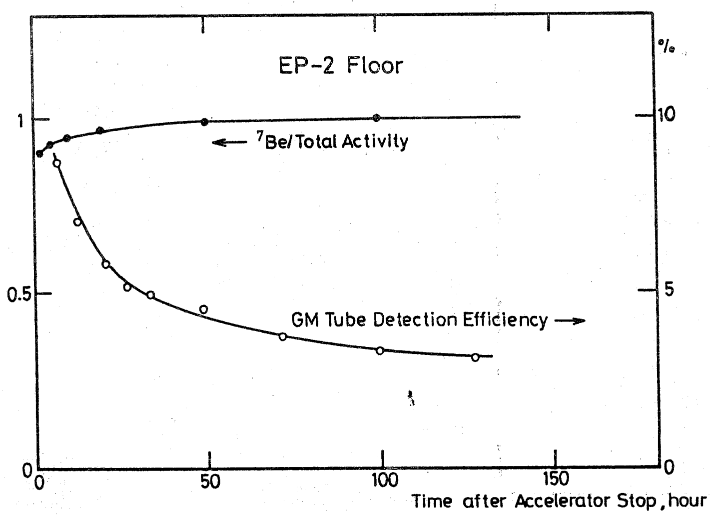

Fig. 1.

Variation of the GM Tube Detection Efficiency with the Time after Accelerator Stop.

Table 1 Surface Contamination of Individual Nuclide and G-M Tube Detection Efficiency

Place	Main Ring Duct	Main Ring Duct	Main Ring Floor	EP-2 Duct	EP-2 Floor
Date and Time after beam off	1979. 8. (30 day)	1980. 6. (1.5 day)	1980. 6. (2 day)	1980. 6. (1 day)	1980. 6. (1 day)
^{7}Be	306 dps/100cm^2	37.9 dps/100cm^2	5.92 dps/100cm^2	23.1 dps/100 cm^2	15.4 dps/100 cm^2
^{18}F				0.0014	0.0005
^{22}Na	14.1				
^{24}Na				3.47	0.551
^{44m}Sc		2.08			
^{44}Sc		0.19			
^{46}Sc	24.1	0.18			
^{47}Sc		0.11			
^{48}V	31.6	0.41			
^{51}Cr	106	1.05			
^{52}Mn	2.92	0.30			
^{54}Mn	40.1	0.18	0.063		
^{56}Mn				0.0058	
^{56}Co	6.47				
^{57}Co	4.45	0.029			
^{58}Co		0.072			
Total	539 dps/100cm^2	42.5 dps/100cm^2	5.98 dps/100cm^2	26.6dps/100 cm^2	16.0 dps/100 cm^2
GM Tube Counting Rates	27 cps	1.23 cps	0.222 cps	2.21 cps	0.893 cps
GM Tube Detection Efficiency	5.0 %	2.9 %	3.7 %	8.3 %	5.6 %

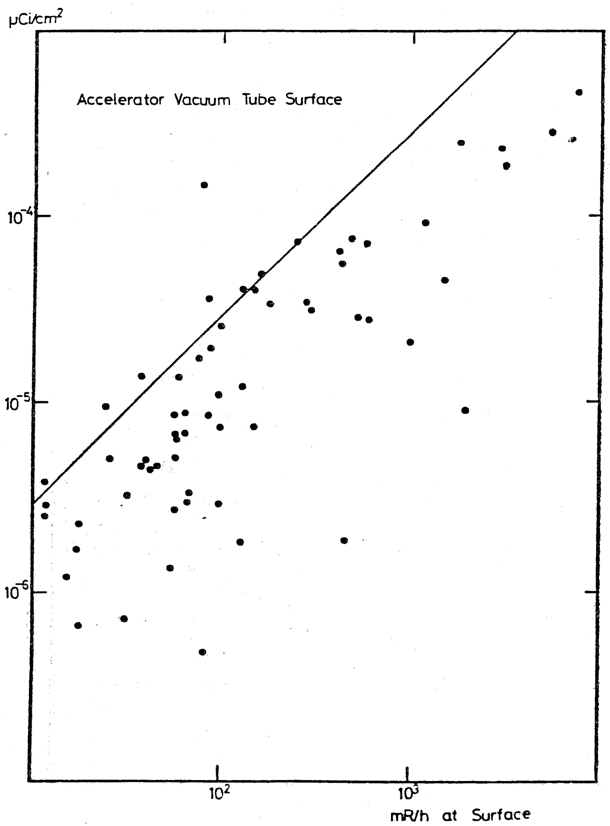

Fig. 2.
Relation between Surface Contamination and Exposure Dose Rate at Surface