MEASUREMENT OF RESIDUAL ACTIVITIES PRODUCED IN VARIOUS METALS BY KEK-PS

H. Hirayama

KEK, National Laboratory for High Energy Physics

1. Introduction

Composition of radionuclides induced in accelerator structures depends very much on kind of accelerated particles, particle energy, materials used in the structure and the operation pattern of the accelerator. It is very important for radiation workers of maintenance to know what material shows the least activity at the time of maintenance. Studies on the residual radiations of various materials have been reported were mainly done by means of irradiation with monoenergetic protons or other wise by calculations. But the radiation fields in accelerator rooms are different very much from those for monoenergetic protons. In this study, radionuclides induced in various metals that were put on vacuum tube of the KEK-PS were measured and decays of residual activities for each metal were estimated.

2. Method of Measurements

0.5-cm thick samples of iron, stainless steel, copper, brass and aluminum were put on the vacumme tube of the Main Ring of the KEK-PS. Three types of irradiation were performed; one is continuous irradiation for 175 hours, second one week operation (irradiation under 8 GeV acceleration for only a few hours) and third one month operation (about 400 hours under 8 GeV acceleration). γ-radiations from each sample were measured with a Ge (Li) detector and a multichannel pulse height analyzer, and radionuclides were identified. From the samples of the continuous irradiation, saturated activities at the irradiation field were obtained. Decays of residual activities for one week and one month operation were analyzed on the assumption that activities should be due to each radionuclide measured with the Ge(Li) detector. Digital survey meter was also used in the case of one month operation.

3. Results and Discussion

Saturated activities per unit volume of 5 metals are shown in Fig.1. That of ^{24}Na induced in aluminum is ten or one hundred times greater than those of other radionuclides. The reaction $^{27}Al\ (n,\alpha)\ ^{24}Na$ has the cross section ten times greater than the reactions $^{27}Al \rightarrow {}^{24}Na$ or $^{27}Al \rightarrow {}^{22}Na$ by high energy hadrons. Therefore it can be seen from Fig.1 that fast neutron flux was about ten times greater than high energy proton and neutron flux at the field of irradiation. Variations of residual radiation leves for various operation patterns can be obtained from saturated activities.

In Fig.2, are shown decay of radiation levels for one week and one month operation. This figure shows that aluminum has about one hundred times smaller activities than any other material after cooling time of two hundred hours.

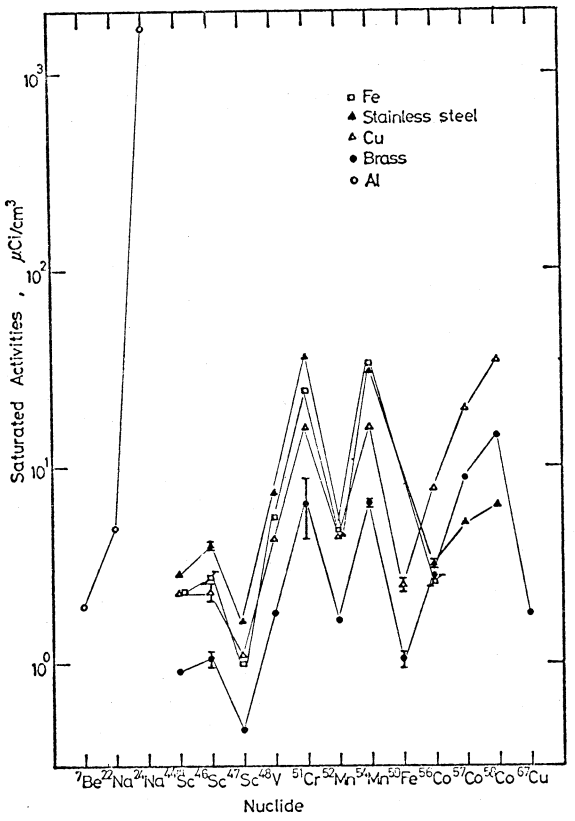

Fig.1 Saturated activities per unit volume at Main Ring

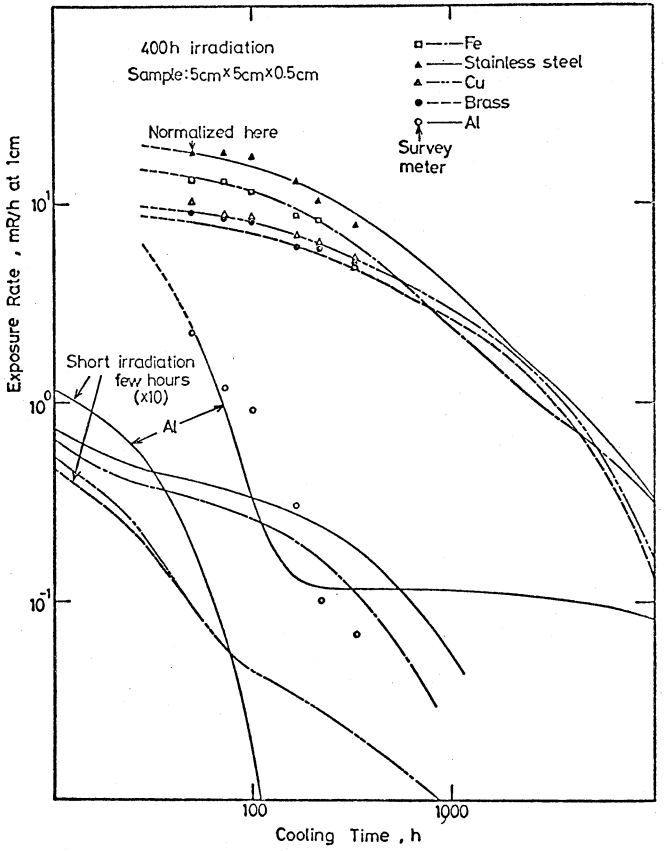

Fig.2 Residual radiation decay curve of 5 samples