TESTING OF THE RADIATION-PROTECTIVE COMPOSITE MATERIAL

***Victor Murashev, * Gennady Koltsov, **Takeshi Saito,**
Mikhail LIFSHITS and Victor GULBIN (*e-mail: vngulbin@mail.ru*)

R&D Institute of Construction Technology, Moscow
*** Moscow Institute of Steel and Alloys (Technology University), Moscow**
**** Institute for Advanced Studies (IAS), Tokyo, 162-0022, 1-29-6 Shinjuku**

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Introduction

This paper presents the results of composite material testing, purposed to protect TV cameras against radiation raying. In order to protect TV cameras against gamma rays, the radiation-protective composite material was developed and used to make the cylindrical protective housing with 30 mm wall thickness. The composite material made from tungsten rods, tungsten particles intruded into molten lead, was placed in the housing made of corrosion-resistant steel. The lead was used here as a compound material [1]. Lead-tungsten composite had physic mechanical properties of the base materials, which were part of the composite. In this case strength characteristics were above, than at lead. Presence of stronger tungsten in the composition affects on increase of strength of the composite as whole.

Experimental

Testing of the radiation-protective material was performed using a TV camera placed inside the protective housing supplied with the lead-tungsten composite, and in active area of GUT-200 installation. GUT-200 installation is the gamma-quanta source with Co^{60} isotope and energy of gamma-quanta 1,173 and 1,332 MeV. Before the housing with TV camera to be tested were placed in active area of GUT-200 (Fig.1) installation, special doze-meters were fastened on the TV camera to define exposure doze of ionizing gamma raying.

For the points with gamma doze rate 1 – 30 R/s, the following data was obtained: 1) the testing table image on the PC monitor; 2) video-signal on the oscillograph screen. The testing table was recorded with immediate processing using the special software, in order to calculate pulse fields from gamma-quanta, classify them regarding brightness and calculate percent of "matched" image elements relatively the total number of matrix elements [2].

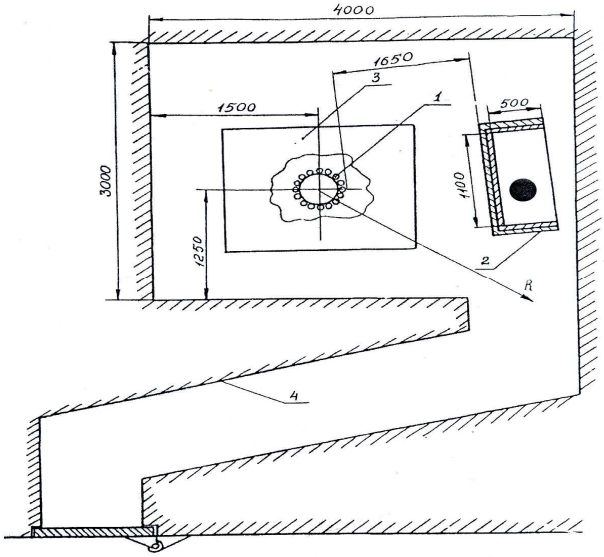

Figure 1. The arrangement of installation GUT-200 and location of the TV camera in active zone: 1 - radiator, 2 - the protective case made of lead-tungsten composite, 3 - platform, 4 - labyrinth.

The IBM compatible PC was applied to record the test results and make statistic processing of video-signals. This PC was a part of the experimental equipment; it had the video-data input board and the special software to process images.

Conclusions

The performed tests shown that application of gamma-quanta in range 1,6 – 3,5 R/s had no visible influence on image quality. It was not registered any visible change of “electric” noises level. TV camera withstanding against integral gamma raying was not less then 2×10^5 R. Thus, it was proved, that the 30 mm thickness protective screen made of lead-tungsten composite reduced gamma-raying 100 times.

The lead-tungsten composite developed for TV cameras protection, allows save their function by integral absorbed dose up to $2,7 \times 10^5$ R with satisfactory image quality, which is expressed by “black-to-white” level change. This phenomenon is confirmed by the researches of digital TV cameras, which were performed using other installations.

These investigation results were used to issue the testing procedures for several radiation-protective composite materials based on heavy metals.

References

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