DEMONSTRATION TEST FOR Ir-192 PEBBLE SOURCE FOR RADIOGRAPHIC TESTING WITH WWR-K REACTOR COOPERATED BY INP AND CTC

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Radiography Testing (hereinafter referred to as RT), one of the key methods of industrial non-destructive testing. However, one of the disadvantages of this method is geometric unsharpness due to the effect of the dimension of the γ source when taking a picture using γ-rays, it affects the clarity of the radiographic images. Theoretically, the clearest image is obtained when the source-to-object distance is infinitely large or the source dimension is as small as possible, that is, a point source. Ir-192 is currently the most used for RT in the world, especially in Japan its radioactivity 370 GBq, and its source shape is predominantly cylindrical (pellets) with a diameter of 1.5mm and a thickness of 0.75-1.00mm (0.25-mm disc shape) and differs in shape from the ideal dotted source.

This paper presents the results of iridium targets irradiation of certain geometric dimensions in the central channel of the atomic reactor WWR-K INP in order to obtain uniformly iridium irradiation for the production of industrial sources. The use of such sources would make it possible to obtain high quality (clarity) radiographic images.

Methods of experimental research

Targets - Iridium metal pebble of two diameters of 1.0 and 1.5 mm were used as studies. To irradiate the targets, a special irradiation device was used, which was an aluminum alloy capsule with disc-shaped supports (Fig. 1). Targets were placed on the disks on different tiers.

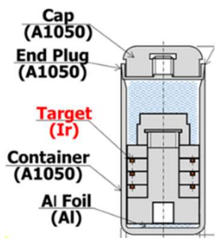


Figure 1.

The irradiation of the device with targets was carried out in the central channel of the nuclear reactor WWR-K for 4 companies (81 days). Neutron flux was estimated from measurements by fluence monitors, which were placed together with the targets in the irradiation device. The average neutron flux during the irradiation period was 4.8×10^{13} n $cm^{-2}s^{-1}$. The irradiated targets were removed from the irradiator and their activities were determined by direct measurement of dose rate followed by recalculation.

Radiographic tests were performed to assess the quality of the obtained irradiated targets. Targets 1.0 and 1.5 mm in diameter were used as a radiation source, which were sequentially installed in a gamma detector «GammaMat». AGFA Structurics D7 radiographic film with 10x24 cm lead screens was used as ionizing radiation detector. A steel sample of welded joint with thickness of 10 mm with artificial internal defects in the form of pores was used as an object of control during radiography. A wire sensitivity standard of 10FEEN type was used to determine the quality of radiographic image.

Radiographic tests using each target were conducted at three different source-film- distances (SFD): 150, 200, and 600 mm.

Experimental results

The measurement results are shown in the table 1 below.

Table 1.

Number of ampule with iridium target	Diameter of iridium target	Dose rate at 1 meter distance, mSv/h	Activity on the measurement date, Ci
pebble 1	1,5 mm	29,4	7,02
pebble 2	1,5 mm	30,0	7,16
pebble 3	1,5 mm	29,3	7,00
pebble 4	1,5 mm	28,5	6,80
pebble 5	1,0 mm	10,9	2,60
pebble 6	1,0 mm	10,7	2,55
pebble 7	1,0 mm	10,8	2,58
pebble 8	1,0 mm	10,6	2,53

The results of target activity measurements showed insignificant deviation in the width of the active zone. Figure 1 shows the distribution of the specific activity of targets 1.0 and 1.5 mm in diameter, respectively.

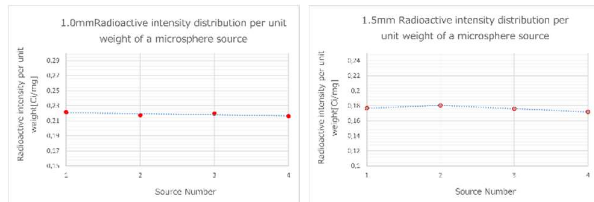
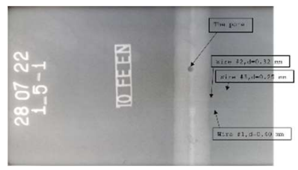


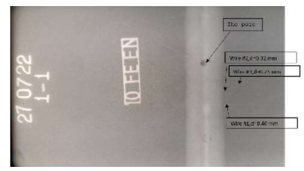
Figure 2.

The images obtained by RT are shown in Fig. 3. Table 2 shows the diameters of the transmittance meter that can be identified by directly observing the film.

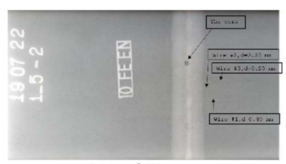
You show. In the visual observation, there was no difference in the identifying line diameter by the difference in the size of the microsphere in every SFD. When we checked the differences in identifying line diameters for each SFD, we found that the number of identifying lines was one higher than the number of 200 mm, with two SFD150 mm, three in 200 mm, and four in SFD 600 mm.



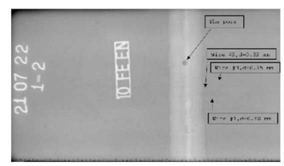
1.5 mm pebble, SFD=150 mm



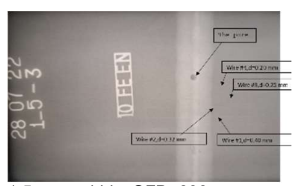
1.0 mm pebble, SFD=150 mm



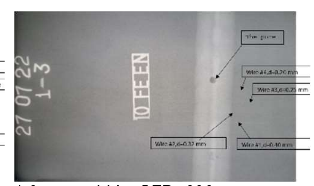
1.5 mm pebble, SFD=200 mm



1.0 mm pebble, SFD=200 mm



1.5 mm pebble, SFD=600 mm



1.0 mm pebble, SFD=600 mm

Figure 3.

Table 2.

	Pebble, Ø1.0mm	*Pebble, Ø1.5mm*
	Number of identified wire diameters (wire diameter)	*Number of identified wire diameters (wire diameter)*
SFD 150mm	*3 (0.25)*	*3 (0.25)*
SFD 200mm	*3 (0.25)*	*3 (0.25)*
SFD 600mm	*4 (0.20)*	*4 (0.20)*

The results obtained by this study are summarized as follows:

1) As a result of irradiation of pebble at fuel area in WWR-K, it was proven that neutrons were uniformly irradiated, and irradiation was possible in the range of dispersion up to 5%.

2) Successful irradiation of micro-spherical Ir-192 sources up to 1.0 mm with the smallest diameter.