Remote Sample Taking Techniques From a Large Metallic Radwaste

Kwonpyo Hong*, Sanghee Jung, Myungchul Park, Sunggeun Kim, and Wanho Oh
Korea Atomic Energy Research Institute, 111, Daedeok-daero 989, Yuseong-gu, Daejeon, Republic of Korea
kp8452@gmail.com

1. Introduction

In order to investigate the inventory of a certain radioactive materials, taking samples from mother materials is usually required. However, if the mother material is large and rigid such as dismantled reactor vessel then it is not easy to take specimen by remote operation.

In this paper our study results of several sample taking techniques are introduced, which techniques could be applied in dismantling field of nuclear reactors for radwaste inventory evaluation.

2. Sample Taking Process

2.1 Sample taking environment

The target object for sampling is assumed to be large(e.g. a few meters in size), heavy(e.g. a few tonnes in weight), metallic(such as stainless steel), and highly radioactive(at least medium level). So, it should be handled in a hot cell or similar shielded facility. Remote handling systems such as manipulators or cranes are also needed for remote operation of sample taking equipment.

The target object would be fixed in hot cell and the sampling tool is remotely moved. The tool usually has 6 degrees of freedom to enable sampling at any situation.

2.2 Core-drilling

Core drilling sample could be obtained from metallic thick plate by completely penetrating the mother material. The maximum penetrating thickness seems about 10 cm for stainless steel. The increased temperature due to drilling is about 25~30 degrees without using coolant [1].

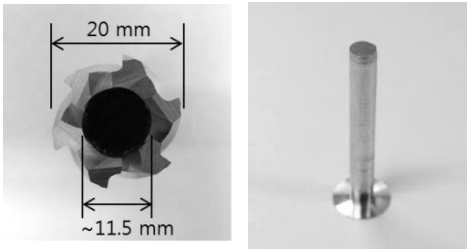

Fig. 1. Core drill bit and obtained specimen.

2.3 Drilling chips

Drilling chips generated in the process of drilling have almost same inventory rate with the mother material except a part of volatile elements. So, it can be a good candidate for inventory evaluation method after finding the inventory correlation between mother material and drilling chips. Following figure shows a usual drill chip of stainless steel.

Fig. 2. Chips specimen by normal drilling.

2.4 Laser ablation

At high flux of pulsed laser the laser-irradiated object is evaporated or converted to plasma. Collecting the ablated dust or gaseous samples the inventory can be evaluated for the surface of radwaste material. However as the collection of gaseous samples is not easy and the amount of obtained sample is too small (~ 10^{-5} cc), it seems not a good sampling method

unless the equipment is an elaborate system.

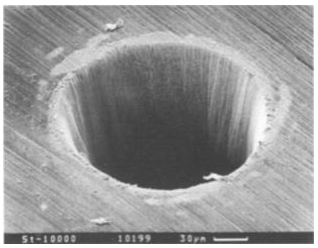

Fig. 3. Ablated hole by femtosecond laser [2].

2.5 Circular saw cutting

3 or 4 times of slope cuttings with a wheel such as side milling cutter can make a wedge type specimen from the surface of mother material [3]. There is no limit on the thickness of object. As the temperature increase due to cutting is about 30 degrees the heat affection to the sample is negligible. Following is a wedge sampling experimental result from Cu alloy.

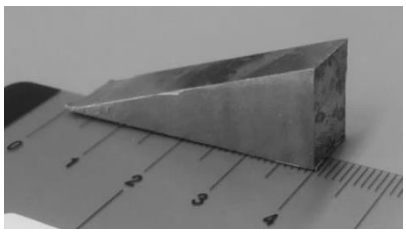

Fig. 4. Wedge specimen by circular saw slope cutting.

2.6 EDM

From the plate type conductor material a specimen can be obtained using electrical discharge machining. This technique is useful in speedy sampling and remote operation, but it should use of liquid insulator so that 2nd liquid radwaste would be produced.

Fig. 5. Specimen taking by EDM.

2.7 Laser cutting

By all around cutting with slope laser beam a conical or disk sample can be obtained rapidly. But in case of thick material if it doesn't fully penetrate the target object, the melting dross wouldn't be discharged. So it has a limit on thickness of target object.

Fig. 6. Laser slope cutting.

3. Conclusion

Several kinds of sample taking techniques from a bulky, metallic, and highly radioactive radwaste were studied. In that case the proper sample taking method seems to be the wedge sampling or the chips sampling. They are relatively easy to take samples and relatively low heat affection to the samples.

These studies are expected to be applied in the field of decontamination and dismantling of nuclear reactors or any highly radioactive heavy metallic objects.

REFERENCES

[1] S. G. Kim, et. al. "Development of core sampling technique for ITER Type B radwaste", Proc. of KNS 2016 Autumn Meeting, Oct. 27-28 (2016)

[2] B.N. Chichkov, Appl. Phys. A 63, 109 (1996)

[3] Kwonpyo Hong et. al. "Development of wedge sampling technique by slope cutting", Proc. of the KRS 2016 Spring Conference, May 25-27, 2016, Mokpo.