

Dissolution Conditions for the Nuclide Analysis of Nuclear Power Plant Solid Wastes

,

150

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167

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1688-5

, , ,

closed vessel

AAS ICP-AES

95%

Abstract

Cotton gloves, cotton caps, cotton socks, latex gloves and shoes covers were analyzed in evaluating a procedure for the rapid decomposition of nuclear power plant

solid waste samples. The decomposition procedure was carried out by closed vessel microwave dissolution technique with HNO₃-HCl-HF acid. The solutions were then analyzed by AAS and ICP-AES. This technique provided recovery values greater than 95% for metallic elements.

1.

, , /
 , , 가 !
 , 가
 가
 가 (dry ashing method)
 가 가
 가
 가
 가 가
 가 가
 (: 405 410 , : 400 410)
 , : 440 450 , : 400 420)
 , 500
 Cs, Re Tc (705 가
) 가 !
 (microwave digestion system)
 가 ,
 가 (thermal gradient)
 , , 가

2.

2.1.

programmable single set-point (Thermolyne, Type 30420-C70)
 (Deaheung Sci., DF-5FA)
 closed vessel (Milestone Model MLS1200 Mega & Ethos Plus,
 Fig. 1.)

atomic absorption spectrometer (Perkin Elmer Model 3100), mono
 channel ICP-AES (JOBIN YVON Model JY 38 Plus) multi channel ICP-AES
 (JOBIN YVON Model JY 50 P)

2.2.

(HNO₃, Fisher Trace metal grade 70%), (HCl,
 Dong yang GR 36%) (HF, Merck 48%)
 Cs, Fe, Ni, Re Sr 가
 500 µg/mL 1 M HNO₃ . ICP-AES
 (Spex plasma standard, 1000 µg/mL, 2% nitric acid solution)
 1 M 가 (18 M)

2.3.

2.3.1.

10-50 g 가 ,
 (Cs, Fe, Ni, Re Sr)

250 μg 가

가

2.3.2.

closed-vessel

MLS 1200

가

가

가

Ethos plus

가

3

0.05-0.1 g

(Cs, Fe, Ni, Re Sr)

250 μg

가

/

가

Fe, Ni, Re Sr

ICP-AES

Cs AAS

3.

3.1.

250 3 /min

250

450 0.5 /min

7

20-30

2.5%, 1%, 0.6%, 0.7%

9%

Table 1. Fig. 2

가

(: Table 2.).

3.2.

가

가

가 가 1000 psi

0.05 g

3.3.

, , , HBF₄

^{4,5}

- : = 6 mL : 1 mL
- : = 6 mL : 0.5 mL
- : : = 5 mL : 3 mL : 0.5 mL
- : : HBF₄ = 5 mL : 3 mL : 0.5 mL
- : : = 6 mL : 2 mL : 0.5 mL
- : : HBF₄ = 6 mL : 2 mL : 0.5 mL

, 가

: : = 5 mL : 3 mL : 0.5 mL

: : = 6 mL : 2 mL : 0.5 mL

3.4.

가

가

가

5 250 W 10 , 400 W 10 , 650 W 5
 , 0 W 10 650 W 5

가

가

250

가

MLS 1200

가

180

10

가, 180 5 , 180-200 5 가 200 5
 432.57 KJ 287.97 watt

4.

(Fig. 2) , programmable 가
 95%
 ICP - AES
 closed - vessel Ethos Plus
 (Fig. 3) , (Fig. 4)
 5%
 ICP - AES 가
 95% ,
 closed - vessel

(: Table 3)

50 g 250 3 /min
 250 450 0.5 /min
 가 7
 0.05 g 6 mL, 2 mL 0.5 mL
 180 10 가, 180 5 ,
 180-200 5 가 200 5
 가

5.

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Fig. 1. Closed vessel acid digestion system. (Milestone MLS1200 and Ethos Plus)

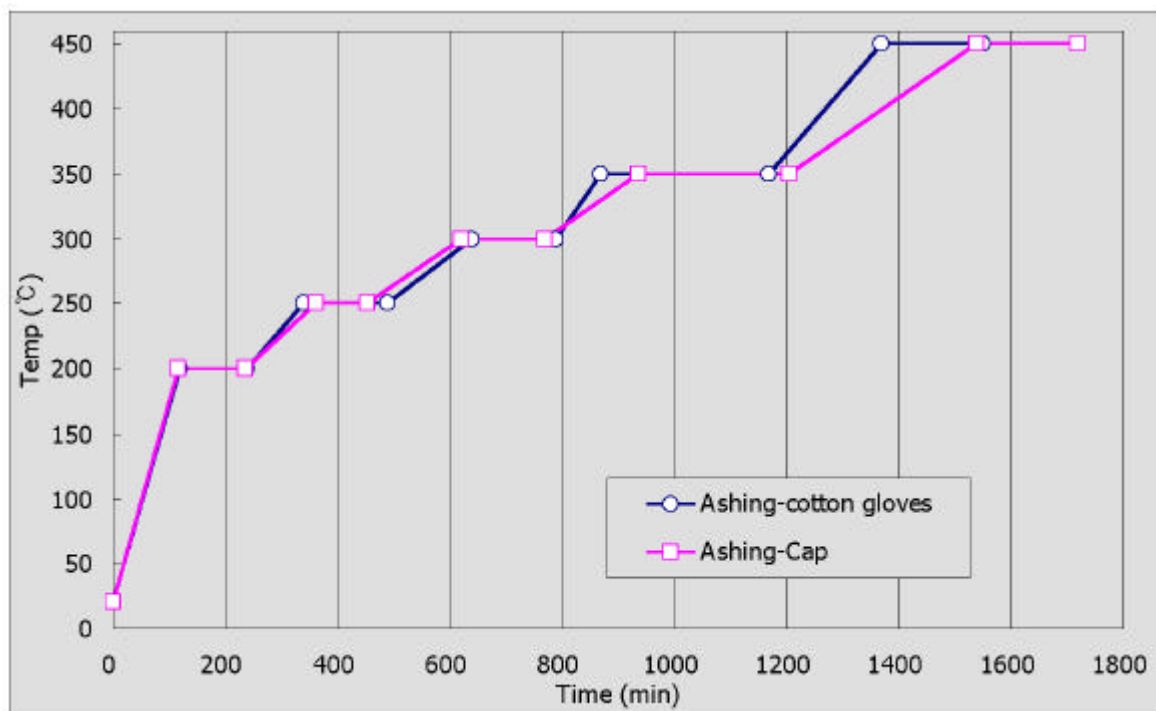


Fig. 2. Variance of ashing time as the change of ashing temperature for the samples (Using programmable muffle furnace).

Table 1. Variance of ash weight for the samples

Sample	Sample weight (g)	Ash weight (g)	Ash percentage (%)
Cotton socks (n=3)	10.0	0.1	1.0
Shoe covers (n=3)	10.0	0.9	9.0
Latex gloves (n=2)	10.0	0.24	2.40
Cotton gloves (n=1)	26.8	0.17	0.63
Caps (n=1)	50.0	0.35	0.70

Table 2. Recoveries of metal during the ashing steps in muffle furnace

No.	Cs (%)	Fe (%)	Ni (%)	Re (%)	Sr (%)
1	96.45	101.23	101.49	96.36	100.00
2	96.45	100.72	101.07	97.44	101.36
3	97.46	102.06	102.24	97.44	101.90
4	97.46	101.13	102.45	98.65	99.69
5	100.51	109.29	108.41	97.27	97.70
AVG ± RSD	97.66 ± 1.71	102.89 ± 3.51	103.13 ± 2.91	97.43 ± 0.84	100.13 ± 1.64

Table 3. Chemical composition of waste ash

	Al ₂ O ₃ (%)	CaO (%)	MgO (%)	SiO ₂ (%)	TiO ₂ (%)	ZnO (%)	Total (%)
Latex gloves	0.52	21.14	8.65	8.58	0.11	22.95	61.95
	0.56	21.85	9.01	0.67	0.12	24.17	56.37
Cotton gloves	0.43	16.73	8.13	42.17	1.78	1.57	70.81
	0.43	16.87	8.14	40.37	1.78	1.55	69.15

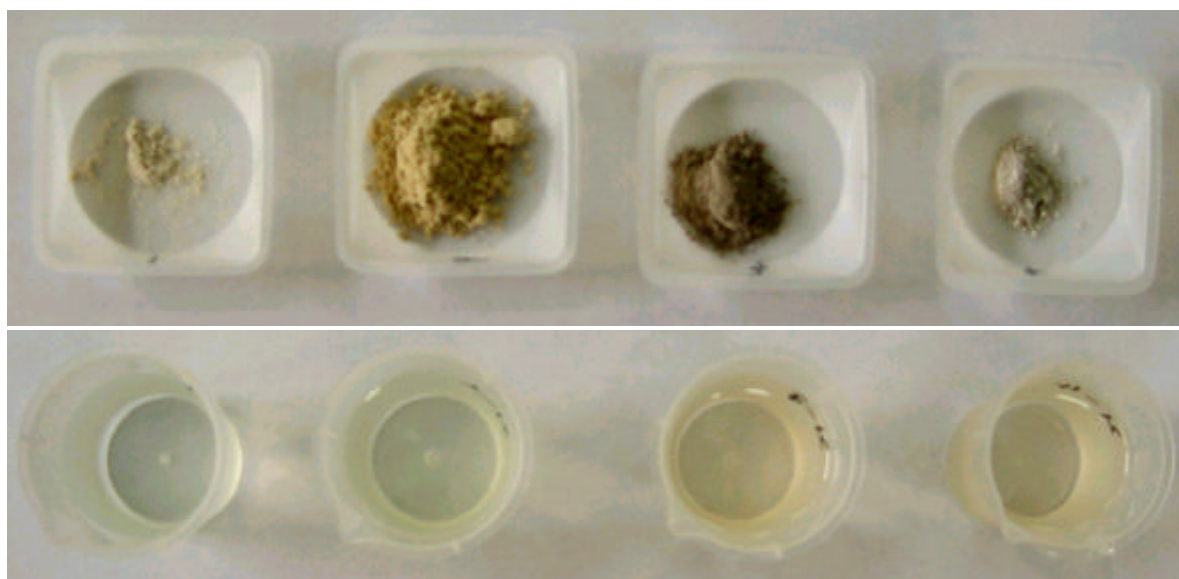


Fig. 3. Sample ashes of mimic nuclear power plant waste and digestion of waste ash using temperature controlled of closed vessel acid digestion system (Left from : shoe covers, latex gloves, cotton gloves, caps).

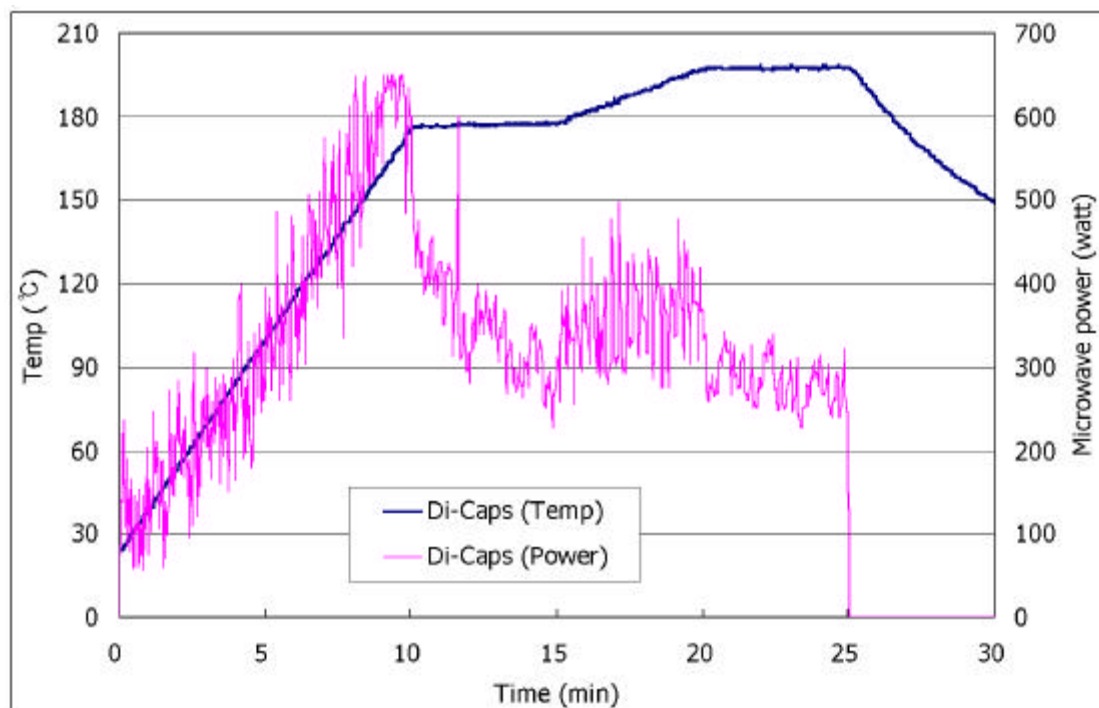


Fig. 4. Digestion procedure using temperature controlled of closed vessel acid digestion system.