A Study on Characteristics for Manufacturing the Sintered Green Body of Moist Particulate and Sludge-type Radioactive Waste

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1. Introduction

It is a study on characteristics and the suitability of disposal for a sintered green body by using the simulated sample of the moist particulate and sludge-type radioactive waste. The moist particulate and sludge-type radioactive waste contain glass components, so cerium oxide (CeO_2) was added to samples in order to maintain molding conditions in the high -temperature furnace at 1100℃. As a result, it was confirmed that the samples had sufficient compressive strength, no harmful substance and were isotropically shrunk.

2. Main Title

2.1 Process of manufacturing the green body

As shown in the table 1, it is the comparative analysis of composition between the original sample and simulated sample.

Table 1. The comparative analysis of composition between the original sample and simulated sample(ppm)

	Si	Sb	Mo	Fe	Al	Cu	Zn	P	Ca	Mg	B	Ti
O.S*	22.3	2.58	332	27.04	35.21	-	1.33	2.27	698.7	21	61.85	0.38
S.S**	34.2	3.39	839.6	37.76	97.8	70.9	2.24	61.86	1704	52.9	123.7	1.69

*O.S : Original Sample **S.S : Simulated Sample

To manufacture the sintered green body, the sample was dried in the dryer to remove moisture, and then put into a super-mixer to make a homogeneous powder. After that, the powder was put into the molding machine and sintered in the high-temperature furnace.

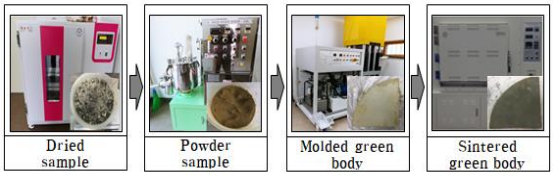

Fig. 1. The process for Manufacturing sintered green body.

According to the optimum condition of the sintering process, the molded green body was put into the furnace at 200℃ for 2 hours and at 300℃ for 1 hour to remove the moisture of the green body. After that, temperature was elevated to 1100℃ and maintained for 3 hours in the furnace to remove the harmful substance in the green body.

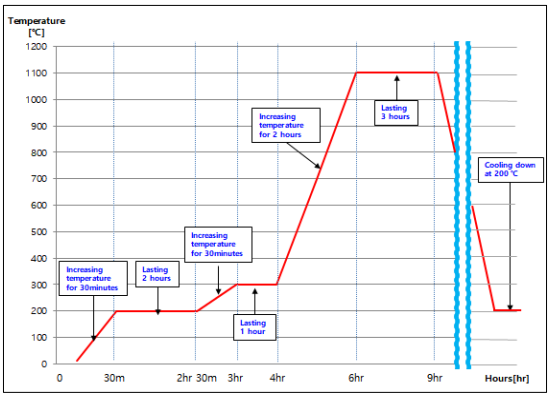

Fig. 2. Temperature and setting time to manufacture the sintered green body.

As shown in Fig. 3, it was sintered green body with the glass-ceramic shaped structure.

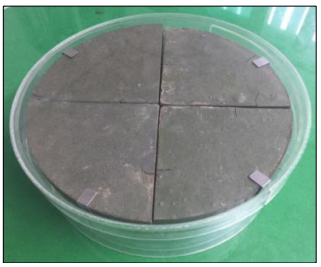

Fig. 3. The fan-shaped disk type of sintered green body.

2.2 Compressive strength test

The compressive strength test is to confirming the structural integrity in the solidification of radioactive waste to satisfy the acceptance criteria of KORAD. In order to confirm the structural stabilities of the sintered green body, it made the specimens which were SB1, SB2. And then, evaluate the compressive strength of the specimens as shown in Fig. 4.

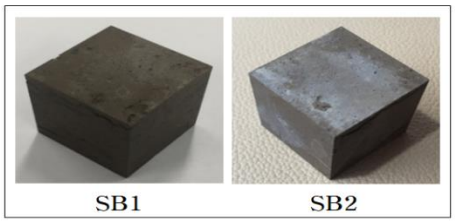

Fig. 4. The specimens of sintered green body.

Table 2. The result of compressive strength test

Compressive Strength test				
Solidification of radioactive waste		Sintered Green body		
Acceptance Criteria of KORAD	psig	Result	Specimen	psig
	500		SB1(Sample 1)	8,267
			SB2(Sample 2)	28,282

The compressive strength test of the specimens showed about 16 ~ 57 times higher than that of acceptance criteria of KORAD. Consequentially, it was observed that the sintered green body had sufficient compressive strength.

2.3 Analysis of composition in sintered green body

As shown in Fig. 5, it is the analysis of composition in the sintered green body by using the XRD. It was confirmed that Sb_2O_3, which is a harmful substance, was oxidized to Sb_2O_5 in the sintering process.

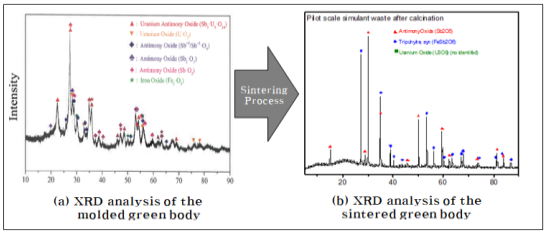

Fig. 5. Analysis composition of sintered green body by using XRD.

According to the analysis results, Sb^{+3}, Sb^{+5} were included in the samples, but after sintering the samples, it was observed that Sb^{+5} was only presented in the samples.

2.4 Evaluation of volume reduction and isotropic shrinkage in sintered green body

As shown in Fig. 6, the length of the sample was reduced by 13% on average and it was confirmed that the volume of the sample was reduced by 35% and was isotropically shrunk.

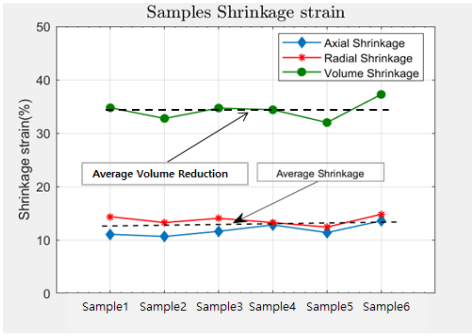

Fig. 6. The result of volume reduction and isotropic shrinkage for the sintered green body.

3. Conclusions

As stated above, it studied the characteristics for manufacturing the sintered green body. The compressive strength of the sintered green body is harder than the acceptance criteria which is 500 psig applied to the solidification of radioactive waste in KORAD. In addition, it was confirmed that harmful substance of Sb^{+3} in the molded green body was removed after the sintering process. Therefore, it is expected that the result of this study will provide the basis for satisfying the acceptance criteria of low-intermediate level radioactive waste in KORAD and it can be applied to the commercial scale design for manufacturing the sintered green body of moist particulate and sludge-type radioactive waste.

ACKNOWLEDGEMENT

This study is the result of conducting the research for securing safety and satisfying the transportation requirements of radioactive waste in Taekwang industry.

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