Drop Test of High Integrity Container

Hyun-jin Park [a*], Woo-seok Choi [a], Ki-seok seo [a*], Sang-hoon Lee [a], Byung-yoon Min [b], Jae-won Kim [b]
[a]*Korea Atomic Energy Research Institute, 150-1, Deokjin-dong, Yuseong-gu, Daejeon*
[b]*Kyelim Polycon Co., Ltd., 228-3, Poi-dong, Gangnam-gu, Seoul*
[*]*Corresponding author: nksseo@kaeri.re.kr*

1. Introduction

Currently, the radioactive waste stored in a nuclear power plant is almost saturated. The establishment of a new radioactive waste disposal site is inevitable and it is urgent to develop a container for a long-term storage in a disposal site. Therefore, a High Integrity Container (HIC) has developed that can be kept in long-term safely in underground and disposal condition. A HIC developed as a prototype, is composed of Polyethylene, Polymer-Concrete, Steel. In this study, Drop test of HIC were conducted to evaluate the long-term performance and safety of HIC. At each test, the acceleration and strains at various points were monitored by strain gauges and accelerometers attached to the test model.

2. Drop Test

To evaluate the behavior characteristics and the structural integrity of a HIC, a lid drop test, a bottom drop test and a side drop test of container were performed. For all of tests, the drop height is 1.2 m. In each test, a certain mount of water filled the container to simulate the weight of radioactive waste in container. Leak tightness was maintained during the tests.

2.1 Lid Drop Test

In a lid drop test, the lid surface of HIC was headed toward the steel target on the ground as shown in Fig. 1. The drop height is 1.2 m. Three strain gauges and one accelerometer are attached to the outer surface of HIC. Strain gauges are attached to 0, 180 degree in the axial direction and to 90 degree in the radial direction at the upper side of the HIC. Strain histories at each position are represented in Fig. 2. Accelerometer is attached to the bottom of the container. The filtered acceleration data manipulated with a cut-off frequency is shown in Fig. 3. A sampling rate is chosen as 50 k. The maximum values of strain and acceleration are shown in Table I.

Fig. 1. Lid drop test with 1.2 m drop height

Table I: Max. Value of strain and acceleration

1.2 m drop				
Strain [με]			acceleration [g]	
0°	90°	180°	raw data	filtered
52	947	147	2,200	394

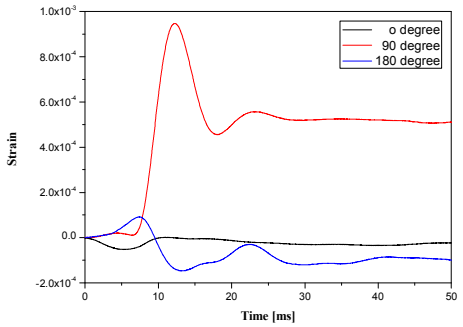

Fig. 2. Strain histories in the lid drop test

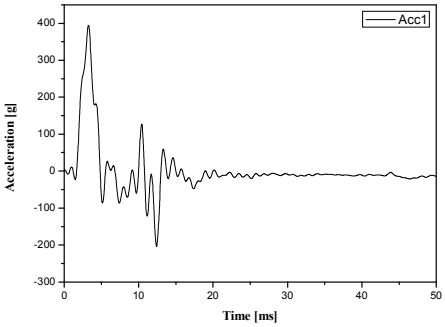

Fig. 3. Acceleration history filtered with cut-off frequency

2.2 Bottom Drop Test

In a bottom drop test, the bottom surface of HIC was placed toward the steel target on the ground. The drop height is 1.2 m. Three Strain gauges are attached in the axial direction at side of HIC. Strain histories at each position of the HIC are represented in Fig. 4. Three Accelerometers are attached to 0, 120, 240 degree at the lid of the container. The filtered acceleration data manipulated with a cut-off frequency is shown in Fig. 5. A sampling rate is chosen as 50 k. The maximum values of strain and acceleration are shown in Table. II.

Table II: Max. Value of strain and acceleration (0°)

1.2 m drop				
Strain [με]			acceleration [g]	
Top	Middle	Bottom	raw data	filtered

63	622	1,033	992	460

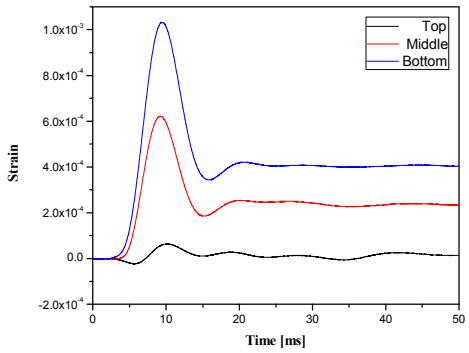

Fig. 4. Strain histories in the bottom drop test

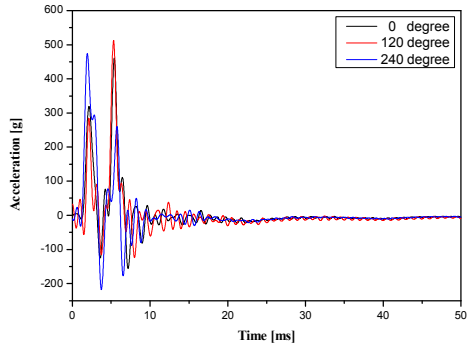

Fig. 5. Acceleration histories filtered with cut-off frequency

2.3 Horizontal Drop Test

In a horizontal drop test, the side surface is headed down toward the steel target on the ground as shown in Fig. 6. The drop height is 1.2 m. Six Strain gauges are attached to 0, 270 degree in the radial direction at the side of the HIC. Strain histories at each position of the HIC are represented in Fig. 7. Three accelerometers are attached to 270 degree in the side of the container. The filtered acceleration data manipulated with a cut-off frequency is shown in Fig. 8. A sampling rate is chosen as 50 k. The maximum values of strain and acceleration are shown in Table. III.

Fig. 6. Horizontal drop test with 1.2 m drop height

Table III: Max. Value of strain and acceleration

1.2 m drop				
Strain [με]			acceleration [g]	
Top	Middle	Bottom	raw data	filtered
1,018	83	716	1,583	170

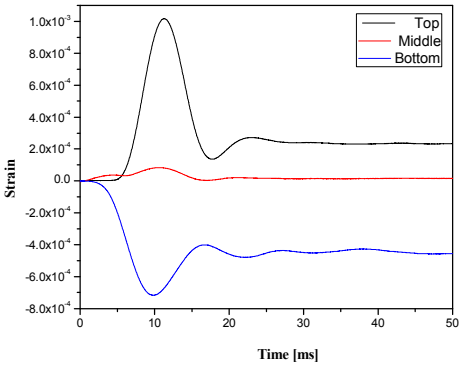

Fig. 6. Strain histories in the bottom drop test

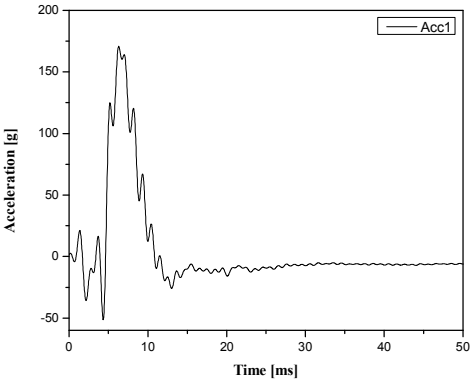

Fig. 7. Acceleration history filtered with cut-off frequency

3. Conclusion

Three drop tests of a HIC were performed based on the transport regulation of container for radioactive waste disposal. The maintenance of structural integrity was evaluated based on the strain and acceleration history and a visual inspection. As a result, no leakage of water in the container was observed after each test, and the measured strain and acceleration were estimated to be in a proper range. In the future, tests for evaluation of a long-term safety should be necessary. The developed HIC needs some supplements based on the environment of domestic disposal site and the useful specifications.

REFERENCES

[1] Korea MEST Act.2008-69, Regulations for Packaging and Transport of Radioactive Material, 2008.
[2] U.S. Code of Federal Regulations, Packaging and Transportation of Radioactive Material, Title 10, Part 71, 1997.
[3] U.S. Code of Federal Regulations, Licensing Requirements for Land Disposal of Radioactive Waste, Title 10, Part 61, 1997.