Analysis Strength of Ir-192 Sealed Capsule for Welding Variable using a FEM

J. H. Park[a], J. J. Kim[a], B. G. Song[b], K. J. Son[a*]
[a]*HANARO Utilization and Research, Korea Atomic Energy Research Institute (KAERI), Daejeon 34057, Korea*
[b]*Daejeon Branch, Hojin Industry Co.,, Daejeon 34057, Korea*
[*]*Corresponding author: kjson@kaeri.re.kr*

1. Introduction

Ir-192 sealed capsules are used to non-destructive test. The sealing technique is very important because the Ir-192 is high radioactive material[1]. Usually, the capsule inserted radioactive material is sealed using a welding. There are many methods to verify the structural integrity of sealed capsule such as impact, percussion, heating, immersion test and so on[2,3].

In this study, a structural analysis was conducted to investigate the structural integrity of Ir-192 sealed capsule for internal pressure and depth of weld zone.

2. Methods and Results

2.1 FEM model and boundary condition

The structural analysis about internal pressure for Ir-192 sealed capsule was conducted by using the static structural module of the ANSYS™

Fig 1 shows the configuration of an Ir-192 sealed capsule. The Ir-192 disks are inserted an inner capsule, an inner capsule is inserted an outer capsule. The material of capsule is STS316L.

Fig 2 shows the analysis models for depth of weld zone. The red area is weld zone. Fig 2 (a) shows the analysis models of 0.225mm and 0.45mm depth of weld for inner capsule. Fig 2 (b) shows the analysis models of 0.225mm and 0.45mm depth of weld for outer capsule.

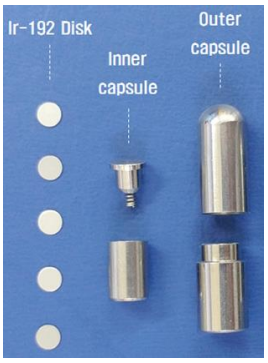


Fig. 1 The configuration of an Ir-192 sealed capsule.

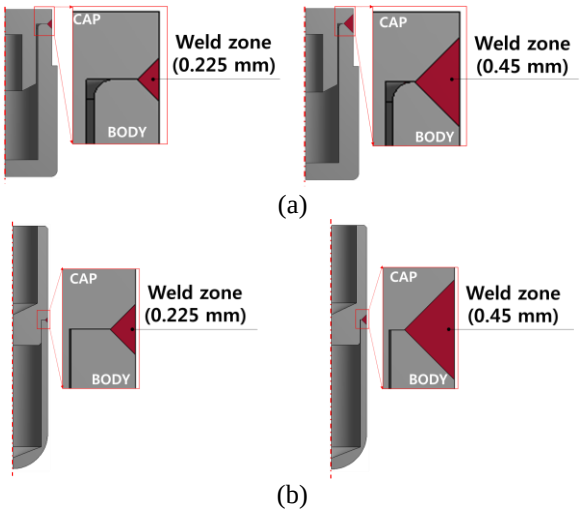


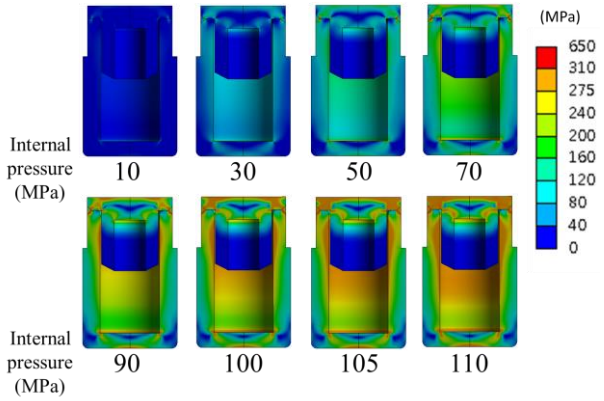
Fig. 2 Analysis models (a) inner capsule, (b) outer capsule.

2.2 Structural analysis

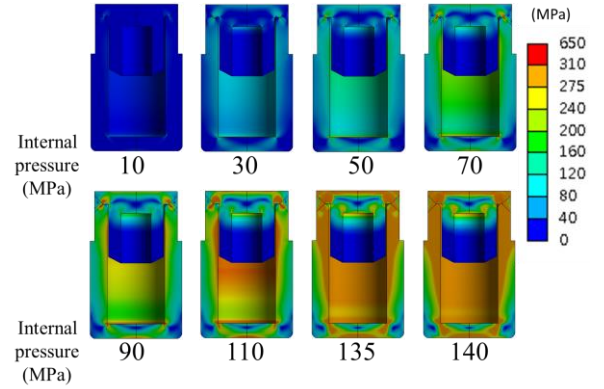
Fig 3 shows the structural FE analysis results of inner capsule for internal pressure. Fig 3 (a) is analysis results for 0.225mm depth of weld zone. Fig 3 (b) is analysis results for 0.45 mm depth of weld zone.

Fig 4 shows the change of stress distribution of outer capsule for internal pressure. Fig 4 (a) shows the stress distribution for 0.225mm depth of weld zone, and Fig 4 (b) shows the analysis results for 0.45mm depth of weld zone.

Fig 5 shows comparison maximum stress of capsule for internal pressure and strength of STS316L. Fig 5 (a) shows a graph about inner capsule. Fig 5 (b) is a graph related to outer capsule. In the case of inner capsule with 0.225mm depth, the maximum stress is bigger than tensile strength of STS316L at 105~110 MPa, and in the case of 0.45mm depth, the maximum stress is bigger than tensile strength at 135~140 MPa. In the case of outer capsule with 0.225mm depth, the maximum stress is bigger than tensile strength at 80~85 MPa, and in the case of 0.45mm depth, the maximum stress is bigger than tensile strength at 90~95 MPa.

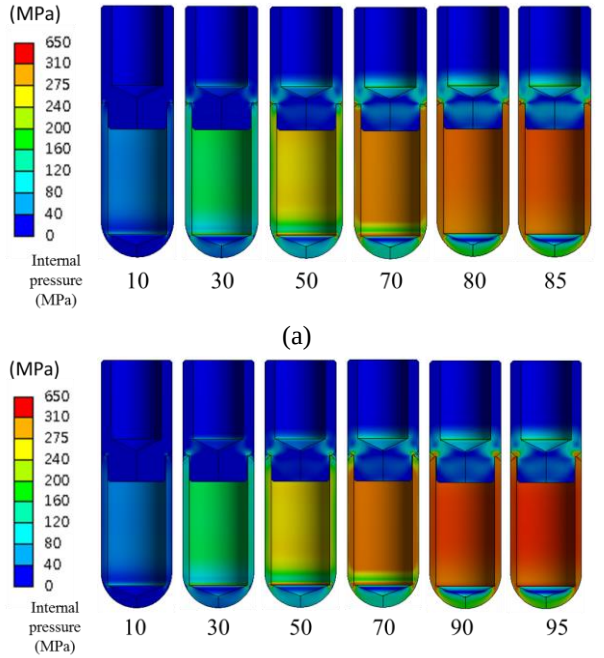


(a)



(b)

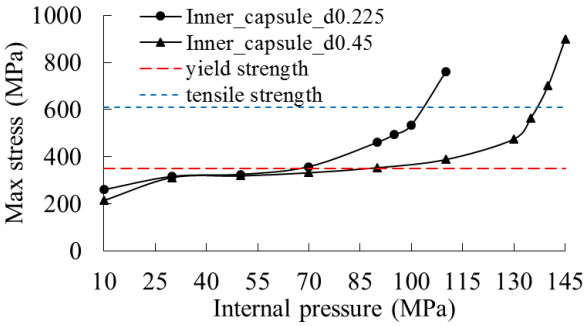
Fig. 3 Structural FE analysis results of inner capsule for internal pressure: (a) 0.225mm depth of weld zone, (b) 0.45 mm depth



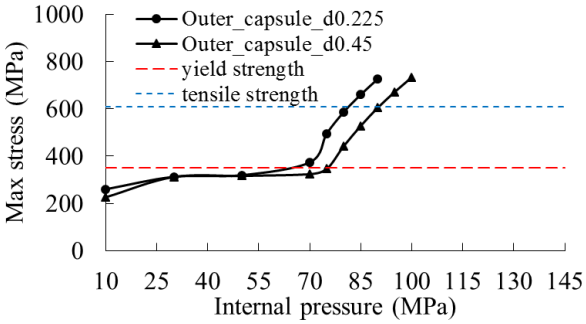
(a)

(b)

Fig. 4 Change of stress distribution of outer capsule for internal pressure: (a) 0.225mm depth of weld zone, (b) 0.45 mm depth



(a)



(b)

Fig. 5 Comparison maximum stress of capsule for internal pressure and strength of STS 316L: (a) inner capsule, (b) outer capsule

3. Conclusions

The structural analysis was conducted in this study to investigate the strength of Ir-192 sealed capsule for internal pressure and depth of weld zone. As a result, in the case of inner capsule, the internal pressure strength of 0.45mm is about 28.5% higher than that of 0.225mm, and in the case of outer capsule, the internal pressure strength of 0.45mm is about 12.5% higher than that of 0.225mm. In the future, we will conduct an internal pressure test and verify the validity of a FEM

REFERENCES

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