A Study on Fracture Characteristics Comparison of Nuclear Graphite IG-11 with IG-110

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1. Introduction

Nuclear graphite that reactor core product, serves as reflector and moderator. Structure soundness of reactor is closely related such a thing. It is important to get hold of fracture characteristics of nuclear graphite. Han[1] studied the fracture characteristics of nuclear graphite IG-11. In this study, fracture characteristics of nuclear graphite IG-11 and IG-110 were studied to compare using compressive test, four points bending test respectively.

2. Experiment

2.1. Property comparison of graphite IG-11 with IG-110

The material properties of graphite IG-11 and IG-110 were shown in Table I. These have been brought to this place by Japan of ToyoTanso[2] was investigated. The material property of IG-110[3] is good against IG-11. Because of IG 110 is upgraded to get to high purity by specific tempering

Table I: Properties of Nuclear Graphite IG-11 and IG-110.[2][3]

Material	Density (g/cm^3)	Hardness Shore	Bending Strength (MPa)	Compressive Strength (MPa)	Tensile Strength (MPa)	Young's Modules (MPa)
IG-11	1.77	51	39	78	25	9.8
IG-110	1.76	51	37.4	76.8	25	8.93

2.2. Compressive test

In order to measure the compressive strength of graphite IG-11 and IG110, specimens are manufactured have cylindrical shape along ASTM C695-21[4] standard. According to it, the specimens have 19 mm diameter and 38 mm length. Compressive strength is:

$$\sigma_c = \frac{P}{A} \quad (1)$$

Where notation is as listed

σ_c : Compressive Strength (MPa)

P : Fracture Load (N)

A : Area (mm^2)

Fig. 1 Compressive test using MTS-810.

Fig. 2 Fracture shape of graphite IG-11 and IG-110

Compressive test of graphite mounted in the load frame using the MTS-810 is shown in Fig. 1. The test spending is 10 minute, each and they have done with 10 specimens. The fractured shape of graphite IG-11 and IG-110 are given in Fig. 2.

2.3. Bending test

In order to measure the bending strength of graphite IG-11 and IG110, specimens are manufactured have beam shape along ASTM C691-91 standard. The specimens have 90 mm length, 20 mm width, and 10 mm thickness. The span gap is 40 mm. Bending strength is defined as,

$$\sigma_b = \frac{P \times L}{W \times D^2} \quad (2)$$

Where the notation is as listed

σ_b : Bending Strength (MPa)

P : Fracture Load (N)

L : Span Length (mm)

W : Width (mm)

D : Thickness (mm)

Fig. 3 Four points bending test using MTS-810.

Fig. 4 Fracture shape of graphite IG-11 and IG-110

Fig. 3 shows the mounted graphite specimens in the load frame for four points bending test. The specimens were fractured about 7 minutes under 0.1mm/mm displacement velocity. The fractured shape is shown in Fig. 4.

3. Results

Compressive test results for 10 specimens that IG-11 and IG-110 were shown in Fig. 5. For IG-11, the maximum compressive strength was 75.4 MPa and minimum value was 64.9 MPa and the mean value was 68.3 MPa. For IG-110, the maximum compressive strength was 65.5 MPa and minimum value was 59.5 MPa and the mean value was 62.7 MPa

Bending test result for 10 specimens that IG-11 and IG-110 were shown in Fig. 6. For IG-11, the maximum bending strength was 46.7 MPa and minimum value was 36.7 MPa and the mean value was 42.2 MPa. For IG-110, the maximum compressive strength was 43.3 MPa and minimum value was 39.7 MPa and the mean value was 41.9 MPa.

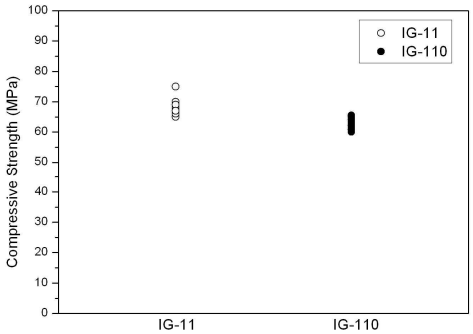

Fig. 5 Compressive strength of graphite IG-11 and IG-110

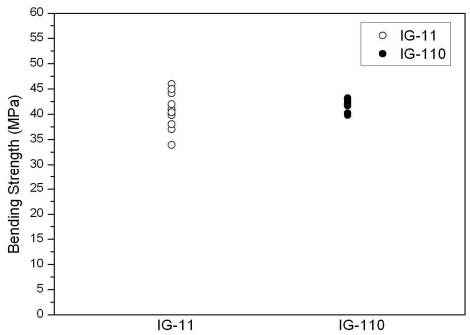

Fig. 6 Bending strength of graphite IG-11 and IG-110

4. Conclusions

In this study, compressive test and bending test of nuclear graphite IG-11 and IG-110 were conducted each. In compressive test result, the mean value of IG-110 was 62.7 MPa and it smaller than the value of IG-11 which have68.3 MPa. Similarly in bending strength test result, the mean value of IG-110 was 41.9 MPa and it smaller than the value of IG-11 which has 42.2 MPa. Each test results have similar value provided by Japan ToyoTanso[2] and.Cho[3]

REFERENCES

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