Change of Oxygen Concentration According to Argon Purging of Storage Vault in ACPF

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1. Introduction

When performing a pyroprocessing experiment, Uranium / molten salt ingot which are by-products are generated and need a place to store them. We have called this place a Storage Vault which is located in the ACPF (Advanced spent fuel Conditioning Process Facility). These products should always be stored in an Argon atmosphere because they have high radiation levels and high temperature.

These by-products (high temperature condition) are easy to react to the small amount of Oxygen. As a result, fire and explosion may occur. These event also cause severe accident. Thus it is essential to measure the Oxygen concentration in the storage vault. Therefore, in order to measure the change of Oxygen concentration according to the amount of Argon in the storage vault, Oximeter was installed in the storage vault outlet to measure Oxygen concentration change.

2. Experimental

The storage vault is divided into vault A and Vault B, and their specifications are shown in Table 1.

Table 1. Volume of vault A and vault B

	Specification
Vault A	Storage rack: 6 ea Volume: $0.0176\ m^3 \times 6 = 0.105\ m^3$
Vault B	Storage rack: 6 ea Volume: $0.0275\ m^3 \times 6 = 0.165\ m^3$

The Oxygen meter used in this experiment is shown in Fig. 1.

Fig. 1. Experimental apparatus (Oxygen meter).

3. Results and Discussion

(1) Vault A

An unused 47 L Argon bomb is filled with Argon gas at a pressure of about 120 bar, which has a volume of about 5,600 L at atmospheric pressure at room temperature (25℃). The initial pressure of the bomb used for Argon purging in vault A is 1,335 psi which is approximately 4,317 L at 25℃ at atmospheric pressure. The Oxygen concentration of the initial Oxygen meter was 206,400 ppm and the resolution of the Oxygen meter used was 0.0001 ppm. Table 2 shows the changes in Oxygen concentration according to amount of Argon purging of Vault A, and the graph is shown in Fig. 2. The amount of Argon needed to reach 100 ppm was analyzed to be about 278.31 L

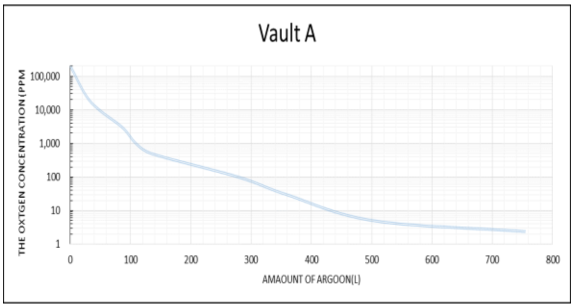

Fig. 2. The graph of change Oxygen concentration of vault A.

Table 2. The change of Oxygen concentration according to amount of Argon of vault A

Pressure (psi)	A mount of Ar (L)	Oxygen concentration (ppm)
1,335	0.00	206,400
1,327	25.59	27,500
1,320	47.98	10,000
1,308	86.37	3,000
1,301	108.76	1,000
1,293	134.35	500
1,248	278.31	100
1,223	358.28	30
1,178	502.23	5
1,099	754.95	2.36

(2) Vault B

The initial pressure of the bomb used for Argon purging in vault B is 1,211 psi which is approximately 3,920 L at 25℃ at atmospheric pressure. The Oxygen concentration of the initial Oxygen meter was 206,400 ppm and the resolution of the Oxygen meter used was 0.0001 ppm. Table 3 shows the changes in Oxygen concentration according to amount of Argon purging of Vault B, and the graph is shown in Fig. 3. The amount of Argon needed to reach 100 ppm was analyzed to be about 217.57 L

Table 3. The change of Oxygen concentration according to amount of Argon of vault B

Pressure (psi)	A mount of Ar (L)	Oxygen concentration (ppm)
1,211	0.00	206,400
1,173	123.14	10,000
1,170	132.86	3,000
1,153	187.95	1,000
1,121	291.65	200
1,113	317.57	100
1,099	362.94	50
1,065	473.11	20
1,028	593.01	10
938	884.66	2
909	978.63	1

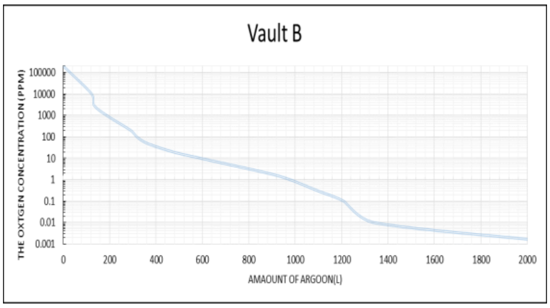

Fig. 3. The graph of change Oxygen concentration of vault B.

4. Conclusions

It uses 595.8L of Argon gas to reach 100ppm by purging Vault A and B at the same time. According to the MBRAUN data which is a famous company of making GLOVE BOX [1], it needs 11 times bigger volume of Argon gas to reach 100ppm. Also it needs 3,000L of Argon gas to purge to reach 100 ppm on this experimental volume which is 0.27m^3. There is a big gap between the MBRAUN data and our experiment result. I guess there were on error on Assuming that everything is Argon gas except Oxygen gas which was measured only. It is hard to say that other substances is Argon gas (purity 99.999%) even the Oxygen is lower than 10 ppm. But the purpose of the experiment was measuring only Oxygen level. It was not a waste of time. Also I guess there was not much error because the Oxygen concentration meter was fixed and corrected before the experiment.

REFERENCES

[1] MBRAUN Inc. Operation Manual Glove Box Systems ver 3.0, 2008.