REPLACEMENT TECHNIQUE FOR FRONT ACRYLIC PANELS OF A LARGE SIZE GLOVE BOX USING BAG-IN / BAG-OUT METHOD

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ABSTRACT

For safety operation of the large size glove box, the degraded acrylic panels of the box must be replaced by the new panels. As the conventional replacement technique, the decontamination of the whole of the glove box and the ALS work for replacement in the isolation tent are necessary for the worker safety and the prevention of the leak of contamination, because the airtight condition of the glove box is broken down during replacement work. Therefore, the decontamination of the glove box and installation of isolation tent are essential prerequisite of this technique, which is required considerable manpower.

The new replacement technique using the bag-in / bag-out method was developed by Japan Atomic Energy Agency.

In this technique, for keeping the airtight condition of the box, the inside of the degraded panel is covered with an airtight panel and the outside is covered over the large bag which is used to replace the acrylic panels. As the benefits of this technique, the prerequisite works are not required and the manpower is less than one fifth of the conventional technique. In addition, the ALS work is decreased.

1. Introduction

In Waste Safety Testing Facility (WASTEF), a large sized glove box (10 meter X 2.3 meter X 4.5 meter) that called the Maintenance box (MT box) was set on the roof of the alpha cells for maintenance of alpha cells and several examinations for the basic study of TRU nitride fuel. The MT box has the Air Line Suit (ALS) system for the maintenance work of the apparatuses in the glove box. The MT box is contaminated by the alpha radionuclides (Am, Pu, Cm). The average of contamination level on the inside of the glove box is about 30Bq / cm^2. The micro cracks were found in the front acrylic panels of the MT box caused by the degradation, which has been used for about 25 years (Fig 1). These micro cracks were not penetrating through the panel, but the degraded acrylic panels of the glove box must be replaced by the new panels from the view point of safety operation of the MT box. As the conventional replacement technique, the decontamination of the whole of the glove box and the ALS work for replacement in the isolation tent are necessary for the worker safety and the prevention of the leak of contamination, because the airtight condition of the glove box is broken down during replacement work. Therefore, the decontamination of the whole of the glove box and installation of isolation tent are essential prerequisite of this technique, which is required considerable manpower.

The new replacement technique using the bag-in / bag-out method was developed by Japan Atomic Energy Agency to save the manpower and safety for replacement work.

2. Replacement process of the developed technique

The bag-in / bag-out method which is generally used bringing objects in and out the glove box, was applied the replacement technique. As the benefits of this method, contamination is not released from the glove box, because the bag keeps airtight condition of the glove box during the replacement work. And the ALS work in the isolation tent dose not needed, because the bag seals off the alpha radionuclides. Therefore the prerequisite works, which means decontamination of the whole of the glove box and installation of isolation tent, are not necessary. In addition, the quantity of the ALS work is reduced. And some devices such as the airtight panel, the large bag and checking panel were developed by JAEA for saving the time and safety operation of replacement work. The developed replacement process is as follows and shown in Fig 2.

1) Decontamination of degraded panel

The inner surface of the degraded panels was decontaminated by the ALS workers before replacement of the panels for decreasing the contamination in the bag for the bag-out work. After that, the panel was covered by the plastic sheet against re-contamination. The sheet can be easily peeled away, if the surface of the sheet is contaminated.

2) Attachment of the airtight panel and the airtightness test

The airtight panel was attached on the inside of degraded panel using the screw bolts which were welded on the inside of the glove box. The weld gun was covered over the spark anti-scattering case for the protection of ALS worker. The negative pressure of the glove box was kept by the airtight panel during the replacement work. And the intake pipe for halogen gas was attached on the glove port of the degraded panel.

The airtightness of the airtight panel was tested by the halogen leak test method. In this test, the halogen gas (HCFC R22) was injected between the degraded panel and the airtight panel through the intake pipe for halogen gas and the airtightness was checked using the halogen gas leak detector which is set in the glove box.

3) Replacement of the acrylic panels using the bag-in /bag-out method

The bag-in /bag-out port was screwed on the outside of the glove box and the degraded panel was covered with the first large bag. The degraded panel was removed from the glove box into the first large bag. At this time, the ALS worker pushed the degraded panel from inside of the glove box to help removing of the degraded panel using the gloves of the airtight panel. And the first large bag containing the degraded panel was sealed by the in-pulse welding machine and the sealed part of the first large bag was separated from the glove box.

The second large bag containing the new panel was set over the rest of the first large bag. The rest of the first large bag was separated from the bag-in / bag-out port and sealed in the second large bag. And new panel was screwed on the glove box using gloves made on the second large bag. After that, the second large bag was removed from the bag-in / bag-out port and no contamination of the outer surface of the new panel was confirmed by the smear method.

4) Airtightness test

The checking panel was screwed on the outside of the new panel to perform the airtightness test of the new panel by the halogen leak test method. The airtight panel was removed by ALS worker from the inside of the glove box. And the halogen gas was injected between new panel and the checking panel and the airtightness was checked by ALS workers using the halogen gas leak detector.

3. development devices

(1) Airtight panel

The airtight panel can keep negative pressure inside of the glove box during the replacement work. Therefore installation of the isolation tent is not necessary. The airtight panel was made by stainless steel, has the regulation valve of negative pressure and two gloves. The regulation valve controls pressure between the degraded panel and the airtight panel for preventing pressure rise against outside of the degraded panel during the replacement work from the view point of the containment of the contamination.

Gloves help to remove the degraded panel by pushing from inside of the glove box. The airtight panel is shown by Fig. 3.

(2) The large bag

The large bag for the bag-in / bag-out method was developed for covering over the acrylic panel, having the air-intake with HEPA filter. The acrylic panels are handled in the bag during replacement work. The air-intake can make air flow, which prevents inside of the bag from being contaminated by radionuclide in the glove box. And HEPA filter prevents outside of the glove box form being contaminated, if the air with radionuclides blows back from the glove box. In addition, the bag has two gloves, which handles the acrylic panels during the replacement work. The large bag is as shown in Fig. 4.

(3) Checking panel

The checking panel was developed by JAEA. The airtight test was performed for each new panels by the halogen leak test method using the checking panel. As the benefit of this panel, it is easy to find the leak from the panels and the test process is very simple.

The checking panel was made by stainless steel, has a pressure gage and a intake pipe for the halogen gas and the panel is screwed on the outside of the new panel. The halogen gas was injected between the new panel and the checking panel and ALS workers checked airtightness with the halogen gas leak detector. The checking panel is shown by Fig.5.

4. Replacement result

Three degraded panels as the size of 1 meter X 1 meter of MT box were safely and successfully replaced using developed replacement technique. The contamination by radionuclides around the working area was not occurred. The working time was 20 days and the number of person-day was 140 (average 7 persons / day). In this case of the conventional technique, the working time of replacement is about 60 days and the number of person-days is over 760 (average 13 persons / day).

The person-day is less than one fifth of the conventional technique and it dose not need a long time for the ALS work. Comparison of the person-day of replacement with the developed technique and the conventional one is shown in table 1.

	Conventional technique (person-day)	Development technique (person-day)
Decontamination	390	35
Installation of isolation tent	130	-
Attached airtight panel	-	38.5
Replacement of panels	39	38.5
Airtight test	26	14
Cleanup of working area	65	14
Uninstallation of isolation tent	130	-
Total	760	140

Table 1: Comparison of the person-day of replacement with the developed technique and the conventional one

5. Summary

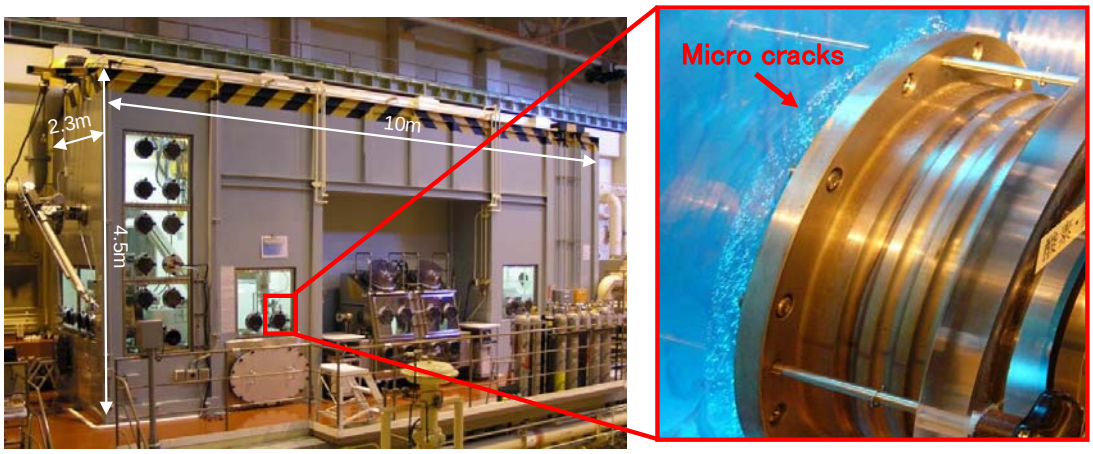
The developed replacement technique for front acrylic panels of a large sized glove box using the bag-out / bag-in method was developed and performed by the Department of Hot Laboratories and Facilities in JAEA.

- Some devices such as the airtight panel, the large bag and the checking panel were developed for keeping airtight condition, the containment of contamination and testing the new panels.
- Three acrylic panels of the MT box were safely and successfully replaced using the developed technique. The contamination by radionuclide around the working area was not occurred.
- The person-day of replacement is less than one fifth of the conventional technique.

Therefore it is confirmed that the developed technique is safer and more economical than the conventional one.

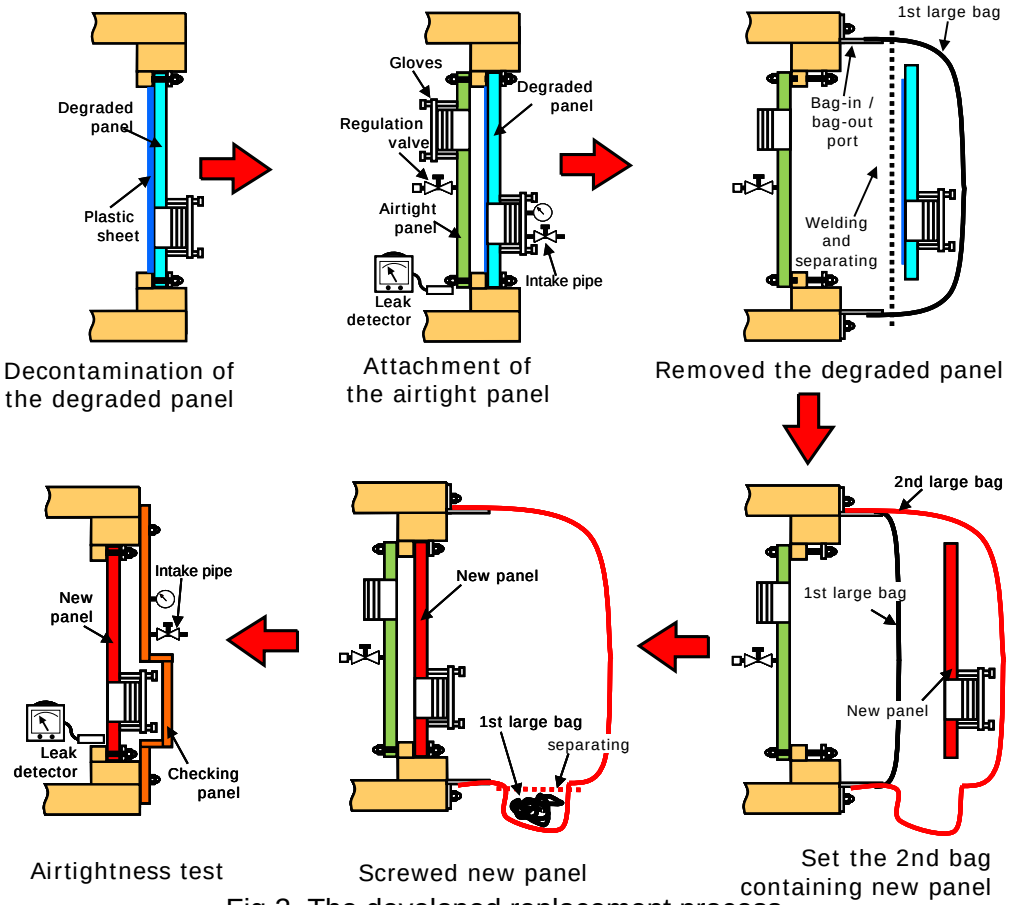
6. Acknowledgment

The authors acknowledge to Mr. S.Uematsu, director of the Department of Hot Laboratories and Facilities at JAEA. The authors would also like to thank to the staffs of Department of Hot Laboratories and Facilities for their assistance in performing the replacement.



The Maintenance box (MT box) The degraded panel

Fig.1 The large size glove box and the degraded panel



Decontamination of the degraded panel

Attachment of the airtight panel

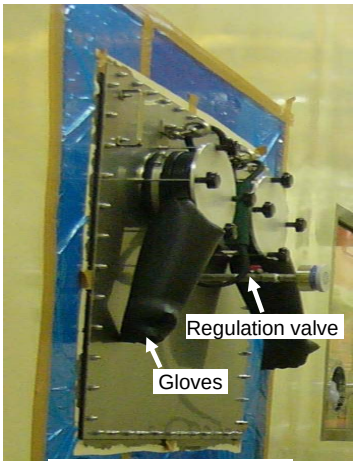
Removed the degraded panel

Set the 2nd bag containing new panel

Screwed new panel

Airtightness test

Fig.2 The developed replacement process



Airtight panel
(inside of the glove box)

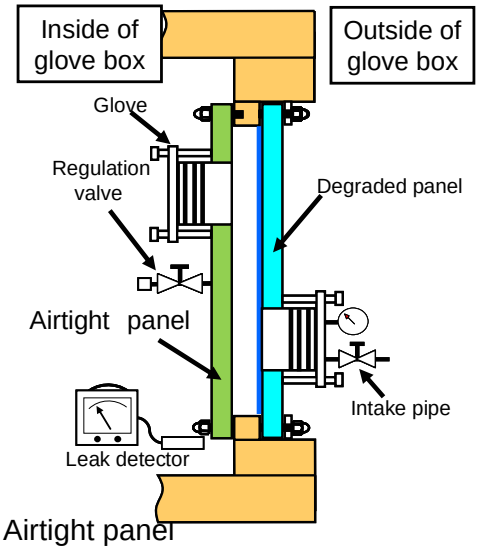


Fig.3 Airtight panel

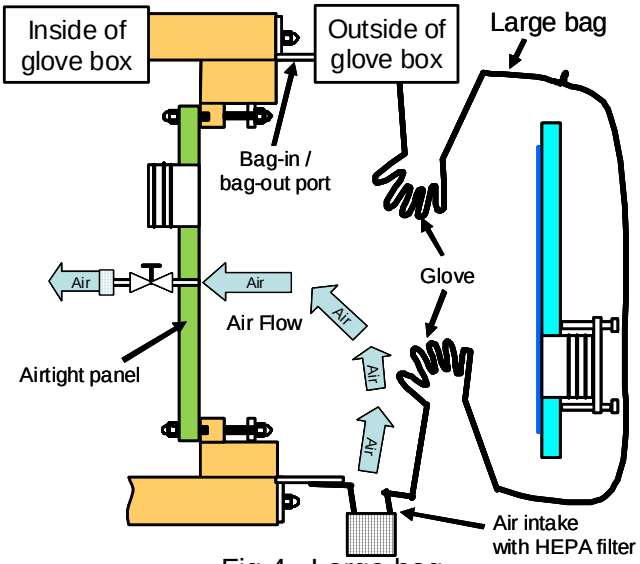
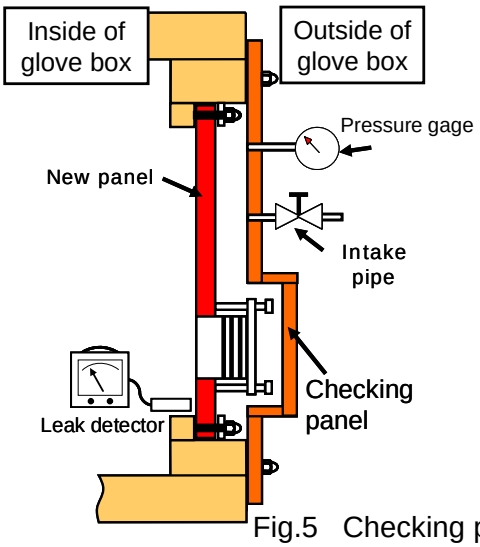
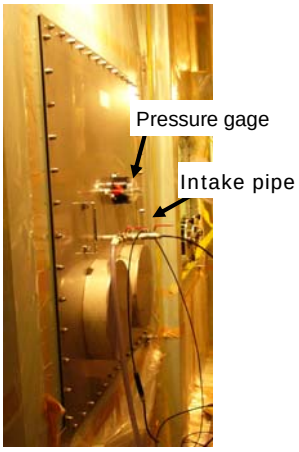


Fig.4 Large bag





Checking panel
(outside of the MT box)

Fig.5 Checking panel