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

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Overview of WASTEF (1/2)

WASTEF: Waste Safety Testing Facility

WASTEF was established in 1982 for examining safety storage and disposal of high-level waste from reprocessing of spent fuel.

The R&D program of high-level waste was finished in 1998.

Current Main activities

- **Experiment on Irradiation Assisted Stress Corrosion Cracking (IASCC)**
  to study on the mechanical property of structural materials in the reactor using the SSRT (Slow Strain Rate Tensile) test apparatus.

- **Experiment on Corrosion test for reprocessing plant materials**
  to study on the corrosion test of the materials that are used for spent fuel reprocessing plant.

- **Experiment on TRU (transuranium elements) Nitride fuel**
  to study on the thermal property of TRU nitride fuels for transmutation.
Overview of WASTEF (2/2)

- 5 concrete cells
  - No.1 ~ No.3: β γ cells
  - No.4 ~ No.5: α γ cells
- 1 lead cell
- 6 glove boxes
- 6 examination rooms
  - TEM & FIB
  - Auger Microprobe
  - Radioactive analysis
  - DSC etc.
- The large size glove box is set on the roof of the concrete cell.
Contents

- Developed replacement technique
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  - Developed replacement technique
  - Developed devices
  - summary
The large size glove box has been used for about 25 years.

| Objective | Maintenance of $\alpha \gamma$ cell
|           | Study of TRU nitride fuel
| Size      | 10m width, 2.3m depth
|           | 4.5m height
| Apparatus | Air Line Suit (ALS)
| Contamination level | 30 Bq / cm$^2$ ($\alpha$)

Micro cracks were found in the acrylic panels caused by degradation.

For safety operation, Degraded panels must be replaced by new panels.
Developed replacement technique

For Saving time and safety operation

Developed technique

<table>
<thead>
<tr>
<th>Developed technique</th>
<th>Conventional technique</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glove box</td>
<td>Glove box</td>
</tr>
<tr>
<td>Bag</td>
<td>Isolation tent</td>
</tr>
</tbody>
</table>

Comparison of replacement technique

<table>
<thead>
<tr>
<th>Developed</th>
<th>Conventional</th>
</tr>
</thead>
<tbody>
<tr>
<td>Airtight condition</td>
<td>Hold</td>
</tr>
<tr>
<td></td>
<td>Break</td>
</tr>
<tr>
<td>Decontamination</td>
<td>Degraded panel only</td>
</tr>
<tr>
<td></td>
<td>The whole of the glove box</td>
</tr>
<tr>
<td>ALS work in the isolation tent</td>
<td>not necessary</td>
</tr>
<tr>
<td></td>
<td>Required</td>
</tr>
</tbody>
</table>
Developed replacement technique

Developed replacement process

1. Decontamination of the degraded panel

2. Attachment of the airtight panel and airtightness test

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

4. Airtightness test using the checking panel
Developed replacement technique

1. Decontamination of degraded panel

Degraded panel: 1.0 X 1.0 m

Contamination level

before

βγ : 1.2 Bq/cm²
αγ : 33.6 Bq/cm²

after

βγ : Background
αγ : Background

Inside of glove box

Plastic sheet
Developed replacement technique

Developed replacement process

1. Decontamination of the degraded panel

2. Attachment of the airtight panel and airtightness test

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

4. Airtightness test using the checking panel
Developed replacement technique

2. Attachment of the airtight panel and airtightness test

Inside of glove box
- Airtight panel
- Glove
- Leak detector

Outside of glove box
- Degraded panel
- Intake pipe
- Intake pipe
- Halogen gas

Development of a replacement technique

Inside of glove box

Outside of glove box
Developed replacement technique

Developed replacement process

1. Decontamination of the degraded panel

2. Attachment of the airtight panel and airtightness test

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

4. Airtightness test using the checking panel
Developed replacement technique

3. Replacement of the acrylic panels (1/2)

1. Bag-in / bag-out port was screwed on the outside of the glove box.

2. The degraded panel was covered with the 1st bag.

3. The degraded panel was removed from the glove box.

4. The 1st large bag containing the degraded panel was sealed and separated from the glove box.
Developed replacement technique

3. Replacement of the acrylic panels (2/2)

1. The 2nd large bag containing the new panel was set over the rest of the 1st bag.

2. The rest of the 1st bag was removed, the 1st bag was sealed in the 2nd bag.

3. The new panel was screwed on the glove box.

4. The 2nd large bag and airtight panel were removed from the bag-in /bag-out port.
Developed replacement technique

Developed replacement process

1. Decontamination of the degraded panel

2. Attached on the airtight panel and airtightness test

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

4. Airtightness test using the checking panel
Developed replacement technique

4. Airtightness test using airtight panel
Developed devices (1/3)

Airtight panel

Keeping negative pressure of the inside of glove box

1. Regulation valve of negative pressure
   controls negative pressure for to prevent pressure rise between the aging panel and the airtight panel.

2. Two gloves
   help to remove aging panel by pushing from inside of the glove box.
Developed devices (2/3)

The large bag
Covered over the acrylic panel
Avoidance of contamination risk

1. Air intake with HEPA filter is used to make air flow. Air flow prevents inside of the bag from being contamination and keep the workability.

2. Two gloves handle the acrylic.
Developed devices (3/3)

Checking panel
Easy airtightness test
Simply and surefire confirmation test

1. Intake pipe for halogen gas is used to inject halogen gas.
2. Pressure gauge confirmed halogen gas pressure between new panel and checking panel.

Conventional method has been performed for the whole of the glove box. This method can not find the leak panel.
Summary

✓ New replacement technique was developed and performed.
  • The time of ALS work is reduced by developed devices.
  • Three degraded panels of the MT box were replaced using developed replacement technique.
  • The working time of replacement was about 20 days.
  • Contamination of radionuclide around the working area was not occurred.

✓ The person-day of replacement is less than 1/5 of a conventional technique.

The developed technique is safer and more economical than the conventional one.
Thank you for your attention
Comparison of the person-day of replacement

Developed technique: average 7 person / day
Conventional technique: average 13 person / day

<table>
<thead>
<tr>
<th>Activity</th>
<th>Conventional technique (person-day)</th>
<th>Development technique (person-day)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Decontamination</td>
<td>390</td>
<td>35</td>
</tr>
<tr>
<td>Installation of isolation tent</td>
<td>130</td>
<td>-</td>
</tr>
<tr>
<td>Attached airtight panel</td>
<td>-</td>
<td>38.5</td>
</tr>
<tr>
<td>Replacement of panels</td>
<td>39</td>
<td>38.5</td>
</tr>
<tr>
<td>Airtight test</td>
<td>26</td>
<td>14</td>
</tr>
<tr>
<td>Cleanup of working area</td>
<td>65</td>
<td>14</td>
</tr>
<tr>
<td>Uninstallation of isolation tent</td>
<td>130</td>
<td>-</td>
</tr>
<tr>
<td>Total</td>
<td>760</td>
<td>140</td>
</tr>
</tbody>
</table>
The working time

Developed technique: average 7 person / day
Conventional technique: average 13 person / day

<table>
<thead>
<tr>
<th></th>
<th>Conventional technique</th>
<th>Development technique</th>
</tr>
</thead>
<tbody>
<tr>
<td>Decontamination</td>
<td>30</td>
<td>5</td>
</tr>
<tr>
<td>Installation of isolation tent</td>
<td>10</td>
<td>-</td>
</tr>
<tr>
<td>Attached airtight panel</td>
<td>-</td>
<td>5.5</td>
</tr>
<tr>
<td>Replacement of panels</td>
<td>3</td>
<td>5.5</td>
</tr>
<tr>
<td>Airtight test</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Cleanup of working area</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td>Uninstallation of isolation tent</td>
<td>10</td>
<td>-</td>
</tr>
<tr>
<td>Total</td>
<td>60</td>
<td>20</td>
</tr>
</tbody>
</table>
Halogen leak test method

Testing process

1. Halogen gas is injected into the test area. And test area is pressurized by halogen gas. Gas pressure is 0.6 kPa

2. Gas pressure is maintained 30 minute.

3. Leak point is searched using halogen leak detector.

Injected gas: HFC R22 (replacing halon)
Gas pressure: 0.6 kPa
Criterion of leakage: $1 \times 10^{-6} \text{ Pa} \cdot \text{m}^3/\text{s}$
Bag-in / bag-out method

**Bag-in**

1. New bag containing objects are set over the old bag.
2. Old bag is removed and objects are into the glove box.

**Bag-out**

1. Objects are set in the bag from the glove box.
2. The bag containing objects is sealed by in-pulse welding machine.
3. The center of welding line is cut using scissors.