FIRST RESULTS FROM THE PSI HOTLAB LIQUID WASTE TREATMENT FACILITY

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Overview - starting where I finished the last time

In theory... Approach – Constraints – Goals

Introducing Fixbox 3... pictures

The ENSI Release Procedure

Hard facts!... The first batches

Complications & Modifications

Conclusions & Outlook
In theory... Approach – Constraints – Goals

Approach:

- concentration increase of liquid waste due to distillation
- more waste in less volume
Constraints to consider:

- concentration of fission and activation products is limited to 2 mSv/h for final storage
- concentration of fissible material is limited to 7 g/L to stay well below criticality
- salts in solidifying solutions has to be < 17 %
- hydrogen ion concentration as base equivalent < 2 mol/kg
Goals:

- processing of ~1000 L existing liquid waste
- processing of ~30 L liquid waste generated every year at PSI
Introducing Fixbox 3... pictures

The distillery
Introducing Fixbox 3... pictures

Blending

Source (top left picture): http://www.myscience.ch
Introducing Fixbox 3... pictures

Maturation
Introducing Fixbox 3... pictures

30-days-old cask strength
Fixbox 10 28. Mai 2010

ENS1 – Release Procedure

facility authorization + Approval conditioning process and waste container type

approval:
- concept
- design
- implementation

facility construction

pretests processing & cement chemistry

type test
- Process definition
- Waste container spec
- approval for final storage (Nagra)

approval: operating limited to 2 years and/or 6 waste charges

evaluation type test

type permission

approval: operating unlimited

Fixbox 3
## Analytical Data - I

<table>
<thead>
<tr>
<th>Batch</th>
<th>Acid content [mol / kg]</th>
<th>Salt [%]</th>
<th>N Stones</th>
<th>Total Mixed Waste [L]</th>
<th>Initial volume [L]</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2,1</td>
<td>8,1</td>
<td>22</td>
<td>17,4</td>
<td>18,6</td>
</tr>
<tr>
<td>2</td>
<td>1,7</td>
<td>16,8</td>
<td>12</td>
<td>10,2</td>
<td>19,3</td>
</tr>
<tr>
<td>3</td>
<td>1,3</td>
<td>13,2</td>
<td>14</td>
<td>11,3</td>
<td>19,0</td>
</tr>
<tr>
<td>4</td>
<td>2,0</td>
<td>14,6</td>
<td>13</td>
<td>10,7</td>
<td>18,9</td>
</tr>
<tr>
<td>5</td>
<td>2,0</td>
<td>13,8</td>
<td>15</td>
<td>12,8</td>
<td>19,8</td>
</tr>
</tbody>
</table>
# Hard facts!... The first batches

## Analytical Data - II

<table>
<thead>
<tr>
<th></th>
<th>Batch 1</th>
<th>Batch 2</th>
<th>Batch 3</th>
<th>Batch 4</th>
<th>Batch 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>U-235 [g]</td>
<td>0.2</td>
<td>0.09</td>
<td>0.05</td>
<td>0.2</td>
<td>6.7</td>
</tr>
<tr>
<td>U-238 [g]</td>
<td>36.9</td>
<td>18.6</td>
<td>6.3</td>
<td>30.4</td>
<td>5.8</td>
</tr>
<tr>
<td>Pu-239 [g]</td>
<td>18.7</td>
<td>4.9</td>
<td>4.1</td>
<td>7.2</td>
<td>9.1</td>
</tr>
<tr>
<td>gross (^a) [Bq]</td>
<td>2.0E+10</td>
<td>1.0E+11</td>
<td>1.4E+11</td>
<td>2.0E+11</td>
<td>3.0E+11</td>
</tr>
<tr>
<td>gross (^b&amp;g) [Bq]</td>
<td>1.0E+11</td>
<td>1.8E+11</td>
<td>6.6E+11</td>
<td>5.2E+11</td>
<td>7.7E+11</td>
</tr>
</tbody>
</table>
Complications & Modifications

Source: http://www.tobysdog.com
Complications and unexpected behaviour in general:

- Precipitations during mixing and distillation.
- After each batch, a sump of 0.5 L remained which was then assigned to the following batch.
- Flushing with ca. 9 L after each batch demands an additional distillation step.
- Poorly fitting gripper jaws of the manipulator made handling of the metal casks for the cementation complicated.
Complications & Modifications

Complications and unexpected behaviour each batch:

- **Batch 1** - samples showed that estimated specifications for the single waste batches were not as exact as it was needed
  - Each waste batch to be introduced into the distillation equipment has to be freshly analysed

- **Batch 2** - none

- **Batch 3** - none

- **Batch 4** - Probably due to increased exothermic reactions the dosing and mixing of the distillate and the cement were more demanding during the process

- **Batch 5** - none
Complications & Modifications

**Modification of the lifting unit for the cementation:**

- The initial lifting unit ruptured due to low quality plastic material used for construction
- A set up with a high quality linear guiding was proposed
  - Whole set up made of metals
- Installation of a splash guard to minimize contaminations to a local area during dosing and mixing
- An exhaust was installed to aspirate acid vapors close to the container preventing minimizing corrosion
Conclusions & Outlook

The first five batches were successfully produced with the FIXBOX-3 facility:

- about 100 L of liquid waste were processed
- 76 cement cylinders were produced and are ready for intermediate storage

Occurring problems were identified.

Modifications to mitigate the problems were performed.

The sixth batch will be produced in a few weeks.
Thank you...

... for your attention!