To: Distribution

Subject: Rate of Hydrogen Loss Through Hastelloy N Pipe Wall

Our discussion last Tuesday about ways of injecting tritium into a molten-salt loop aroused my curiosity about how long tritium gas would remain in a hot metal capsule. Dick Korsmeyer prepared the attached plot which shows the rate at which hydrogen will pass through Hastelloy N at various temperatures and partial pressures. He used a square root relationship between permeation and hydrogen pressure which, of course, makes no allowance for the impeding effects of oxide films or fluids inside or outside of the pipe. From the values taken from Dick's plot, I have calculated the quantities given in the table on the next page.

For convenience I dealt with a capsule or section of pipe which had a surface area of 1 cm² for each cm³ of volume (a long 1-cm-diam. pipe meets this condition). Please note that I have based my results on a 0.5 cm thick wall by doubling the rates that Dick gives for a 1-cm-thick wall.

The last column in my table gives the loss rate as a "half-life". This isn't really legitimate, since less time is required for each succeeding loss of one-half the amount present. However, it may give you a feel for how the escape rate varies with the temperature and pressure.

M. W. Rosenthal

MWR:jl

Attachments

Distribution
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RATE OF HYDROGEN LOSS THROUGH HASTELLOY N PIPE WALL

Wall Thickness 0.5 cm
Surface Area 1 cm\(^2\) per ml

<table>
<thead>
<tr>
<th>Temp. (\circ F)</th>
<th>Partial Pressure, atm.</th>
<th>Loss Rate Std. cc/hr-cm(^2)</th>
<th>Gas Initially Present, Std.cc per cc of container</th>
<th>Initial Loss Rate (^a) %/hr.</th>
<th>&quot;Half-life&quot; (^b)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1000</td>
<td>1</td>
<td>(8 \times 10^{-3})</td>
<td>(0.34)</td>
<td>2.3</td>
<td>25 hr.</td>
</tr>
<tr>
<td></td>
<td>(10^{-2})</td>
<td>(8 \times 10^{-4})</td>
<td>(0.34 \times 10^{-2})</td>
<td>23</td>
<td>2.5 hr.</td>
</tr>
<tr>
<td></td>
<td>(10^{-4})</td>
<td>(8 \times 10^{-5})</td>
<td>(0.34 \times 10^{-4})</td>
<td>230</td>
<td>14 min.</td>
</tr>
<tr>
<td></td>
<td>(10^{-6})</td>
<td>(8 \times 10^{-6})</td>
<td>(0.34 \times 10^{-6})</td>
<td>2300</td>
<td>1.4 min.</td>
</tr>
<tr>
<td>1200</td>
<td>1</td>
<td>(2 \times 10^{-2})</td>
<td>(0.30)</td>
<td>6.6</td>
<td>8.9 hr.</td>
</tr>
<tr>
<td></td>
<td>(10^{-2})</td>
<td>(2 \times 10^{-3})</td>
<td>(0.3 \times 10^{-2})</td>
<td>66</td>
<td>53 min.</td>
</tr>
<tr>
<td></td>
<td>(10^{-4})</td>
<td>(2 \times 10^{-4})</td>
<td>(0.3 \times 10^{-4})</td>
<td>660</td>
<td>5.3 min.</td>
</tr>
<tr>
<td></td>
<td>(10^{-6})</td>
<td>(2 \times 10^{-5})</td>
<td>(0.3 \times 10^{-6})</td>
<td>6600</td>
<td>32 sec.</td>
</tr>
</tbody>
</table>

\(^a\) Initial loss rate divided by amount of gas initially present.

\(^b\) Time it would take gas content to drop to half its initial value.
Hydrogen Escape through Hastelloy N 1 cm Thick

vs Temperature and Pressure

Data of Webb, A.I.
See TM-2358

Hydrogen Mass Velocity - Std cc/hr-cm²

Temperature - °F

R.B.K. 10/7/39