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TID-5989

Dr. Leonard A. Topper, Physical Science Administrator
Technical Liaison Division
U. S. Atomic Energy Commission
New York Operations Office
376 Hudson Street
New York 14, New York

TID-5982

Subject: Letter Report No. 14 under AEC Contract
AT(30-1)-2298

Dear Dr. Topper:

- (1) Data for nickel is complete and listed in Tables I and II. The data are plotted in Figures I, II, III, and IV. Figure II compares the data with that obtained by Smithells and Ransley.
- (2) Data for Ni-2% Cu are listed in Table III.
- (3) Data for Ni-4% Cu are listed in Table IV.
- (4) The system Ni-1% Cu developed a high temperature leak and had to be dismantled.
- ~~(5) A quotation from Nuclear Metals concerning the cost of s.s. to Zircaloy tubes is included. These tubes would be used in the fabrication of zirconium diaphragms.~~

Respectfully submitted,

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DWR/b

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TABLE I

Rate of Hydrogen Permeation Through Nickel

Diaphragm diameter = 0.9971 inch

Diaphragm thickness = 0.0545 inch

<u>Temp. °C</u>	<u>P(atm)</u>	<u>Rate cm³hr⁻¹</u>	<u>Specific Rate cm³hr⁻¹/cm²mm⁻¹</u>
800	2.0	12.69	3.486
		11.25	3.092
		9.66	2.654
		10.77	2.960
		11.01	3.026
		11.56	3.178
		11.60	3.187
		<u>Aver. 11.22</u>	<u>3.083</u>
800	1.5	9.880	2.715
		9.718	2.671
		9.578	2.632
		9.845	2.705
		9.706	2.667
		<u>Aver. 9.744</u>	<u>2.678</u>
800	1.1	8.410	2.311
		8.401	2.309
		8.400	2.308
		<u>Aver. 8.403</u>	<u>2.309</u>
760	2.0	8.997	2.472
		8.967	2.464
		9.056	2.489
		8.919	2.451
		<u>Aver. 8.985</u>	<u>2.468</u>
760	1.5	7.532	2.070
		7.592	2.086
		7.492	2.059
		7.238	1.999
		<u>Aver. 7.463</u>	<u>2.051</u>

TABLE I (Continued)

760	1.1		6.633	1.823
			6.610	1.816
			6.586	1.810
		<u>Aver.</u>	<u>6.610</u>	<u>1.816</u>
700	2.0		6.046	1.661
			6.006	1.650
			5.932	1.630
			6.074	1.669
		<u>Aver.</u>	<u>6.015</u>	<u>1.653</u>
700	1.5		5.025	1.381
			4.914	1.350
			5.094	1.399
			5.180	1.423
			5.231	1.437
			5.236	1.439
		<u>Aver.</u>	<u>5.114</u>	<u>1.405</u>
700	1.1		4.421	1.215
			4.349	1.194
			4.455	1.224
			4.489	1.234
			4.261	1.171
		<u>Aver.</u>	<u>4.395</u>	<u>1.207</u>
640	2.0		3.999	1.099
			3.990	1.096
			3.978	1.093
		<u>Aver.</u>	<u>3.989</u>	<u>1.096</u>
640	1.5		3.379	0.9286
			3.424	0.9410
			3.509	0.9642
			3.464	0.9521
			3.489	0.9568
			3.458	0.9503
		<u>Aver.</u>	<u>3.453</u>	<u>0.9488</u>
640	1.1		2.764	0.7596
			2.803	0.7703
			2.820	0.7750
			2.773	0.7621
			2.758	0.7580
		<u>Aver.</u>	<u>2.784</u>	<u>0.7650</u>

TABLE II
SUMMARY OF RESULTS

Rate of Hydrogen Permeation Through Nickel

Diaphragm diameter = 0.9971 inch

Diaphragm thickness = 0.0545 inch

<u>Temp. °C</u>	<u>P(atm)</u>	<u>Rate cm³hr⁻¹</u>	<u>Specific Rate cm³hr⁻¹/cm²mm⁻¹</u>
800	2.0	11.22	3.083
	1.5	9.744	2.678
	1.1	8.403	2.309
760	2.0	8.985	2.468
	1.5	7.463	2.051
	1.1	6.610	1.816
700	2.0	6.015	1.653
	1.5	5.114	1.405
	1.1	4.395	1.207
640	2.0	3.989	1.096
	1.5	3.453	0.9488
	1.1	2.784	0.7650

TABLE III

Rate of Hydrogen Permeation Through Ni-2% Cu

diaphragm thickness = 0.1268 inch

diaphragm diameter = 0.6252 inch

<u>Temp. °C</u>	<u>P(atm)</u>	<u>Rate cm³/hr</u>	<u>Specific Rate cm³hr⁻¹/cm²mm⁻¹</u>
800	2.0	2.887	4.697
		2.919	4.748
		2.926	4.758
		2.896	4.710
		2.949	4.795
		<u>Aver. 2.916</u>	<u>4.742</u>
760	2.0	2.274	3.697
		2.217	3.605
		2.361	3.839
		<u>Aver. 2.284</u>	<u>3.714</u>
700	2.0	1.593	2.591
		1.618	2.631
		1.607	2.613
		<u>Aver. 1.606</u>	<u>2.612</u>

TABLE IV

Rate of Hydrogen Permeation Through Ni-4% Cu

diaphragm thickness = 0.1285 inch

diaphragm diameter = 0.6260 inch

<u>Temp. °C</u>	<u>P(atm)</u>	<u>Rate cm³hr⁻¹</u>	<u>Specific Rate cm³hr⁻¹/cm²mm⁻¹</u>
800	2.0	2.674	4.395
		2.712	4.459
		2.677	4.401
		<u>Aver.</u> 2.687	<u>4.418</u>
760	2.0	1.897	3.118
		1.918	3.153
		1.887	3.101
		<u>Aver.</u> 1.900	<u>3.124</u>
700	2.0	1.451	2.386
		1.490	2.449
		1.549	2.547
		1.573	2.585
		<u>Aver.</u> 1.516	<u>2.492</u>
640	2.0	1.047	1.721
		1.034	1.704
		1.063	1.747
		<u>Aver.</u> 1.049	<u>1.724</u>

+ = 2.0 atm
• = 1.5 atm
○ = 1.1 atm

Log P vs $1/T$ Plot for PURE Nickel
figure I

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Figure II

Diffusion Data For
- Nickel -

- 20 atm
- x 1.5 atm
- ▲ 1 atm

Figure III