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# CHEMISTRY DIVISION QUARTERLY REPORT

December, 1952, January, February, 1953

## The Solubility of Hydrogen and Deuterium in Various Solvents

M. Cook and D. N. Hanson

April 13, 1953.

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## The Solubility of Hydrogen and Deuterium in Various Solvents

M. Cook and D. N. Hanson

In the past year, exploratory data have been taken to determine the relative solubilities of hydrogen and deuterium in various solvents in the vicinity of room temperature and atmospheric pressure. This investigation is one phase of a program to determine the feasibility of separating deuterium from hydrogen by means of rectified absorption.

The initial problem was to design an apparatus which would give data accurate to 0.1 percent. Literature values of gas solubilities frequently show discrepancies of the order of 3 percent which is the approximate difference in solubility between hydrogen and deuterium. A unique apparatus has been designed and used successfully wherein the rate of solution can be detected to within 10 ppm. based on the original gas charged. By varying the pressure on the system and plotting the rate of solution vs. pressure the equilibrium pressure is very readily determined.

The data completed in the past three months are the following.

| Solvent | T, °C | $H_2$ Solubility moles/qm, atm. $10^6$ | $D_2$ Solubility moles/qm, atm. $10^6$ | $D_2/H_2$ |
|---|---|---|---|---|
| n-$C_7H_{16}$ | 15.09 | $6.47_3$ | $6.65_0$ | 1.027 |
| " | 25.09 | $6.87_8$ | $7.03_5$ | 1.023 |
| " | 35.05 | $7.28_8$ | $7.43_3$ | 1.020 |
| " | 50.0 | $7.92_3$ | $8.07_6$ | 1.019 |
| " | 65.0 | $8.63_9$ | $8.76_8$ | 1.015 |
| n-$C_7F_{16}$ | 12.08 | 3.333 | 3.460 | 1.038 |
| " | 25.09 | 3.616 | 3.733 | 1.032 |
| " | 35.05 | 3.861 | 3.968 | 1.028 |
| " | 50.0 | 4.303 | 4.393 | 1.021 |
| Benzene | 15.09 | 3.03 | | |
| " | 25.09 | 3.31 | | |
| " | 35.05 | 3.51 | | |
| " | 45.0 | 3.89 | | |

These data represent duplicate runs on both $H_2$ and $D_2$. The solubility of $D_2$ in benzene is currently being measured.

Inasmuch as the separation factor increases appreciably as the temperature decreases, a new thermostat capable of providing a temperature of -35°C has been designed and is presently being constructed in the project shops.

Another phase of this program is the measurement of $H_2$ and $D_2$ solubilities in liquid $N_2$ in the range from 1 to 100 atmospheres pressure. Presently this apparatus is being ~~assembled and a test~~ run is scheduled for about April 1st.

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