clearance was studied in a series of tubes in which the distance between the walls was varied from 1.3 mm to 22.0 mm. The gas separation (ratio of ammonia to methane) rose sharply with increasing wall clearance to a rather broad maximum at 7 mm. The effect of gas pressure was investigated from 11 to 60 cm of Hg for the different tubes. The 7 mm tube gave a maximum gas separation of 27 per cent. at 20 cm pressure. The pressure however is not critical nor is the optimum pressure the same for all gas mixtures. In these tests the temperature difference between the walls was 350° and the average temperature of the gas close to 150°. By varying the power input it was found that the final gas separation increased with the temperature difference between the walls. The rate of separation was investigated for a wall clearance of 7 mm and a temperature difference of 350°. The separation rose to 90 per cent. of its final value in 15 minutes. The absolute rate at which gas could be removed without decreasing the separation factor was not determined with accuracy; it was observed, however, that 1 cc of gas (N. T. P.) could be removed every 15 minutes without influencing the percentage separation. This speed suggests that a continuous flow method of operation should be feasible.

A number of gas mixtures have been studied in addition to the one mentioned above. The operation of the tube can be shown in a striking manner with a uniform 50–50 mixture of helium and bromine. In the course of a few minutes the bromine completely disappears from the top of the tube and becomes concentrated at the bottom. The separation of isotopes is easily demonstrated with HCl, in which gas the ratio of Cl^{35} to Cl^{37} was changed at a pressure of 20 cm from 3.2, its normal value, to 2.8 in a few minutes. The optimum conditions of operation depend, of course, on the nature of the gas. The results obtained with different gas mixtures lead to the conclusion that the separation depends primarily on the difference in mass of the two components divided by their sum.

Experiments have been performed which throw additional light on the mechanism of operation. When the entire tube was inclined 13° from the vertical the separation was decreased from 27 per cent. to 5 per cent. In another apparatus a series of corrugations was placed every 3 cm along the inner tube in such a manner that any gas moving along the heated wall would be deflected into the intervening space. In a 50–50 methane-ammonia mixture the average temperature of the gas was reduced about 15° and the final separation enhanced about 4 per cent. The design of the tube also appears to have a marked effect on the gas separation. A tube was built along the lines described by Clusius and Dickel with a heated tungsten wire extending down the center and a 7 mm clearance. After a run of several hours a smaller final separation of the chlorine isotope was observed with an 800° difference in temperature than was obtained in 15 minutes with the concentric glass tubes for a 350° difference in temperature. A 350° difference in temperature gave only a negligible separation. A similar tube with a 4 mm platinum ribbon down the center failed to show an appreciable separation. It is evident that separation is augmented by symmetry of the two surfaces. An all-glass apparatus in which the outer wall was heated and the inner cooled gave a separation value only slightly lower than when the inner wall was heated; the average temperature of the gas, however, was materially higher.

The rate of mixing of the separated gases has been investigated for various tubes. The results show that the rate of back diffusion increases with wall clearance and becomes very rapid for outside tubes of larger diameter.

Reviewing the above results as a whole, it is evident that conditions involving both wall symmetry and corrugations enhance swirl definition and thereby enhance separation. On the other hand, separation is materially lower in straight wire or ribbon-centered tubes as well as in tubes having small wall clearances in which swirls are either poorly defined or impossible. It appears that the mechanism of separation is different in the two cases. Under conditions where swirls are well defined the separation results from the combined action of initial and thermal diffusion within the swirls. In wire-centered tubes or glass tubes with small wall clearances where the swirls are poorly defined, the mechanism may involve thermal diffusion and an overall convection current.

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